TREATISE

ON

AMMUNITION.

WAR OFFICE—1902.

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Ordnance College,
Woolwich,
18th *April*, 1902.

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LIST OF ABBREVIATIONS.

A.C.	Army Circular.
A.O.	Army Order.
A.O.S.	Army Ordnance Regulations.
A.P.	Armour Piercing.
B.L.	Breech Loading.
C.	Common, to both Land and Naval Service.
C.S.	Cast Steel.
C.I.	Cast Iron.
E.O.C.	Elswick Ordnance Company.
F.S.	Forged Steel or Field Service.
F.G.	Fine Grain.
G.G.	Gardner-Gatling.
G.S.	General Service.
L.S. or L.	Land Service.
L.G.	Large Grain.
M.G.	Machine Gun.
M.H.	Martini-Henry.
M.L.	Muzzle Loading.
N.S. or N.	Naval Service.
P.	Pebble.
Q.F.	Quick Firing.
Q.F.C.	Quick Firing Converted.
R.B.L.	Rifled Breech Loading (Armstrong).
R.F.G.	Rifled Fine Grain.
R.L.	Royal Laboratory.
R.M.L.	Rifled Muzzle Loading.
S.B.	Smooth Bore.
S.A.	Small Arm.
V.S.	Vent Sealing.
§	Paragraph List of Changes.

[N.B.—*This edition is corrected up to 1st April* 1902. *As some typographical errors may have occurred in publication, it is requested that, should any be discovered, they may be at once pointed out, in writing, to the Under Secretary of State for War.*]

TREATISE ON AMMUNITION.

CHAPTER I.—GUNPOWDER.

COMPOSITION.—PROPERTIES.—CLASSIFICATION.—VARIOUS DESCRIPTIONS OF GUNPOWDER AND THEIR USES.

EXPLOSIVES are mainly used for the propulsion of projectiles, or as disruptive agents. The explosives commonly met with in the service are (i) gunpowder, which is used both as a propellant and for disruptive purposes; (ii) cordite, which at present is only used as a propellant; and (iii) gun-cotton, which is used as a disruptive agent.

Explosives which may be met with in the Service are given in Chapter IV. Miscellaneous.

Explosives used for the propulsion of projectiles are sometimes termed "propulsives" or "propellants," and those for disruptive purposes "disruptives."

Gunpowder for many centuries was the only explosive in general use, but in recent times many other explosives have been invented. An account of the manufacture, and action when fired of gunpowder, can be found in other works.*

Gunpowder is an intimate mechanical mixture of saltpetre, sulphur, and charcoal. A short account of the properties of these ingredients will be found at p. 29.

In England, black powder is, and for a long time has been, made of the ingredients mentioned above in the following proportions: saltpetre 75 parts, charcoal 15 parts, sulphur 10 parts.

The proportions of Prism[1] brown and S.B.C. powders are—saltpetre 79 parts, charcoal 18 parts, sulphur 3 parts; and of E.X.E. powder, saltpetre $77\frac{6}{10}$ parts, charcoal $17\frac{10}{10}$ parts, and sulphur 5 parts.

In addition from 1·5 to 2·2 per cent. of water is a recognised ingredient in brown powders.

The charcoals for these powders are composed of special material and the preparation of them is confidential.

* "Treatise on Service Explosives, 1900"; "Researches on Explosives, by Captain Sir Andrew Noble, K.C.B. (late R.A.), F.R.S., &c., and Sir Frederick Abel, Bart., F.R.S., &c.; "Notes on Explosives," by Dr. W. R. Hodgkinson, F.R.S.E., &c.; Professor Bloxam's "Chemistry"; Professor Vivian Lewes's "Service Chemistry," and "The Manufacture of Explosives," by Oscar Guttmann, Assoc. M.I.C.E., &c.

The explosiveness of powder of a given composition can be modified by varying the charcoal, the amount of moisture, and its physical condition. The effect of the above variations on fired powder is discussed in "Treatise on Service Explosives."

Speaking generally, a large grained powder, highly glazed, made from highly-burnt charcoal, and of high density, other things being equal, will burn slower and so have less explosiveness than a powder of opposite characteristics. If, however, the grain be very small as in mealed powder, the interstices between the grains are not sufficiently large to allow a free passage of flame, and so a charge of mealed powder would ignite in one place only and would burn comparatively slowly.

On the introduction of rifled ordnance, it was found advisable to use a slower burning powder than that used with S.B. guns. More work is thrown on a rifled gun than on a S.B. gun of the same calibre.

A charge of slow-burning powder gives rise to a lower maximum pressure than a charge of quick-burning powder, and the pressure is better sustained throughout the bore, and so for equal velocities with a projectile of a given weight the slow-burning powder strains the gun less.

To obtain a slow-burning powder, the density and size of grain were increased on the introduction of rifled guns, and "R.L.G." density 1·7, size $\frac{1}{8}$-inch to $\frac{1}{4}$-inch, superseded "L.G.," size $\frac{1}{16}$-inch to $\frac{1}{8}$-inch. Again, when R.M.L. guns of 7-inch calibre and upwards were made, "P.," a powder of higher density and larger grain (density 1·75, size $\frac{3}{8}$-inch), which burns more slowly and strains the gun less than "R.L.G.," was adopted.

Then "$P.^2$," a powder of larger size (about 1·5-inch cubes) was manufactured for the heavier R.M.L. guns.

To ensure regularity of burning, moulded or prism powders were next introduced. These powders are moulded into regular hexagonal prisms, having a hole running through the centre of each. Thus not only is the powder of uniform size, but the pressure of the gas is better sustained, since as each prism burns, the decrease in surface on the outside is to some extent counterbalanced by the increase of the inside surface of the perforation. It is also probable that after a certain time the prism breaks up, thus forming additional surfaces for combustion, and consequently for the evolution of gas.

Moulded black powders were first introduced, to be shortly afterwards superseded by moulded brown powders.

The brown powders have been very satisfactory in that the pressures they give are moderate, while the velocities are high, but they are far from being smokeless. They are more difficult to ignite, and require a primer of a few prisms of black powder.

For the short bore of the 7-pr., for small arms and machine guns, and for shrapnel shell with bursting charges in the base, quick-burning powders are required. Such powders have small grain.

Advantages.

The advantages of gunpowder are:—

(*a*) Its rate of combustion is gradual compared with that of many other explosives; by altering the proportions of the ingredients and varying the mechanical processes of manufacture, its explosiveness can be modified so as to suit every description of weapon.

(*b*) The ingredients are easily produced.

(*c*) They are comparatively cheap.

(d) Gunpowder is, with proper precautions, safe in manufacture, in store, and in transport; it also keeps well.

Gunpowder ignites at a temperature between 550° F. and 600° F., various conditions tending to modify the exact temperature. For instance, gunpowder made with slack burnt charcoal ignites at a lower temperature than gunpowder similar in other respects made from a highly-burnt charcoal. Mealed powder, again, will ignite more readily than the same meal pressed into a prism. Powder will deteriorate at lower temperatures than that which causes its ignition; sulphur begins to vaporise at about 239° F., and water is given up by powder at a still lower temperature. Water being recognised as a component in the more modern powders, baking such powders in hot magazines may cause them to give rise to abnormal pressures in the bore of a gun when fired.

Liability of gunpowder to explode by a blow or by friction.

Gunpowder can be exploded by a blow or friction, especially when a thin film of powder-dust is nipped between hard surfaces, or, if it receives a glancing blow, even between wooden surfaces. Dr. Dupré has fired gunpowder with a light hammer on stone. In fact, Dr. Dupré has found that the majority of explosives, spread in a thin layer on a wooden floor, may be exploded by a glancing blow from a broomstick. This fact forms a clue to most of the precautions laid down to be taken when dealing with gunpowder. When they are carefully observed the risk of an explosion is small. No departure should be made from the letter or spirit of the regulations laid down for dealing with explosives. The regulations for magazines will be found detailed at p. 444.

There have been no conclusive experiments to determine the amount of friction necessary to explode gunpowder, but there is abundant evidence showing that gunpowder will ignite by friction against the walls of rifled shells when fired. The property of igniting from concussion was made use of in old pattern Palliser shell; the powder was found to explode on the impact of the unfuzed shell against iron plates. Experiments have shown that the larger descriptions of gunpowder (Prism, P.^{2} and P.) can be exploded by the impact of a bullet having a striking velocity of rather more than 600 feet per second.

The experiments were tried on cartridges exposed, and in various Service packages. The smaller grained powders were not so exploded even when the bullet had a much higher striking velocity. Probably the large grain powders were easily ignited, because they presented more resistance, while with the small grain powders the bullet was more gradually checked.

A case of brown powder struck by a projectile ignited and burnt without explosion.

Gunpowder stands climate well. Pure saltpetre is not deliquescent to any great extent: the glaze and density of powder aid to preserve it from damp; still, in very damp climates, or in a damp magazine, it is necessary to keep powder in metal cases, the air being excluded by luting. § 2431.

Keeping gunpowder in a very damp atmosphere will tend to separate the ingredients by wetting a portion of the saltpetre, which on a change of atmospheric conditions may effloresce or be carried to the surface of the grains by the escaping water vapour causing a capillary action.

The dryness and proper ventilation of powder magazines are therefore points of great importance. The rules for the ventilation of magazines will be found detailed at p. 449.

Gunpowder should not be allowed to remain in direct contact with metal, as if there is the least damp (if it be heated) the saltpetre will attack and corrode the metal, thus spoiling the powder and damaging its envelope. This effect may be noticed in the earlier patterns of Snider ammunition in which the brass case was unprotected from the powder. Again, paper, if of any thickness, is found to cause powder to deteriorate, as it is given to absorb and retain damp. This causes part of the saltpetre to be absorbed into the paper, which becomes more or less impregnated with it at the expense of the powder. This difficulty can be overcome by varnishing the paper. The paper cylinders contained in certain R.B.L. cartridges were found to deteriorate the powder until they were varnished.

There are various descriptions of powder in the Service. A specification guides the manufacture of each description, and governs its receipt into the Service.

The powders in the Service are enumerated in the following list, being classified as shown.

Service gunpowders include all descriptions used for firing projectiles, whether from cannon or small arms.

Serviceable gunpowders include, in addition, blank and shell gunpowders.

Class.	Designation.		Description.
	General.	Detail.	
I.	Service ...	S.B.C. Prism[1], brown ,, black Prism[2] E.X.E. P.[3] P. S.P. Q.F.[1] M.G.[1] L.G. R.L.G. R.L.G.[2] R.L.G.[4] F.G. R.F.G. R.F.G.[2] Pistol Rifled Pistol	1. All new gunpowder. 2. All unused gunpowder, the packages of which have been opened for examination, and which has been found serviceable. This is to stand first in order for practice purposes. 3. Gunpowder returned into store (including the contents of cannon cartridges) which on examination may be found uninjured. 4. Gunpowder which, after repair, is found fit for service.
II.	Blank ...	Blank L.G. new or reduced.	1. L.G., R L G., R.L.G.[2], in bulk or from broken-down cannon cartridges, too dusty or broken in grain for Class I, and which cannot be repaired for the same. 2. Gunpowder, specially manufactured as blank L.G.
		Blank F.G. new, or reduced.	1. F.G., R.F.G., R.F.G.[2], and pistol too dusty or broken in grain for Class I, and which cannot be repaired for the same. 2. Gunpowder, specially manufactured as blank F.G.
III.	Shell... ...	Shell P.	1. P. and S.P powder in bulk, or from broken-down cartridges, too dusty or broken in grain for Class I, and which cannot be repaired for the same. 2. Gunpowder specially manufactured as shell P.
		Shell Q.F. ...	Q.F.[1] powder in bulk, or from Q.F. cartridges which has deteriorated, or is no longer required in Class I.
		Shell L.G	L.G., R.L.G., R L.G.[2], and R.L.G.[4], in bulk or from broken-down cannon cartridges, too dusty or broken in grain for Class II.
		Shell F.G. new.	Gunpowder specially manufactured as shell F.G.
		Shell F.G., reduced.	F.G., R.F.G., R F.G.[2] and pistol powder, too dusty or broken in grain for Class II.
		Q.F. shell, F.G.	Gunpowder specially manufactured for bursting charges of 3-pr. and 6-pr. Q.F. shells.

Class.	Designation. General.	Designation. Detail.	Description.
IV.	Doubtful ...		All gunpowder awaiting examination.
V.	Condemned...		All gunpowder found unfit for any of the above classes, but available for blasting purposes, or for sale.
VI.	Condemned for extraction.		Gunpowder, obtained from shells and S.A.A. or other cartridges or charges which contain their own means of ignition, except Q.F. cartridges, and which is to be immediately wetted.

A short notice of each of the above gunpowders follows :—

Moulded Powders.

Prism[1] *Black.*—This powder was introduced in 1881. It is moulded into regular hexagonal prisms ·976-inch ± ·008-inch in height. The diameter measured over the sides is 1·366 inch ± ·008-inch. In the centre is a circular hole ·393-inch in diameter. Its density is not less than 1·76. §§ 3951, 4730, 6090.

Use.—B.L. guns, 8-inch, Mark VII; 6-inch Marks IV and V; R.M.L., 17·72-inch, and 12·5-inch; and primers for Prism[1] brown and S.B.C. cartridges, and for E.X.E. cartridges for 12·5-inch R.M.L; 8-inch and 9·2-inch B.L. for gunnery ships.

Prism[2].—This was introduced in 1881. The prisms are 2-inch ± ·03-inch high, and 2·35-inch ± ·03-inch in diameter over the sides. §§ 4105, 6551.

The axial perforation is rather more than ½-inch in diameter, and each prism weighs a little over half a pound. The minimum density is 1·75.

Use.—R.M.L. guns, 17·72-inch and 12·5-inch.

The existing stock of Prism[2] gunpowder will be used up as follows :—

1st.—For N.S. when available, and to be expended in practice, whenever possible, in the 12·5-inch Mark II R.M.L. gun.

2nd.—For L.S. when available, and to be expended in practice, whenever possible, in 17·72-inch, 12·5-inch Mark I, and 12·5-inch Mark II R.M.L. guns, but with the latter for practice only.

Prism[1] *Brown.*—This was introduced in 1884. It is of the same dimensions as Prism[1] black. The brown colour is due to slack burnt charcoal, and its density is not less than 1·8. § 4731.

Use.—B.L. guns, 12-inch and 9·2-inch Marks I to VII, and 8-inch Marks III chase-hooped, IV, and VI, and R.M-L., 16-inch.

S.B.C.—This was introduced in 1887. Similar in size and appearance to Prism[1] brown, except that each prism has a circular indentation in the centre of one face as a distinguishing mark; some early lots have not this mark. The density is not less than 1·85. §§ 5392, 5410, 8226.

Use.—B.L. guns, 16·25-inch and 13·5-inch and 9·2-inch for gunnery ships.

E.X.E.—Introduced in 1887 to supersede P.[2], Prism[1] black, and Prism[2] in R.M.L. guns, and as the charge of all 6-inch B.L. guns, except Mark V. It is of Prism[1] size, and has an indented ring round the centre perforation on one face as a dis- §§ 5409, 6133, 6729, 8575.

tinguishing mark. It is of a dark slate colour, due to the admixture of two charcoals in its composition.

Its density is not less than 1·8.

Use.—B.L. guns, 6-inch, Marks III, chase hooped, IV, and VI; R.M.L., 12·5-inch Marks I and II; Q.F., 6-inch; and B.L. 8-inch and 9·2-inch Marks I to VII for gunnery ships.

The prisms in certain lots of E.X.E. are too large for the ordinary 6-inch B.L. cartridges. The cases containing these prisms have been therefore marked "large prisms."

Cubical or Cut Powders.

§§ 2103, 3327, 3795, 3814, 4729, 6157. *P. or Pebble.*—This powder was introduced in 1871. The grains are approximately cubical in form with rounded edges. They pass through meshes $\frac{3}{4}$-inch in the clear, and are retained on $\frac{3}{8}$-inch meshes. Minimum density 1·75.

Use.—R.M.L. guns, 12-inch, 35 tons, to 80-pr.

§§ 4539, 5217, 5826, 5980, 10896. *S.P.*—Certain lots of P. which have given good results at proof,* are subjected to a further proof, and if satisfactory, are marked S.P. No more P. or S.P. will be made.

Use.—B.L., 5-inch, 4-inch, Q.F. 12-pr. and 4·7-inch and R.M.L. 10-inch on high angle mounting. It may be used instead of P. powder when the latter is not available.

§§ 3066, 3671. *P.*^{2}.—This was introduced in 1876. The grains are approximately cubical, with a length of edge about 1·5 inch. The minimum density is 1·75.

E.X.E. will ultimately supersede it.

Use.—To utilise the existing stock, charges of P.^{2} have been approved for practice on gunnery ships for 6-inch and 5-inch B.L., and for 10-inch R.M.L.

§§ 10502, 10914.

§ 5891. *Q.F.*^{1}.—This was introduced in 1887. It is similar to the powder originally supplied for use with the Hotchkiss 6-pr. Q.F. and which was known as "French C.^{2}." The grains are nearly cubical in shape, being about $\frac{1}{2}$ inch square by $\frac{3}{10}$ inch thick. The minimum density is 1·75.

Use.—3-pr. and 6-pr. Q.F.

Granulated or Grained Powders.

L.G. (*Large Grain*).—This is the old cannon powder, and remains the Service powder for S.B. guns and mortars, the bursters for shrapnel shell having the bursting charge loose in the head, and as a substitute in case of emergency in P. mixture for F.G.; size 8 to 16 mesh.

No more will be made.

§ 2708. *R.L.G.*—This was introduced in 1860 for the use of the Armstrong R.B.L. guns. It is retained on a sieve of 8 meshes to the inch, and passes through a sieve of 4 meshes to the inch. Density about 1·7.

Use.—R.M.L. guns, 9-pr. to 64-pr. (except 13-pr.); R.B.L. guns, 9-pr. to 40-pr.

No more will be made.

§§ 3760, 6390. 9509. *R.L.G.*^{2}.—Introduced in 1878. Size 3 to 6 mesh; minimum density, 1·65.

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* Selected Pebble is now manufactured to specification, and the manufacture of Pebble powder has ceased.

Use.—R.B.L., 9-pr. to 7-inch; R.M.L., 9-pr., and 12-oz. charge for 2·5-inch star shell; R.M.L. howitzers, 8-inch, 6·6-inch, and 6·3-inch. In L.S. it may be used for any guns for which R.L.G.[4] is employed, should the latter not be available. The existing stock of cartridges filled with R.L.G.[2] for which R.L.G.[4] has been approved, will be treated as follows:—1st. For N.S., will be replaced as soon as R.L.G.[4] is available, and used up in gunnery ships. 2nd. For L.S., will be used up, future supplies being of R.L.G.[4] if available; if not, R.L.G.[2].

R.L.G.[3].—This powder was made in India, and there was used for R.M.L. guns, 25-pr. to 80-pr., and for all S.B. guns. Size of grain, from 2 to 3 mesh. None has been made recently.

R.L.G.[4].—Introduced in 1887. Size, 2 to 3 mesh; minimum density, 1·65. §§ 5272, 5361, 5457, 7216.

Use.—Q.F. 6-inch for practice on gunnery ships; R.M.L. guns, 10-inch on high angle mounting, 13-pr. to 64-pr., and 2·5-inch; 6·3-inch R.M.L. howitzer, when existing stock of R.L.G.[2] cartridges is used up.

M.G.[1].—Introduced in 1882 It is highly glazed and angular in shape, and can be pressed into a pellet. Size, 7 to 14 mesh; minimum density, 1·75. § 4175.

Use.—1-inch Nordenfelt gun, and cartridge for 1-inch aiming rifle.

F.G. (*Fine Grain*).—Size, 16 to 36 mesh. § 2286.

Use.—S.B. small arms, 7-pr. R.M.L. gun, and for bursting charges of shrapnel shell having bursting charge in the base.

This powder is no longer made.

R.F.G.—Size, 12 to 20 mesh; average density, 1·6. §§ 2708, 5163, 6614, 7684.

Use.—Snider S.A. ammunition, 7-pr. R.M.L. gun, and for bursting charges of shrapnel shell when F.G. is not available. The manufacture is discontinued except when required for Snider ammunition.

R.F.G.[2].—Introduced in 1873. Size the same as R.F.G.; density, 1·72 to 1·75. §§ 2487, 3065, 5163, 6614.

Use.—Martini-Henry S.A. ammunition, machine guns of small-arm calibre and 1-inch aiming rifle cartridges; 7-pr. R.M.L. gun, and for filling shrapnel shell having the bursting charges in the base, and for igniters of cartridges.

Pistol.—Size, 44 to 72 mesh.

Use.—Enfield pistols, and for the bursting charges of shrapnel shell having the charge in the base.

No more of this powder will be made.

Rifled Pistol.—Size, 20 to 36 mesh; density, 1·58 to 1·65. § 3974.

Made from Blank F.G. siftings.

Use.—Enfield and Webley pistols.

The size of P. and granulated powders is determined by the sieve through which it is passed in manufacture; the sieves are distinguished according to the number of subdivisions in a linear inch; thus an 8-mesh sieve would have 64 holes in a square inch.

Blank Powders.

Blank powders are used for saluting and blank charges, and may either be powders reduced in class from "Service," or specially manufactured as "Blank."

Waltham Abbey Blank L.G. is made from the final siftings of Service black powders, the size of grain being from 8 to 16 mesh. § 5108.

Blank L.G. comprises L.G., R.L.G., and R.L.G.^{3}, classed as "Blank."

Waltham Abbey Blank F.G. is the final siftings of Service black powders; the size of grain is 16 to 30 mesh.

Blank F.G. comprises pistol, F.G., R.F.G., and R.F.G.^{3}, classed as "Blank."

Blank L.G. is used for all natures of blank cannon cartridges, for shell filling instead of shell L.G., and when new for shrapnel shell.

§ 9720. Blank F.G. may be used for all natures of S.A. blank ammunition, with P. for shell filling, and when new for shrapnel shell.

§ 10498. Blank F.G. New is used as an alternative to R.F.G.^{3} for the primers or igniters of cordite cartridges.

R.L.G.^{4}, P., Q.F.^{1}, P.^{2}, and moulded powders are not to be placed in Class II.

Service gunpowders are not to be used for blank or saluting cartridges when any gunpowder classed under the head of blank is available.

Shell Powders.

Shell powders are manufactured or selected for shell filling.

§ 7714. *P. Mixture* consists of shell P. and shell F.G. It is used for filling all common, double, and armour-piercing shell for rifled ordnance except these noted below. In case of emergency Service L.G. may be used instead of shell F.G.

Shell F.G. includes Pistol, F.G., R.F.G., and R.F.G.^{2}, and is used with P for shell filling and for the bursting charges of 9, 12, and 20-pr. R.B.L. segment shells. Also when new for shrapnel shells.

§ 6686. *Q.F. Shell F.G.* is used for the bursting charges of 6-pr. and 3-pr. Q.F. shells. It is a specially manufactured powder.

§§ 7714, 7715, 10837. *Shell Q.F.* is Q.F.^{1} selected for shell filling; it is mixed with F.G., and used for filling 12-pr. Q.F. common shell Mark I. Should P not be available it may be used with F.G. for filling all natures of commor,

§ 8597. double, and armour-piercing shell up to and including 6-inch B.L. and 40-pr. R.M.L. or R.B.L., except 3-pr. and 6-pr. Q.F.

§ 8416. *Shell L.G.* includes L.G., R.L.G., R.L.G.^{2}, and R.L.G.^{4}, reduced to "Shell"; it is used for the bursting charges of 20-pr., 12-pr. and 9-pr. R.B.L. common shell, S.B. common shell, and for bursters of 7-inch and 40-pr. R.B.L. segment shell.

A mixture of R.L.G.^{2} and R.F.G. is used as the bursting charge of the 2·5-inch R.M.L. ring shell.

§§ 7685, 9720. Service powders, or shell powders specially manufactured as such, are used for filling shrapnel shell and in future new "Blank F.G." and "Blank L.G." specially manufactured as such may be used for filling shrapnel. Blank L.G. will only be used for those with the burster in the head; Pistol, F.G., R.F.G., and R.F.G.^{2} for those with the bursting charges in the base; L.G. or Pistol, F.G., R.F.G., or R.F.G.^{2} for those with the burster in the head if a bag is used, and L.G. if loose in the head. Barrels containing shell F.G. specially manufactured are marked "Shell F.G., new"; those containing F.G. reduced in class "Shell F.G. reduced"; and barrels containing Blank L.G. or F.G. specially manufactured will be marked, "Blank L.G., new" or "Blank F.G., new"; those containing reduced blank, "Blank L.G. reduced" or "Blank F.G. reduced."

The effect of firing a shell containing a bursting charge of gunpowder is to set back the latter in a hard mass. The adoption of

P mixture instead of L.G. for shell filling has increased the destructive effect. This may be partly due to the greater charge of P. mixture (a 40-pr. shell holds about 3 lb. of P. mixture or 2 lb. 8 oz. of L.G.) and to less caking on shock of discharge.

Powders classed as shell powders are generally those found dusty or broken in grain, and not according to specification, and so unfit for Service powders, but suitable for shell filling.

Failing shell powders the higher classes of powder may be used, the only reason for using the inferior powder being to prevent waste.

Gunpowder of Class VI will at once be thoroughly wetted, and placed in old barrels. When such wetted powder unduly accumulates it is destroyed by being sunk in deep water.

Packing.

All grained powder not made up into cartridges is packed in barrels, and all made, or re-packed at Purfleet, since January 8th, 1885, is placed in waterproof bags inside the barrels, which, when so packed, contain 100 lb. of L.G., R.L.G., or any fine grained powder, 110 lb. of R.L.G.^{2}, R.L.G.^{4}, and Q.F.^{1}, and 125 lb. P. or P.^{2}.

Prism powders are packed in special zinc-lined waterproof cases which always contain 100 lb.

For description of these packages, *see* Chapter VI.

Loose gunpowder, except P.^{2} and moulded powders, held on charge by the Royal Artillery, will be placed in serge bags, each containing 10 lb., and stowed in barrels with waterproof bags, or in metal-lined cases. *See* table, p. 467.

Gunpowder, except that which has been wetted, is placed for purposes of storage and transport in Group I, Division I, and wetted gunpowder which is treated as an explosive in Group II, Division II; *see* p. 443.

Service gunpowder, for convenience for store and issuing purposes, is divided and marked into lots or brands. These lots consist generally of 100 packages or more, the contents of which are of uniform quality. A brand consists of two or more lots blended together so that the whole brand is of uniform quality.

Examination.

Instructions for the Inspection, &c., of gunpowder will be found in the Regulations for Army Ordnance Services, 1900.

CHAPTER II.—GUN-COTTON.

GUN-COTTON.—MANUFACTURE AND PROPERTIES.—ISSUE.—PACKING AND TRANSPORT OF WET AND DRY GUN-COTTON.—APPARATUS FOR CUTTING.—DRYING.

WHILE gunpowder is used as a propulsive as well as a disruptive agent, gun-cotton is almost entirely used in the latter capacity, with a few trifling exceptions in which its rapidity of ignition and the comparatively low temperature at which that ignition takes place are made use of. These various uses will be found in detail below.

A large proportion of the guncotton made is now used in the manufacture of cordite. (This does not alter the above statement as to its uses.)

Gun-cotton is chiefly manufactured at Waltham Abbey, but a considerable amount has been obtained from the trade. The composition will be best understood by giving a brief sketch of its manufacture. Fuller details will be found in "Treatise on Service Explosives, 1900."*

The best white cotton waste which has been cleaned from grease by boiling with alkalies, and which should contain not more than 1·1 per cent. oily matters, is employed. It may be considered pure cellulose $C_6H_{10}O_5$. It is picked over to remove foreign substances, passed through a teasing machine, and dried. It is then steeped for a short time in the strongest nitric acid not under 1·50 sp. gr., to which three parts by weight of strong sulphuric acid, 1·842 sp. gr., have been added, the use of the latter being to take up the water which results from the action of the nitric acid on the cellulose, and which, if left unabsorbed, would weaken the strength of the nitric acid, and thus prevent the proper conversion of the cotton into true gun-cotton. The cotton, now converted into gun-cotton, is very thoroughly washed, wrung out, pulped, and boiled, to rid it of the free acid, which, if left in, even in minute quantities, would not only be fatal to the keeping qualities of the gun-cotton, but would make it dangerous to store, owing to its liability to decomposition and spontaneous combustion. After the washing process alkaline matter is added, except when required for the manufacture of cordite, and in this state it is moulded and pressed into any required form. When finished it should contain from 1 to 2 per cent. of alkaline matter.

* Much information will be found in Bloxam's "Chemistry," 5th edition, p. 507; Abel's "Investigations and Applications of Explosive Agents, 1871"; Abel's "Contributions to the History of Explosive Agents" (from the Proceedings of the Royal Society, No. 150, 1874); Thorpe's "Dictionary of Applied Chemistry, 1891," Article "Explosives"; "Extracts," Vol. VIII, p. 59, Vol. IX, p. 37, Vol. X, pp. 28, 179; "Report of Committee on Storage and Transport of Gun-cotton, 1872"; "Notes on Explosives," by Dr. W. R. Hodgkinson, F.R.S.E., &c., and "Treatise on Service Explosives, 1900."

The following equation shows approximately the formation of gun-cotton :—

$$C_6H_7O_2(OH)_3 + 3HNO_3 = C_6H_7O_2(NO_4)_3 + 3H_2O$$

Cellulose, Nitric acid, Cellulose-trinitrate, Water.

Gun-cotton when dry *may* ignite at 277° F., it *must* ignite at 400° F.; its mean igniting point may be taken at about 340° F. Gunpowder ignites at about 560° F. The low igniting point of gun-cotton is taken advantage of in using loosely twisted strands of it as additional priming for a special fuze, used with very small charges. It is used as an primer in the cordite cartridges for B.L. field guns and howitzers. Gun-cotton is also used in the form of dust, mixed with mealed powder, for priming for electric tubes, &c. Bloxam.

Gun-cotton varies considerably in its rate of burning, according to its mechanical condition and mode of firing. If it be merely washed without being pulped, it retains its original colour and appearance, and can only be distinguished from ordinary cotton by the peculiar harsh feel of its fibres. In this state it can be twisted into strands, woven into fabrics, or treated, in fact, in any way in which ordinary cotton can be treated. For torpedo and mining operations it is in our Service pulped, moulded and compressed by hydraulic power into primers or slabs, which may of course be of any size or shape required.

When dry gun-cotton, perfectly unconfined, is ignited by a flame, or by a heated body, it burns quietly and very rapidly with a bright yellow flame; if, however, the cotton is confined in a strong case, even of wood, the action is very different; it explodes with great violence, and the strength of the explosion will depend upon the thickness of the case; to develop it fully a strong iron case is required. Dry gun-cotton.

Compressed dry gun-cotton may be detonated, even when unconfined, by the action of various detonating bodies, of which fulminate of mercury is found the most suitable. It is not very easy to distinguish between explosion and detonation, but for practical purposes they may be considered to depend on the degree of rapidity with which a change of state occurs. In the case of an explosion the action takes such an appreciable time that the inertia of surrounding bodies is overcome and projection results. With a detonation the time is so short that the inertia only of the very nearest particles of matter is overcome, and very little projection but much local disruption results.

About 5 grains of fulminate of mercury enclosed in a tube and ignited in close contact with compressed dry gun-cotton produces detonation, but to guard against any chance of failure, Service detonators contain from 32 to 37 grains. A description of Service detonators will be found in Chapter VII.

When the detonation is required to spread from one primer to others, it is not necessary to have them absolutely in contact; rows of primers from 30 to 40 feet in length, with intervals of from ½ an inch to 1 inch, have been detonated by a primer at one end, set in action by a fulminate detonator.

To produce detonation, the gun-cotton must be in a compressed form; loose flocculent gun-cotton cannot be detonated, it is merely scattered by the detonator. The explanation is that the cohesion produced by the hydraulic pressure brings the particles of the compound close enough to be within range of the detonating wave. They then respond to, and convey the wave from one part to the other of the mass.

Ordinary dry gun-cotton contains about 2 per cent. of moisture. If the moisture amounts to 5 per cent. the gun-cotton can be easily ignited by a flame, but probably will not detonate with a service detonator. Dry gun-cotton may be exploded with comparative ease by percussion, but the explosion is usually very local and confined to the part struck.

The chemical constitution of gun-cotton is quite unaltered by immersion in or storage under water, and when dried again the gun-cotton will possess all its original qualities of easy ignition and susceptibility to detonation, so long as its mechanical cohesion is not destroyed.

On this account, gun-cotton in its Service forms cannot be kept for an indefinite time in a large volume of water, as it becomes disintegrated, and the loss of its compressed form deprives it of its susceptibility to detonation. If re-pressed, however, it would regain its former properties.

Wet gun-cotton in the Service, therefore, contains only about 25 parts of water to 100 parts of dry gun-cotton, which is sufficient to prevent its ignition, but not enough to cause it to suffer from disintegration.

Wet gun-cotton may itself be detonated by fulminate if a considerable quantity of the latter be used; or, as is the safest and most convenient plan in practice, by detonating a small quantity of dry gun-cotton in contact, or nearly so, with the wet mass, by means of an ordinary detonator. One or two half-pound dry primers of gun-cotton, when thus detonated, will communicate their action to a large mass of wet gun-cotton. For instance, a charge of gun-cotton may be suspended in water, entirely unprotected from the latter, and detonated by means of a dry primer protected in a waterproof case. Wet gun-cotton is actually more powerful in its effects when detonated than dry.

It is impossible to ignite wet guncotton by a flame. If a slab of wet guncotton containing about 15 per cent. of water be put on a fire it will gradually smoulder away as the outer portions in contact with the fire become dried, but it will not explode.

Report of committee on storage of gun-cotton.

An experiment carried out in May, 1873, showed that a ton of wet gun-cotton when exposed to the action of fire in a strongly built magazine did not explode, but gradually smouldered away as above described.

It is not known, however, whether large quantities might not explode if strongly confined and subjected to great heat for a length of time.

These properties are most important. They allow the gun-cotton to be stored wet, in which condition it is safe from any danger of explosion by fire, and it can be re-dried at will for use in small quantities, or left wet for use in large charges, subject to the use of a dry primer as above mentioned. This property renders it the best agent of its class for storage and military purposes; and is in marked contrast to the behaviour of dynamite, one of its principal rivals on the large scale, under similar circumstances.

When gun-cotton is detonated its action is so very rapid* that no confinement is required, thus there ceases to be any necessity for using a strong case for torpedoes, or for tamping mines, and it can be

* The rate at which detonation is transmitted from mass to mass in a row of *wet* gun-cotton slabs ranges from 18,000 to 20,000 feet per second; the rate is slower with *dry* gun-cotton, being about 17,000 feet.

used to cut down stockades, &c., by simply attaching slabs loosely to the obstacle.

The force of detonated gun-cotton is stated to be at least four times that of exploded gunpowder, weight for weight. "Extracts," Vol. IX. p. 38.

The chief products of the explosion of gun-cotton are aqueous vapour, carbon monoxide, carbonic acid and nitrogen; the carbon monoxide is highly dangerous in confined spaces, such as mines, &c., as it is an active poison and very inflammable.

For this reason gun-cotton is unsuitable for mining purposes in the U.S., except under special conditions, when the miners are not required to enter the ground again after the charge is fired.

The chief properties of gun-cotton, as compared with those of gunpowder, may be summed up as follows:—

(1) Dry gun-cotton can be inflamed at a much lower temperature than gunpowder.
(2) Dry gun-cotton is more easy to explode by percussion than gunpowder.
(3) The explosion of gun-cotton is unattended by smoke.
(4) The action of gun-cotton is much more rapid than that of gunpowder. This comparative suddenness of action has hitherto resisted all attempts to employ gun-cotton successfully as a propelling agent in other than small arms.
(5) The metal of a gun or small arm from which gun-cotton is fired is much less heated than with gunpowder.
(6) Gun-cotton is uninjured by moisture.

Gun-cotton is used in the Service for torpedo and mine charges, and for demolitions. Experiments have been carried on from time to time with a view to utilise it in shells. Use.

The forms of gun-cotton employed in the service are given in Table I, p. 460. Priming charges, primers and slabs are designated by letters. §§ 9617, 9670.

The weight of gun-cotton dry is to be taken as the basis for demands, except in the case of charges, priming, and primers, torpedo, which will be issued by number.

Primers are cylindrical in shape, and the perforations mentioned in the table are intended to receive the detonators. All 1-oz. and 2-oz. primers issued dry are coated with paraffin in the R.L. to preserve them from damp.

Wet Gun-cotton.

Wet gun-cotton is issued in the forms of slabs or primers packed in metal cases or metal-lined boxes, intended equally for transport and store, or made up in charges for Brennan and Whitehead torpedoes, and mines, all hermetically sealed. Issue, transport, and packing of wet gun-cotton.

The closing plates of the cases or metal linings are fitted with a screw plug, for removal, to allow the escape of gas that may have formed, or the re-wetting of the gun-cotton.

The *Mines, Naval, 72 lb.*, and the *Countermines, Naval, 500 lb.*, are now issued filled with slabs, which are contained in tinned copper cases. Formerly 9-oz. primers only were used in order that the mines might be unpacked, if necessary, and the gun-cotton used separately. Mines.

The charges of Whitehead torpedoes of earlier patterns, both of Fiume and R.L. manufacture, are enclosed in hermetically sealed Whitehead charges.

japanned copper cases,* which fit into the head of the torpedo, but in IV and subsequent Marks the head itself is made of phosphor-bronze and contains the charge of wet gun-cotton. All are furnished with a central hole at the point in which the dry primer is inserted when the torpedo is prepared for service.

Brennan charges. The Brennan charges are contained in the steel head of the torpedo.

Packages. The packages are the 50-lb. box, a similar 15-lb. box, and the half-sized metal-lined case, specially prepared to take gun-cotton for G.S., and a 16-lb. box similar to the 15-lb. box, except in dimensions, for R.A. equipments. (This box has not yet been published in List of Changes.) The above boxes are for store and transport.

§ 7068. There are also the 16¼-lb. case for N.S., and a tinned copper box, to contain eight ½-slabs, for siege train, both of which are issued two in a packing case, and also a tinned copper box, to contain one ½-slab, for cavalry pioneers, which is issued in a special packing case to take 16.

§§ 4660, 7192, 9615, 10169. The *Box, gun-cotton, wet, 50 lb., Marks II* and III, wood, with copper tinned inner case*, is made of deal with elm ends, to each of which are attached two rope handles by means of cleats. The whole of the box is painted red. The lid is secured by brass screws, and has two recesses for labels, and in the centre a G.S. plug, which can be removed to examine the gun-cotton. Inside the box is an inner case of tinned copper, which projects slightly over the edge of the box, and has a handle at each end to facilitate its removal. This inner case has a hole in the top, the edges of which are strengthened by a wire soldered to the outside of the flange, and this hole is closed by a rectangular plate of the same material, soldered on when the box is full. In the centre of the closing plate is a small metal screw plug, which comes immediately under the G.S. plug of the lid, and can be removed when desired. To prevent danger in soldering on the plate, the top of the inner case is filled with strips of wood, painted with Jeffrey's black, and the spare spaces not occupied by the gun-cotton are filled up with pieces of wood similarly prepared. The interior of the copper case is lacquered with the same material. On the exterior of the box are two labels, one white, giving directions for examination, and opening the box, and date of packing; the other red, giving the nature of slabs or primers packed in the box, the weight of gun-cotton, and the gross weight. On the inner case is another label with the weight of the copper case, and its contents, and the limit of increase or decrease in weight, which must not exceed 2 per cent. of the gun-cotton; directions for examination and re-wetting, and the date of packing.

Mark II boxes had an extra securing screw in the centre of each side of the lid and the hole in the inner case was smaller. Those Mark II boxes which are converted as above are known as Mark II*, while new boxes are Mark III.

§ 9615. *Box, gun-cotton, wet, 50 lb., Mark II, | C | and lifting band.*—To facilitate the removal of gun-cotton slabs from existing Mark II boxes, a tinned copper band will be placed round one of the slabs on the top tier in packing. The words "and lifting band" have consequently been added to the nomenclature as above.

It is to be noted that, in all cases where the weight of gun-cotton

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* These are gradually becoming obsolete, and will eventually be withdrawn from the Service.

is given independently of the package, the weight of that material in a dry state is intended.

A former pattern of this box (Mark I.) had several circular perforations in the sides and lid with a view of minimising the resistance in case of an explosion, but it did not satisfy the conditions of the Explosives Act, and is no longer made. Where such boxes exist they may still be used for store purposes, but for transport they require to be enclosed in an outer case. §§ 4145, 4306.

Before the introduction of the copper inner case, the same wooden boxes, lacquered inside with Price's black, were issued for transport and store of wet gun-cotton, for which purposes they may still be used; but when returned to Woolwich in the ordinary course they will not be re-issued. §§ 3371, 4006.

The *Box, gun-cotton, wet*, 15 *lb., Mark II*, is similar in all respects except size to the 50-lb. box described above. It contains 13½ lb. when packed with 1½-lb. slabs, 14 lb. when packed with 2-lb. slabs, and 15 lb. when packed with 2½-lb. slabs. §§ 4291, 4306, 4659, 7448, 10169.

The *Box, gun-cotton, wet*, 16 *lb., R.A. Equipment.*—This box has been sealed for service but has not appeared in List of Changes. It is similar to the 15-lb. box, but slightly larger, holding eight 2-lb. slabs.

Some *Cases, powder, metal lined, half*, have been specially prepared to take gun-cotton, by making the bottom removable, so that the metal lining may be taken out and weighed when necessary, and by inserting in the bung a screw plug which can be taken out to allow of the escape of gas or to admit of re-wetting. In the wood lid is a small hole to allow of access to this plug without opening the lid. An arrow on the bung and another on the exterior of the case denote when the bung is in the correct position, with the plug under this hole. The interior of the lining is also coated with Jeffrey's black. These altered cases are still available for packing gunpowder if specially required for that purpose, but care must of course be taken to see that they are thoroughly dry before inserting the powder. § 4680.

The *Box, gun-cotton, eight ½-slabs*, for siege train is a rectangular box made of tinned copper to contain eight 1-lb. slabs, R. It is painted black; the lid is sealed by a tape band shellaced on, and has a loop at the top but no plug for re-wetting. This box has not appeared in List of Changes. It is issued two in a packing case, painted red.

The *Box, gun-cotton, one ½-slab, Mark II*, for cavalry pioneers, is made of tinned copper to contain one 14-oz. slab of gun-cotton, V. It is closed with a soldered strip similar to fuze cylinders, and it has a loop on top for lifting, and a screw plug for re-wetting. §§ 7068, 8313.

It is packed in the *Case, packing, gun-cotton, wet, cavalry pioneers*, which is made of deal with elm ends, dovetailed together, and the bottom secured with brass screws. To each end are attached rope handles secured by means of cleats. The interior of the case is divided into 16 partitions, each to hold one box. The top is secured by brass screws. It is painted red outside. § 7068.

Mark I differs from the above in having no screw plug, and it is closed with a tape band.

The *Case, gun-cotton, wet, charges, Naval*, 16¼ lb., is the package in which gun-cotton is issued to the Royal Navy. It is used for outrigger torpedoes, and for general demolition purposes.

The present pattern, Mark IV, consists of a tin cylinder about 10½ inches high, and the same diameter, strengthened by three tinned iron hoops and painted red. Construction. § 4360.

Two holes pass completely through the cylinder, one in the axis, the other parallel to it; the former is for attaching the case to a

spar, and the other to contain the dry priming charge. The case is lacquered black inside, and contains 30 9-oz. primers, of which 20 are whole and 10 cut so as to fit closely against the cylinder intended to contain the dry priming charge. To ensure complete contact the whole are tightly packed with wooden wedges of suitable shape.

To prevent all chance of the heat from the soldering iron reaching the gun-cotton, the case is provided with a false tin bottom having a flange 0·2 inch deep, which is inserted over the cotton before the bottom is soldered on. In the other end is a small gun-metal plug, which can be unscrewed to allow the escape of gas or to re-wet the explosive.

On the exterior is a label giving the nett and gross weight, with instructions for periodical examination and re-wetting the gun-cotton; and a caution that to be safe in store the case must never be more than 6 oz. less than the gross weight marked upon it.

These cases are sometimes packed with slabs of wet gun-cotton.

§ 3911. *Mark III* had an asbestos wad instead of a false tin bottom. This occasionally led to the accumulation of gas.

§ 3820. *Mark II* had no strengthening bands and a felt wad.

§ 3581. *Mark I* was weaker than Mark II, and there were no cut primers, the interstices between the whole ones being filled up with broken cotton.

Disposal. Marks I and II are replaced by Mark IV as opportunities offer.

Issue. § 7192. Two in a deal box. This box is made of deal with elm ends. It has the lid and bottom secured with brass screws. It is painted red outside.

Wet gun-cotton was formerly transported in plain deal boxes, and stored in tanks holding about 1 ton each, and though this method is now obsolete, some stations may still have filled tanks.

Dry Gun-cotton.

How issued. All dry gun-cotton is at present issued in brass, copper, or tin cylinders.

A "package" comprises a number of such cylinders packed together in wooden boxes for convenience in transport and storage.

Packing of dry gun-cotton. Dry gun-cotton is packed in the following tin cylinders:—

- 2¼-lb. cylinder for N.S. and submarine mining.
- 2¼-lb. „ (of different dimensions) for submarine mining.
- 4-lb.-8-oz. cylinder for submarine mining.
- 9 2-oz. primers, F, in a cylinder for cavalry pioneers.
- 5 2-oz. „ „ „ R.E.
- 8 1-oz. „ H, „ „ equipment disabling ordnance.
- 5 1-oz. primers, H, in a cylinder for N.S. and R.E.

§ 9617. These cylinders are lettered from A to J in the same way as priming charges and primers, and consequently care is necessary to prevent confusion. On each will be found labels giving instructions for opening and re-closing, &c. A description of each, with its contents, follows.

Dry gun-cotton is also issued as priming charges for torpedoes in copper or tinned brass cylinders as detailed in the table on p. 46*0*. For the sound rocket, 2-oz. primers are issued five in a tin cylinder.

The *Cylinder*, *A*, was formerly used by cavalry pioneers, and is replaced by B. § 9617.

The *Cylinder*, *E*, was formerly used by R.A. and is withdrawn from the service. § 9617.

The *Cylinder*, *gun-cotton*, *primer*, *J*, 2¼ *lb.*, *empty*, is used to contain the 2¼-lb. charge, and when issued filled, it is sealed as, *Gun-cotton*, *dry*, *charge*, *priming*, *C*, 2¼ *lb.*, mentioned in the table on p. 460, for the Navy only. It is issued empty to R.E. for submarine mining. It is a tin cylinder, painted red and made to contain four 9-oz. primers, banded together with white paper to prevent them adhering to the lacquer of the cylinder, and prevented from shaking about by a thick felt wad. It is used in the Navy as a priming charge for the 16¼-lb. case. §§ 9617, 4665, 4744, 7451, 9517.

The two uppermost 9-oz. primers have a wooden pin fitted into one of the holes to ensure the other holes being in line for the insertion of the detonator. On the exterior of the case, besides the list of the contents and instructions for re-closing the case, are directions for use when used as a priming charge for outriggers, &c. Description.

The lid is sealed by a tape band shellaced on.

The *Cylinder*, *gun-cotton*, *primer*, *H*, is a tin cylinder painted black, and similar to the above, but shorter. It also contains four 9-oz. primers, forming the 2¼-lb. charge for submarine mining and sealed as *Gun-cotton*, *dry*, *charge*, *priming*, *B*. The primers are banded together with white paper and prevented from shaking about by a felt wad. A doubled tape round the primers facilitates their extraction. It is issued for submarine mining only. §§ 3789, 9617, 9618.

The *Cylinder*, *gun-cotton*, *primer*, *G*, is a tin cylinder painted black, and made to contain three 1-lb.-8-oz. primers, forming the 4-lb.-8-oz. charge for submarine mining, sealed as *Gun-cotton*, *dry*, *charge*, *priming*, *A*. These primers are also banded together, steadied by a felt wad, and have the doubled tape band for extraction. The lid is sealed by a tape band as above, and it is issued for submarine mining only. §§ 4744, 9617.

The *Cylinder*, *gun-cotton*, *primer*, *B*, is the one issued to cavalry pioneers. It is made of tin, painted black, and the lid is fastened by a bayonet joint and attached to the body by a piece of whipcord to prevent its being lost. The cylinder is lined with brown paper and contains nine 2-oz. primers, F. A doubled tape with the bight passed below the primers and attached underneath to a wooden disc enables them to be withdrawn. §§ 6018, 9617.

The *Cylinder*, *gun-cotton*, *primer*, *D*, which is issued for the equipment disabling ordnance is similar to the cylinder for cavalry pioneers, except in dimensions, and contains eight 1-oz. primers, H. § 9617.

The *Cylinder*, *gun-cotton*, *primer*, *C*, is a tin cylinder, painted black, and contains five 2-oz. primers, F, for issue to R.E. It is lined with stout brown paper and the primers can be extracted by the usual doubled tape, the bight underneath being attached to a pasteboard disc. The lid is sealed by a tape band as in cylinder, J. §§ 4291, 9617.

The *Cylinder*, *gun-cotton*, *primer*, *F*, is similar to cylinder, C, but smaller, and contains five 1-oz. primers, H. It is issued to the Royal Navy and R.E. §§ 4291, 9617.

The cases containing the *Gun-cotton*, *dry*, *primer*, *torpedo*, *D*, 6 oz., have in one end a cylindrical recess to take the detonator, and the other is closed by an indiarubber diaphragm between two metal plates, which can be pressed together by means of a screw. To prevent the indiarubber disc adhering to the sides of the copper cylinder the edges are covered with paper. Torpedo primers. § 9617.

The cylinders containing the *Gun-cotton, dry, primers, torpedo, A, B, and C*, of 12¾ oz. and 1 lb. 1 oz., are made of tinned brass, and have at one end a cylindrical projection threaded on the exterior to fit the pistol, and threaded internally to receive a plate for closing it. This plate has a recess in the centre to receive the detonator, closed by a screwed washer; after the gun-cotton is inserted a felt washer is placed on top and the closing plate screwed in, an indiarubber disc is placed in the recess for detonator and secured by the screwed washer, thus expanding the indiarubber disc and hermetically sealing the cylinder.

The cylinder containing the Brennan torpedo primer is made of brass, one end being closed by a brass cap. The top edge of the cylinder is coated with waterproof (Pettman) cement and the cap forced on, thus hermetically sealing the cylinder.

Issue.
§ 10158.

These are the cases immediately surrounding the gun-cotton, but as they themselves require protection in transport, they are generally packed in wooden boxes which are painted red on the outside, the numbers in the boxes being as follows:—

2½-lb. Naval charges, C	10 or 20
2½-lb. Submarine charges, B	12
4½-lb. „ „ A	4
2-oz. primers for the R.E.	8
2-oz. „ for cavalry pioneers	4
1-oz. „ for the R.E.	16
1-oz. primers for the Naval Service	10
1-oz. „ „ equipment disabling ordnance	as required.
Torpedo primers, A, B, and C	6* or 12*
„ „ D	6† or 12†
Brennan torpedo primers	6

When no special box is provided, the cylinders are packed in any convenient wooden case.

Equipment for disabling ordnance.
§§ 3457, 3758.

For the hasty or deliberate disablement of ordnance by means of gun-cotton certain stores will form part of the war equipment of the siege train. Full details of them and instructions for their use will be found at p. 455 *et seq.*

§ 6018.

Somewhat similar equipment will be furnished to cavalry pioneers for hasty demolition of rails, stockades, &c.

Apparatus, cutting, wet gun-cotton.
§§ 3939, 3443.

Wet gun-cotton slabs, &c., may be cut into such portions as may be required by an *Apparatus, cutting, wet gun-cotton slabs*, issued for the purpose. It consists of a cast-iron frame which has two uprights, in each of which is fitted a gun-metal clamping plate, suspended on the end of a set screw, for holding the gun-cotton slab when in position for being cut. The saw (resembling an ordinary meat saw) used in cutting the slab passes between the uprights.

There is a sliding bed of cast iron fitted to hold the gun-cotton slab, which rests on a wooden block, so as to allow of its being cut in any part, either parallel to a side, or diagonally. This apparatus is for submarine mining purposes.

§ 3940.

For L.S. purposes a simpler and smaller apparatus is issued to the R.E. It consists of a rectangular block of wood, with two movable wooden clamping pieces, which work on four iron screws fitted with gun-metal fly-nuts and washers. To use it, the wet slab is placed on the lower block in the required position, and held in place by the clamping pieces being firmly screwed down on it. The saw works between the clamping pieces.

§ 10284.

* With double-ended pin spanner, Mark II. Mark I is obsolete.
† With screw-driver and extracting bolt.

An *Apparatus, cutting, wet gun-cotton quadrants*, is supplied for Submarine Mining Services. The guillotine cutter is removable, and a plain knife or circular gouge, of which there are two sizes, may be used. § 4200.

Wet gun-cotton may be dried by simple exposure to the air of a dry room till it ceases to lose weight, or by leaving it in the open air in dry weather exposed to the sun and wind. Even without sun it will dry in about ten days. Of course the actual time taken to dry any given specimen will depend on climate, state of atmosphere, &c. Drying gun-cotton.

The use of artificial heat in evaporating moisture from wet gun-cotton is strictly prohibited.

Dry gun-cotton for the purpose of storage is classed in Group I, Division II, and so may be placed in magazines with other explosives of its class, and when possible it should be kept under the same hygrometric precautions as gunpowder, while the temperature should not exceed 120° F. Storage.

Wet gun-cotton, except in mines or countermines, may be placed in a magazine or explosive store with other explosives of its class, and is classed in Group I, Division III. Mines or counter-mines, containing wet gun-cotton only, are classed as Group II, Division II, and may be placed in stores with other explosives of its class, but not in magazines.

The several packages, when stored, are to be in distinct stacks, and, as far as the nature of the accommodation of the store will allow, will be kept a few inches above the floor level. Each description of box, case, cylinder, &c., will be kept separate. Stacking.

Cases, cylinders, &c., of gun-cotton, are not to be taken out of the boxes, &c., in which they are packed, the latter being placed as far as possible on their sides so as to allow the removal of the closing plugs without unstacking them.

As far as the buildings will admit, each stack of boxes, cases, &c., is not to be more than 6 feet high. As wide a passage as possible is to be preserved between adjoining stacks, and between the stacks and the walls, so that a person may pass round each stack, and to allow access to the closing plugs.

Pieces of gun-cotton sometimes become detached from discs and slabs in handling, packing, and unpacking boxes, and unloading mines. Small fragments and dust also accumulate in cutting and shaping slabs in loading mines. Damaged gun-cotton.

The solid pieces cut off the slabs in filling mines should be re-wetted, placed in half metal-lined cases prepared for gun-cotton, and kept wetted. These should be returned for Land Service to the Principal Ordnance Officer, and for Naval, to the Naval Ordnance Officer, Royal Arsenal, Woolwich, by the first opportunity, unless they can be used up at the station, for submarine mining and practice, in lieu of whole discs and slabs. M.R., 204.

Whenever any cases for gun-cotton are emptied, they will, before being placed in store as empties, be thoroughly washed out, so as to ensure their being entirely free from any dust or remains of gun-cotton. Empty cases.

Inspection.

Instructions for the inspection of dry and wet gun-cotton will be found in the Regulations for Army Ordnance Services, 1900.

CHAPTER III.—CORDITE.

COMPOSITION.—MANUFACTURE.—PROPERTIES.—USE.—PACKING.

CORDITE is the smokeless explosive adopted in our Service for propulsive purposes.

§§ 6632, 7279. It consists of nitro-glycerine 58 parts, gun-cotton 37 parts, and mineral jelly 5 parts, incorporated together and gelatinised by the aid of a solvent, acetone. Its composition for small arms and for all natures of ordnance is the same, the required rate of combustion being obtained by varying the diameter of the cord.

A short account of nitro-glycerine will be found in the following chapter. Mineral jelly, or vaseline, is one of the products of the fractional distillation of crude petroleum oil.

Acetone is a colourless, aromatic, and inflammable liquid which possesses the property of dissolving both gun-cotton and nitro-glycerine. It does not form part of the finished product, being driven off when the cordite is stoved.

The mineral jelly was originally introduced to prevent metallic fouling in the service magazine rifle. Experience has now shown it to operate beneficially in regulating the explosiveness of the product, and in improving its stability under varied climatic conditions. It also serves as a lubricant during manufacture.

The process of manufacture is as follows:—

Manufacture.* Nitro-glycerine, in the proper proportion, is poured on to dry gun-cotton, to which no alkali has been added, and the two are mixed by hand.

In this condition it is known as cordite paste.

The paste is placed in an incorporating machine, some acetone being first poured in. The machine is started, and the remainder of the acetone is added. After kneading for 3½ hours, the mineral jelly is added, and the kneading continued for a further period of 3½ hours. The mixture, in the condition of a plastic dough, is then placed in cylindrical moulds. The mould is inserted in a press, and the cordite is forced through a die with one or more holes. The cordite comes through the die in long cords, and is cut to length and placed in trays or wound on reels. The cordite is then stoved, at a temperature of about 100° F., from 3 to 14 days, the time varying with the size. This operation drives off the acetone or any moisture, the cordite becomes tougher, and its diameter decreases. Cordite is then blended.

§ 7485. All lots of cordite from each manufacturer have consecutive numbers, irrespective of size, and one or more initial letters to identify the manufacturer, except Waltham Abbey cordite, which has only the lot number.

* See "Treatise on Service Explosives, 1907."

Finished cordite resembles a cord of gutta percha, and its colour varies from light to dark brown. It should not look black or shrivelled, and should always possess sufficient elasticity to return to its original form after slight bending. Appearance.

Cordite is poisonous. Properties.

Cordite is practically smokeless; on explosion a very thin vapour is produced which is dissipated rapidly. This smokelessness can be understood from the fact that the products of combustion are nearly all non-condensible gases and contain no solid products of combustion which would cause smoke.

For the same muzzle-velocity a smaller charge of cordite than of gunpowder is required, owing to the greater amount of gas produced by it. Cordite is very slow burning compared with gunpowder, and on this account the maximum pressures are low, and the pressure on the projectile in the bore is well sustained. This is also helped by the fact that the gas has no work to do in expelling solid residue as in the case of gunpowder, and consequently more of its energy is available for the work of propelling the projectile.

The rate of burning of a charge of cordite is affected by the diameter of the cords; with equal weights a larger size presents a superficial area less in proportion to the volume of the charge than a smaller size, and so, other things being equal, a charge of large sized cordite burns slower than one of small. Cordite ground small ignites at about 355° F.; but charges in a gun are difficult to ignite, and a "primer" of gun-cotton yarn or fine grain powder is used to extend the flash from the tube. A stick of cordite burns with a strong flame; fired in the open it burns away without explosion, even when in large quantities.

Experiments have shown that cordite is safe in storage and that when ignited it will usually burn and will not explode. If, however, small sized cordite is confined in strong cases and fired, it will explode. "Extracts," 1897, p. 60.

Experiments carried out to test its stability and constancy of composition, have shown that it will keep well in all climates.

The nitro-glycerine contained in cordite freezes at a fairly high temperature (about 40°), and if frozen cordite is suddenly thawed by being brought into a warm room, a slight amount of exudation may be noticed, as a thin oily film of nitro-glycerine on the outside of the cords, which, however, is reabsorbed after a short time. For these reasons it is laid down that the temperature of magazines in which cordite is stored should not habitually exceed 100° F. (although experiments have shown that it is capable of standing higher temperature for long periods without injury), nor fall below 45° F., and if artificial means of heating are resorted to, the temperature should not be allowed to exceed 60° F. "Extracts," 1895, p. 48; 1898, p. 119. Temperature of magazines for cordite.

Cordite in made-up cartridges which may have sweated does not require any special treatment. When in bulk, if sweating is observed, it should not be handled until it has returned to its normal state, which it will do by being kept at a temperature not below 45° F.

Felt wads or other mass of absorbent material should not be left in actual contact with cordite, as after a prolonged period nitro-glycerine may be absorbed. It is for this reason that all felt wads in Q.F. ammunition now have glazed board discs on the side next the cordite.

It suffers if exposed to direct sunlight, but not when enclosed in either shalloon or silk cloth cartridges. It is therefore ordered

that when being made up into cartridges it should not be so exposed.

Cordite is not affected in any way by damp or water. If wetted with fresh water a cordite charge, on emergency, can be fired at once. Before returning a wetted charge to store, it should be thoroughly dried in a ventilated building. Cordite wetted with sea water should be well washed in fresh water and dried before re-packing. Cordite is influenced more by heat than powder, so that pressure and muzzle-velocity depend on the temperature of the charge before it is fired. The following table shows the effect of temperature on some cordite cartridges :—

Gun.	Service charge.	Ballistics specification limits charge at 80° F.	Correction + or − for 1° F. above or below 80° F.
	lb. oz.		
12-inch, VIII ..	167 8	2365—2400 f.s.	2·25 f.s.
	Size 50.	<17·0 tons	·1 ton.
9·2-inch, VIII ..	63 0	2345—2380 f.s.	2·0 f.s.
	Size 40.	<17·0 tons	·1 ton.
6-inch Q.F... ..	13 4	2185—2225 f.s.	2·5 f.s.
	Size 30.	<16·0 tons.	·08 ton.
4·7-inch Q.F. ..	5 7	2175—2210 f.s.	2·75 f.s.
	Size 20.	<15·5 tons	·055 ton.
4-inch Q.F... ..	3 9	2300—2340 f.s.	3 f.s.
	Size 15.	<15·0 tons	·12 ton.
12-pr. 12 cwt. Q.F.	1 15	2220—2260 f.s.	2·5 f.s.
	Size 15.	<15·0 tons	·075 ton.

On the other hand, the amount of moisture in powder greatly affects pressure and velocity—it does not do so with cordite.

Back flash. "Extracts," 1896, p. 62; 1898, p. 123.

In some cases, after firing cordite charges to windward, on opening the breech a flame has issued. This is caused by the burning up of the carbonic oxide and hydrogen formed by the explosion, which take fire at the muzzle on coming in contact with the air in their heated condition and burn down the bore. It is not considered sufficiently serious for special orders in the case of field guns or howitzers, but with heavy guns the numbers opening the breech are cautioned against standing immediately in rear of the gun, or exposing cordite either bare or in a cartridge to the flame.

Percussion.

Cordite of small lengths and small diameter can be fired by percussion; increasing the size diminishes the susceptibility. At short ranges ·303 bullets failed to explode 6-pr. and 4·7-inch Q.F. cartridges; in some cases the cordite failed to fire. A filled shell burst in a limber box among cordite cartridges produced less effect than when burst among powder cartridges; some of the cordite cartridges were not ignited.

Detonation. "Extracts," 1895, p. 45.

Experiments show that detonation cannot occur in a gun fired under Service conditions. Cordite lightly confined has been detonated by using a priming charge of dry gun-cotton and a detonator.

Unsealed vents erode very quickly.

Advantages

The advantages of cordite over gunpowder are :—

(1) Smokelessness.

(2) Superior ballistic results with smaller charges.

(3) Reduction of chamber diameter, and so a lighter breech screw.
(4) Recoil of gun less violent.
(5) Absence of fouling.
(6) Not damaged by exposure to moist atmosphere.

Cordite is distinguished as follows:

(*a*) When made in specified lengths, by a fraction the numerator of which represents the diameter in hundredths of an inch of the hole in the die through which the cordite is pressed, and the denominator the nominal length of the sticks in inches. Size. §§ 7279, 8536, 9110.

The nominal length is the nearest whole number of inches above the maximum length to which the cordite is cut.

(*b*) When made in indefinite lengths (to be cut as required) by a number representing the diameter of the die as before.

Specifications for cordite now lay down limits of weight between which 100 inches of each size must weigh.

For example. Cordite Mark I $\frac{5}{11}$ signifies cordite of present Service composition, between 11 and 12 inches long, and of a nominal diameter of ·05 inch, the actual diameter is less as the cordite shrinks after it is squirted through the die, on cartridges, however, the nominal diameter alone is marked, thus, "Size 5."

The sizes of cordite made and the charges for the various guns will be found in Table II, p. 464.

Cordite has been made in the following nominal lengths: sizes 5 to 10, 12 inches; size 15, 14 inches; size 20, 17 inches; size 30, 24 inches; sizes 40 and 44, 26 inches; and size 50, 17 inches. Size 10 is also made in 7-inch lengths. Length. §§ 7279, 8536, 9110.

Cordite is pressed into hollow cylinders, about four inches long and one inch internal diameter, and ·2 inch, ·15 inch, ·1 inch, or ·05 inch thick. These cylinders are used to support the Mark III igniter in the following Q.F. or Q.F.C. cordite cartridges:— Cylinders. §§ 8873, 10095

·2	inch cylinder,	6-inch,	Marks IV, V, VI, and VII.	
·15	,, ,,	4·7-inch,	,, III, IV, and V. 4-inch Mark II.	§ 10781.
·1	,, ,,	6-inch,	,, I and II, reduced.	
·05	,, ,,	12-pr. of 8 and 12 cwt.	Full, and reduced; 4·7 and 4-inch, reduced.	

Case, Cordite, 100 lb., Mark I, C, has been adopted for the transport and storage of cordite. It is a strong deal box, the body being dove-tailed together, and the bottom secured by 16 2-inch brass screws, with a lid of deal clamped with hard wood, which is secured by eight gunmetal screws working in nuts let into the sides and ends of the case; at each end is a mahogany cleat for a rope handle. A strip of fearnought is attached to those portions of the lid, which come in contact with the case, by copper tacks and shellac. It is painted stone colour outside and is lined with non-absorbent paper and unpainted inside. The case was formerly varnished inside with a mixture of shellac, methylated spirits, and venetian red. Packing. §§ 7394, 8497, 8868, 8869, 8910, 9030, 9264, 10170, 10460.

The first cases were painted black inside; those which are varnished have the letter V in black, 2 inches high, painted on the lid and one end. These cases will be used up, but with paper linings.

The quantities of the various sizes of cordite to be packed in this case are given in the table, p. 466. When packed with size $\frac{12}{17}$ two wooden packing pieces in the form of a stool, are used.

§§ 7929, 8869, 8368, 8910, 9030, 9264, 10170.

Case, Cordite, converted, Mark I | N | .—A pattern of this case has been sealed to govern the conversion of such Marks III, IV, and V, 100-lb. powder cases as may be required for use in the storage and transport of cordite in bulk.

The lining is taken out of the powder case and the lid is prepared with fearnought, the case painted outside and lined with non-absorbent paper, the older cases being varnished inside in the same way as the 100-lb. case. The case was formerly provided with a packing piece which is now discontinued. This case is for use in the Navy only. The quantities and sizes of cordite to be packed in it are given in the table, p. 466.

§§ 9030. 10170.

Case, Cordite, Converted, Mark II | C | .—This case differs from Mark I by having two sets of grooves cut in the sides, one set 14 inches and the other 17 inches from one end, and by having a movable deal partition added, for use in packing cordite of 14 and 17-inch lengths. Both these cases are lined with paper, whether varnished inside or not. It is intended for both Land and Naval Services, and the amounts and sizes of cordite to be packed in it are given in the table, p. 466.

§ 10780.

Case, Cordite, 100 lbs., Mark II | C | , differs from Mark I in dimensions, being wider, slightly longer and shallower. The amounts of cordite to be packed in it will be found in the table, p. 466.

Cordite cases will be marked on the lid and sides as follows:—

(*a*) Printed paper label on the front giving designation of case and directions for closing.

(*b*) Stencilled with red paint on the lid:—

1. Mark of cordite.
2. Number of lbs. weight in the case.
3. Place or name of manufacturer.
4. Size of cordite.
5. Month and year of manufacture.
6. Lot number.
7. Tare weight of the case.

(*c*) Stencilled with red paint on both ends:—

1. Place or name of manufacturer.
2. Mark and size of cordite.
3. Lot number.
4. Number of the case in lot.

The following labels are also placed on the cases:—Government explosives label, so placed as to be torn or removed in opening the case; classification label; station label. The classification label has a red disc printed on it, in the centre of which is the Number 1, *see* p. 444. The label is of blue paper for Land Service, white paper for Naval Service. The station label is calico, with the monogram of station printed on it in black. It is placed so as to be torn when the case is opened.

The small sizes of cordite, which are not cut to length, are wound on a drum.

§ 10666.

The *Drum, cordite, transport, Mark I,* and *Case, cordite, drum, Mark I,* are used for packing and transport of sizes 5 and $3\frac{3}{4}$.

The drum is a tinned iron cylinder, 8 inches in diameter, and about $22\frac{1}{4}$ inches long. To each end a tinned iron flanged ring is secured with copper rivets.

The case is a square deal box, strengthened by wood battens and provided with cleats and rope handles. On the inside of the top and

bottom, four wood corner pieces are secured, which fit over the flanges of the drum and steady it.

The lid is attached by screws. *See* table, p. 466, for packing.

The *Barrel, Special, transporting, Cordite*, is used for transporting cordite, $3\frac{3}{4}$ and 3, on drums to India. It is a machine-made barrel of deal, length 26 inches, diameter of bilge 17 inches, diameter of head $15\frac{3}{4}$ inches. The heads are in three, and sometimes four, pieces; the middle piece is of deal and the cants of oak, on the inside of the head is screwed, with four $1\frac{1}{4}$-inch iron screws, a conical disc of deal $8\frac{7}{8}$ inches diameter; these discs fit in the end of the drums, and prevent shaking during transport. It is bound with 14 ash hoops, four on each chime, and three on each quarter. There are two dowels in bottom end to support the back head.

Storage.

Cordite for transport and storage is classed as Group I, Division I.

In addition to the orders as to temperature, previously mentioned (on p. 21), the present regulations state that magazines containing cordite should be dry and under the same hygrometric and other precautions as powder magazines. Each stack of boxes containing cordite should not exceed 11 feet in height. Each particular kind of cordite will be kept together where practicable.

Stacking cases.

Stacks of cases will have a clear space left between them and the walls, to allow of the free circulation of air and prevent injury from damp. All packages containing cordite should be so stacked, that at least one end or side is free from contact with other packages, or with a wall or partition. The interval or space so required need not exceed three inches.

Inspection, etc.

Instructions for the inspection of cordite will be found in the Regulations for Army Ordnance Services, 1900.

CHAPTER IV.—COMBUSTIBLE COMPOUNDS USED IN LABORATORY COMPOSITIONS, AND MISCELLANEOUS EXPLOSIVES.

VARIOUS EXPLOSIVES.—INGREDIENTS USED IN LABORATORY COMPOSITIONS.—METHOD OF MIXING.

THOUGH gunpowder, cordite, and gun-cotton are the substances at present employed in the British Service for propulsive and disruptive purposes, yet there are many others,* chiefly used for destructive purposes; of some of these a brief account will be given here.

Tonite or cotton powder is gun-cotton with the addition of a nitrate, usually barium nitrate. For storage purposes it is classed as Group I, Division II, and should not be stored in magazines the temperature of which exceeds 120° F.

Nitro-glycerine is a heavy oily liquid (sp. gr. 1·6), freezing at about 40° F., and found in many explosive mixtures.

It is produced by the action of nitric acid on glycerine, thus:—

$$C_3H_5(OH)_3 + 3HNO_3 = C_3H_5(NO_3)_3 + 3H_2O.$$

In its manufacture sulphuric acid is added to the nitric acid as in making gun-cotton.

It is easily exploded by friction, or percussion, and if heated to about 360° F. it detonates. It can be detonated by means of a Service detonator. It is one of the ingredients of cordite. In a liquid state it is inconvenient for use as an explosive, and so in commerce it is usually found mixed with other substances. Such mixtures are termed "*dynamites*." Dynamites may be classed in two divisions; (i) Those containing an inert base; (ii) those containing a combustible or explosive base.

Dynamite No. 1 may be taken as an example of the first class. It is a brown pasty mass consisting of a siliceous earth, called "Kieselguhr," impregnated with about 75 per cent. of nitro-glycerine. In actual contact with water, the nitro-glycerine at once separates from the earth. Like most other nitro-glycerine mixtures it freezes at about 40° F., and, in its frozen state, is, under ordinary circumstances, less liable to explosion from detonation or percussion than when thawed, but more susceptible to explosion by simple ignition; and should any of the nitro-glycerine have exuded, the dynamite cartridges are much more sensitive to explosion by a blow. Dynamite should not be exposed to the rays of the tropical sun. It can be detonated by a Service detonator. For storage it is classed in

* *See* the late Lieut.-Colonel Cundill's "Dictionary of Explosives" and "Treatise on Service Explosives," 1900.

Group I, Division II, and should not be stored in magazines the temperature of which exceeds 120° F.

Blasting Gelatine is an example of the second class of dynamites. It is made by dissolving finely divided gun-cotton in nitro-glycerine, soluble gun-cotton is the form chiefly employed. The product is a gelatinous mass, the colour of honey, and varying in consistency from a tough leather-like substance to a jelly. It contains 93 to 95 per cent. of nitro-glycerine, and is a most powerful explosive. It is practically unaffected by water, and can be detonated by a Service detonator. It is classed for storage in Group I, Division II, and should not be stored in a magazine the temperature of which exceeds 120° F.

Blasting gelatine is to be stored under water in suitable tanks, in the perforated boxes containing 45 lb., as received from the makers. The water in the tanks should be kept clean and changed every three months. Should any deposit of nitro-glycerine be observed at the bottom of the tank, a report should be made of the circumstance.

For transport, the perforated box containing the blasting gelatine is packed in a zinc-lined wood case, the lid of which is screwed down on an india-rubber washer to form a water-tight joint. On receipt, the perforated box should be as soon as possible removed from the outer case, and placed in water.

Gelignite or gelatine dynamite, is blasting gelatine with the addition of an absorbing powder, consisting usually of nitrate of potassium or sodium (about 75 parts), wood meal (24 to 25 parts) and sometimes, a little soda (1 part). The proportions are about 65 per cent. of blasting gelatine to 35 per cent. of the powder. Gelignite, which is less violent in its action than blasting gelatine, is now largely used in commerce. It is classed for storage in Group I, Division II, under similar conditions to dynamite.

Ballistite is a mixture of nitro-glycerine and nitro-cotton, with or without the addition of camphor or aniline, and is intended for use as a propelling agent as for 15-pr. Q.F. It is classed for storage in Group I, Division I; the temperature of magazines in which it is stored should not exceed 120° F. § 10726.

Picric acid is formed by the action of nitric acid on phenol (carbolic acid C_6H_5OH), thus:—

$$C_6H_5OH + 3HNO_3 = 3H_2O + C_6H_2(NO_2)_3OH.$$

It is a yellow substance which can be melted at a temperature under that at which it decomposes. When confined or melted into a compact mass it can be detonated. It can be fired by percussion. With bases it forms picrates, which are more sensitive to percussion or friction than picric acid, and in some cases the explosive effect is greater. Lead picrate is peculiarly sensitive. Picrates are capable of acting as detonators to any picric acid within reach of their detonative influence. Picric acid and picrates, unmixed or mixed with other substances, have been used for shell filling, &c.

It is classed for storage in Group I, Division III, and may be stored in a magazine or store by itself, or with other explosives of its class, but when placed in a magazine, it must be repacked into powder barrels with waterproof bags, or 100 lb. powder cases with calico bags substituted for the linings. § 8838.

Powder barrels for packing picric acid are marked with a band of yellow ochre paint, 1-inch wide, round the bilge, and have stencilled, in yellow ochre paint, on the top end, "To be used for Picric Acid

only." These barrels are not to be used afterwards for packing any other explosives.

§ 8456. *Lyddite* has been introduced as the Service high explosive for filling shell. It is picric acid brought to a dense state by fusion and poured into the shell where it solidifies. A cavity is left for the exploder of picric powder by which the detonation of the lyddite is secured. It has a density of 1·6 and consequently the same shell will contain a greater weight of lyddite than of P. mixture. It is classed for storage with picric acid in Group I, Division III. (For lyddite shells *see* p. 208).

§ 8456. *Picric powder* formerly consisted of two parts of ammonium picrate and three parts of saltpetre, manufactured in very much the same way as ordinary granulated gunpowder. "Dry mixed" picric powder has lately been introduced. It is more certain in its action and is easier and safer to make. It is a mixture of 43 parts of ammonium picrate and 57 parts of saltpetre. The two ingredients are dried, reduced to a very fine state of division and thoroughly mixed together in the dry state. It is of a bright yellow colour and when strongly confined is a powerful explosive.

Exploders, Lyddite Shell. §§ 8564, 8770, 9398, 9679, 9877, 9959, 10148, 10498, 10504, 10747. It is used as an exploder for lyddite shells and is enclosed in a shalloon bag and waterproof paper cylinder in order to keep it dry, which is important.

Exploders of different weights are used in different shells, and in some cases a primer of 8 drams R.F.G.^{2}, or Blank F.G. new, is added.

The following table gives the various exploders in the Service and the shells with which they are used :—

Exploders, Lyddite Shell.	Length.		In Shalloon Bag and Paper Cylinder.
	ins.		
5-oz. with primer. Mark I	17·5	C	B.L., Q.F. or Q.F.C. shells formerly taking 5¼-oz. exploder.
4¼-oz. with primer. Mark I	16·1	C	B.L. howitzers 5·4-inch and above; B.L., Q.F., or Q.F.C. gun shells, 6-inch and above, and R.M.L. 10-inch (except shells formerly taking 5¼-oz or 4-oz. exploders).
4¼-oz. without primer. Mark I.	14·35	L	B.L., 5-inch howitzer.
4-oz. Mark I	13·35	C	Q.F., 4·7-inch.
3¾-oz. Mark I	12·5	C	B.L., or B.L.C., 5-inch gun; R.M.L., 6·3-inch howitzer.
3½-oz. Mark I	11·4	C	B.L., 9·2-inch; B.L., Q.F, or Q.F.C. 6-inch; Q.F. 4·7-inch; B.L. howitzers, 8-inch, 6-inch, 5-inch and R.M.L. 10-inch shells formerly taking 4-oz. exploder.
3¼ oz. Mark I	10·7	L	B.L., 30-pr.
3-oz. Mark I	9·0	N	B.L., Q.F., or Q.F.C., 4-inch.

The exploders of existing shell differ from those mentioned above and will be replaced by the new ones in the waterproof cylinders. *See* table, p. 511.

Issue. These exploders are issued in the shells, and also spare to replace those which are extracted for proof.

§§ 9907, 10026. *A Box, Exploders, Lyddite, Land, Mark I*, has been issued to contain these spare exploders. The box is made of deal, with elm ends, painted yellow; the lid is secured by brass screws working into nuts

let into the top of the box. It is fitted with a copper-tinned lining which has a groove formed round the top to receive luting, *see* p. 73, into which a copper-tinned lid is pressed so as to make an air-tight package. Cleats with rope handles are attached to each end of the box. The box is provided with packing pieces of varnished deal for use with different sized exploders. Mark II box differs only in packing pieces, a felt wad over the exploders also is used.

This box is for L.S.; the naval box has wire handles.

Picric powder must be stored in a magazine with explosives of its class; it is placed in Group I, Division II. Storage.

Instructions for the inspection of these exploders are given in the Army Ordnance Regulations, 1900.

Examination of Picric Acid, Picric Powder, Lyddite, Blasting Gelatine, and Dynamite.

When there is any lyddite, picric powder, or picric acid in store, not in shells, samples of them (about 1 lb. of each) should be forwarded annually to the Principal Ordnance Officer or Naval Ordnance Officer for transmission to the Chief Inspector, Royal Arsenal, for chemical examination.

Instructions for the examination of Dynamite and Blasting Gelatine will be found in the Regulations for Army Ordnance Services, 1900.

Ingredients used in Laboratory Compositions.

The combustible compositions may be divided into two classes, those which detonate and those which do not; as an aid to memory it may be remarked that chlorate of potash will be found in the detonating class, and saltpetre in the compositions which do not detonate.

Sulphur (S) burns at a low temperature (about 500° F.), and gives out great heat. This is useful in enabling the other ingredients of the various compositions, of which sulphur forms a part (*e.g.*, gunpowder), to ignite in the first place, and the heat given out by the burning sulphur increases the rapidity and power of action of the whole. Sulphur melts at 239° F. This substance is found in all the burning compositions, and, owing to its property of detonating with chlorate of potash, in the greater part of the detonating compositions.

Sulphur has been used in the R.L. in two forms, viz., sublimed sulphur, known generally as "flowers of sulphur," and ground distilled sulphur. A full account of the preparation and properties of these two forms of the element will be found in the "Treatise on Service Explosives, 1900," and in Bloxam's "Chemistry." It is sufficient here to say that the sublimed sulphur consists of spherical granules composed of insoluble, or electro-positive sulphur, enclosing soluble, or electro-negative sulphur. The distilled sulphur, on the other hand, consists almost entirely of the soluble variety which crystallizes in the form of rhombic octahedra. The use of sublimed sulphur has been discontinued, on account of the deleterious influences found to be exerted on some of the compositions of which it formed a part by free acids which, from the mode of its manufacture, it is liable to contain. These may be removed by washing, but it has been found advisable on the whole to make use of ground distilled sulphur only.

Saltpetre, or *Nitrate of Potash*, or *Nitre* (KNO_3) is used as a source of oxygen. One cubic inch of saltpetre contains about 207 grains

weight of available oxygen, equivalent to that contained in about 3,000 cubic inches of air. As most of the laboratory compositions burn in a more or less confined space, some source of oxygen is indispensable. This need is supplied by saltpetre, which is found in all non-detonating compositions.

Saltpetre is supplied to the R.L. from Waltham Abbey; a full account of the process of refining will be found in the "Treatise on Service Explosives, 1900." The presence of any salts containing chlorides is carefully provided against, as they would render saltpetre liable to deliquesce, a fault from which pure saltpetre is comparatively free.

Ground saltpetre is used in the R.L. It is supplied in a powder fine enough to pass through an 80-mesh sieve.

Chlorate of Potash ($KClO_3$) contains, weight for weight, more available oxygen than saltpetre. As, however, it has the property of detonating on being rubbed or struck when mixed with sulphur or sulphide of antimony, it cannot with safety be used in the ordinary burning compositions. It would manifestly be highly dangerous to use it instead of saltpetre in gunpowder, for instance. This property, however, renders it most useful in detonating compositions, in all of which (except when fulminate of mercury alone is used) it is to be found. In mixing these compositions, great care is necessary to avoid accidents from detonation.

Nitrate of Baryta ($BaON_2O_5$) is used in certain explosive compounds, as Tonite, as a source of oxygen. It is also used in the stars for star shell and light rocket. It is a white substance and is less sensitive to atmospheric moisture than saltpetre.

Sulphide of Antimony, or *Crude Antimony* (Sb_2S_3), like sulphur detonates with chlorate of potash, and gives a more violent explosion. It burns with a long flame or flash, which renders it useful in compositions intended to ignite other bodies at a little distance; thus it is used in caps, friction tubes, and in the detonating composition for fuzes.

Fulminate of Mercury ($HgC_2N_2O_2$) is a most dangerous substance to handle, and should never be dealt with by inexperienced men. It detonates readily and with great violence on being rubbed or struck. It will also explode when heated to 360° F., or on being touched with nitric or sulphuric acid. It is kept wet till required for use, in which condition it is harmless. It is prepared by the action of alcohol on a solution of mercury in nitric acid. The products of its explosion are metallic mercury, carbonic oxide, and nitrogen. It is used alone in detonators for gun-cotton, and in company with other ingredients in cap composition.

Magnesium (Mg) burns with a very brilliant white flame, and is used in a powdered state in light compositions. It is prepared with 25 per cent. of paraffin to preserve it from oxidation.

Red Orpiment, or *Realgar* (As_2S_2), is a sulphide of arsenic. When used in conjunction with saltpetre it burns with a brilliant white flame, producing arseniate and sulphate of potash. It is thus very useful in light compositions.

Turpentine is used as a solvent of rosin. It is an ingredient of the lacquer used for the interior of shells. It is highly inflammable.

Methylated Spirit is alcohol, or spirits of wine (C_2H_6O), of sp. gr. ·83, mixed with 10 per cent. of wood spirit or methylic alcohol (CH_4O), the latter being derived from the destructive distillation of wood. The only object of adding the methylic alcohol is to render

the mixture nauseous and undrinkable. The spirit is used for damping detonating compositions, so that they can be handled in the form of a paste. It evaporates without injuring the compositions, of which it forms no part in their ultimate form. It is used also as a solvent for shellac.

Charcoal is carbon prepared from wood, and contains more or less oxygen and hydrogen. The longer the charcoal is burnt in its manufacture, the more nearly will it approach pure carbon (C). It acts as fuel in gunpowder, &c., combining with the oxygen of the saltpetre, and, in the combination induced by ignition, forms a highly heated, expansive gas. It is used also in rocket composition. It is supplied to the R.L. in a finely divided state fit for use.

Mealed Powder is largely used in the R.L. in the manufacture of ammunition. It is ordinary powder reduced to an impalpable dust by drumming it in a revolving barrel with gun-metal balls, until it will pass through an 120-mesh sieve. The meal from Prism' brown, used in fuze compositions, is prepared by breaking the prisms into small pieces with a wooden mallet, and then crushing them by hand on a metal slab with a metal roller. The meal so obtained is passed through an 120-mesh sieve. It ignites readily and burns rapidly, and is used in fuze composition, quick match, friction tubes, &c. It causes compositions to burn readily and quickly, and the rate of burning may to some extent be regulated by the quantity of mealed powder employed.

Rosin or *Colophony* is the resin obtained from the turpentine or viscous exudation obtained by incising the bark of various species of pine trees. The rosin is held in solution in the oil or "spirits" of turpentine, and is freed from it by distillation. It is used in lacquer for the interior of shells, &c., and is run in a melted state into the interstices between the balls of rifled shrapnel shell to bind them together.

Shellac, or more correctly *shell-lac*, as distinguished from *stick* or *seed lac*, is the exudation of certain tropical trees punctured by an insect. It is a complex rosin. It is largely used dissolved in methylated spirits of wine, for various varnishes, and also for damping various detonating compositions. The spirit evaporates, and the shellac, remaining behind, acts as a sort of cement.

Phosphide of Calcium (Ca_2P_2) is prepared by passing phosphorus vapour over red-hot quick-lime. The result is a dark brown mass with an unpleasant phosphoric odour. It is a mixture of pyrophosphate of lime and phosphide of calcium. It is used in life-buoy apparatus (*see* p. 431) for giving a flame, as, on being brought in contact with water, it evolves phosphuretted hydrogen (PH_3) a gas which is spontaneously inflammable.*

Method of Mixing Laboratory Compositions.

The leading points to be attended to in making up laborator compositions are :—

1. Purity of the ingredients used.†

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* The mode of production of the phosphurretted hydrogen may be shown by the following equations :—

(1) $5\ Ca_2P_2 + 10\ H_2O = 10\ CaO + 10\ PH_3$ (liquid phosphide of H).

(2) $10\ PH_2 = 6\ PH_3 + 2\ P_2H$ (solid phosphide of H).

† Samp'es of the ingredients are analysed in the Chemical Department, Royal Arsenal, and in the Composition Establishment, R.L.

2. The proper proportion of each ingredient to be accurately weighed.
3. The thorough mixing, or incorporation of the ingredients.

In order to ensure the mixing being complete, it is necessary to have the ingredients in a state of very fine division; this enables the different bodies to be brought into close contact with each other, and thus ensures their acting on one another when inflamed.

Nitrate of baryta and chlorate of potash are reduced to an impalpable powder by being placed in a revolving barrel along with a number of gun-metal balls. Sulphide of antimony is pulverised either in a mill under iron runners when required for tube composition, or in a metal mortar for cap compositions. Sulphur is reduced to a finely divided state in a special mill. Other substances are supplied to the R.L. in a state of fine division. The ingredients are passed through a very fine sieve* to ensure the powders being sufficiently fine.

There are two different methods of mixing burning compositions commonly used in the R.L., one consists in placing the ingredients in a revolving barrel with gun-metal balls, and "drumming" them; this method is used for mixing rocket compositions. The second consists in placing them in a revolving barrel, fitted up with wooden arms or fans in the interior, so arranged that when the barrel revolves in one direction, the fans revolve in the other; this method is used for mixing mealed powders for fuze compositions.

While the above methods are being used for what may be called the *burning compositions*, it is found necessary to adopt another method for the detonating compositions, which would explode under friction or pressure.

The ingredients are mixed in a conical silk bag, suspended from an india-rubber ring inside a leather cylinder, behind a wrought-iron boiler plate screen. The silk bag contains washers of india-rubber threaded on strands of silk twist; a cord connects the bottom of the bag to the end of a lever pivoted in the top of the screen. The operator, who is entirely protected by the screen, effects the mixing by moving the lever up and down, thus agitating the bag. On the completion of the operation a pin which limits the movement of the lever is withdrawn, the bag is inverted by pulling down the lever to its full extent, and the composition falls into a small box placed to receive it.

The details of the apparatus are shown in Plate I.

Priming composition for electric tubes and detonators, and composition for stars, are mixed in a similar apparatus, which only differs in the bag containing india-rubber balls instead of washers.

Residue. When the ingredients are thoroughly incorporated in proper proportions with a view to form a large volume of gas on explosion, there should be little or no solid matter left, as is the case with gun-powder, but the laboratory burning compositions are, as a rule, required to burn for a considerable time, and the volume of gas evolved is of no importance, hence the proportions employed are chosen with a view to cause them to burn a certain definite time, and there being a residue of solid matter, or slag, is unimportant.

Regularity. The most important point aimed at is regularity of burning. By increasing the density of a composition, its time of burning will be increased, as there will be more matter to be burned in a given

* In some cases an 80-mesh, in others an 120-mesh is used.

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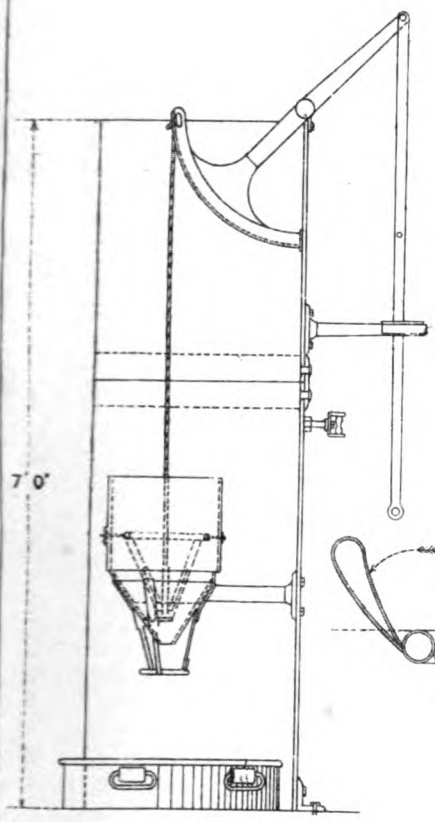
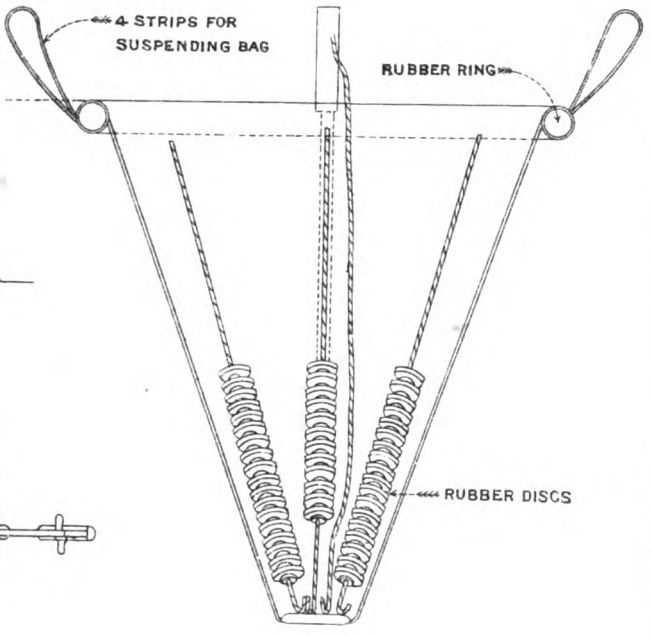
APPARATUS FOR MIXING FULMINATE COMPOSITION FOR PERCUSSION CAPS.

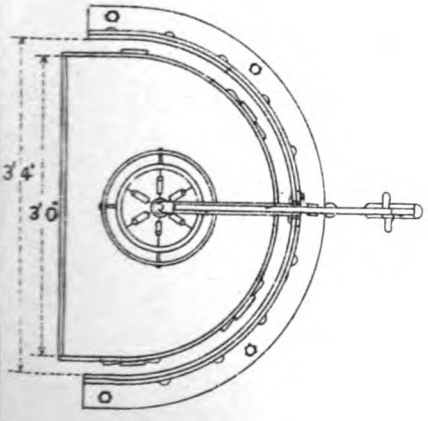
SCALE 1/24TH





SECTIONAL ELEVATION OF BAG.

SCALE 1/4TH.



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volume, therefore, by subjecting the composition to a very heavy pressure, the time of burning is prolonged.

The pressure is generally applied in the R.L. by means of hydraulic presses, and in some cases such as war rockets it reaches several tons per square inch.

A table of the various compositions used in the R.L. is given on p. 552, *et seq.*

Many of the compositions possess the property of burning under water; as they do not depend on air for the supply of oxygen, water will only extinguish them when it comes into sufficient contact with the burning matter, to reduce its temperature below the point of combustion. When the composition is enclosed in a case, having a vent or vents, and a sufficient amount of gas is generated to give a high pressure when issuing from the vent, the water cannot make its way to the composition, which will therefore continue to burn. This may be illustrated by plunging a wood time fuze, when well lit, into a bucket of water, it will continue to burn. Burning under water.

CHAPTER V.—CARTRIDGES.

GENERAL REMARKS.

MATERIALS USED. — GRAVIMETRIC DENSITY AND AIR-SPACE. — POSITION OF VENT.—CLASSIFICATION OF CHARGES.

SECTION I.—POWDER CARTRIDGES.

MATERIALS.—GENERAL DESCRIPTION OF PRISMATIC CARTRIDGES.—R.B.L. STORES.—BLANK.—MAKING UP AND FILLING.—MARKING.

SECTION II.—CORDITE CARTRIDGES.

MATERIALS. — GENERAL DESCRIPTION. — MAKING UP AND FILLING. — MARKING.

SECTION III.

GAUGES. — COVERS, CARTRIDGE. — DRILL CARTRIDGES. — ISSUE OF CARTRIDGES.

THIS chapter is devoted to the subject of cannon cartridges and is divided into three sections, the first dealing with powder cartridges, the second with cordite cartridges, and the third with drill cartridges and miscellaneous stores connected with cartridges generally. There are also a few preliminary remarks on material, shape, &c. which apply equally to powder and cordite cartridges.

Cartridges for quick-firing guns, and small-arm and machine guns are considered in later chapters.

Up to the beginning of the seventeenth century* it appears to have been the practice to load guns with loose powder, weighed on the spot. About that time the custom of enclosing the charge of a gun in an envelope made its appearance. This envelope is known as a cartridge and was introduced for safety, rapidity and convenience of loading.

Shape.

Powder cartridges, except those for prismatic powder, are usually of a cylindrical or slightly coned shape, kept in shape by braid hoops and the end closed by choking. Prismatic powder cartridges are in the shape of a more or less regular prism with flat ends sewn on; and cordite cartridges are cylindrical or coned, but the top is closed in a peculiar manner described later.

A good cartridge for service should possess the following qualifications:—

Requisite properties of material used.

1. The material should be strong enough to bear reasonable knocking about when filled, and to stand the wear and tear of travelling.

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* *See* "Treatise on Ammunition," by the late Col. Sir V. Majendie, K.C.B., pp. 128, *et seq.*, for various interesting details connected with the history of, and the materials used for, cartridges.

2. It should be so close in texture that the powder, even if slightly dusty, will not readily work its way through, and yet be permeable to the flash from the tube, &c., intended to fire it.
3. Lastly—and this is of the greatest importance—the material should consume entirely in the gun when fired; or, if this end cannot be obtained, it should leave no smouldering fragments, or sparks, in the bore.

If much residue is left in the gun the vent is apt to be choked. If sparks remain, and the gun is re-loaded almost immediately, a serious accident will probably occur. Several accidents have thus occurred, especially when using blank serge cartridges, generally due to carelessness in sponging or serving the vent.

Materials used.

These conditions are very well fulfilled by the materials in use in the Service, *i.e.*, shalloon, serge, and silk cloth.

Chemical test.

Samples of all materials received for the manufacture of cartridges are tested by the W.D. chemist with a magnifying glass for closeness of texture, and chemically for purity of the material. Any admixture of cotton would be most objectionable, as that material has a tendency to carry fire.

Shalloon. § 8700.

Shalloon was originally introduced because of the lesser thickness of material in the choke, which is liable to come underneath the vent when a very small cartridge is used.

It is made entirely of "long" wool and is woven twilled. It is entirely a worsted fabric prepared like the warp* of a serge. It is red, and there are two Marks, I and II, Mark II being less glazed than Mark I, and 36 inches wide. Shalloon is used for both powder and cordite cartridges, lists of which are given in the sections I and II.

Serge.

Serge† is woven twilled. The warp is made from "long" wool, which is first combed on a combing machine and then spun into a worsted thread on a worsted spinning frame. The weft is made from "short" wool, carded on a carder and afterwards spun on mules. The warp thread is named "worsted," and the weft thread named "woollen" by way of distinction. It is superseded by silk cloth as it is not strong enough for the heavier charges, and, as it is rather more liable to "hold fire," it is not suitable for blank cartridges. It has only been used for powder charges, and the rules regarding its use will be found in the section on powder cartridges.

Silk cloth. §§ 1780, 1822, 1829, 1868, 2047, 2116, 2633. §§ 4460, 6317, A.O. 1888, cl. 462.

Silk Cloth is made of the refuse silk from the outside of the cocoons. It is stronger and of closer texture than serge, and is not so liable to "hold fire" or smoulder. It was originally introduced on the score of safety for blank charges, as in firing these there is not so much heat and pressure as when shotted rounds are fired, and therefore less chance of the cartridge being entirely consumed.

It has superseded serge for powder cartridges and is used for cordite cartridges except howitzer and the smaller gun cartridges. Details will be found in the sections on powder and cordite cartridges.

The silk cloth is steeped in a cold saturated solution of boracic acid, 5 oz. boracic acid to one gallon of water, and dried at a temperature not exceeding 120° F. This is to prevent a fungoid

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* The warp threads are those running the length of the fabric, the weft threads those running across.

† Flannel differs from serge in being a thin fabric, woven plain, and made entirely of "short" wools, both warp and weft.

growth forming on the cartridge and consequent rotting, but it does not preserve the cloth from rotting from any other cause.

Classes of silk cloth. § 5817.

Silk cloth is divided into three classes, No. 1, 47 inches wide; No. 2, 54 inches wide; and No. 3, 40 or 52 inches wide; and rules for their use will be found in the sections I and II.

Testing strength of the cloth. § 3816.

Each of these classes is required to possess a minimum strength. The mode of testing is to place a piece of the cloth, 3 inches wide and 10 inches long, in the clamps of a testing machine, the clamps being 6 inches apart. The strain is gradually applied.

Class No. 1 should stand a strain of 150 lb. both warp and weft.
„ No. 2 „ „ „ 200 „ „
„ No. 3 „ „ „ 300 „ „

A.O. d. 1.12.99.

After issue silk cloth may be tested by cutting a test piece, free from holes for braids, from the cartridge in the direction of either warp or weft, 10 inches long, and 1 inch wide (when lengths of 10 inches cannot be obtained, shorter lengths must be used).

The test piece will be passed through the ring of a weight made up to the necessary amount, which it must support when lifted by the two ends.

The following are the minimum weights the three classes of silk cloth should lift (1) when new and (2) to be considered serviceable for use —

Class No. 1, minimum when new 65 lb.; minimum for use 56 lb.
„ No. 2, „ „ „ 80 lb.; „ „ „ 70 lb.
„ No. 3, „ „ „ 100 lb.; „ „ „ 84 lb.

All No. 1 Class silk cloth are sewn with silk sewing, Nos. 2 and 3 Class with silk twist. The silk twist should support a weight of 13 lb., and the sewing silk a weight of $5\frac{1}{2}$ lb.

Silk braid. § 6586.

Silk braid for hooping is made in two widths, 0·35 inch wide and 0·65 inch wide. These braids should support a weight of 28 and 85 lb. respectively. For beckets the silk braid is also made in two widths, 1·5 inches and 1 inch, which should support a weight of 250 and 160 lb. respectively.

Effect of the shape of the cartridge.

The shape of the cartridge has some effect upon the behaviour of a charge, very long cartridges, for instance, producing wave pressures. This tendency may be overcome by igniting the charge in or near the centre, by means of a tube as in the B.L. 80-pr. full charge (now obsolete), or by the position of the vent as in R.M.L. guns. Complications in cartridges such as the long tube of the B.L. 80-pr. are better avoided.

In a M.L. gun the cartridge must be made of a diameter sensibly less than that of the bore of the gun, to ensure easy loading; in a B.L. gun the same holds good in a lesser degree with the chamber. The interval between the cartridge and the gun facilitates the passage of the flash from the portion of the cartridge first ignited, and thereby causes more rapid ignition of the entire charge.

Gravimetric density.

The gravimetric density of a charge of powder in the chamber of a gun is the ratio of its weight to the weight of that volume of water which would fill the space behind the projectile in the gun.

It has been found that when the gravimetric density of a charge is decreased, the pressures and the velocity of the projectile both fall off.

When a certain additional quantity of powder is added (keeping to the same decreased gravimetric density of charge) the velocity of the projectile becomes as great or greater than before, but the

maximum pressure in the bore is found to be less than with the smaller charge of greater gravimetric density.

The gravimetric density of cordite charges is invariably small.

The allowing to a charge of powder in the bore of a gun a greater cubic space than it would occupy if it completely filled the section of the bore or the chamber, and the projectile were rammed home hard upon it, is termed air-spacing.

Methods of air-spacing.

Charges have been "air-spaced" in various ways; by internal hollow cone in the cartridge, as in the 80-pr. B.L.; by lengthening the cartridge, as in some of the heavy R.M.L. guns, or in chambering the gun, as in the 13-pr. R.M.L. In the heaviest R.M.L. guns the chamber and lengthened cartridge have been combined with the use of mild and regular powder.

To ensure constant air-space it is, of course, necessary that the projectile should be brought up at the same point in ramming home.

Sticks.

In certain old R.M.L. cartridges, now obsolete, this was obtained by having a stick down the centre of the cartridge, which stopped the projectile and prevented the cartridge being compressed. Sticks will be found in the cordite cartridges for use with special case shot in some of the heavy R.M.L. guns. In this case the stick is intended for a stop as the case shot have no studs (except the 12·5-inch) and would therefore not be brought up by the rifling. The stick also gives the cartridge the necessary rigidity and prevents its being deformed in loading.

It may be mentioned here that B.L. guns afford much more facility for rendering a heavy charge manageable than M.L. guns do. In the case of the latter, whatever the dimensions of the chamber may be, the diameter of the cartridge must be limited by the diameter of the bore, as expanding cartridges have not been found to work well on a large scale, and consequently a heavy charge is apt to be unduly long. In B.L. guns, on the other hand, the cartridge is introduced directly into the chamber, and its diameter is not limited by that of the bore. Consequently much liberty is given for the regulation of the length and diameter of cartridge.

In B.L. guns.

In the latest B.L. guns, the great mildness and regularity of the prism brown powder, and the air space due to the central hole in each prism, have made it practicable to use charges which completely fill the chamber, and give high velocities with low pressures in the gun.

Measurement of.

"Air space" is measured by the number of cubic inches which each lb. of powder in the charge would occupy if the charge were evenly distributed throughout the space behind the projectile. Practically the solid content of the chamber in cubic inches is divided by the number of lbs. in the charge.

To form a correct judgment on results obtained by experiments it is necessary to know the gravimetric density or air space allowed for charge as well as the weight and nature.

Conversion of air-space to gravimetric density.

The gravimetric density of a charge may be determined by dividing 27·73, the number of cubic inches filled by 1 lb. of water at 60° F., by the air space of the charge.

Thus one of the charges of the 8-inch B.L. gun was 100 lb. Prism[1] black, and the capacity of the powder chamber 3,050 cubic inches. Hence the air space is 30·5, and by calculation we find the gravimetric density to be 0·909. Such a charge would be written

100 lb. Prism[1] black $\frac{30{\cdot}5}{0{\cdot}909}$

An example of a cordite charge will show how low the gravimetric density is compared to gunpowder.

The charge for the 6-inch B.L. gun, Mark VII, is 20 lb. of cordite, size 20, and the capacity of the chamber is 1,715 cubic inches, giving an air space of 85·75, and gravimetric density of 0·324.

Effect of the position of the vent on the ignition of the cartridge.

The position of the vent, or the place at which the cartridge is ignited, influences the rate of explosion of the charge, and consequently the muzzle velocity of the projectile and the pressure in the chamber or strain on the gun. This is most felt when large charges of violent powder are fired, but to a less extent when small charges are used, or when slower burning powders are employed. With the most modern guns, in which slow burning powders are used, and due regard is paid to air-spacing, the effect is so small that other advantages gained by igniting the cartridge by an axial vent more than counterbalance it, and consequently this method of firing has been adopted in the heaviest R.M.L. and the B.L. guns.

In the old type R.M.L. guns the charge is ignited by a radial vent striking the cartridge at a distance of four-tenths of its length from the rear, the position which was found by experiment to give the highest muzzle velocity with guns of this class when firing quick burning powder. The R.M.L. field and siege guns and howitzers have a radial vent entering the chamber at the rear, so as to permit the use of reduced charges, and all R.B.L. guns are rear vented except the side-closing 40-pr., the flash striking the cartridge in the direction of its axis.

Names of various charges.

The various charges for guns are classified as follows:—

Charges used with projectiles are termed "Service charges."

When a gun has two such charges they are termed "*Full*" and "*Reduced*" respectively; if it has only one this is called the "*Full*" charge.

Charges specially supplied for saluting are called "*Saluting*," and those for exercise without projectiles "*Blank*" charges.

Saluting or blank charges are invariably made of powder, Blank L.G. being used.

Full charges are used with B.L. guns for firing all projectiles on service, and with heavy R.M.L. guns for firing armour-piercing projectiles, and in certain cases common and shrapnel shell* and case shot. "Reduced" charges are used with B.L. guns for firing projectiles principally for practice, and with heavy R.M.L. guns for firing projectiles other than armour-piercing ones.

Blank and saluting cartridges. § 9811.

Blank or saluting cartridges are issued for 12-pr. of 6-cwt., 15-pr., 4-inch, 5-inch, and 6-inch B.L. guns. Blank charges for B.L. guns or howitzers above 6-inch are obsolete, and no blank firing will take place with such guns. Also blank firing from B.L. guns or howitzers above the 15-pr. and 5-inch respectively is not to be carried out unless a shotted round has been fired within one month previously. Blank cartridges are issued for practically all R.M.L. and R.B.L. guns. These are used for saluting from the 7-inch, 80-pr., 64, 25, 16, 13, and 9-pr. and 2·5-inch R.M.L. guns and all R.B.L. guns. For details *see* Tables 8, 9, 10, pp. 476, 477, 478.

Gun charges, both powder and cordite, in the larger natures are divided into fractions for convenience in handling, and also to allow

* For a list of the common and shrapnel shell that must be fired with reduced charges, *see* p. 247.

reduced charges to be used. This practice was introduced with the heavier R.M.L. powder cartridges, and has been developed considerably in B.L. charges.

Section I.—POWDER CARTRIDGES.

Materials

The materials used for powder cartridges are shalloon, serge, and silk cloth.

Shalloon. 4679, 9509, §§ 5360, 6389, 9390.

Shalloon is used for the smallest cartridges, viz., 6-oz. and 12-oz. cartridges for the 2·5-inch R.M.L. gun, 4-oz., 6-oz., and 8-oz. cartridges for the 7-pr. R.M.L. gun, details of which will be found in Table 5, p. 469.

Choking and hooping.

These cartridges are hooped with blue worsted braid, and choked with silk twist, except the 4-oz. which is choked with worsted.

Serge.

Serge has been used for R.M.L. cartridges up to the 110-lb. charge for the 12-inch of 35 tons, but is only now used for R.B.L. and R.M.L. charges below 85 lb., which will be used up in the L.S. The present sealed patterns of R.B.L. service cartridges for L.S. are of serge.

Choking and hooping.

Serge cartridges for R.M.L. guns are choked with worsted and hooped with blue worsted braid, except some converted ones, hooped with worsted. For R.B.L. guns they are choked with twine and hooped with braid.

Conversion of serge cartridges.

The rules for the conversion of serge cartridges will be found in former editions of this Treatise.

Silk cloth.

Silk cloth is now used for:—

1st.—All cartridges issued to the Navy.
2nd.—For B.L. guns for Land Service.
3rd.—For R.M.L. guns for charges of 85 lb. weight and upwards, and is superseding serge for charges below 85 lb. weight.
4th.—For the siege train.
5th.—For the reserve store of R.M.L. field and siege artillery.
6th.—It will be invariably employed for saluting cartridges for all descriptions of ordnance.

Practically all new cartridges are made of silk cloth.

§ 5817.

Class 1 silk cloth is used for all powder charges up to 14 lb. inclusive.

Class 2 silk cloth is used for powder charges from 14 lb. to 85 lb., and as strengthening linings for the B.L. 12-inch, Mark III, cartridge and 16·25-inch cartridge both for Naval Service, and all 13·5-inch cartridges.

Class 3 silk cloth is used for powder charges above 85 lb., and for all prism powder cartridges. This is on account of the sharp edges and the hardness of the prisms.

Choking and hooping. § 5567.

All silk cloth powder cartridges for rifled guns are hooped with silk braid, except the 2½-lb. charge for the 8-inch R.M.L. howitzer, which has no hoops. Silk cloth powder cartridges are choked with silk twist except the 7-inch and 40-pr. R.B.L. choked with twine and cartridges for moulded powders which have no chokes.

The hoops are of ·35-inch silk braid for cartridges of cut or granulated powders under 40 lb. weight, and of ·65-inch for those of 40 lb. and above, and all prism cartridges.

Beckets. §§ 5680, 6090,

All cartridges of cubical or granulated powders of 30 lb. and

6113, 6586, 6843.

upwards have a lifting becket of silk cloth, forming a loop about 3 inches long above the choke.

Prismatic cartridges have two beckets at each end, sewed across on each side of the central holes, of silk braid, 1 inch wide for charges over 12 lb. and under 50 lb., and 1·5 inches wide for charges of 50 lb. and upwards. The 6-inch B.L. 12-lb. E.X.E. cartridge has its beckets made of the ordinary ·65-inch hooping braid. Some of the earlier prismatic cartridges had beckets made of strips of No. 3 class silk cloth, turned in at the edges, and these are still found in the cartridges of the 13·5-inch and 16·25-inch B.L. guns.

As before stated the heavier charges are divided into fractions for convenience in handling. They are divided as follows:—

B.L. cartridges.

B.L. 5-inch $\frac{1}{2}$ charges and whole charges.
„ 6-inch $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ charges.
„ 8-inch to 13·5-inch $\frac{1}{4}$ charges.
„ 16·25-inch $\frac{1}{8}$ charges.

Some of the earlier charges for 8-inch and 9·2-inch will be found made up in two cartridges.

R.M.L. cartridges.

R.M.L. 6·6-inch
„ 9-inch (on high angle mounting) } $\frac{1}{2}$ charges.
„ 12·5-inch Mark I gun
„ 9-inch (on high angle mounting)
„ 12·5-inch Mark II gun
„ 16-inch } $\frac{1}{4}$ charges.
„ 17·72-inch
„ 9-inch (on high angle mounting), $\frac{1}{8}$ charge.

The smallest charge fired in the 9-inch on high angle mounting is $\frac{3}{8}$ of the full charge.

10-inch R.M.L. on H.A. mounting. § 9717. § 2838.

The charges for the 10-inch R.M.L. gun on high angle mounting are peculiar, consisting of a full charge of 48 lb. S.P. and two reduced charges of 14 lb. R.L.G.[4] and 5 lb. R.L.G.[4]. The cartridge for the 44-lb. P. charge (reduced charge for 10-inch R.M.L. gun) is used for the 48-lb. S.P. charge, the nomenclature being altered and the marking which does not apply being barred out. P. powder may be used if S.P. is not available. All other charges are made up in one cartridge.

Cartridges of Prism Powder.

Cartridges of prism powder are made for B.L. guns, 6-inch, and higher natures, and for R.M.L. guns, 12·5-inch, and upwards. In these cartridges the prisms are arranged in regular layers of the same number in each layer, except the top, which is sometimes incomplete to adjust the weight. When these cartridges are made of Prism[1] brown or S.B.C. powder, the centre prisms in the top and bottom layers are of black powder, which acts as a primer and prevents hang fires.

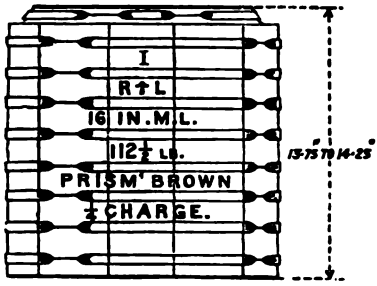
Cartridges of E.X.E. powder also have this primer, except in the case of the 12-lb. cartridge for the 6-inch B.L. gun.

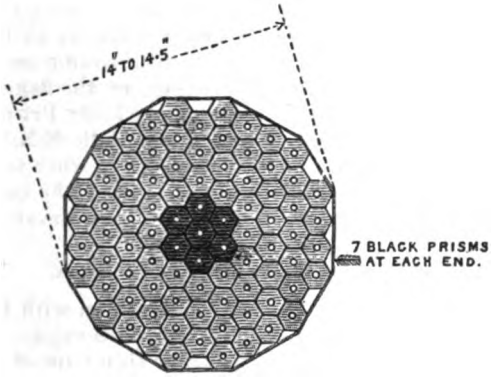
§§ 4755, 4771.

The 12-inch B.L. 73¾-lb. cartridge, owing to its shape, has a primer of 9 instead of 7 black prisms.

The shape of the filled cartridge is a more or less regular prism, and there is no choke, the ends of the cartridge being sewn to the body. Both ends have a central hole covered with silk netting to allow the passage of the flame from the tube; and to prevent the

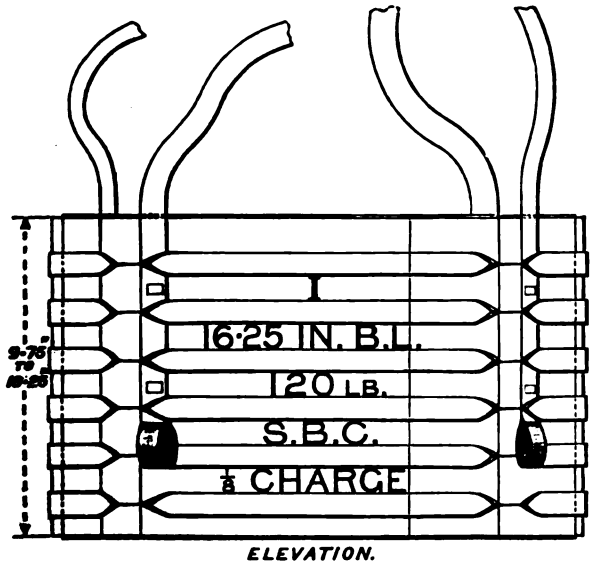
escape of powder dust, &c., from these holes, they are covered with shalloon discs, which should be removed before loading.





SECTION.

Certain cartridges require brief description. The S.B.C. cartridges for the 15·25-inch B.L. gun are fastened together when filled



ELEVATION.

by means of four straps of No. 3 class silk cloth, the lower ends of which are made into loops as shown in the cut.

The 16-inch and 17·72-inch R.M.L. guns. §§ 4100, 4803.

The 16-inch and 17·72 R.M.L. guns both take the same weight of powder, and the cartridges for them were formerly identical: but that for the 16-inch is now filled with Prism[1] brown, while that for the 17·72-inch takes black powder, Prism[1] or Prism[2]; and the cartridges which both contain 112½ lb. powder are lettered accordingly.

12·5-inch Marks I and II cartridges. §§ 5144, 5486, 5508, 5713, 6090, 6551. 7659, 9315.

The 12·5-inch R.M.L. guns, Marks I and II, have had several charges of prism powders, as well as of cut powders. At present the Mark I gun has an 82½-lb. ½ charge of Prism[1] or Prism[2] black for the L.S. and a 58-lb. E.X.E. ½ charge for N.S. The Mark II gun has a 50-lb. E.X.E. ¼ charge for both Land and Naval Services, as well as a 52½-lb. Prism[2] black ¼ charge for N.S.

In the Mark II gun there are no stops at the end of the rifling, and in order to prevent the possibility of the projectile being rammed beyond the rifling, the cartridges are made up to such a length as will fill the whole chamber. In order to bring them up to the requisite length, discs of wood, ·3-inch thick, soaked in paraffin and perforated with numerous holes to admit of the passage of the flame, are placed between the second and third layers of the 52½-lb. Prism[2] cartridge, and between the fifth and sixth layers of the 50-lb. E.X.E. cartridge. Four of these cartridges form the full charge, and when three are used as a reduced charge, a cylindrical wooden wad of the same length is inserted after the last cartridge, in order to fill up the space.

Discs.

Wooden wad

Stores for use with R.B.L. Cartridges.

R.B.L. stores.

Certain special stores are issued in connection with R.B.L. guns, viz., lubricators, sockets, paper cylinders, and tin cups.

§ 1486.

The *lubricator, service*, consisting of two thin cups of tinned iron soldered together, containing a mixture of equal parts of tallow and linseed oil, attached to a wad of felt, backed by millboard (the wad being coated with beeswax), is inserted into the cartridge. It is put on the top of the powder, just above the top hoop in all cases, except the 40-pr. and 7-inch, which have their lubricators detached to save room in the magazine.

In the case of inside lubricators, the edge of the millboard wad is rounded off.

Cartridges carried in the limbers of field batteries have suffered from grains of powder finding their way up between the edge of the lubricator and the cartridge. These grains form lumps which wear the serge through and form holes, through which the powder may gradually work out. For this reason it is desirable that the lower edge of the lubricator should be as nearly opposite the upper edge of the first braid hoop as possible.

The lubricator proper is fastened to the wads by the stalk in the case of a detached lubricator, and by a copper wire in the case of inside lubricators, the wire being fastened to the closing disc.

Use.

The use of the lubricator is to prevent the guns from leading; the cups being crushed by the discharge, the lubricant is squeezed out, and the wad following wipes and polishes the bore.

Packing and issue.

Lubricators are generally packed in "cases for Laboratory stores," as follows:—

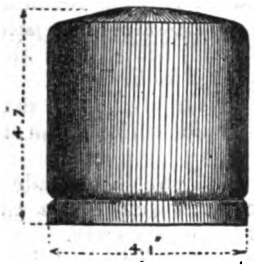
7-inch	24 in No. 2 case.
40-pr.	48 in No. 3 „
20-pr.	99 in No. 4 „
12-pr.	168 in No. 4 „

With the 40-pr. and 7-inch, a *socket R.B.L. cartridge* of wood is choked into the neck of the cartridge, into which the lubricator screws. The socket has a groove around its neck, smeared with kit composition and Spanish brown, by means of which it is securely fixed in its place. The corresponding cartridges have a running string in the mouth for choking in the socket for the lubricator. §§ 1939, 2170.

There are three sizes of *Cylinders, Paper, R.B.L. Cartridges*, one 4·7 inches long, diameter 4·1-inch for the 10-lb. charge, 7-inch R.B.L., and one 4·5 inches long, diameter 3·25 inches for 11-lb. charge of the 7-inch R.B.L., for the 40-pr. and the 5-lb. charge, R.L.G.[4], for the 6[4]-pr. R.M.L. gun special, for R.N.R., except at Poole, the other is 4·5 inches long, and 2·5 inches diameter, and is used for the 20-pr. R.B.L.; they are necessary to bring the cartridge up to length. The latter is half-filled with powder, the cylinder is next inserted, so as to be in the centre, and then the rest of the charge. One end is formed by choking up the cylinder on a former, and closing the hollow by a paper plug; the other end has a groove choked into it, so as to support a card-board disc, which is glued in. These cylinders are varnished. The end formed of the cylinder itself is the strongest, and is placed downwards in the cartridge. §§ 792, 5789.

These cylinders are issued separately in vats containing 220 for the 10-lb. cartridge 7-inch gun, 390 for the 11-lb. cartridge 7-inch gun, or for the 40-pr., and 700 for the 20-pr. cartridge. Issue.

Cylinder for 7-inch 10-lb. Charge.



It was found necessary to varnish the paper, as otherwise it absorbed moisture and damaged the powder. Paper is very apt to absorb moisture when unvarnished, and for this reason it is never desirable to have it in direct contact with powder. § 1939. Cl. 97, A.C. 1870.

Tin Cups are used for all R.B.L. guns to prevent any escape of gas; they have a rim, which is pressed back by the explosion of the powder against the sides of the bore, thus preventing the gas from getting behind them. The central hole allows the flash from the tube or primer to reach the cartridge. Tin cups. §§ 1794, 6131, 4418.

The 40-pr. side closing gun has a tin cup which differs from that of the screw gun, by having a long rectangular slot which extends across the greater part of its diameter.

With R.B.L. guns up to 40-pr. which have copper bushes, tin cups are only used for practice and exercise, as the copper withstands the escape of gas better than iron, but 7-inch and 40-pr. (side closing) guns require them as a service store. A.C. Cl. 197, 1871, and Errata A.C., Dec., 1871.

For these two guns, one tin cup per cartridge is to be issued for service, and as many as required are to be used at practice. Issue.

They are packed in packing cases for Laboratory stores.

Saluting Cartridges.

Blank or saluting charges are invariably enclosed in silk cloth cartridges, which are filled with Blank L.G. powder.

The saluting cartridges of the B.L. 15-pr. and 12-pr. of 6-cwt. Mark I have a loop of silk braid sewn across the bottom for withdrawing them from the gun if necessary. The cartridge for the B.L. 15-pr., Mark I, is pear shaped to prevent it from passing the vent which projects slightly into the bore. R.B.L. saluting cartridges also have loops across the bottom, of silk twist for 12-pr. and 9-pr. and silk braid for all others.

§ 10427. The blank cartridge for 15-pr. or 12-pr. B.L. except Mark I 15-pr. guns is cylindrical.

MANUFACTURE OF POWDER CARTRIDGES.

Empty cartridges are issued ready for filling. Should they have to be made locally, a sample will be obtained from the Royal Arsenal, Woolwich, which will be strictly adhered to.

All cartridges hooped with braid will be issued with the braids cut to proper length, tied with a loop at one end, and run into the empty cartridge. Kitted "twine, choking, bags burster" will be run into the empty R.B.L. 7-inch and 40-pr. cartridges before issue for choking on to the wood sockets.

The following detailed instructions for making up are given, but they must be only taken as a guide since patterns may change, and the "Magazine Regulations" 1899 direct that a sample cartridge should be obtained from Woolwich.

Shapes to which cartridges are cut

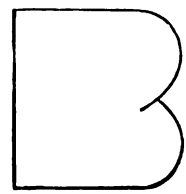
Cartridges to contain prism powder are made in three pieces, the body rectangular, the two ends being cut to the form of the finished cartridge.

R.M.L. guns. Those for heavy R.M.L. guns are made of two pieces of silk cloth or serge, one circular which forms the bottom, one nearly rectangular which forms the coned body.

Cartridges, however, for the 7-inch, 8-inch, and 9-inch reduced charges are made of one piece of material shaped as shown in (Fig. 1).

The cartridges for the 6·3-inch howitzer, the 80-pr., 64-pr., 7-pr., and 2·5-inch guns are of similar construction.

Cartridges for the 8-inch and 6·6-inch R.M.L. howitzers, and the 6·6-inch, 40-pr., 25-pr., 16-pr., 13-pr., and 9-pr. guns are made of two pieces of material, one circular for the bottom, and one rectangular for the cylindrical body.



B L. guns. All cartridges of cubical and granulated powders for B.L. guns are made cylindrical, of two pieces of material, one circular and one rectangular.

A.C. 1883. 1. The patterns will be strictly adhered to in cutting out.

Cl. 155. 2. The cartridges will be cut so that the width of the material runs in the width of the cartridge.

3. The cartridges, before being sewn, will be printed in black with the numeral showing pattern, the monogram showing place of manufacture, nature of gun, weight of charge, description of powder, and in cases when applicable $\frac{1}{2}$, $\frac{1}{4}$, or $\frac{1}{8}$ charge, and with lines for hoops and seams.

The R.B.L. 7-inch and 40-pr. will also be printed with lines for the choke; all marking on cartridges will be done with printer's ink; about $\frac{1}{4}$ oz. of ink is sufficient for 100 cartridges of each nature, except the R.M.L. 17·72-inch, 16-inch, and 12·5-inch, and the B.L. 16·25-inch and 13·5-inch, which require about $\frac{3}{4}$ oz.; the B.L. 12-inch, 10-inch, 9·2-inch, and 8-inch about $\frac{1}{2}$ oz.; and the 12·5-inch R.M.L. other than prism, for which about $\frac{3}{8}$ oz. per 100 is required.

4. All cartridges, when made by hand, will be made up with the edges overlapping $1\frac{1}{4}$ inches, and sewn together with three rows of stitches, with the exception of the following, viz., the R.M.L. 7-pr. and 2·5-inch 1-lb. 10-oz. and 12-oz. cartridges, the edges of which will overlap 1 inch, and will have two rows of stitches; and the R.B.L. 12 or 9-pr. exercising and saluting cartridges, the edges of which will be simply stitched together and turned inwards. Serge cartridges, and shalloon, 7-pr. 4 oz., will be sewn with worsted; shalloon R.M.L. 7-pr. 8 oz., and 2·5-inch 6 oz., and silk cloth cartridges with sewing silk or twist. All cartridges, when made by machine, will be made up with the edge overlapping 1-inch, and two rows of stitching. Cartridges for prism powder will be made up by machine, with the edges overlapping 1 inch, with two rows of stitching up the sides, and two in the bottom, one inside and one out; the top and bottom will have a hole cut in the centre about 2·5 inches for 6-inch B.L., and 4 inches in diameter for higher natures. The edge of the hole will then be turned in and stitched round by machine with silk sewing for B.L. 16·25-inch, 13·5-inch, and 10-inch, and R.M.L. 17·72-inch, 16-inch, and 12·5-inch $82\frac{1}{2}$ lb., in the others the edges are not turned in but left raw. Over this hole is securely fastened a piece of silk twist netting, each cross of the netting being secured by two stitches by hand. Discs of shalloon, 4·25 inches in diameter for the 6-inch, 5 inches for the 8-inch B.L.; 5·5 inches in diameter for 9·2-inch and 10-inch B.L., and 6·5 inches in diameter for all heavier calibres, will be placed over each hole, and attached round the edge, after filling, by shellac. To the shalloon disc is sewn a piece of broad silk braid forming a loop about $1\frac{1}{2}$ inches long, so that it may be removed before loading.

5. The B.L. 16·25-inch, 13·5-inch, and 12-inch Mark III,* have an inner lining of No. 2 class silk cloth, and the beckets are continued up the sides to give additional strength.

The 16·25-inch has four straps of No. 3 class silk cloth, fastened longitudinally on the outside, the lower ends of these straps being made into loops into which the loose ends of the straps of the next cartridge below it are fastened to attach them together when filled.

The 13·5-inch have specially strengthened ends. Each end consists of two pieces of No. 3 class silk cloth, with an additional circular piece 10 inches in diameter, sewn round the centre, and further strengthened by four strips doubled to a width of 2 inches, which are sewn at right angles to each other on the outside.

6. Braids for hooping, cut to the proper length, and with loops tied in one end, will be run into all empty cartridges—except the

* The B.L. 12-inch Mark III cartridge is for N.S. only. The Mark II, which is to govern future supplies for L.S., is without the inner lining.

R.M.L. 8-inch howitzer, 2½-lb., and such cartridges as the R.M.L. 7-inch or 64-pr. when they are ordered to be converted from S.B. cartridges of similar diameters. Converted cartridges made up from material obtained by cutting up old cartridges will, as a rule, be made up similarly to cartridges of new material. Braid ·65 inch wide will be used for all charges of 40 lb. and upwards, and all prism cartridges.

7. Beckets for lifting will be attached to all cartridges of 30 lb. and upwards, and all prism cartridges. For R.M.L. cubical powder cartridges they will be made of strips of serge or silk cloth about 2 inches wide, and cut to such a length that the loop may be about 3 inches long, or not more than will reach, when laid down, within half an inch of the outside of the cartridge when filled: each end of the becket will be sewn on the cartridge below the top line of braid, one end at the seam, the other opposite.

8. The beckets for the prism cartridges for the B.L. 16·25-inch and 13·5-inch are cut 4 inches in width and turned in on each side, the edges to meet so that they are made 2 inches in width; two beckets are then laid flat across the top and bottom, one on each side of the hole in the centre, and securely sewn by machine with silk twist. This operation is done before the bottom is sewn in the cartridge. After the beckets are sewn on the top, the edge of the top is turned in to the size and shape of the cartridge and then sewn by machine with silk sewing.

Beckets for prism cartridges, other than the above, are now made of silk braid, 1½ inches in width for the B.L., 12-inch to 10-inch, and R.M.L., 17·72-inch, 16-inch, 12·5-inch, 82½-lb., 52½-lb., and 50-lb. E.X.E. cartridges; for the B.L. 9·2-inch, 8-inch, and 6-inch, 22½-lb. Prism[1] black, the braids are 1 inch in width. These beckets are attached in the usual way. These braids should support a weight of 250 lb. and 160 lb. respectively. The 6-inch B.L. 12-lb. cartridge has beckets of ·65-inch braid used for hooping.

9. The saluting cartridges for R.B.L. guns will be fitted with a loop across the bottom, by which they will be held when being placed in the chamber of the gun. The loop for the 12-pr. or 9-pr. will be made of silk twist, all others will be made of silk braid.

The saluting cartridges for B.L. 15-pr. Mark I and 12-pr. of 6-cwt. Mark I guns are similarly fitted with a loop of silk braid sewn across the bottom.

10. Kitted twine will be run into the empty R.B.L. 7-inch and 40-pr. cartridges for choking on to the wood sockets.

Filling Powder Cartridges.

1. In filling cartridges particular care is to be taken that a record of the powder, with maker's name, lot and date of filling is kept in a book for reference.

2. The following limits of weight for the charge will be allowed above or below the weight laid down for each nature of cartridge:—

Prism powder	1 oz.
P.[2]	2 „
P. and smaller grain	½ „

3. If it is desired to check the weight of the charge in a filled cartridge, an allowance must be made for the weight of the empty cartridge, which is slightly less than a new one, as some of the material is cut off after choking.

Cartridges filled with grained and cubical powder.

4. The following stores are required:—

Funnel, cartridge, Mark II, made of copper without a seam. § 4044.

Needles, magazine, 4-inch, Mark II, of phosphor-bronze. §§ 8719, 9864.

Needles, magazine, 9-inch, Mark I, for putting in braid hoops.

Scissors, magazine, for cutting off chokes, &c.

Prickers, cartridge, consisting of a phosphor-bronze needle fitted into a wooden handle. § 7410.

A table in the Magazine Regulations, 1899, gives the quantities of silk twist, &c., required for 100 cartridges of each nature.

5. Care will be taken to see that the cartridges are thoroughly dry before being filled, and that the instructions for laboratory operations are adhered to. The proper charge will be carefully weighed out and inserted in the cartridge by means of the "Funnel, cartridge."

6. Cartridges will be choked by drawing together the mouth of the cartridge into several plaits with the 4-inch phosphor-bronze needle, threaded with three strands of worsted for serge cartridges, or with two strands of silk twist for silk cloth cartridges, up to 14 lb. inclusive, except R.B.L. serge 20-pr. and under with lubricators, for which twine, choking, three-thread, is used, and R.B.L. 7-inch and 40-pr. After drawing together the mouth of the cartridge, three turns will be taken round the plaits, and the choke thus formed will be further secured by passing the needle three times through it, alternately above and below the turns, thereby stitching down the turns round the choke at two points equidistant from each other, a pricker being used to make a hole for the needle when necessary. Charges above 14 lb., without beckets attached, require three strands of silk twist passed round the plaits three times, and the needle passed through the choke four times, making three securing stitches. Charges with beckets will have the choke first formed, and temporarily secured by taking two turns round the choke, the becket drawn tightly in on both sides, then three turns will be taken round the choke, the needle passed through the choke and becket five times, making four securing stitches. The becket should form a loop about 3 inches in length over the choke. §§ 5194, 6766.

N.B.—As many of the charges for heavy guns cannot be conveniently weighed in ordinary scales, it is necessary to subdivide them into convenient portions. The practice in the R.L. is to weigh—

Charges up to about 22 lb. in one portion.
„ of from about 22 lb. to about 60 lb. in two portions.
„ „ 60 „ 100 „ three „
„ „ 100 „ 130 „ four „

Each portion should be well shaken down before the next one is put in.

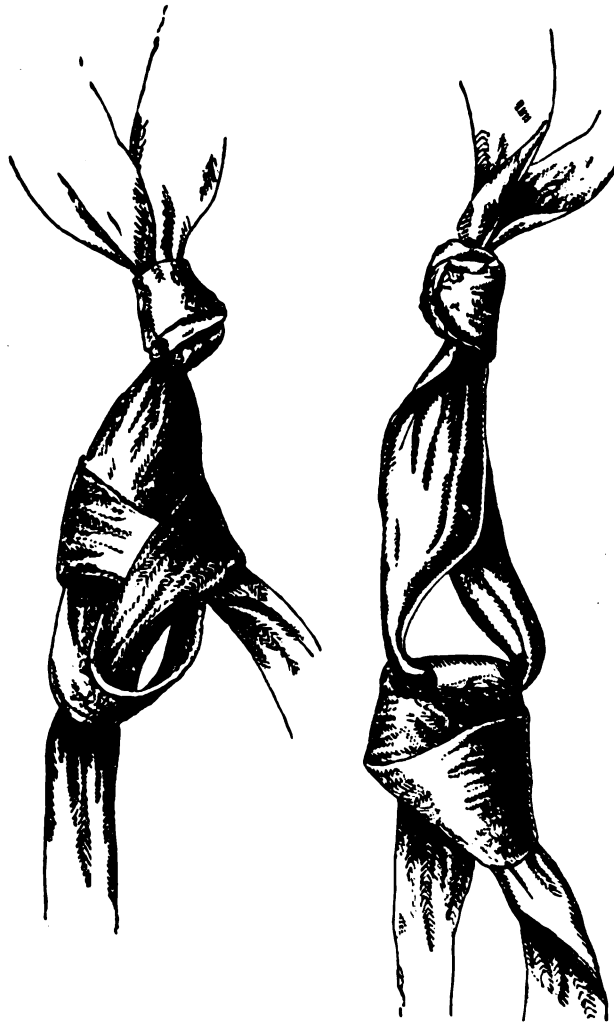
In making up these large cartridges it is advisable also to check the weights by weighing the finished cartridge on a platform machine, if there is one available, deducting the previously ascertained weight of the cartridge, &c., from the gross weight shown by the machine.

7. The cartridges will be made up to their proper lengths and diameters by means of the hoops, which should be drawn tight so as to make a firm cartridge.

8. Hooping—

1st. With braid hoops.—Draw the braid through the serge or silk cloth until the knot of the loop comes home to the serge or silk cloth, the single end being already passed through the loop from underneath,

pass the single end to one side of and under the loop, then draw the hoop tight, and keep it so by placing the forefinger of the left hand firmly on the loop; bring the running end between itself and the loop, and draw tight the single bend thus formed, *taking care that the bend bites on the loop and not on the single end*, otherwise the knot will slip. This is a most important point and men are very apt to make the bend on the wrong place, unless experienced, or closely



THE RIGHT WAY. THE WRONG WAY.

watched by experienced men. The sketch makes the difference plain.

The maintenance of the proper form of the cartridge depends on the hooping being thus secured.

2nd. With worsted, or silk twist.—After making the last stitch in choking, the needle will be turned downwards, and carried through the powder and out at the seam in the line for the front hoop, the

worsted or silk twist will then be carried tightly round the cartridge so as to form a hoop, and will be stitched to the cartridge at two or three points in the same way as the turns at the choke were secured, and the remainder of the hoops will then be similarly formed.

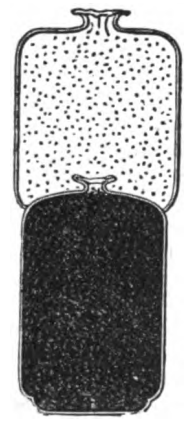
If the cartridge is not of the proper length, on account of the powder being denser than usual, it must be brought up to length by tightening the hoops.

9. The R.B.L. cartridges which have paper cylinders inside, viz., 7-inch, 40-pr., and 20-pr., will have half the charge inserted, the paper cylinder will then be placed on the powder *in the centre of the cartridge*, the flat side uppermost, and the remainder of the charge then filled in.

10. The R.B.L. cartridges which have the lubricators outside, viz., 7-inch and 40-pr., when filled will be choked *tightly* round the groove of the wood socket, into which the lubricator is screwed, the greatest care being taken to fix the socket in the centre of the cartridge.

11. The R.B.L. cartridges which have the lubricators inside, viz., 20-pr., 12-pr., and 9-pr., when filled with the proper charge, will have the lubricator placed inside with the papier maché disc next the powder, and the cartridge then choked tightly over the top. The line which is printed on the cartridge for the top hoop should be close under the papier maché disc, and the hoop drawn very tight, so as to prevent any grains of powder getting round or over the lubricator.

12. The R.B.L. 20-pr., 12-pr., or 9-pr. saluting cartridges have attached to the upper part a bag containing sawdust, which forms a wad. The upper bag will be turned down, and the lower bag, or cartridge proper, will be filled with the powder charge, well shaken down, and then choked, as described in para. 6. The upper bag will then be brought up, and a portion of sawdust put in and pressed down with a stick, a portion more of sawdust will then be put in, pressed down, and so on, proceeding as before, until the wad is of the proper size; they will then be choked and finished, tying the braids tight, so as to make a firm cartridge.



13. The B.L. 15-pr. blank cartridge for Mark 1 gun is conical in shape, the base being of sufficient diameter to prevent its passing the projecting vent in loading; it is therefore necessary to keep this part up to the full diameter of the ring gauge, and to make it as firm as possible.

A.C. 1884. Cl. 212.

14. The cartridges, except for howitzers, after being choked and hooped, will have the ends of the choke cut to a convenient length, which should in no case exceed half the diameter of the cartridge; the superfluous ends of the hoops will also be cut off.

Cartridges filled with Prism powder.

15. The following stores are also required:—

§§ 4818, 5565, 5680, 5822, 5935, 6053, 6126, 6443, 7295, 8785, 9295, 9296.

Apparatus, filling cartridges, except for Prism[2], to assist untrained men in building up the prisms. It consists of a zinc envelope open at both ends, having as many sides and being of the same length as the finished cartridge. One end of the envelope is closed by a detachable wooden bottom, which fits inside it and is secured by three brass thumb screws.

For use with the above, a *pedestal* is required, of less diameter than the envelope, upon which the apparatus stands.

Needles, magazine, nickel-silver, $1\frac{3}{4}$ inches long, for sewing.

16. *Cartridges, Prism[1] Black.*—These cartridges are made up as follows:—The prisms are built up by hand in the *Apparatus*, using the correct size for the particular cartridge, which is placed upon the pedestal. The envelope is filled with the required number of layers of prisms, as laid down in List of Changes; a few vertical cuts are made in the top edge of the empty cartridge, which is then drawn downwards over the envelope,* and the screws holding the wood bottom taken out, and the envelope drawn down from between the prisms and empty cartridge; the latter is then held down tightly over the prisms while the braids are being secured, commencing with the bottom hoop, which is then uppermost; the superfluous ends being afterwards cut off. The cartridge is then reversed, and after the wood bottom is taken out it is placed on the scales, and the necessary prisms removed from the top layer, or added to it, until the weight of powder is correct; an empty cartridge being placed in the scale with the weights to compensate for the one containing the powder.

In making up cartridges of Prism powder, the top layer should not contain less than 75 per cent. of the number of prisms in a complete layer, one or more complete vertical tiers of prisms being taken, if necessary, to make up the requisite number in the top layer. The vertical tiers removed should be the outer ones, which will least alter the shape of the cartridge. With powder of low density, one or more additional vertical tiers may be inserted, provided that the maximum diameter laid down for the cartridge be not exceeded.

The superfluous choke is then cut off to within about 1 inch of the top layer of prisms, the overlap is turned in and the edge brought flush with the charge. The top is then placed on and secured at a few places, and then oversewn all round with a nickel-silver needle $1\frac{3}{4}$ inches long threaded with two strands of silk twist, a pricker being used to make a hole for the needle when necessary. If the cartridge is lined the lining is cut

* B.L. 16·25-inch, 13·5-inch, and 12-inch Mark III have the inner lining first drawn downwards over the envelope.

and turned in with the body.* The top and bottom of the cartridge have each a hole in the centre fitted with network, which is covered over with shalloon patches, stuck on with shellac to prevent the powder dust from falling into the package.

These cartridges, if necessary, may be made up, by careful manipulation, without using a zinc envelope by building up the prisms on a wooden bottom cut to the same shape as the cartridge, and with skilled men this method will be found more expeditious.

17. *Cartridges of Prism*[1] *brown and S.B.C. powder* are made up in a similar manner; but a primer of Prism[1] black powder is inserted at each end of the cartridge to facilitate ignition, the number of prisms in the primer and their position being laid down in List of Changes.

18. *Cartridges of E.X.E. powder* are made up in a similar manner; but the 6-inch B.L. 12-lb. charge has no primer of Prism[1] black powder inserted at each end to facilitate ignition. The 50-lb. 12·5-inch R.M.L. cartridge has also a perforated wood disc between the fifth and sixth layers of prisms.

In stitching on the top of the 6-inch 12-lb. E.X.E. cartridge, care must be taken that the stitching is on the top, in order not to increase the diameter, which must be kept as small as possible.

19. *Cartridges, Prism*[2].—The required number of prisms will be built up in layers on a wooden bottom of the required shape, the empty cartridge is then drawn over the whole, and the remaining operations proceeded with the same as with Prism[1], with the exception of the zinc envelope which is not required for Prism[2]. The 52½-lb. cartridges for the 12·5-inch R.M.L. Mark II gun have a wooden disc between the second and third layers of prisms.

Marking Filled Powder Cartridges.

20. Cartridges will be marked with the nature of powder they contain. If filled with a different nature or weight of powder from that already marked on the cartridge, the marking should be altered to agree with the contents. A record of powder used in all cartridges, with maker's name, lot, and date of filling, will be marked on the package, and will be kept in a book for reference. The lot number and the initial of the manufacturer of the powder will also be stencilled, in printer's ink, on the back of the cartridge containing prism powder; 3 oz. of ink will suffice for 100 cartridges.

21. All cartridges issued from store filled will have the initial or monogram of the station at which they are filled stamped on the bottom end.

22. The cartridges filled by the Royal Artillery will be distinguished by having no initial letter or monogram stamped on them. This order does not apply to cartridges filled by working parties of Royal Artillery for the Army Ordnance Department.

In addition cartridges are issued marked with the numeral of the cartridge, gun for which intended, and the fraction of the charge when the cartridge does not contain the full charge.

23. The following initials and monograms will be used at the several stations mentioned :— §§ 7050, 7235, 9807, 9853, 10685.

* The following heavy cartridges are cross-stitched over the beckets for further security, viz. :—B.L. 16·25-inch, 13·5-inch, and 12-inch, and R.M.L. 17·72-inch and 16-inch. Those having an inner lining have the bottom of the lining tacked to the bottom proper, at five or six places round it.

Home Stations.

Alderney	A	Gosport	G
Aldershot	AT	Guernsey	GY
Blackness Castle	BC	Harwich	H
Burscough	BH	Jersey	J
Caterham	CM	Newcastle	NC
Chatham	C	Pembroke	P
Chattenden	CDN	Selby	SY
Chester	CR	Sheerness	S
Colchester	CCR	Shorncliffe	SHC
Cork	CK	Southampton	SN
Curragh	CH	Tilbury	TY
Devonport	D	Tipnor	T
Dover	DR	Upnor	U
Dublin	DN	Warley	WY
Edinburgh	E	Waterford	WD
Exeter	EX	Weedon	WN
Fleetwood	FD	Woolwich	W
Fort George	FG		

Stations Abroad.

Barbadoes	BDS	Malta	M
Bermuda	B	Mauritius	MS
Cape Town	CT	Natal	N
Colombo	COL	Quebec and Montreal	Q
Egypt	EGT	St. Helena	ST H
Gibraltar	GIB	St. Lucia	ST L
Halifax, N.S.	HX	Sierra Leone	SL
Hong Kong	HK	Simons Bay	SB
Jamaica	JCA	Straits Settlements	SS
Kingston, Canada	K	Trincomalee	TRI

Naval Depôts.

Aden	AN	Sydney	SYD
Bombay	BOM	Coquimbo	COQ
Esquimault	ESQ	Ascension	ASC
Simons Town	ST	Lodge Hill	LH

IV.—Finished Cartridges.

24. All cartridges will be very carefully examined and gauged as to length and diameter previous to packing.

Instructions for the examination of filled powder cartridges will be found in the Regulations for Army Ordnance Services, 1900.

Section II.—CORDITE CARTRIDGES.

Cordite cartridges are issued for B.L. guns and howitzers and for certain R.M.L. guns.

As before mentioned they all require a primer, which, except in the case of the B.L. field guns and howitzers, is made of R.F.G.[2] powder or Blank F.G. new, enclosed usually in shalloon, or shalloon and silk cloth bags. The primer for the exceptions consists of gun-cotton yarn.

The materials used are shalloon and silk cloth.

Shalloon is used for the smallest cartridges, the B.L. 10-pr, 12-pr. of 6 cwt. and the 15-pr. guns, and for all B.L. howitzer cartridges It is also used in the primers of the other cartridges. Materials.

Silk cloth is used for all B.L. gun cartridges above the 15-pr., and for all R.M.L. cordite cartridges. No. I class is used for cartridges up to the B.L. 5-inch, and No. II class for B.L. 6-inch to 12-inch and all R.M.L. cordite cartridges, No. III class for the B.L. 12-inch, Marks VIII and IX, and 13·5-inch cartridges.

The heavier cordite cartridges are divided into fractions for convenience in handling as in the case of powder cartridges.

The fractions are as follows:—

B.L. guns	6-inch Marks VII and VIII,	half charges.
	8 „	half and quarter charges.
	9·2 „	
	10 „	
	12 „	
	13·5 „	
R.M.L. guns	12·5-inch Marks I and II.	half charges.

Cordite cartridges are issued filled. In case they should have to be made up locally, a sample cartridge or drawing, and detailed description of the method of manufacture, must be procured from the Royal Arsenal, Woolwich.

An apparatus, cutting cordite, has been introduced for use in making up cordite cartridges. It consists of an oblong mahogany board, about 9½ inches wide and 40½ inches long, having a metal knife working in a fixed pivot near one end. It is provided with a graduated scale, and is fitted with an adjustable end, which can be fixed, by means of a winged nut, at any required distance from the knife, enabling cordite sticks to be cut to any desired length. § 10083.

The larger cartridges have to be built up carefully and tied of various places with silk twist, and although a detailed description in each cartridge to be made up should be obtained as above, a few notes on the general method of making them up, with a short description of each cartridge, will be given here. There is no apparatus sealed for the purpose of assisting in filling these cartridges, but certain articles are used in the Royal Arsenal, and a description of these is given with the cartridges they concern. They are all more or less rough articles which could be made up locally as

required. A record of the cordite used in all cartridges, with maker's name, lot, or batch, and date of filling, will be kept in a book for reference.

Cordite cartridges for B.L. guns.

Cartridge, B.L., 10-pr., 6 oz. 14 drams cordite, and 3 oz. 9 drs. for star shell, size 5, Mark I, are similar to the 12-pr. Mark II cartridge.

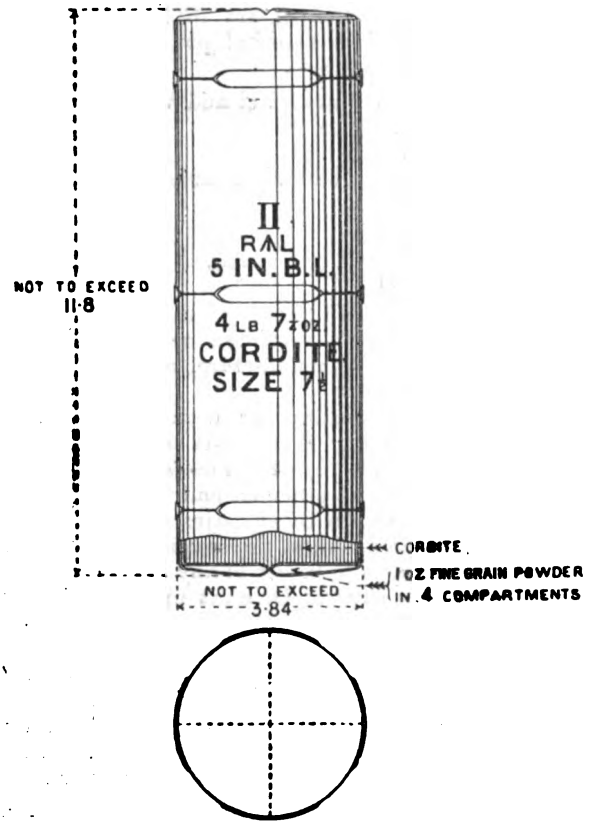
§ 8317. *Cartridge, B.L., 12-pr., 6 cwt., 12 oz. 7 drs. cordite, size 5, Mark I,* consists of a bundle of cordite 5½ inches long, tied together in three places with silk twist and inserted in a cylindrical shalloon cartridge, each end of which is closed by double thickness of shalloon, containing 4 drams of fine grain powder as a primer.

§ 10580. The Mark II cartridge differs from Mark I in having a priming of one dram of guncotton yarn at each end instead of fine grain powder.

§§ 7597, 8314, 8199. *Cartridge, B.L., 15-pr., 15¾ oz. cordite, size 5, Mark I,* consists of a bundle of cordite, 11 inches long, secured in five places by silk twist, and having a primer at each end, consisting of two drams of guncotton yarn, prepared with indiarubber solution to waterproof it, wound round the bundle, commencing ½ inch from the end. The

Cartridge, B.L., 5-inch, 4 lb. 7¼ oz. cordite, size 7½, Mark II | L | silk cloth.

Scale ¼.



whole is inserted in a shalloon cartridge, choked at one end with silk twist.

Cartridge, B.L., 4-inch, 3 lb. 1 oz. cordite, size 5, Mark I, consists of a bundle of cordite secured in three places by silk twist and inserted in a cylindrical silk cloth cartridge, each end of which is closed by a double thickness of shalloon, cross stitched to form four compartments, which are filled with ½ oz. fine grain powder to form a primer. § 7596.

Cartridge, B.L., 30-pr., 2 lb. 6 oz. cordite, size 10, Mark I, is similar to the above.

Cartridge, B.L., 5-inch, 4 lb. 7¼ oz. cordite, size 7½, Mark II, is of silk cloth, similar in shape to the 4-inch, but the end of the cartridge is formed of an inner thickness of silk cloth and an outer one of shalloon, cross-stitched as before, and containing a primer of 1 oz. fine grain powder. The cartridge is also hooped in three places with silk braid, the hooping being done in the same manner as for powder cartridges. § 9334.

The Mark I cartridge was of silk cloth, of larger diameter at one end, without hoops, and having the primer only at the larger end. The weights are the same. §§ 7595, 7634. 10298.

The charge for the 5-inch B.L.C. gun for naval service consists of 5 lb. 4 oz. cordite, size 10, made up like the 5-inch B.L., Mark II, but provided with six perforated felt studs at each end, as described for the 6-inch B.L., Mark VII, p. 58. § 10633.

The latest patterns of cordite cartridges for B.L. guns, 6-inch to 13·5-inch, inclusive, with a few exceptions to be detailed later, are made up on one model, the only difference being in external shape, some being cylindrical, others slightly coned. The exceptions are the cartridges for the B.L. 6-inch Marks VII to X, and the 9·2-inch Marks IX and X, 12-inch Marks VIII and IX. These will be fully described later on. Cartridges for heavy B.L. guns. §§ 9645, 9671, 9738, 9739, Excep ions. 9740, 9766, 9767, 9805, 10205.

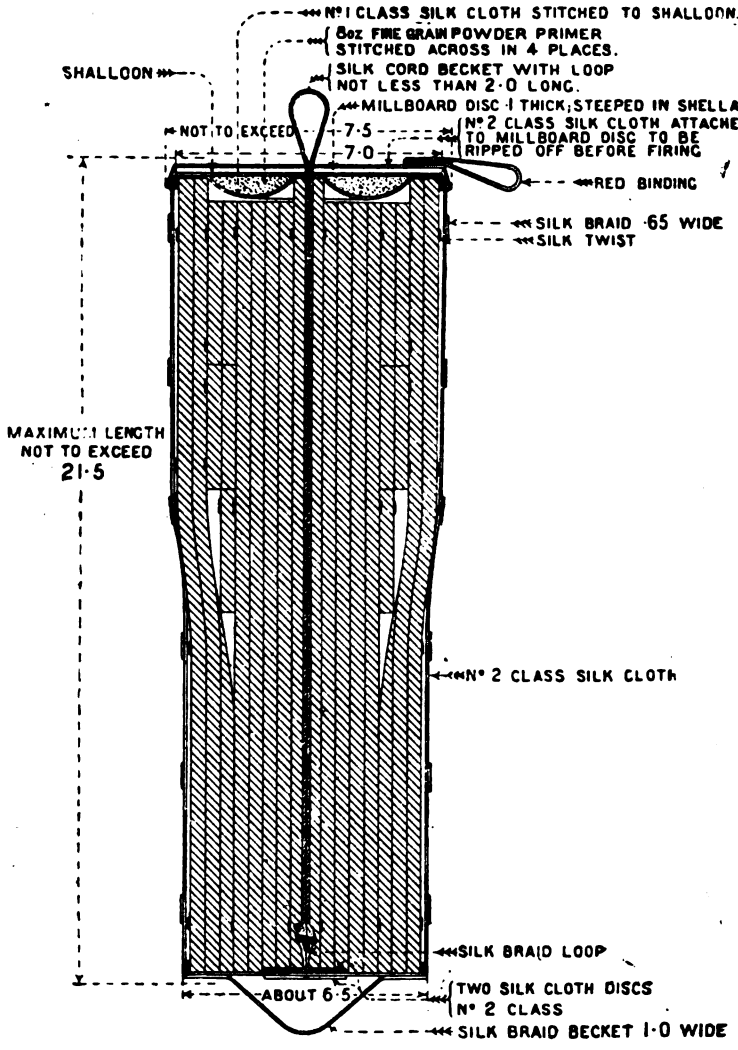
The cordite is built up and enclosed in a silk cloth cartridge, open at the top, hooped in the ordinary way with silk braid, and having a silk braid becket across the bottom.

In addition the heaviest charges have a becket round the cartridge, near the centre in the half charges and near the top for quarter charges, and 9·2-inch half charges. All the cartridges except the 6-inch have a becket of silk cord running up through the centre of the charge and forming a loop at the top; the end of this cord is attached to a silk braid loop which is secured to the inside of the base of the cartridge, being stitched to two discs of silk cloth, sewn on, one inside and the other outside the cartridge. This becket is useful for pulling the cartridge out of the cylinder or case in which it is packed. They also, except the 6-inch, have a becket at the bottom. The top of the cartridge is closed by a primer, of fine grain powder, enclosed in a bag, the inside of which is made of a disc of silk cloth, and the outside of a larger disc of shalloon. These discs are sewn together by two concentric rows of stitching, one near the centre and the other near the outer edge. The whole is then cross-stitched so as to form four compartments, which are filled with the fine grain powder. This ensures a portion of the powder being always opposite the vent of the gun, while there is no powder actually over the centre of the primer. A hole is made through the centre for the cord becket to pass through, and the outside edge of the shalloon disc is provided with a draw-string of silk twist. The cartridge is sewn to this primer and the powder lies in an annular groove formed at the top of the cordite, as will be detailed below. A mill-board protecting disc, to the outer side of which a disc of silk cloth is attached by § 10298.

glue and sewing, is placed over the primer and very lightly attached to the cartridge by four stitches. The disc is painted with a red cross and the word "primed," and is provided with a loop of red braid on which the words "Tear off" are printed. This disc has a hole in the centre, through which the cord becket is passed, and the disc is to be torn off before loading.

Cartridge, B.L., 9·2-inch, 31 lb. 8 oz. cordite, size 40, Mark II | N | silk cloth, half charge for Mark VIII gun.

SCALE = 1/5



§ 9765. A number of these cartridges were made with a disc of silk netting, sewn to the cartridge, over the primer, to strengthen it. This netting is now dispensed with, but no change of Mark is entailed by this alteration. A cartridge of this design is illustrated in the woodcut.

The cartridges for the 6-inch, 12-inch, Marks VIII and IX, and 13·5-inch B.L. are cylindrical; those for the 8-inch, 9·2-inch, 10-inch, and 12-inch, Marks I to VII, are slightly coned.

These cartridges are built up as follows:—

Making up cordite cartridges.

The cordite is cut to the correct length and weighed. A portion is bundled round the silk cord becket (except for the 6-inch, which has no becket), which is doubled so that the bight forms a loop at the top. This bundle is tied in several places with silk twist. Round the central bundle, or core, layers of cordite sticks are placed, and also tied with silk twist. These layers are made of sticks slightly shorter than the central ones. Outside this, again, comes another layer of full-length sticks, tied as before, thus forming an annular recess for the primer, at one end. Elastic bands, which may be made up locally, are used to keep the different layers in position while they are being tied. In some cartridges the cordite sticks are too short to reach from end to end; in these cases the central core is made of two bundles, butting against each other, and the outer layers are put on so as to break joint and so form a rigid cartridge. In the coned cartridges, the primed end is made larger than the other by inserting layers of short sticks at that end and then putting on the outside layer as before.

A wooden ring is now placed in the recess at the top of the charge to prevent displacement of the sticks, and the charge is laid on its side. The empty cartridge is taken and a few vertical slits about two inches deep made round the mouth. The cartridge is then turned inside out, and the ends of the cord becket are tied to the braid-loop on the base of the cartridge by a single bend. The becket is pulled up so as to bring the base of the cartridge tight against the cordite, opening out the sticks slightly with a pricker or piece of wood, so that the knot may go up between them. The charge is now placed base upwards upon a pedestal, the top of which is not greater in diameter than the built-up charge. Two men pull the cartridge down over the charge, and it is then hooped in the ordinary way, commencing at the top hoop. The cartridge is next placed base down upon a table, the wood ring is taken out, and the surplus silk cloth is cut off to within about one inch of the cordite. The cartridge is pushed down so as to expose the end of the charge, and the primer is placed in position, the loop of the becket being pulled through the hole in the centre. The shalloon projecting beyond the cordite is turned down, and the running string drawn tight and tied. The mouth of the cartridge is then pulled up, turned in all round flush with the edge of the primer, and sewn all round to the shalloon of the primer, using two strands of silk twist and the $1\frac{3}{4}$-inch nickel-silver needle. The cartridge is then completed by placing the mill-board and silk cloth disc on the top, the becket passing through a hole in the centre of it, and attaching it to the cartridge by four single stitches, at equal distances round the edge.

Some of the earlier patterns had no central cord becket, but the chief difference lay in the primer, which fitted into a recess at the top of the charge, but did not extend over the edge of the cordite. A disc of silk netting was placed over the primer and was sewn all round to the edge of the cartridge. There were thus bare ends of cordite exposed round the edge of the cartridge, which was considered a possible source of danger from the back flash, which is sometimes met with in guns firing cordite charges. This danger would of course be greater after the protecting disc had been torn off.

"Extracts," 1898, p. 123.

§§ 9717, 9766, 9805. To remedy this, such cartridges will be converted by having a disc of shalloon placed over the primed end as follows:—

1. Remove the mill-board disc by cutting the four securing stitches.
2. Place the shalloon disc over the netting, draw the silk-cord becket (in those cartridges where it exists) through the hole in the centre of the disc, sew the edge of the shalloon to the outer edge of the silk cloth cartridge with a double strand of silk twist, and replace the mill-board disc.
3. Add a * after the numeral on the cartridge, and mark the disc with the monogram of the station and date of alteration.

§ 7594. The Mark I cartridge for the 6-inch B.L. gun, Marks IV to VI, is made up in the same manner as the Mark I for the 5-inch B.L. gun, described before.

Composite cartridges. §§ 10233, 10367, 10388, 10593. A new system of making up cartridges for the heaviest guns is now adopted. In these cartridges two sizes of cordite are used, a large size and a small, and the cartridges are known as "composite" cartridges. They have been introduced for the latest Marks of 9·2-inch and 12-inch B.L. guns, and for the 13·5-inch B.L. In external appearance they do not differ from those described. After tying the central bundle of large-sized cordite round the silk cord becket, a bundle or rope of cordite, size $3\frac{3}{4}$, is wound round this core from one end to the other; the outer layers of large-sized cordite are then built up as before described. The heavier cartridges have a braid becket round the outside, stitched to it in four places. *See* Plate II.

This method of making up enables a larger charge to be fired, increasing the muzzle velocity, but without any increase in the chamber-pressure. It has also been found that with this design of cartridge greater regularity is obtained when using reduced charges

§ 9927. As an instance, the original cartridge for the 12-inch B.L., Mark VIII, weighed 83 lb. 12 oz., size 50 cordite, for the half charge, and 41 lb. 14 oz. for the quarter charge. These cartridges have been replaced by composite cartridges, the half charge now weighing 87 lb., made up of 83 lb. 4 oz., size 50, and 3 lb. 12 oz., size $3\frac{3}{4}$.

In the same way the quarter charge weighs 43 lb. 8 oz.; 41 lb. 10 oz., size 50, and 1 lb. 14 oz., size $3\frac{3}{4}$.

6-inch B.L. Mark VII and VIII. § 10408. The charge for this gun differs from those hitherto described, and is made up in half charges, which are laced together. Each half charge consists of 10 lb. cordite, size 20, bundled together and tied with silk twist. The outer layer of cordite is made of longer sticks than the remainder, so as to form a recess at one end for the primer. This bundle has a silk cloth cartridge drawn over it and hooped with silk braid in the ordinary way. The edge of the silk-cloth is then cut off to within an inch of the cordite, and the primer is placed on. The primer consists of two discs of shalloon sewn together round the edge and divided, by cross-stiching, into two compartments, which are filled with fine grain powder. The primer is sewn to a large silk cloth ring having a draw-string run round it. The primer is laid on the top of the cordite and the draw-string pulled in and tied. The edge of the silk cloth is now turned in flush with the cordite and sewn all round to the primer. The silk cloth ring has attached to its outside six perforated felt studs, which prevent the heated vent axial of the gun from pressing against the primer.

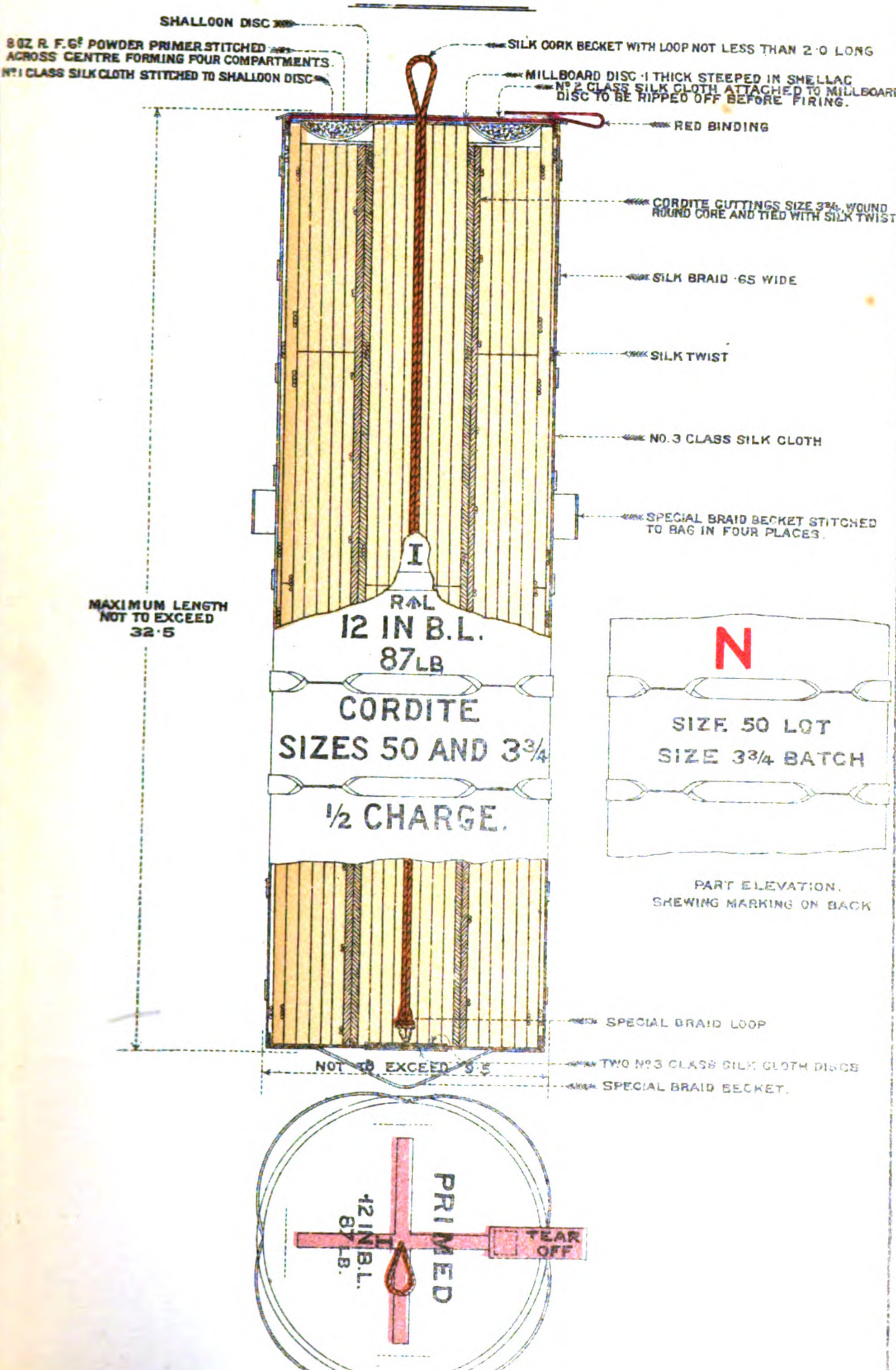
The bottom of the cartridge is strengthened by a band of silk braid to keep it from tearing, when the charges are laced together. Two half charges are placed base to base and laced tightly together by a piece of silk braid passed through the end hoops.

Plate II.

CARTRIDGE B.L. 12 INCH 87 LB CORDITE SIZES 50 AND 3¾ MARK I |N|

SILK CLOTH, 83 LB. 4 OZ. SIZE 50. AND 3 LB. 12 OZ SIZE 3/4, ½ CHARGE MARK VIII GUN.

SCALE 1/6.



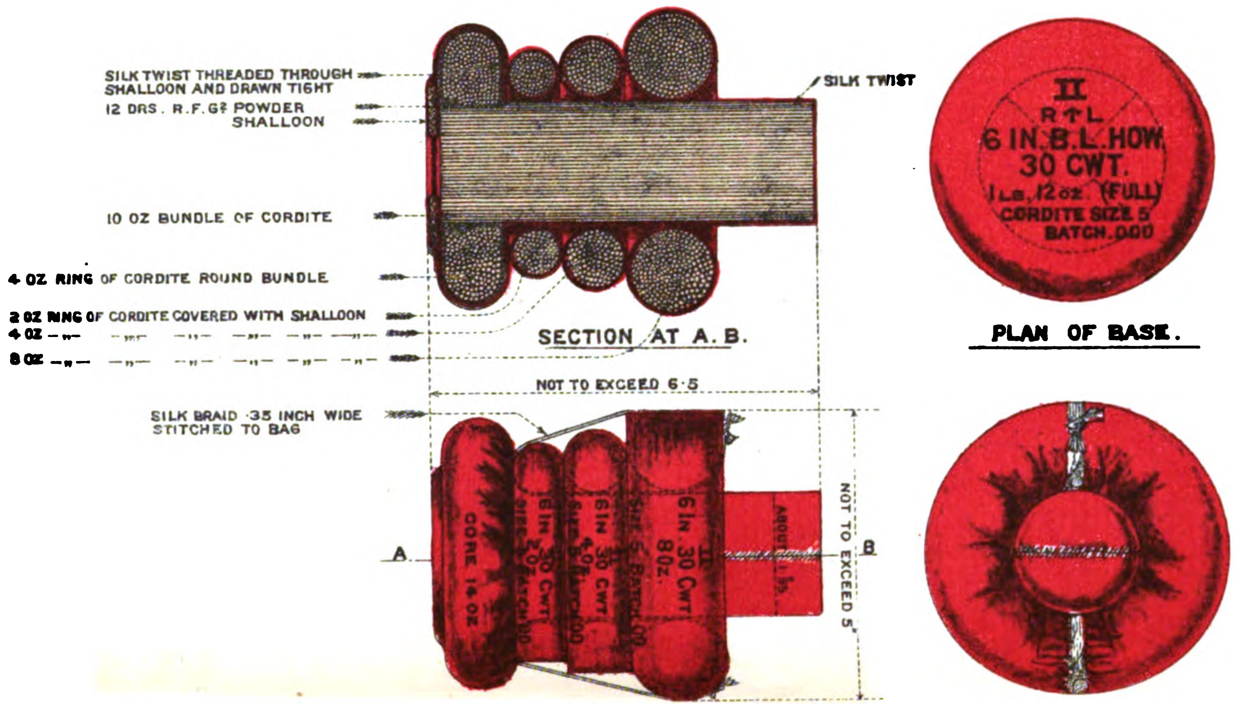
875. 9. 1900

E. Weller & Graham, Ltd Litho London

Cartridge B.L. 6 Inch 30 Cwt. Howitzer 1 lb. 12 oz. Cordite Size 5 Mark II |L|

Shalloon; Core and Three Rings.

Scale ⅓.



SECTION AT A.B.

PLAN.

PLAN OF BASE.

PLAN OF TOP.

876. 9. 1900

E. Weller & Grahams, Ltd Litho. Lond.

The two halves thus form a convenient whole, primed at both ends.

The cartridge for the 6-inch Marks IX and X consists of 20 lb. size 30 cordite. It is in one whole charge, made up as described for the ½ charge above, but without the strengthening band. § 10409.

Cordite cartridges have been sealed for the following R.M.L. guns, for use with "special" case shot:—9-inch, 10-inch, 11-inch, and 12·5-inch; the 10-inch and 11 inch are also for use as a service charge. They are made of cordite enclosed in a silk cloth cartridge, and have a stick down the centre to give rigidity. Each end of the cartridge is choked round the stick with silk braid. The 9-inch cartridge has a primer round the centre formed of a double thickness of silk cloth, divided into six compartments, each of which is filled with R.F.G.²; while the 10-inch, 11-inch, and 12·5-inch Mark I gun cartridges have two similar primers, a short distance apart near the centre. This is to ensure the primer being immediately below the vent, no matter which end of the cartridge is loaded first. The 12·5-inch Mark II gun has an axial vent, and therefore the primer is placed at one end of its cartridge, round the stick and contained in shalloon. Cordite cartridges for R.M.L. guns.

Cordite cartridges for B.L. howitzers.

The cartridges for B.L. howitzers are all alike, and consist of a mushroom-shaped core of cordite enclosed in shalloon, upon the stalk of which three or more rings of cordite are placed. The powder* primer is contained in the head of the core, and the rings are attached to the core by pieces of silk braid, which are stitched to the core and tied round the rings. The cordite used is small: size 3¾ for the 5-inch, 5·4-inch, and 6-inch of 25 cwt.; size 5 for the 6-inch of 30 cwt.; and size 7½ for the 8-inch. This method of constructing the cartridge affords a simple and ready means of varying the charge, which is a necessity for the charges of howitzers. See Plate III.

The cartridge is made up as follows:—The core is made of a bundle of cordite, weighed out and tied in two places with silk twist. This is inserted into a funnel-shaped shalloon bag, and projects slightly from the end. Round this end is placed a ring of cordite which forms the mushroom head. This ring is made up in a wooden block, which has a ring-shaped recess in it and also a hole in the centre.

Eight slots are cut through the rim and projecting centre. Strands of silk twist are laid in these slots, and are cut in the centre so as to form eight pieces. The cordite is then neatly coiled in the ring on top of these pieces of silk twist, which are then tied round it. The ring thus formed is placed on the exposed end of the cordite bundle, and lies in the funnel-shaped part of the bag. This part of the bag is just large enough to extend over the edge of the ring, and has a draw-string in its edge, which is pulled tight and tied. Then the primer, consisting of two discs of shalloon, sewn together by two concentric rings of stitching, the space between being filled with fine grain powder,* is placed over the head of the core. The outer disc is large enough to completely cover the head, and has a draw-string round its edge, which is pulled in and tied tightly round the stalk of the mushroom-shaped core.

Each ring is formed of a bundle of cordite, weighed, and inserted into a shalloon cylinder, open at both ends. The ends of

* The primer for the latest 5-inch and 5·4-inch howitzer cartridges consists of guncotton instead of gunpowder.

the cylinder are brought together, turned in and stitched together. The rings for the 5-inch and 5·4-inch howitzer cartridges are all of equal weight, but the 6-inch of 30 cwt. has rings of 2 oz., 4 oz., and 8 oz., and the 6-inch of 25 cwt. rings of 2 oz., 5 oz., and 11 oz. With rings of different weights, the smallest is placed on the core first, and in all cases the rings are secured by two pieces of silk braid, the centre of each piece sewn to the primer. One end of each braid is brought up inside the rings and tied to the other end, which is outside, by a reef knot, thus holding the whole cartridge together.

Marking Cordite Cartridges.

Cordite cartridges are marked in the same way as powder cartridges, with nature of cordite, and weight. If filled with a different nature or weight from that already marked on the cartridge, the marking should be altered to agree with the contents. The lot number, which includes the initials of the manufacturer, except when the cordite is made at Waltham Abbey, will be also stencilled on the back of the cartridge (*see* Plates).

Howitzer cartridges have the above information stamped on the base of the core, and in addition the weight of the core is stamped on its edge, and each ring is marked with its weight, and the size and batch number of the cordite in it.

All cordite cartridges have the initial or monogram of the station where they are filled, marked on the back near the bottom for gun cartridges, and on the top of the core for howitzer cartridges. This monogram is not stamped on by the Royal Artillery when they fill cartridges for their own use. The initials and monograms of stations are given on p. 52. All cordite cartridges are carefully examined, and gauged for length and diameter previous to packing.

Section III.—GAUGES, ETC.

Gauges, Cartridge.

The gauges used with filled cartridges for B.L., R.B.L., and R.M.L. guns are the "*gauge, cartridge, length, universal, Mark II,*" and "*gauges, cartridge, ring.*"

§ 9804.

The universal gauge tests the length and may also be used to test the diameter.

The ring gauges test the diameter and are all "high" gauges, that is to say, the greatest diameter of the cartridges must pass through them.

Mark II.
§§ 3307, 4946, 9904.

The universal gauge has a slip of paper pasted on one side on which is a printed table giving the lengths and diameters of all rifled cartridges. The edge of the gauge is graduated in inches and tenths. There is an arrangement for allowing the proper limit of variation of length to be given.

The paper slip has been corrected up to November, 1899.

The gauge is represented in the cut. It is simply an adaptation of the sliding callipers, having two movable arms *a* and *b*, which can be placed in position on the main limb on either side of the fixed stop *d*

The stop *c* can be set so as to allow the proper limit by moving *a*. Clamping screws, shown in cut, serve to secure *c* and *b* in position.

For gauging lengths.

The arrangement for giving the variation in length is not now used, and the gauge is used as a high gauge, being set at the greatest length of the cartridge.

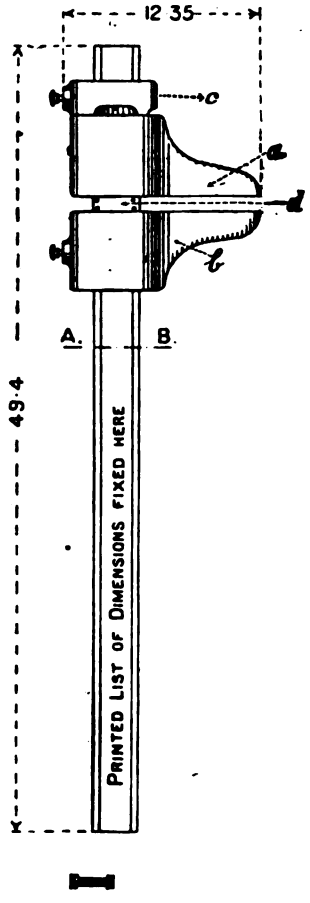
The upper sliding arm should be fixed firmly against the zero block by clamping the sliding-stop against it. The lower arm is then placed with its inner edge at a distance from the zero-block equal to the length of the cartridge, given on the slip, and clamped. It should be possible to pass the cartridge between the arms.

The gauge can be used in the same manner for testing the diameters of cartridges, but the ring gauges provided will be found more convenient for this purpose. For gauging diameters.

Gauge, Cartridge, Length, Universal, Mark II | C |.

Wood; for filled cartridges.

Scale $\frac{1}{4}$.



Section at A.B.

The Mark I differs from Mark II in having the lengths of various cartridges marked on its side, instead of the paper slip, the edge of the gauge is not graduated in inches and tenths. Mark I. §§ 2074, 3307.

The so-called brass ring gauges consist of rings of gun-metal, with straight handles; they are marked on and near the handle with the designation and numeral, also the diameter, and the words "FILLED CARTRIDGE," and further where the gauge does not apply to Gauges, cartridge, ring.

all the cartridges of a gun, &c., as in the case of howitzers which have three or more gauges each, the weight of the charges of those for which it is intended is stamped on the gauge.

Some ring gauges are intended for more than one cartridge.

R.B.L. guns.—Another description of cartridge gauge has been issued for R.B.L. cartridges, viz. :—

Gauges, cartridge, length, R.B.L.—Wood sliding for length.

§ 2849. These have not been sealed for any calibre except 7-inch, but unsealed patterns exist for all; they are used in making up cartridges; each one consists of an open frame with a cross piece, with a certain play allowed as limit of error. The cartridge is passed beneath to test its length.

Gauges are issued loose, in numbers according to demand.

§§ 729, 1874, 2730, 3029, 3117, 3304, 4060, 4259, 4536, 4678, 4683, 5106, 5146, 5531, 5858, 6189, 8414, 9810, 10621. *Covers, cartridge paper*, are issued to cover cannon cartridges which are not contained in metal or metal-lined cases, or which are intended for field or siege service. They are simply brown paper bags on which are marked the contents of the cartridge which they cover. They are not issued to the Royal Navy for field or boat service.

They are made of sizes suitable for all S.B. and R.B.L. cartridges, Covers marked for two or more charges are, when used for any particular charge, to have the markings for the other charges crossed out. These covers have also been made for all the various charges used with R.M.L. guns up to the 80-pr. inclusive, and also for the charges used for the 8-inch, 6·6-inch, and 6·3-inch howitzers. They are also made for the blank charges for the 12-pr. and 15-pr. B.L. guns. They are made of 90-lb. brown paper (*i.e.*, weighing 90 lb. to the ream) for all sizes, except those for the 7-pr., which is of 45-lb. paper. They fit tightly over the cartridge, the bottom being notched, turned in, and pasted over a circular disc of paper, so as to take up as little room as possible in packing.

In packing cartridges covered with the above covers in a barrel or box, the interior of the latter is also lined with brown paper.

§§ 7657, 8136, 8223, 8312, 8498, 9157. *Covers, cartridge, canvas.*—The covers for the 2 lb. 6 oz. for 30-pr., $15\frac{3}{4}$ oz. for 15-pr., 12 oz. 7 drs. for 12-pr. of 6-cwt. B.L. guns and $11\frac{7}{16}$ oz. for 5-inch B.L. howitzer cordite charges, are made of canvas, with a drawing string in the mouth for bringing it together.

In field batteries the covers to some extent preserve the cartridge from wearing out; they are also stated to preserve the cartridge from damp. Moreover, they prevent powder dust working through the cartridges into the limber boxes.

§§ 794, 1002. Waterproof bags may be specially demanded; they are made of two thicknesses of fine white paper cemented together by india-rubber dissolved in naphtha.

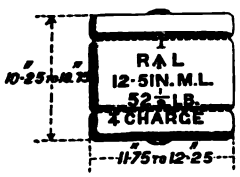
§§ 2048, 2439, 3185, 954, 1581, 1686. Waterproof covers for cartridges, 7-inch R.M.L. guns and upwards, are provided for the Navy; they are bags of fine cambric, waterproofed by vulcanised india-rubber, attached on one side (not made in the R.L.). They are issued to all armoured vessels having main-deck batteries, in the proportion of eight covers for full charges per gun, for all guns of 7-inch calibre and upwards, mounted on the

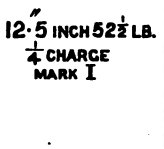
§ 6162. main-deck battery and in turrets. These waterproof covers will become obsolete as soon as the existing stock is used up.

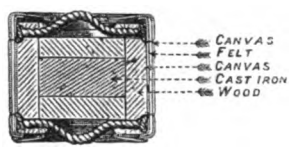
Drill Cartridges.

B.L. and R.M.L. §§ 4099, 4133, 4277, 4279, *Cartridges, drill, B.L. and R.M.L.*, are a special manufacture and are issued complete. The latest patterns are made to the same shape,

weight, and dimensions as the Service cartridges they represent. They consist of wooden cylinders built up in segments, usually containing a cast-iron cylinder to give the necessary weight, and covered with raw hide. Cartridges, drill, B.L., Mark II, 8-inch to 16·25-inch, are weighted with lead and are made with polygonal sides. As cartridges covered with raw hide would be liable to slip out of the bore when used on board ship, the Mark I drill cartridge for the 16-inch and 17·72-inch guns, and those representing the 12·5-inch 80-lb.* 4159, 4754, 5942, 6130, 6733, 8413, 8684, 8763, 8945, 9261, 9262, 9318, 9297, 9298, 9506, 9510, 9534, 9569, 9582, 9623, 9695, 9312, 9328, 9349, 9875, 9908, 9977, 9978, 10355, 10367, 10379, 10594.







half charge, and the 52½-lb. quarter charge are covered with a jacket of sail canvas, doubled over the side of the cartridge and enclosing a layer of felt. One end of the jacket is permanently sewn to the shape, and the other end is run together with a piece of whipcord drawn tight after the wood block has been inserted. When worn out, the jacket can be replaced by another.

The representatives of all prism cartridges have rope handles at each end so fitted that they do not project.

Cartridges, drill, R.M.L 17·72-inch or 16-inch, Mark II.—The Mark II drill cartridge representing the 112½-lb. ¼-charge for the 17·72-inch or 16-inch R.M.L. guns, differ principally from the Mark I in being covered with raw hide and in having a hole passing through the centre. §§ 6130, 7217, 9446.

Special stores issued for 17·72-inch R.M.L. :—

Discs, wood.
Hook, Mark I, iron.
Lanyard, about 5 feet.
Loops, 11-inch.
Gas-checks, R.M.L. drill.
Plugs, shell, base drill.

The disc of elm, corresponding in diameter to its cartridge; it is 4½ inches thick, and is fitted with a brass boss in the centre to hold the screwed eye-bolt on the lanyard.

The 17·72-inch lanyard is of a flexible iron ⅝-inch wire rope, about 5 feet long, having an iron hook secured to one end to engage the eye-bolt at the base of the drill projectile; at the other end a screw-bolt is secured, having the upper end of the shank square in form where it passes through the disc, and the lower part cut with a thread to take a tightening nut with milled head.

The loop resembles a selvagee, and is about 11 inches long.

The gas-checks are similar to the service gas-checks, but have a hole in the centre 1 inch in diameter.

The drill plugs are the ordinary base plugs of the common shell, with an eye-bolt screwed into rear end.

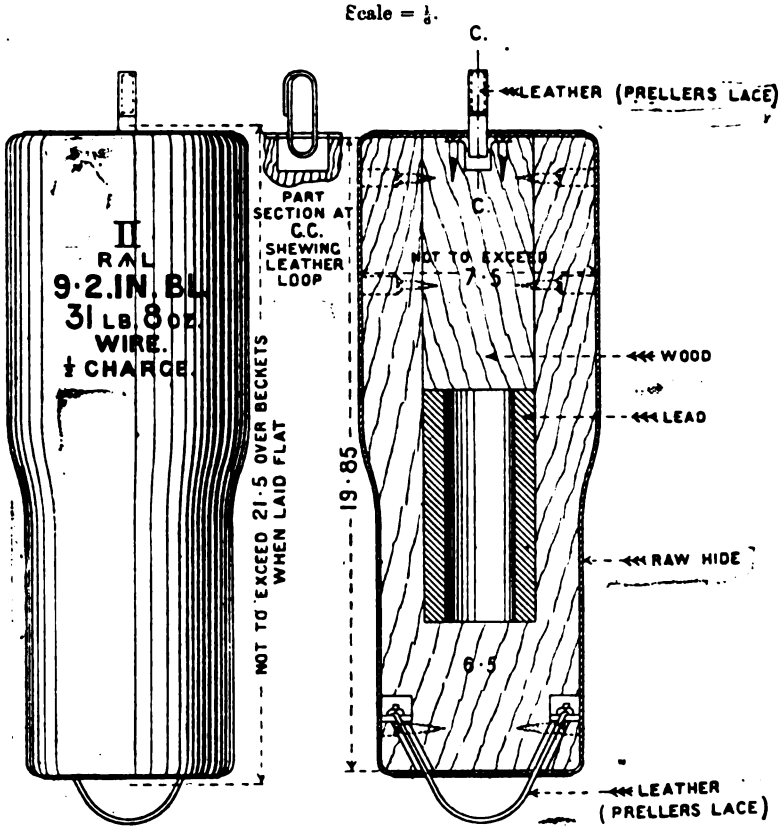
The iron hook is screwed on its shank to fit the G.S. fuze-hole of the drill projectile. The spun yarn loop on the end of the rammer fits over this hook.

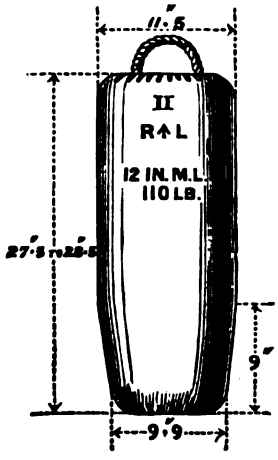
* This cartridge will be used at drill to represent the Service cartridge R.M.L. 12·5-inch 82½-lb. Prism[1] black, § 5942.

Cartridge, B.L., drill, 9·2-inch, 31 lb. 8 oz., Mark II | N |

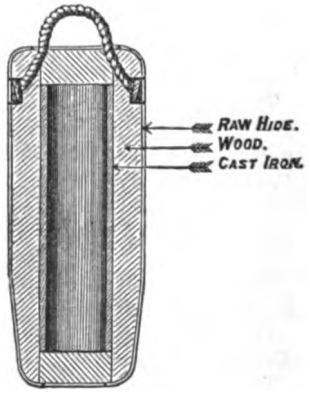
Raw hide; ⅛ charge, for wire guns.

Scale = ⅛.





12 INCH 110 LB.
MARK II.



Drill representatives of cordite cartridges are issued for B.L. guns and howitzers except the 12-pr. of 6 cwt. and 15-pr. B.L. guns and the 5-inch B.L. howitzer. They are made of raw hide, and

conform to the general shape, weight, and dimensions of the service cartridges. The representatives of cartridges, 6-inch and upwards, however, have no disc to be torn off, and the primed end of the cartridge is represented by being painted white with a red cross. It has also a small becket projecting from its centre. These cartridges are stamped with the usual marking to be found on service cartridges.

Cartridges, B.L., for instruction, are issued for the B.L. howitzers. They consist of a core of wood and three rings of twine covered with leather. The three rings are secured to the core by two leather strips, and the cartridge is marked in a similar manner to the service one. They are used for instruction and not for drill. §§ 8413, 9446, 9052.

Cartridges, drill, R.B.L. guns, are made of a wood cylinder covered with felt and placed in a leather case, the base of the cartridge is shod with copper, and they have dummy lubricators, the detached lubricators having gun-metal stalks screwing into gun-metal sockets in the cartridges. The cartridge is marked in black, like the service cartridge, viz., with the nature of gun and weight of charge.

All drill cartridges are issued loose, in numbers as demanded. Issue.

Storage and Inspection of Filled Cartridges, Powder and Cordite.

Filled cannon cartridges, powder and cordite, are placed in Group I, Division I, for storage.

The various cases, &c., in which they are packed are described in the next chapter, with orders as to stacking, &c.

For examination of filled cartridges, *see* the Regulations for Army Ordnance Services, 1900.

CHAPTER VI.—POWDER BARRELS—VARIOUS CASES, USED TO CONTAIN GUNPOWDER AND FILLED CARTRIDGES, GUNPOWDER AND CORDITE.

POWDER BARRELS.—HINTS ON COOPERING.—METAL-LINED AND OTHER CASES.—ZINC CYLINDERS.—CARTRIDGE CASES.

In this chapter will be described powder barrels and the various other cases, in which gunpowder and filled cartridges for ordnance are transported and stored. A description of the boxes specially used with small-arm and Q.F. ammunition will be given hereafter in the chapters devoted to those subjects.

§§ 1884, 2553, 3320, 6127. § 1324. § 2119.

Barrels, powder.—The present pattern is Mark III. There are three sizes, *whole*, *half*, and *quarter*. They are machine made; the timber is of the best Quebec oak, thoroughly seasoned; but teak would be used when the barrels are required for issue to stations where they would be exposed to the attacks of white ants; and Memel oak staves if a supply of Quebec oak was not available.

Powder barrels consist of three parts, viz.:—

1. Staves.
2. Heads.
3. Hoops.

Staves.

The most protuberant part of the barrel is known as the "bilge," and the centre of the bilge is distinguished as the "pitch."

Between the bilge and the end of the barrel is the "quarter."

The extreme end is known as the "chime."

To distinguish one end of the barrel from the other, that which is opened (when required) is known as the "top end," the other as the "back end." The top end may be known by having the staves bevelled off close to the chime to facilitate heading.

There are thus also the "top" and "back bilge," the "top" and "back quarter," the "top" and "back chime."

Heads.

The heads are known as the "top heads" and "back heads" respectively. When a head is in three parts, the "dowels" having been broken or pulled asunder, the two outside pieces are known as the "cants" or "outsides"; the other part is known as the "middle" piece.

Hoops. § 6444.

All powder barrels have four copper hoops, the remaining hoops are of ash or hazel. At stations where rattan cane is available, and the stock of spare ash or hazel hoops is exhausted, the cane may be used locally, for making spare hoops.

These hoops are situated about the chime and round the bilge of the barrel, and are known as the copper "chime" and "bilge" hoops.

An ash hoop is placed at each end, outside the copper hoop next the chime, and another ash hoop on the inside of each of the copper hoops next the bilge. The spaces between the two copper hoops at each end are covered with ash hoops; four on the whole barrel, three on the half barrel, and two on the quarter barrel. This gives a total number of 12 ash hoops to the whole, 10 to the half, and 8 to the quarter barrel.

All powder barrels before issue, and such as are repaired at out stations, are to be hooped as above. § 3739.

The ash hoops generally strengthen the barrel, and, moreover, protect it by keeping the bilge off the ground when stacked on their sides, and it is stated that they keep the copper hoops from slipping. Use of the ash hoops.

Powder barrels are used to transport and store cubical and granulated powders when not made up into cartridges; they are also occasionally used to hold cannon cartridges, and then would have brown paper lining. Use.

Powder barrels are also used for packing picric acid, and when so used, they will have a band of yellow ochre, 1 inch wide, painted round the bilge, and be stencilled on top with the words, "To be used for picric acid only," also in yellow ochre. Powder barrels which have been used for picric acid are never to be used for any other explosive. § 8838.

Barrels of gunpowder are not to be rolled, but will always be carried by hand or on trucks or barrows. Barrels not to be rolled.

The whole barrel contains 125 lb. P. or P.^{2} powder, 110 lb. Q.F.^{1}, R.L.G.^{4}, or R.L.G.^{2}, if with a waterproof bag, or 120 lb. R.L.G.^{2} if without a waterproof bag. Of every other description of grained powder it holds 100 lb. The half barrel contains 50 lb., and the quarter 25 lb. Contents.

In former days powder barrels were made by hand. In 1866, machine made barrels, Mark I, were introduced. They had 10 to 12 ash and four copper hoops. Previous patterns. § 1324. Mark I.

Mark II barrels at first had only four ash hoops, but subsequently six. Mark II. §§ 1884, 2553.

The general dimensions of all the patterns are alike. A powder barrel is said to be "full-bound," when, like Mark I or Mark III, the entire space between the chime and bilge copper hoops is filled up with ash hoops. Barrels with only four or six ash hoops are called "quarter bound."

A powder barrel suitable for military purposes should possess the following properties:— Requisites of a powder barrel.

1. Sufficient strength to stand moderately rough usage without leakage.
2. It should be perfectly watertight, so that damp cannot penetrate it.

To make up for the deficiencies of the above barrel in the second requirement, a *Bag, powder barrel*, has been introduced to enclose the powder inside the barrel. All new powder and powder re-packed at Purfleet will, in future, be packed in these bags inside the barrel. §§ 4752, 6208.

Mark II bag differs from Mark I in being made of one piece of stronger material.

Waterproof bags are invariably used in powder barrels which are to contain picric acid.

Gunpowder barrels will be marked on the head with black paint (except when stated to the contrary) as follows:—

(*a*) Barrels containing Class I or Service Gunpowder—

1. Showing contents: "Gunpowder."
2. The number of lbs. weight in the barrel.
3. Place or name of manufacturer, thus: "Waltham Abbey,' or "Curtis and Harvey."
4. Letter or letters indicating the nature of the gunpowder in red paint, thus: "P.²" or "R.L.G."
5. "Blended" and number of the brand (when two or more lots have been blended so as to form a brand) stencilled across the old markings in black paint.
6. Date of manufacture of the gunpowder.
7. "Bag, waterproof" (when the powder is enclosed in a waterproof bag).
8. Number of the lot to which the barrel belongs, except when two or more lots have been blended so as to form a brand, when the original lot number should be obliterated.
9. The tare weight of the barrel (including the weight of the waterproof bag).

(*b*) Barrels containing Class I gunpowder, which has been repaired or re-dusted, will be marked as follows:—

1, 2, 3, and 4. As before.
5. Date of repair of the gunpowder.
6. "Bag, waterproof" (when the powder is enclosed in a waterproof bag).
7. Number of the lot to which the barrel belongs.
8. The tare weight of the barrel (including the weight of the waterproof bag).
9. "Repaired," or "re-dusted," as the case may be, with the date marked across the head.

(*c*) Barrels containing gunpowder which has been reduced to Class II Blank, or III Shell, will have the marking obliterated, and will be marked:—

1. "Gunpowder."
2. The number of lbs. weight in the barrel.
3. P., Q.F., L.G., or F.G. (as the case may be) in black paint.
4. "Blank" "Shell" or in the case of F.G. "Shell reduced" (as the case may be).
5. Date of reduction.
6. "Bag, waterproof" (when the powder is enclosed in a waterproof bag).
7. The tare weight of the barrel (including the weight of the waterproof bag).

(*d*) Gunpowder reduced to Class V under competent authority, will be marked "Condemned" in white paint across the previous markings, which should be left visible.

Powder barrels will also have the following labels (*see* p. 443).

Government explosives label.
Classification label.
Station label.

The Government explosives and station labels are so placed as to be torn or removed when the package is opened.

Hints on Coopering.

The following hints on coopering are introduced, as likely to be useful :—

To unhead a barrel. First method.

A barrel can be unheaded in two ways. The first and more common method is to place the barrel with the top end uppermost, and then to remove the top chime hoops and loosen the top quarter hoops. The left hand is then pressed upon the middle piece of the head, which is struck gently with the adze or mallet close to the chime on the side nearest the cooper, until it is started out of the groove and falls into the barrel.

Second method, or "boxing."

The second method is called "boxing out" the head, and is adopted when the groove is deeper than usual, or when from other causes, such as the barrel being incorrectly made and having too sharp a curve, the head cannot be readily removed by the first method. The hoops are loosened and removed as before, and the left hand placed upon the head, and a few smart blows are struck with the mallet round the pitch of the barrel, by which means the staves are, as it were, sprung back, and the head being thus released, falls through.

Heading a barrel. Head whole.

To head a barrel.—The head, if whole, is placed with its bevelled edge (on the side away from the cooper) in the groove, the left hand is then placed upon it, and the head slightly struck, as much as possible in the direction *away* from the workman, with the adze or mallet; in this manner it is driven into the groove all round. The chime hoops are then replaced. If, on heading a barrel, the head should accidentally be driven a little below the groove, it can generally be jarred back into its place by laying the barrel on its side and tapping the top end of the staves.

It is forbidden to use nails in re-heading a barrel; sometimes copper nails have been used, but these are objectionable even when the barrel is empty, as in unheading they are apt to get into the barrel, and so find their way to the powder when the barrel is re-filled.

Head in two pieces.

When the head is in two pieces, the dowels (if still adhering) must be cut off. The larger piece is then placed with the whole of the left front in the groove to the left hand side away from the workman. The small piece is then placed alongside the larger, its further edge also entering the groove; the left hand is then placed over the junction and by means of a few gentle blows, given with care, and at the spots where they may seem to be most required, the head is driven into the groove.

Head in three pieces.

If the head is in three pieces, the dowels must be cut off and the pieces matched according to the lettering on the head. One of the "cants" or "outsides" is then placed as the larger piece in the last case, and supported by the left thumb, which is brought over the side. The middle piece is then placed against it, its further edge in the groove, and its straight edge pressing hard against the side of the "cant." The other cant is then placed in the groove. Proceed as when the head is in two pieces.

In heading and unheading gunpowder barrels, the person employed will never use the bare adze against the copper hoops, but will invariably apply the metal driver.

Flagging.

Sometimes when the barrel is headed, the head will be found to be a little out of round, or injured at the edge, thus leaving an opening between the head and staves. It then becomes necessary to use the "flagging tool." One of its teeth is pressed against the

inside of the stave where the opening appears, and the other tooth outside the stave to the right. By pressing against the handle, and using it as a lever, the opening is widened, and a little "Dutch rush" or "flag" (if not procurable, paper or rag will serve) is placed inside the gap; the flagging tool is then removed, and the stave being released springs back into its place, pinching in the rush against the head.

To avoid using a knife (*which should never be allowed to enter a magazine*), the rush should be placed as much as possible flush with the top of the head of the barrel.

Iron or steel prohibited.

No implements of iron or steel are admissible for use in magazines or laboratories, and the use of iron or steel in any form is strictly forbidden in the construction of packages intended for gunpowder. Any exception to this rule must be specially authorised. The hoops of powder barrels will be secured with copper rivets only.

To alter the size of a hoop.

If the ash hoops are too large, they may be reduced in diameter to the required size by placing a small three-sided prism or wedge of wood, called a "Dutchman," between the shoulders or notches of the hoop. If the hoop is too small, it may be enlarged by cutting away part of the shoulders.

Taking to pieces or "shaking" a barrel for stowage.

Before taking a hand-made barrel to pieces for stowage (called "shaking" a barrel), the staves must be numbered round the inside with a piece of chalk or a pointed tool; with machine-made barrels it is not necessary. The hoops are then removed, and laid aside. The ash hoops (if the barrel is to be sent away) are seldom packed with it; the copper hoops are not doubled up, but are tied together. The head is divided into two or three pieces by pulling open the joints without breaking the dowels.

The staves are then packed round the "ends," and the pack secured with twine or with some of the wooden hoops.

To put a barrel together.

To put the barrel together again, the pack is untied. One of the copper chime hoops is then taken in the left hand, and held at about the height of the barrel from the ground, the cooper kneeling on his right knee. The staves, as numbered, and with their top ends uppermost, are then arranged round the inside of the hoop, their lower ends resting upon the ground, the first few staves as they are arranged being supported by the outside of the left leg and left foot.* In this manner the barrel may be built up, when the upper bilge hoop is slipped on. The barrel is then turned round and the other bilge hoop slipped on. The head is then put together, and the back head is placed into the barrel (working chiefly from the inside); the back chime hoop is then placed on. The barrel is then headed up, the top chime hoop being previously removed to admit of this being done; the chime hoop is then put on again.

To remove a stave without "shaking" the barrel down.

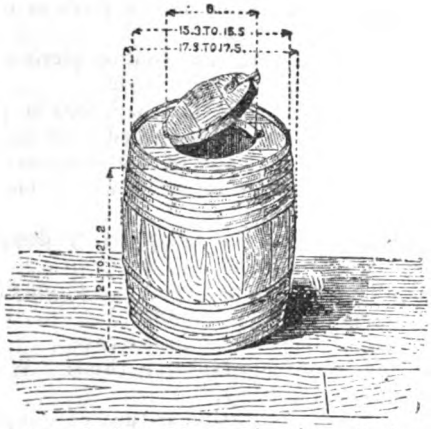
All the hoops, except the bottom chime hoop and the top bilge hoop, must be removed; remove the required stave, and replace it by another, and then replace the hoops.

§ 774.

Barrel, ammunition, gun.—Of two sizes, *whole* and *half;* full bound; four copper hoops; staves of oak or teak for tropical climates. The top is generally teak, and has a circular opening into which a wooden lid fits, working on a hinge, and secured by a screw bolt. A gun-metal key is used to screw or unscrew the bolt. The whole size will contain all S.B. cartridges. They are rarely met with now.

* Perhaps a simpler method is to use two hoops, one placed on the ground, and the other held up as above described.

These barrels are the same size as powder barrels, but are not intended to contain loose powder. They are used in dry magazines to contain cartridges. No luting is used to close the lid.



Case, transport explosives, Mark I | C | is similar in construction to the case, transport detonators, described at p. 108, but differs in dimensions and in the lid, which is provided with 12 square-headed screws and painted kharki colour. Dimensions 33·15″ × 18·25″ × 10·8″. § 10954.

Cylinders, ammunition.—When powder is sent by rail, it is put in a flannel bag and placed in a half or quarter barrel. The barrel is covered by a canvas bag, and placed in an iron case or cylinder. These iron cases are only made of two sizes, half and quarter; any other combustible stores are sent in the same manner, except high explosives. Small arm cartridges may be sent without being placed in iron cases, as they are very difficult to ignite in any way, and will not explode in mass under any circumstances.

The *Case, powder, 100 lb., Mark V, wood, zinc lined, prismatic*, is designed for the transport and storage of prism and other moulded powders. It is a stout deal box, with lid of teak clamped with hard wood, which is secured by ten brass screws working in gun-metal nuts let into the sides and ends of the box. It stands on two ledges attached to the bottom, and at each end is a cleat of hard wood for a rope handle. The exterior dimensions are 2 feet 5¾ inches long, 1 foot 3½ inches wide, 9¼ inches deep over all, and there is a circular recess for the safety label in the lid and side. §§ 8263, 8285, 8497.

The zinc lining is removable, and has a flanged recess at top for luting, the zinc lid is also flanged to fit in recess of zinc lining, and is fitted with two folding wire handles for lifting.

The inside of the lining and lid are coated with Price's black lacquer, the outside of the lining is varnished with copal varnish which is stained with vegetable black so that it may readily be seen when the case is covered, and the exterior of the box is painted red. Boxes, the linings of which are so varnished, will have a red cross (a brighter colour) painted on one side. The bars of the cross are 1 inch wide, and as long as the space will permit. On the bars, stencilled in black, are the date and initial of station. § 9087.

Marks II*, III, and IV will be converted by having a similar lining and lid to Mark V inserted, and will then be distinguished by the addition of an asterisk after the roman numeral, thus: II**, III*, IV*. §§ 4390, 4915, 5075, 5615, 6272, 8263, 8285.

Instructions for using up Mark I case are contained in § 4912. § 4215

Closing the case.

To close the above cases, fill the recess or groove on top of zinc lining with luting, then press in flanged edges of zinc lid, and with the thumb smooth off the luting level with the top of the rim of the groove, wipe clean round the edges with a piece of cotton waste or rag, then screw on the wooden lid.

Used for picric acid.

100 lb. powder cases, when used to contain picric acid, have their linings removed and calico bags substituted.

§ 5315.

Each of these cases is to be packed with 100 lb. powder, and no more; the empty space, if any, being filled with suitable pieces of varnished wood, which will be made of the necessary size, and provided locally as required; and, when filled, will be marked on the lid and sides as follows:—

§ 6272.

(*a*) Printed paper label on the front, giving designation of case and directions for closing.

(*b*) Stencilled with black paint (except in 4) on the lid:—

1. Showing contents: "Gunpowder."
2. The number of lbs. weight in the case.
3. Place, or name of manufacturer, thus: "Waltham Abbey," or "Curtis and Harvey."
4. Letters or words indicating nature of gunpowder in white paint, thus: "E.X.E." or "Prism[1] Brown."
5. Month and year of manufacture.
6. Lot number.
7. Tare weight of case.

(*c*) Stencilled with white paint on both ends:—

1. Place or name of manufacturer as in (*b*) 3.
2. Letters or words indicating nature of gunpowder as in (*b*) 4.
3. Lot number in large figures.
4. Number of case in lot.

Also the Government explosives, classification and station labels, *see* p. 443.

§§ 4386, 9245.

A *Brace, magazine, Mark II*, and a *bit* for the same, both of phosphor-bronze, are supplied for use with these cases, for which the ordinary "driver, screw, magazine," is not strong enough.

Beside the above, prism powder is sometimes transported in zinc-lined cases supplied by contractors, which are altered to hold 100 lb.

Issue to foreign stations.

All of these cases, whether Service or contractor's, when issued to foreign stations, are to be rendered air-tight previous to issue, by the application of a tape band about 2 inches wide at the junction between the lid and the case. This band is then to be securely fastened to the wood by means of shellac cement, and painted the same colour as the case. Such cases should not be opened, if it can possibly be avoided, until the contents are required for making up cartridges.

Besides the packages described above, gunpowder, in the form of made-up cartridges or bags of spare powder, is transported and stored in the following cases:—

For Land Service.	*For Naval Service.*
Box, pack, transport.	Case, powder, metal lined.
Cases, metal lined—	,, ,, pentagon.
Mark I, special.	,, ,, rectangular, plain.
Mark II, field.	Cases, powder, rectangular, corrugated.
Cases, powder, metal lined.	Cases, powder, cylindrical, brass.
,, ,, cylindrical, brass (z).	Cylinders, cartridge, zinc.
Cylinders, cartridge, zinc.	

All packages will be carefully examined in the interior to ensure their being free from moisture before being used for packing cartridges. Packages to be examined.

Boxes, pack, transport, ammunition, wood, cartridge, are issued for the B.L., and R.M.L. 16-pr., 13-pr., 9-pr. and 2·5-inch ammunition. The same box serves to contain the cartridges for either calibre. It is made of 1-inch yellow pine, and fastened together by dovetailing and by metal screws working in countersunk washers. It has a rope handle, and two leather keepers are fixed to the back for pack saddle straps. It is painted lead colour. Dimensions $19\frac{1}{2}'' \times 13\frac{1}{2}'' \times 15\frac{1}{2}''$. §§ 3832, 3874, 6446.

Cartouche, pack, transport, R.M.L., is made of waterproofed sail canvas, painted black on the outside. It has four flaps buckled over the cartouche proper to keep out rain, &c. It is carried over the shoulder by a webbing strap. It measures $17\frac{1}{2}'' \times 10\frac{1}{2}'' \times 13\frac{1}{2}''$. §§ 3832, 6446.

Case, metal lined, field, Mark II, is of wood, provided with a sliding lid with pin, and with a cleat and rope handle at each end. The interior is fitted with a removable zinc lining, with a groove for luting at the top, and the lid of the lining is flanged to fit into the groove. The case is for field service B.L. reserve cartridges, and is only used for the carriage of cordite cartridges, which are packed without their covers on, in ammunition and store wagons, in ammunition columns and parks. These cases are stencilled to show the exact nature and number of cartridges they contain. §§ 8946, 9109, 10272.

The Mark I case, which is known as *Special*, differs in dimensions. No more will be made, and existing cases will be used for such services, other than mobilization, as may be ordered.

Cases, powder, metal lined, Mark IV, are of three sizes—whole, half, and quarter; they are rectangular cases of deal, strengthened by oak corners, and the cleats of ash, the sides and ends are secured by dovetailing, and the top and bottom by brass screws. They are lined with tinned copper. Their dimensions are:—Whole, $17'' \times 17'' \times 20\frac{1}{2}''$. Half, $13\frac{1}{2}'' \times 13\frac{1}{2}'' \times 16\frac{1}{2}''$. Quarter, $10\frac{1}{2}'' \times 10\frac{1}{2}'' \times 14''$. §§ 5406, 6033, 10665.

The cases are *Land* and *Naval*, differing from each other only in the handles, which are of rope for the former and wire for the latter.

A square lid opens on hinges on top of the case; it is screwed down by two gun-metal bolts by means of a gun-metal key; this lid covers a circular opening, which is closed by an inner lid or bung of tinned copper.

Metal lined powder cases are used for the storage and transport of the smaller cartridges, powder and cordite, and for small combustible stores generally. The half size also for wet gun-cotton, when specially fitted as described on p. 15.

The cases are painted stone colour. Marking and labels are given with zinc cartridge cylinders and naval cases, pp. 84 and 91. Painting and marking. §§ 6646, 9570.

The whole size will take all R.B.L. cartridges, R.M.L. up to 9-inch, and B.L. up to 6-inch inclusive.

The case is closed by covering the side of the bung all round flush to the top and bottom rim with luting, pressing it well home, and filling up the recess round the bung with luting, and smoothing it down with the thumb, wipe clean with a piece of cotton waste or rag. The wooden lid is then closed, and the two gun-metal bolts screwed down alternately, giving not more than one turn at a time to each, so as not to strain the bolts or hinges. To close the case.

The luting to be used for securing the lids of powder cases and metal lined cases is Mark III, which consists of 80 parts, by weight, of whiting, 20 parts of mineral jelly (vaseline), and one part of Mark III luting. § 8766

castor-oil. It will be issued from Woolwich ready mixed in tin cylinders each containing 1 lb.

The luting, before use, will be beaten up with an ordinary wood mallet on a wooden tray until it is of the required consistency.

Marks I and II, luting. §§ 9016, 10146.

Mark I luting, consisting of equal parts of beeswax and tallow, is reverted to for Naval mining and torpedo services. With this exception Marks I and II luting is not to be used in future. Any Mark II luting already on packages that is found defective will be replaced by Mark III, but packages are not to be specially opened for the purpose of determining the mark of luting with which they are closed.

§ 5780.

Bag, powder, 10 lb., Mark I, serge.—Whenever loose powder is stored in metal-lined or pentagon cases, it will be packed in serge bags, which are not to contain more than 10 lb. powder. The mouth of this bag will be tied with twine.

§§ 2483, 7566.

Case, powder, pentagon, of two sizes, whole and half. The lid hinges on a curved bolt; there are slots in the projecting rim of the lid, and corresponding projections on the neck of the case; the lid will only open when the slots and projections are in a corresponding position. The dimensions of the whole size case are, 19·3″ × 15·5″ × 11″.

There is a second socket furnished for the bolt, in case the other should get broken. The body of the case is made of sheet brass, the top and fittings of cast brass.

The whole size takes all R.B.L. cartridges, R.M.L. up to 8-inch inclusive, full charges of "P." powder excepted, and B.L. up to 6-inch 21-lb. When packed with B.L. 6-inch 12-lb., E.X.E., quarter-charges for Naval Service, wood packing pieces will be used.

There are five pieces to a set, viz.:—

Two tapering pieces, each not to exceed $14\frac{1}{2}'' \times 3\frac{1}{2}'' \times \frac{3}{4}''$.
Two rectangular „ „ „ $6'' \times 3\frac{1}{2}'' \times \frac{3}{4}''$.
One securing piece, not to exceed .. $8'' \times 7\frac{1}{2}'' \times \frac{3}{4}''$.

These packing pieces will be made locally as required.

The half case is produced by taking a section of a pentagon along a line bisecting the long side of the head and perpendicular to it. It has four sides, and is used by the Navy for convenience in stowage, generally for small stores.

The shape enables the pentagon case to pack well in a ship's magazine.

§ 1322.

There is a lever and spanner issued for opening this case, the spanner works the jam screw, and the lever turns the lid. The present pattern is Mark II, which is available for this and the following case.

To close the case.

The groove round the neck of the case is filled up with Mark III luting, the bung is then inserted, and tapped gently down with a wooden mallet, the recess round the bung is then filled in with luting, and well smoothed down with the thumb, wipe clean round the edge with a piece of cotton waste or rag, and clean the lid. The projection on the point of the lever is then inserted in the ring on the curved bolt, and the lever turned from left to right. The spanner is then used to turn the screw and jam the curved bolt.

To open the case, unscrew the set screw free from the curved bolt with the spanner, turn the lid from right to left with the brass lever until the inclines are clear, then raise the lid and lift out the bung.

§ 975.

The *Case, powder, rectangular, plain*, is made of sheet brass, the top and fittings being of cast brass. It is opened and closed in much

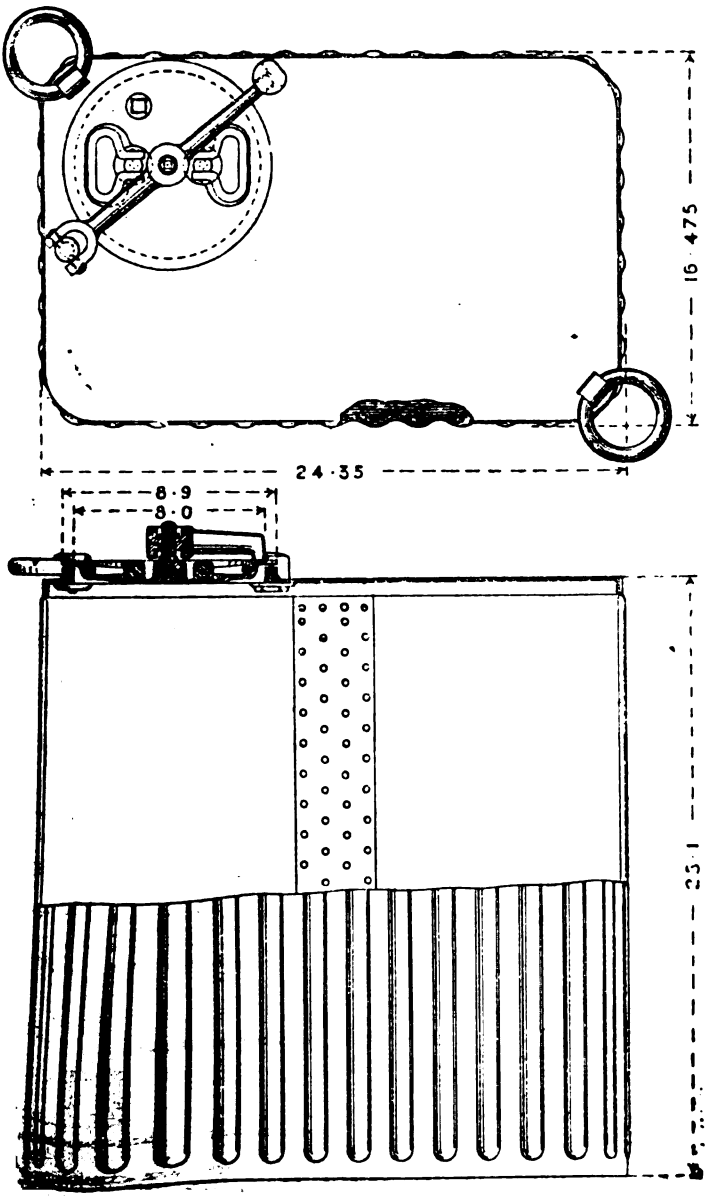
the same way as the pentagon case. The head working on the curved bolt is a ring in this case. It has two holes, either of which takes the front projections on the lever.

The case will take all R.M.L. cartridges up to the 9-inch inclusive, full charges of "P." powder excepted. No more will be made. The dimensions are, 22″ × 18¼″ × 11″.

The lid of this case, and also of the Mark I "A" corrugated case, will be secured with luting, in a similar manner to that of the pentagon case.

Case, Powder, Rectangular L (Mark IV).

Brass, corrugated for 12 6-inch B.L. ¼-charges or 24 ¼-charges. (Scale ⅛.)



Cases, powder, rectangular, A to N.—Made of corrugated sheet brass, with cast gun-metal top and fittings. The corrugations strengthen the case. These cases are used for N.S. only.

§ 10219. There are fourteen sizes of these cases, lettered from A to N, (*see* cut).

The present patterns are A and L, Mark IV; B to G, Mark III; H to J, Mark II; M, Mark II; and N, Mark I. They are double riveted, and have the brass strips on the vertical joints at the sides $3\frac{5}{8}$ inches wide, instead of $1\frac{3}{4}$ inches, as in the earlier patterns.

§ 9517. The lid, except of the M case, is circular, and provided with a flange which fits into a circular groove in the raised lip round the opening in the case, and is secured by a cross bar working on a pivot at one end, and fitting under a projection at the other. A central screw bolt bears upon the lid; when this is tightened all is fixed in its place, when loose the bar can be turned on one side and the lid lifted out. All these circular lids, of new and repaired cases, have a hole in them, closed by a gun-metal screw-plug, this hole is used for making air connections for testing purposes. This caused an advance of numeral in the pattern, or the addition of the symbol * to the existing numeral.

The plugs used, both for rectangular and cylindrical cases, are the same as are used for closing the hole in B.L. shells, 8-inch to 13·5-inch, and R.M.L. 12·5-inch and 16-inch, for the Mark II small lifting eye-bolt.

All these cases have handles of copper wire covered with leather, for lifting.

D, E, F, G, H, I, and J cases have a wood lining at the top to prevent the cartridge being cut by the lower ends of the top fittings.

To open the central screw in the cross bar a key is required.

§ 2538. The Mark II key is made of gun-metal, with a cross handle bevelled off at one end, for the purpose of extracting the ring handles of the lid of the case, if they should become fixed in the recess.

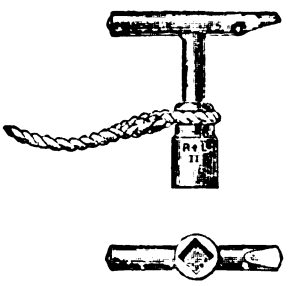
§§ 5017, 7076, 9616. The Mark III key differs from the above in having one end of the cross handle formed into a toe for raising the lid of the "M" case. It will, however, be used for other rectangular cases, when the existing store of previous patterns is used up.

§ 8073. The Mark IV key is similar to Mark III, but is made of aluminium bronze, and is consequently stronger.

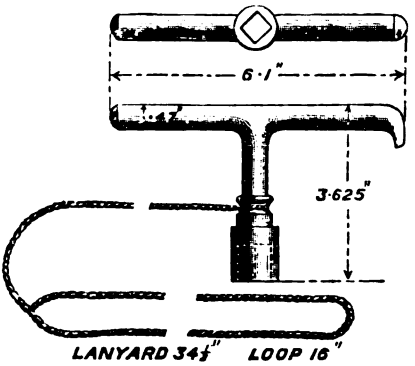
It is also used for Q.F. naval cartridge outfit boxes, 12-pr. to 6-inch.

To open a case, unscrew the tightening screw, unfasten the cross-bar, and lift out the lid.

Mark II.



Mark III.



Mark I "A" corrugated case opens in the same way as the plain rectangular case, the neck and lid project beyond the sides, entailing the necessity of placing battens between the cases, thus causing loss of space in the magazine. On return to Woolwich they are altered to Mark II before re-issue. § 1369.

The lids of these cases are secured as follows:— Securing lids.

Twist loose jute, or hemp (untwisted white spun yarn is best, if available) round to a compact and uniform thickness of about one quarter of an inch, and of sufficient length to form a complete ring to fit into the circular groove on the top of the case.

Thoroughly coat the twisted jute or hemp with Mark III luting, by holding some luting in one hand and drawing the jute or hemp through it; place it in the groove, and press it down therein so as to present an even and uniform surface to receive the edge of the lid, then fill up the whole of the groove with luting. Cover the side of the lid all round with luting flush with the rim; put on the lid in such a position that the handles will be covered by the cross-bar, and tap it gently down with a wooden mallet until it is well home in the groove; put the cross-bar in its place, and screw down the tightening screw with the metal key, cleaning off the superfluous luting with a piece of waste.

At depôts at home and abroad, such naval powder cases as are fitted with testing plugs will be tested for air-tightness by means of the "pump, air, testing powder cases."— Testing powder cases. A.O.R. 1900.

1. On receipt into store.
2. After packing.

The test will only be considered satisfactory when the indicator on the gauge of the pump remains stationary (under compression or exhaust) for a period of not less than 1½ minutes at a pressure of 1½-lb. per square inch. Any cases which fail at this test should be emptied and returned to Woolwich as soon as they can be spared, if the defects are such as cannot be satisfactorily remedied locally.

The *Pump, air, testing powder cases, Mark I*, is issued for the above test. It is a single acting pump and can be used for either compressing or exhausting the air in the cases. It is fitted with a gauge for indicating "compression" or "exhaust," which will read to 3-lb. either way. § 8806.

Connection with the powder case is made by means of an india-rubber pipe having a nozzle which screws into the hole in the lid of the case.

The pump fits into a wooden box, provided with a leather handle.

The rectangular powder cases will take the following powder or cordite cartridges:—

"A" 7-inch, 8-inch, and 9-inch R.M.L. cartridges, dimensions 22" × 23" × 10". §§ 1402, 1909, 3795.

"B" takes 10-inch R.M.L. cartridges, dimensions 26" × 20" × 11". §§ 1700, 1909.

"C" takes 12-inch (25-ton) R.M.L. cartridges, dimensions 22" × 24" × 13". §§ 1771, 1909, 8114.

"D" takes 12-inch (35-ton) R.M.L. cartridges, dimensions 24" × 32" × 13". § 2208.

"D" also takes B.L. 10-inch, 63-lb. Prism[1] brown, and 13·5-inch 93-lb. 12-oz. and 46-lb. 14-oz. cordite cartridges. § 9172, 10254.

"E" takes 11-inch R.M.L. cartridges, dimensions 20½" × 12" × 28½". § 2776.

"F" takes 12·5-inch or 12-inch (35-ton) R.M.L. cartridges, or 8-inch and 9·2-inch B.L. cartridges, dimensions 24½" × 34½" × 13". §§ 3061, 8577, 7633.

§§ 3878, 10254. "G" takes 12·5-inch R.M.L. cartridges, and B.L. 13·5-inch, 93-lb. 12-oz., and 46-lb. 14-oz. and B.L.C. 5-inch, 5-lb. 4-oz. cordite cartridges, dimensions $36\frac{1}{2}'' \times 24\frac{1}{2}'' \times 13\frac{1}{2}''$.

§§ 4682, 10255. "H" for 8-inch B.L. cartridges, dimensions 18·45" × 21·484" × 12·084".

§§ 4682, 5007, 9764. "I" for 9·2-inch B.L. cartridges, dimensions 25·095" × 24·284" × 13·284".

§§ 4682, 5077, 8716. "J" for 10-inch B.L. cartridges, dimensions $28\frac{1}{2}'' \times 28\frac{3}{4}'' \times 15\frac{1}{4}''$.

§ 10636. A canvas lifting band is supplied for use with 10-inch B.L. 38-lb. cordite cartridges, packed in the J case. It is placed upon the last cartridge, which should be inserted in the case with the large or printed end uppermost.

"K" for 12-inch B.L. cartridges, dimensions $32\frac{1}{2}'' \times 25\frac{1}{4}'' \times 17\frac{1}{2}''$.

§§ 4567, 5823, 6512. "L" for 6-inch B.L. cartridges, dimensions 24·33" × 16·475" × 27·475".

§ 5917. "M" for 4·7-inch Q.F. cartridges, dimensions 19·125" × 13·25" × 17·5". For description in detail of this case, *see* p. 322, *et seq.*

§ 10219. "N" for 9·2-inch B.L. cartridges, Marks IX and X guns, dimensions 17" × 17" × 37".

Packing pieces. For A, D, F, G, H, I, J, and L cases, packing pieces of wood, coated with shellac varnish, are supplied to fill up space, and prevent the cartridges from being injured by shaking about. The dimensions, &c., are as follows:—

For A, when packed with B.L. 6-inch 12-lb. E.X.E. cartridges:—

One bottom piece	$21\frac{3}{8}'' \times 6\frac{1}{4}'' \times 3\frac{6}{16}''$.
Three side pieces	$22'' \times 7\frac{1}{8}'' \times 2''$.

§ 8114. For C, when packed with B.L. 6-inch 12-lb. E.X.E. cartridges:—

Two side pieces	$21\frac{1}{4}'' \times 6'' \times 1\frac{1}{4}''$.
Two bottom pieces	$12\frac{1}{4}'' \times 6'' \times 2''$.
One top piece	$12'' \times 10'' \times 1\frac{3}{8}''$.

§ 9472. For D, when packed with B.L. 10-inch 63-lb., Prism[1] brown cartridges:—

Two bottom pieces	$23\frac{6}{10} \times 6\frac{1}{10} \times 5\frac{6}{10}$.

When packed with B.L. 13·5-inch, 93-lb. 12-oz., and 46-lb. 14-oz. cordite cartridges:—

Two packing pieces	$23\frac{1}{2}'' \times 6'' \times 7\frac{3}{4}''$.

§ 8113. For F, when packed with B.L. 8-inch $29\frac{1}{2}$-lb. cartridges:—

§ 7633.

Two end pieces, not to exceed..	$30\frac{5}{8}'' \times 9'' \times 1\frac{3}{4}''$.
„ side „ „ „ ..	$30\frac{5}{8}'' \times 12'' \times 1\frac{3}{4}''$.
„ „ „ „ „ ..	$30\frac{5}{8}'' \times 11\frac{3}{4}'' \times 1\frac{3}{4}''$.
One bottom piece „ „ ..	$18\frac{5}{8}'' \times 9'' \times 6\frac{3}{8}''$.

§§ 7950, 8853. When packed with R.M.L. 12·5-inch 50-lb. cartridges:—

Two bottom pieces	$23'' \times 10\frac{1}{8}'' \times 5\frac{5}{8}''$.
„ side „	$30\frac{3}{4}'' \times 11\frac{3}{8}'' \times \frac{5}{8}''$.
One end piece	$30\frac{3}{4}'' \times 11\frac{3}{8}'' \times \frac{5}{8}''$.
„ top piece	$10\frac{1}{8}'' \times 4\frac{3}{8}'' \times 1\frac{1}{8}''$.

§ 8577. When containing B.L. 9·2-inch 41-lb. cartridges:—

One bottom piece	$20\frac{1}{8}'' \times 11\frac{1}{8}'' \times 2\frac{7}{8}''$.
„ back „	$30\frac{5}{8}'' \times 12\frac{1}{4}'' \times 2\frac{3}{4}''$.
„ front „	$30\frac{5}{8}'' \times 12\frac{1}{4}'' \times 1\frac{3}{8}''$.
Four side pieces..	$30\frac{5}{8}'' \times 10\frac{1}{4}'' \times \frac{5}{8}''$.

§§ 5530, 7173, 7423, 8327. For G, when packed with $52\frac{1}{2}$-lb. Prism[2], and 50-lb. E.X.E. cartridges:—

One bottom piece	$22\frac{5}{8}'' \times 11\frac{1}{4}'' \times 1''$.
„ end „	$32\frac{5}{8}'' \times 11\frac{1}{4}'' \times 1\frac{1}{2}''$.
Two side pieces	$32\frac{5}{8}'' \times 11'' \times 1''$.

For G, when packed with 58-lb. E.X.E. cartridges:— § 8194.

Two bottom pieces	21″ × 5½″ × 7¼″.
„ side „	33″ × 11⅝″ × 1¼″.
One end piece	33″ × 11″ × 2⅜″.

When packed with B.L. 13·5-inch, 93-lb. 12-oz., and 46-lb. 14-oz. § 10635. cordite cartridges:—

Two packing pieces	23½″ × 6″ × 10⅛″.

For H, when containing 29½-lb. cartridges:— §§ 5289, 6774.

One bottom piece	18⅝″ × 9¾″ × ⅝″.
„ end „	17″ × 9¾″ × 1⅞″.
„ side piece strengthened by two ⅝″ battens across the body	17″ × 9¼″ × 1¼″.

When containing 26-lb. cartridges:— § 4914.

One bottom piece	18¼″ × 9⅝″ × ⅝″. § 8388.
Two end pieces	16⅞″ × 10⅛″ × 1¼″.
„ side „	16⅞″ × 9″ × 1¾″.

When packed with B.L. 8-inch 14-lb. 6-oz. cordite cartridges:—

Two packing pieces	20½″ × 5⅝″ × 2″.

For I, when packed with 41-lb. cartridges:— § 5007.

One bottom piece	20⅝″ × 11⅜″ × 2¾″.
Two end pieces, each	21⅜″ × 11⅜″ × 1¼″.
One side in two pieces, each ..	22″ × 10¾″ × ⅝″.

When packed with 15-lb. 12-oz. cordite:— § 8577.

Two top pieces	12⅝″ × 5¾″ × 2½″.
„ „ „	10½″ × 5⅞″ × 3½″.

When containing 36-lb. cartridges:—

One bottom piece	20⅜″ × 10″ × 2 7/16″.
Two end pieces	21⅝″ × 10″ × 1¼″.
„ side „	22¾″ × 10¾″ × 1⅞″.

When containing 21-lb. and 10½-lb. cordite cartridges:— § 9764.

One bottom piece	19⅛″ × 2½″ × 12″.
„ back-end piece	21·6″ × 2½″ × 12″.
„ front-end piece	21·6″ × 1·25″ × 11·4″.

For J, when packed with B.L. 10-inch cartridges:— § 7174.

One back piece	27⅜″ × 11¼″ × 4″.
„ front „	27⅜″ × 11⅛″ × ¾″.
„ bottom „	22⅞″ × 11⅛″ × 2⅞″.
Four side pieces	27⅜″ × 15⅜″ × 1½″.

When packed with 19-lb. cordite cartridges:—

One bottom piece..	22·9″ × 11·6″ × 3·25″. § 8716.

For L, when packed with B.L. 6-inch 10-lb. cordite cartridges:— § 10795.

Two end pieces	24″ × 7¾″ × 2¾″.

The actual number of cartridges contained in each size will be found in the tables, pp. 467 *et seq.*

Some of the large cartridges are stored in *cases, powder, cylindrical*, of which each size only takes one nature of cartridge. These cases are also known by letters: O, P, Q, R, S, T, U, V, W, X, and Z.

With the exception of Z they are all for Naval Service. They are all, except cases S and Z,† fitted with the hole and plug for the air-test as described for the rectangular cases.

† The screw plugs put in some S cases have been sweated in.

§ 9317. Existing cases which come through Ordnance Factories will be fitted with this plug and a * added to their numerals.

Use. The cases take the following cartridges:—

Case O. Four ¼ cordite charges for B.L. 12-inch guns, Marks I to VII.

Case P. One ½ or two ¼ cordite charges for B.L. 13·5-inch gun.

Case Q. „ „ „ „ „ „ 12-inch Mark IX gun.

Case R. One ½ or two ¼ cordite charges for B.L. 12-inch Mark VIII gun.

Case S. Four ¼ powder charges for B.L. 16·25-inch gun.

Case T. Two ¼ „ „ „ „ 13·5-inch gun.

Cases U, V, and W each take four ¼ powder charges for the B.L. 12-inch gun. These cases are not common to the several ships armed with 12-inch B.L. guns, but the patterns are specially adapted to the arrangements for stowing and working on board particular ships.

Case X takes four ¼ powder charges for the R.M.L. 16-inch guns on board H.M.S. Inflexible.

Case Z is the only L.S. case and takes two ¼ powder charges for the R.M.L. 17·72-inch gun.

A short description of each of these cases follows.

§ 10218. *Case, powder, cylindrical, O, Mark, I | N |* is similar to the R case, Mark III, but differs in dimensions.

§ 9830. *Case, powder, cylindrical, P, Mark I | N |* . The body of the case is made of stout sheet brass butt jointed, open at one end; on the exterior two gun-metal bands are attached to the body with solder, between these bands over the joint is secured, with rivets and solder, a lifting bar of gun-metal; the bar has two eyes formed in the centre of its length. At each end of the case there is a stiffening ring also of gun-metal secured to the body with rivets and solder, having four bearing surfaces on each, which give stability to the case in stowage; the top ring forms the mouth of the case, inside of which a groove is formed, and in this groove the locking cams on the lid work. Two joint strips of sheet brass are riveted and soldered over the joint between the bands and stiffening rings.

The bottom is pressed up from sheet brass and fits over the end of the case and is secured by rivets passing through it, the body, and bottom stiffening ring.

The lid is made of gun-metal, having a flange on the upper surface strengthened by 12 small stays, four locking cams, worked by a key, are fitted in it at right angles and secured from the underside of the lid by means of a nut held by a set screw, these cams engage in a short groove inside the top of the case thus securing it. A recess is formed on the underside of the lid and tinned to receive a dermatine washer, which is secured in the recess with india-rubber solution, and painted with whiting to prevent its adhering to the mouth of the case. A wood packing piece painted stone colour is screwed to the underside of the lid by four metal screws working in four sockets cast on the underside of the lid. On the upper surface a circular recess is formed, across which is a handle for the purpose of lifting the lid.

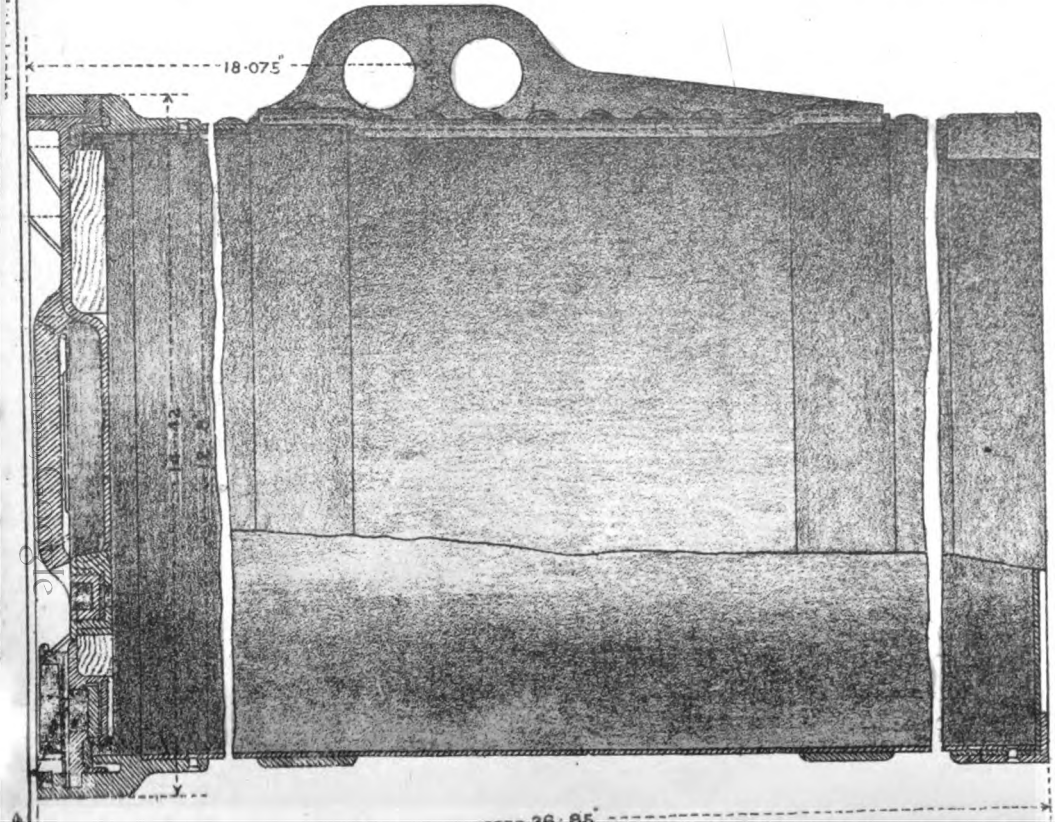
It is fitted with the usual plug for the air-test.

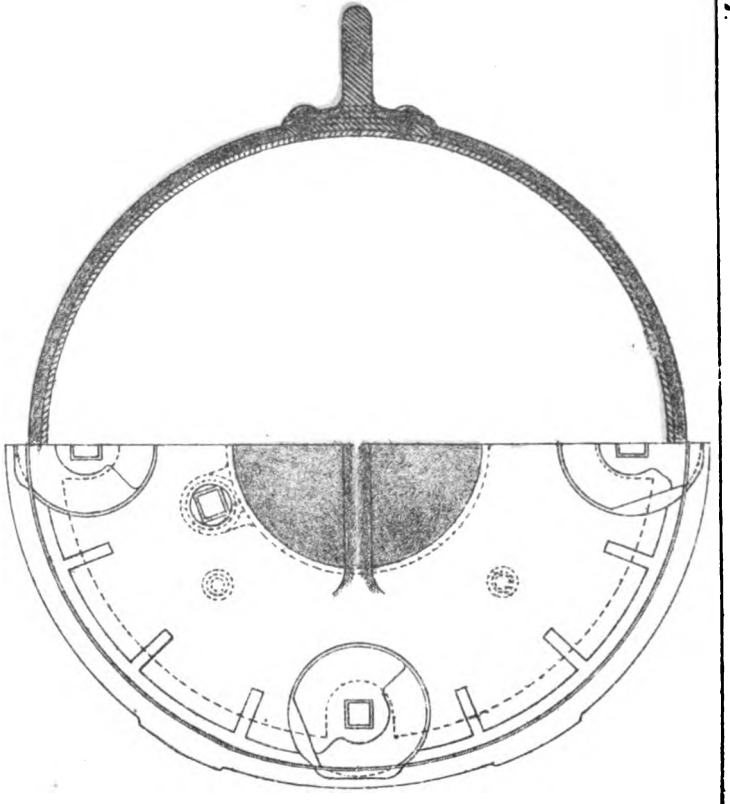
Radial lines are cut on both body and lid, and must be made to coincide when the case is closed. A small pin then engages in a slot in the rim of lid and prevents the lid from turning.

CASE POWDER CYLINDRICAL R. LARGE. MARK II N

BRASS; 12 IN. B.L. MARK VIII GUN ½ CHARGE.

SCALE ¼





To face page 81.

For working the locking cams a key is required. This is the *Key, O to R, Mark II.* It is made of gun-metal, about 5 inches long with a cross handle. It has a square projection which fits into the recesses in the cams, and is fitted with a lanyard of white line. It is also used with all cylindrical and rectangular cases to remove the air-testing plug. Key. §§ 9831, 9584, 8644, 10218.

The Mark I key only differs from the above in being shorter in the shank. § 8155.

The *Case, powder, cylindrical, Q, Mark I | N |* is similar to the P case, except in dimensions, being smaller and in having only three locking cams in the lid instead of four. A brass packing piece or stool is issued with this case. §§ 9584, 10369.

The same key is used for locking the cams as for those of the P case.

The *Case, powder, cylindrical, R, small, Mark III | N |*. This is similar, except in dimensions, to the Q case, described before. It also uses the same key. § 8852, 10521. §§ 8155, 8644.

The *Mark II* R case differs from Mark III in dimensions, being larger, and in having four locking cams. It is, in fact, similar to the P case, except in dimensions. (*See* Plate IV.) It is known as case, powder, cylindrical, R, large, Mark II. § 8483, 10521.

The *Mark I* case, of which a few were issued, differs from Mark II in the lid having no flange; the upper stiffening ring is weaker and the groove in which the cams lock is continuous. § 8483.

These cases, Marks I and II, require packing pieces as they are too large for the cartridges. These are loose, of varnished wood, five to a set; one bottom piece and four side pieces. § 8577.

Place the lid in the mouth of the case so that the radial lines cut on both coincide. Then secure the lid by turning the locking cams, till they engage in the recesses in the case. Securing lids, O, P, Q, and R cases.

Case, powder, cylindrical, S, Mark III.—The body is made of sheet brass butt jointed, open at both ends, on the exterior three gun-metal bands are attached to the body with solder, the two outside ones at a distance of 9·5 inches from the ends, and the third one in the centre. The lifting bar is also of gun-metal and secured to the body over the longitudinal joint and to the bands with rivets and solder. The case is strengthened at each end by a ring of gun-metal with four lugs cast on each side at an angle of 55° with a vertical line passing through the centre of the lifting bar, secured to the ends of the body with rivets and solder. Each end of the case is closed by an embossed brass lid strengthened at the rim with a gun-metal ring having four gun-metal handles pivoted in positions corresponding to the lugs on the body, the upper end of the handles are formed into cams which bear on the top of the lugs to start opening the lids, at the other end of the handle is fitted a dermatine ring to prevent injury to the case. These handles are pivoted circumferentially, and rock in opposite directions, so that two adjacent ones move towards, or away from, each other. The lower part of each handle is a tube, threaded internally, and having a hexagon on the exterior at the top, thus forming a nut by which the lid is secured. (*See* Plate V.) §§ 7225, 7565, 7743, 7914, 9353.

Two stops on the ends of the body engage in corresponding slots in the flange of the lid to prevent the latter turning in locking and unlocking the handles, underneath the lid is a packing ring of wood secured by four gun-metal screws working in [illegible] soldered on to the lid. In a recess formed inside the lid, [illegible] is tinned to prevent deterioration, fits a dermatine washer, §§ 6511, 7513. 9979.

which makes an air-tight joint with the end of the body, which is also tinned for the same purpose.

This case is too weak for the air test to be applied, and the plugs in some cases, which were fitted with them, have been sweated in.

In each long space between the handles on the lid are placed two flat bearing pieces to give greater stability in stowage.

One handle on lid, and lug on each end of the body are painted *blue* and *red* respectively, and the body and lids are numbered; this is to ensure the cylinder always being closed with its own lid, it is also stencilled with the monogram of the station with letters 1¼ inches long. This system of marking applies to all cylindrical cases for Naval service.

For screwing up and unscrewing the handles a metal spanner is provided.

§§ 7598, 9353. A Mark IV S case was originally sealed, but as none of the original Mark III cases were ever issued, the Mark IV case had its numeral altered to III, and it is the case described above.

§§ 5174, 7565, 7743. The *Mark II* S case differs from *Mark III* in being made of corrugated brass, which is lined inside with sheet manganese bronze or brass to prevent injury to the cartridge, from rubbing against the corrugations. The handles work outwards on the lid, and the lugs on the mouth of the case are made to suit this. The handles, also, have no dermatine rings. India-rubber rings are used instead of dermatine to seal the joint between lid and body, and they are attached, by india-rubber solution, to each end of the body. The under surface of the lids, bearing upon these rings, are tinned to prevent them sticking to the rings.

§§ 6151, 9979. The S case has been fitted with an additional wood packing piece or disc, secured to the wood ring of the lid by eight screws, to fill up space when containing Mark II cartridges.

§§ 5174, 7565, 7743. The *Mark I* S case (no description published in List of Changes) as originally made differs from *Mark II* in having no lining or packing piece, the bearing surfaces of the lid not being tinned, and the handles being of a weaker pattern with smaller nuts. Mark I cases will be altered as follows, in accordance with special orders. It will be lined, furnished with packing pieces, and strengthened handles, and will have the bearing surfaces of the lids tinned before issue to H.M. ships. They will then be marked with the numeral II.

§§ 7565, 7743, 9317. *Case, powder, cylindrical, T, Mark V*, resembles the Mark III S case, but differs in dimensions. It may also be recognised by having only two gun-metal bands on the exterior, the lifting bar being attached to them and to the body. It is fitted with a plug for the air test in both lids, similar to the fittings described for the P case.

§§ 7484, 7565, 7743. The *Mark IV* T case only differs from the Mark V in not having the fittings for the air test.

§§ 7005, 7565, 7743. The *Mark III* T case differs from the Mark IV in the handles, which work outwards, the lugs being made to suit. The handles are fitted with india-rubber rings to prevent them damaging the body when turned down against it.

§§ 5174, 7565, 7743. The *Mark II* T case is similar to the Mark II S case, except dimensions.

§§ 5174, 7565, 7743. The *Mark I* T case is not described in List of Changes. It is similiar to the Mark I S case, and the orders for conversion apply to it as well.

§§ 5174, 7565, 7743, 7914. *Case, powder, cylindrical, U*, Mark II, is similar to the Mark II S case, except in dimensions and in the lifting bar, instead of which,

ROYAL LABORATORY DEPARTMENT.

CASE POWDER CYLINDRICAL S MARK III (N)

BRASS 10·25 INCH B.L.

SCALE 1/6.

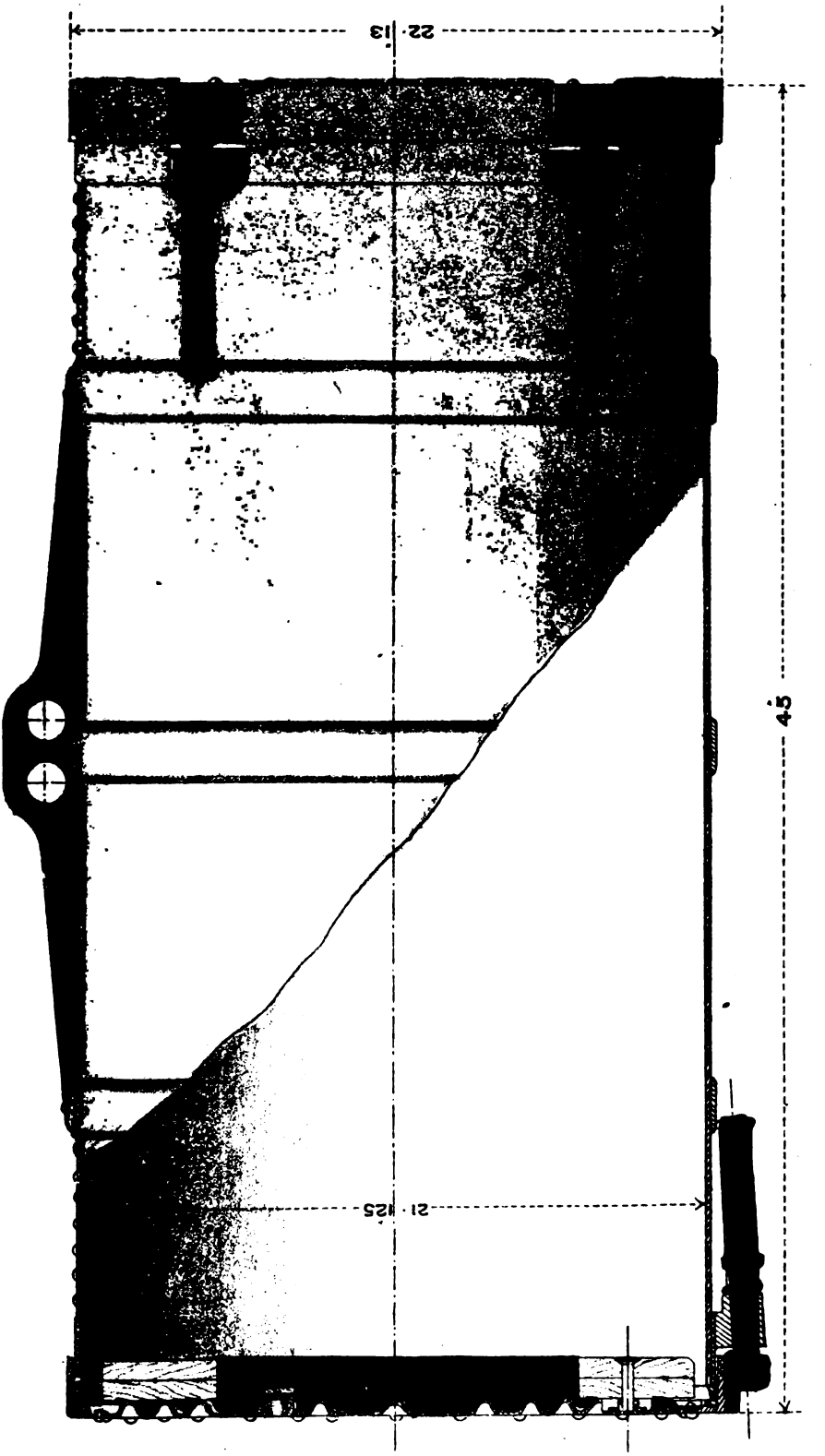


FIG. 9 1900

E. Weller & Grahams, Ltd Litho. London

a gun-metal plate, with two lifting holes, is attached to the centre of the case, on the outside.

The *Mark I* U case (not published in List of Changes) differs from the Mark II in the body, on the inside, having a strip of brass over the longitudinal joint. A gun-metal plate, with two lifting holes, is attached to the centre of the opposite side, so that when the case is suspended by it, the brass strip is at the bottom, and forms a rubbing piece for the rammer to slide on in loading. The handles are of a weaker pattern, bearing surfaces of the lid not tinned, and there is no packing piece in the lid §§ 5174, 7565, 7743, 7914.

Existing patterns of the U case will be eventually superseded by the Mark III V case. § 7914.

Case, powder, cylindrical, V, Mark III, is similar, except in dimensions, to the Mark III S case. It also differs in, and may be recognised by, having four gun-metal bands round the body instead of three, and the lugs and handles being equidistant round the case. Each lid is fitted in the centre with a plug for the air test as described with the P case. This case will eventually supersede existing patterns of U, V, and W cases. §§ 7565, 7743, 7914, 9354.

The *Mark II* V case is similar to the Mark II S case, except that its handles and lugs are equidistant round the case. §§ 5174, 7565, 7743, 7914.

The Mark I V case is somewhat similar to the Mark I U case, from which it differs in details. A description is hardly necessary. §§ 4870, 7565, 7743, 7914.

Case, powder, cylindrical, W, Mark II, is a plain brass case, the lids of which are formed of two copper plates, with a wood lining between them, the whole riveted inside a gun-metal ring. It has the fittings for air test as described with the P case. The lids are fitted with dermatine rings. §§ 4681, 7565, 7914, 9317.

The *Mark I* W case only differs in having no fittings for the air test.

The *Mark III* V case will eventually supersede the W case. § 7914.

Spanners are provided for use in screwing up the handles of the above cylindrical cases, S, T, U, V, and W. §§ 4681, 5174.

Spare rings, in the proportion of 50 per cent., will be issued with the cases to replace any that may deteriorate or may become injured in removing the lids. These rings are issued 20 in a tin cylinder. § 5174.

India-rubber solution will also be issued for securing them on the cases. The solution will be applied in the recess for the ring with a brush; if too thick, a little naphtha should be added.

Case, powder, cylindrical, X, Mark III is made of sheet brass, strengthened by two gun-metal rings, and at the ends by gun-metal bands having four projecting slotted lugs. Into these lugs fit four screw-bolts which are pivoted in corresponding lugs on the lids. These screw-bolts are provided with butterfly nuts, so that when they are turned down, and the nuts screwed up, the lid is firmly attached to the case, and by reversing the process, it can be easily removed. §§ 4465, 7565, 7743, 9317.

The lifting bar is attached to the case, over the longitudinal joint, and to the bands round the body by rivets and solder. The lids are similar to those of the Mark II W case, but are provided with leather washers soaked in ozokerine to make a water-tight joint with the case. The lids are fitted with the plugs for the air test as in the P case.

Two eye-bolts on the case are used for securing it to the trolley, on which it is brought up to the gun. When it arrives there both lids are removed, and one end of the case is brought directly in front of the muzzle. The rammer is inserted at the other end and drives the cartridge home.

§§ 4465, 4535, 7565, 7743. The *Mark II* case only differs in having no fittings for the air test. Some Mark II cases of early manufacture had an india-rubber washer instead of leather.

§§ 4106, 4465. The *Mark I* case had a detached lifting bar, and will be fitted with the fixed bar as it passes through ordnance factories, and marked I*. When fitted with the plug for air test it will be marked I**.

§ 7844. *Case, powder, cylindrical X, Key, Mark I,* consists of a metal handle terminating in a ring, with a vertical slot cut across it. When in use the end of the screw enters the ring and the slot grips the two wings of the fly-nut. It is used to start or tighten the fly-nuts of the screws which secure the lids of the X case.

Securing lids, S to X. § 7565. In order to ensure the above-mentioned cylindrical cases always being closed with their own lids, and that each lid is placed on the same end of the case, and in exactly the same position each time the case is closed, a number will, in future, be painted in 1¼ inch figures, on the body of the case and on each lid; and one handle on one lid and its corresponding lug on the case will be painted red, and one handle on the other lid and its corresponding lug blue.

Cylindrical cases manufactured since August, 1893, until the adoption of the marking described above, have had a small letter and number stamped on each lid and corresponding end of case.

The marking of existing cases will be carried out locally as opportunities offer.

To close the cases when filled, place the lid in position with the red or blue handles opposite the similarly painted lugs, and screw up the nuts of the handles sufficiently to just allow the nuts to enter under the points of the lugs, so that the handles require slightly tapping home by means of a light wood mallet, those opposite each other being tapped home consecutively. When the cases are empty, the nuts only require to be screwed up to give sufficient pressure to keep the handles in the lugs, and to prevent them working loose during transit a piece of tarred spun yarn is attached to one handle and passed round the case, a half hitch being made on each handle over which it is passed. Should any difficulty be found when cases are being opened in withdrawing the handles by hand, they should be prised out by means of the handle of the spanner. To adapt the spanner for this purpose, its handle should, for a length of one inch from the end, be filed to the form of a screwdriver, tapering to a thickness of ·15 inch. This will be done locally as required. In future, spanners will be issued so adapted.

Painting and marking naval cases. §§ 4869, 4944, 6646, 7091, 9570, 10085. Pentagon, rectangular and cylindrical Naval powder cases are painted stone colour, inside and out. Filled cases which are not already painted, or which require re-painting, will be painted externally as a laboratory operation, without emptying them. Empty cases in the same condition will be painted before filling.

The above cases and metal lined powder cases when containing Service cannon cartridges for the Navy, will have the particulars of the contents and the letter "N" stencilled on them with red paint, the size of the type being ½ inch for letters, 1 inch for figures, and 1½ inches for the "N," though larger type may be used if convenient. The word "Cordite" is also stencilled in red when the cartridges are filled with cordite. On packages containing blank or saluting cartridges (N.S.), the stencilling will be in white, except the letter N, which will be blue.

The following labels will, however, still be retained:—

Group and division label.

Government explosive label.

Packer's label (for interior of lid).
Instructions for handling.
Station label.
Contents labels—
In Naval Service.—Loose, inside lid of cases, one for each cartridge, which may afterwards have to be repacked into brass cases.

The "packer's label" gives details of packer's name, place and date of packing.

The "station label consists of a strip of muslin, about 3 inches by 1¼ inches, with the initials of the packing station in black. It is pasted over the junction of the lid and body.

Information to be stencilled.

The following general information (varying with the nature of the contents) should be stencilled on each package:—

Number of cartridges in the package.
Designation and numeral.
Nature, lot number, and initials of maker of powder, or size and lot number (which includes initials of maker) of cordite.
"½, ¼, or ⅛ charges," as the case may be, if not whole ones.
Monogram of station and date of filling.
The words "For practice only," or "For gunnery ships only," where service ammunition has been sentenced to be so used.
Tare and gross weight.

The words, "For practice only" or "For gunnery ships only," to be in black.

The stencilling should allow room for any labels, and should be in the following positions:—

Metal-lined cases—
On the top; except tare and gross weight, which are placed on the sides.

Brass pentagon cases—
On the lid; except tare and gross weight, which are placed on the plain part of the top.

Brass rectangular cases—
On plain part of top; except tare and gross weight, date, and monogram, which are placed on the lid.

Brass cylindrical cases—
On the body and ends. Corrugated cases will be stencilled on the bands instead of on the body.

The explosive label is placed across the junction of lid and body, so that it must be torn if the lid is opened.

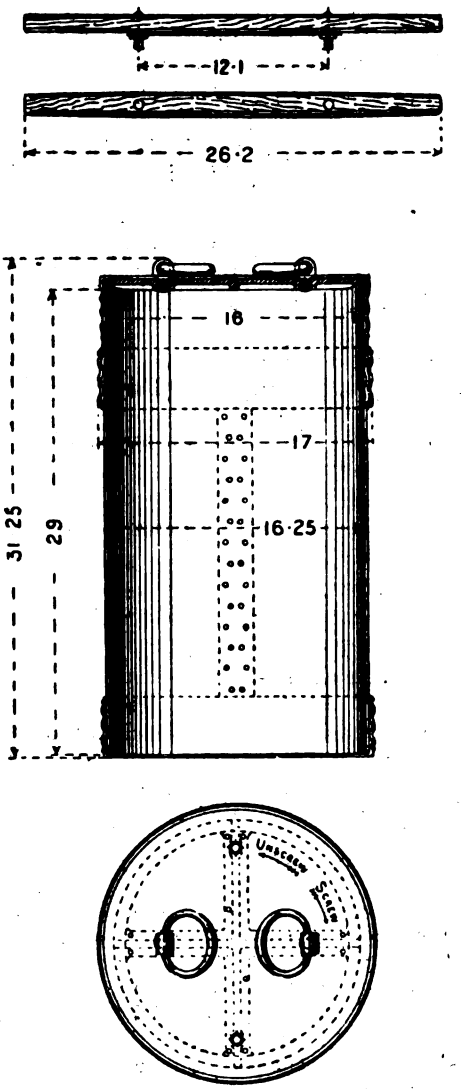
In addition, cylindrical cases will be stencilled on the body and on each, end with the monogram of station in black, in 1¼ inch letters, immediately after the number previously mentioned. § 7743.

Case, powder, cylindrical, Z, Mark I, is for use in L.S. magazines. It contains two quarter charges for the 17·72-inch R.M.L. gun. It is made of sheet brass, with butted joint. The bottom is of slightly thicker brass, stamped into the form of a cap, with a corrugated rim 3·75 inches deep riveted to the body. The lid is formed of a similar §§ 4255, 6036.

cap, strengthened inside with a disc of gun-metal, and having the rim formed in spiral corrugations into a screw of half an inch pitch which fits into similar corrugations in the upper end of the case. The top of the case is strengthened by a band of sheet brass riveted on just below the lid, which is fitted with two twisted wire handles covered with leather and provided with two small holes for the reception of the lever used for closing, &c. A leather washer soaked in ozokerine is fitted to the inside of the lid, and is kept in its place by the internal strengthening disc.

Case, Powder, Cylindrical Z, Mark I.

Brass, land service 17·72-inch, two-quarter charges. Scale $\frac{1}{12}$.



The *lever* used with these cases is of wood, and has two brass studs which fit into the holes in the lid of the case, the two ends of the lever forming handles. Lever.

Screw on the lid by hand from left to right, and tighten up by means of the lever until the leather washer bears hard upon the top edge of the case; apply a coat of gum shellac, dissolved in sufficient methylated spirits to be of a workable consistency, to the junction of the case and lid, then fasten round the junction a tape band $2\frac{1}{8}$ inches wide, well coated with a shellac cement; the tape should overlap about 4 inches, the end being turned under to form a loop of about 1 inch; it should be placed so that the edges may be protected as much as possible by being in the hollows of the corrugations; work the tape, except the loop, well into the corrugations with the hand, and, when well set, give the band a coating of thin shellac cement, and when dry a coat of stone colour paint if available. Securing lid.

To open the case, tear off the tape band, and unscrew the lid from right to left by means of the lever. Labels bearing the above directions are pasted on the lid of each case. To open case.

The Z case is painted stone colour inside and out. The marking and labelling is the same as described for the Naval cases, except that the stencilling is in black for Land service, there is no letter "N," and the stencilling is on the body of the case. Painting and marking. § 10085.

Cylinders, cartridge.

Cylinders, cartridge, made of zinc, are used in the L.S. to transport store, and bring up to the gun the cartridges for B.L. guns 6-inch to 13·5-inch inclusive, and for R.M.L. guns, 7-inch to 17·72-inch inclusive. There is a departmental pattern of a zinc cylinder to contain the 20-lb. P. charge for the 80-pr. R.M.L. guns in Victoria.

Zinc cylinders are also used for the temporary storage of the reserve of filled cartridges for the R.N. until required for issue to vessels, when they will be transferred to the proper cases, &c., suitable to each particular magazine. Their calibres are:—

B.L. 16·25-inch to 6-inch.
R.M.L. 16-inch to 7-inch.

The same cylinder will take the $112\frac{1}{2}$-lb. cartridge for the 16-inch or 17·72-inch R.M.L. guns; when containing the cartridge for the latter gun it is used for transport or for storage in Army Ordnance magazines only. When issued to the R.N. or the R.A. the cartridge is transferred to the case used in the particular ship or magazine for which it is issued.

Four patterns of zinc cylinders may be met with in the Service, viz.:—

Those with bayonet joints, to become obsolete when emptied. §§ 1269, 4349.
Those with side hooks, known as A pattern, also to become obsolete when emptied. §§ 2171, 9233.
Those with screw tops, known as B pattern. § 4195.
Those with screw tops and side handles, known as C pattern. §§ 4709, 9233.

A numerical system of nomenclature for zinc cylinders has now been adopted and cylinders of B and C patterns are now known by numbers from 1 to 37. §§ 8947, 9233.

Cylinders of A pattern are to retain their original nomenclature, since they are not to be refilled and in most cases they differ in dimensions from corresponding cylinders of B and C pattern.

These numbers are stamped on all new cylinders; existing

cylinders will have the numbers stencilled on them. This will be carried out locally.

A list of these numbered cylinders, giving dimensions and also the cartridges which can be packed in them, will be found in the tables, pp. 479 *et seq.*

§§ 2173, 3350. The bayonet-jointed cylinders are difficult to open, and to facilitate the operation metal straps are supplied to the stations which have them in store.

§ 4349. In order to gradually withdraw these cylinders from the Service, it is ordered that whenever one of them is opened for any purpose it will not be used again, but will be replaced by one of a subsequent pattern. To meet these requirements, a supply of spare cylinders is to be demanded and retained in the sub-district.

§§ 2171, 2172, 2185, 2270, 2760, 2295, 3042, 3405, 3418. "A" cylinder.—The lid is fastened on by means of hooks on the lid and buttons on the body. Hooks, handles, and rivets are made of galvanised iron.

These cylinders also are not to be used again when once emptied.

§ 4195. "B" pattern cylinders have the lid attached by means of a screw of about $\frac{1}{2}$-inch pitch, forming corrugations in the lid and top of the cylinder. The handles, of iron, are attached to the lid and are used for screwing it on or off.

§§ 4709, 7078. It is found that cylinders having their handles on the top of the lid are liable to be distorted if at all roughly handled, so that they are fastened and opened with difficulty. To remedy this, pattern C has been introduced, the only difference between it and B pattern being that it has its handles attached to the sides of the body, and lugs on the lid for opening and closing.

The cylinder is made of zinc, with a strengthened bottom and lid attached by the same screw as the B pattern.

The lid has a recess in which is fitted a dermatine washer which makes an air-tight joint with the top of the cylinder. To form fulcra for a lever to turn the lid, and at the same time allow the cylinders to be stacked on end, two hinged metal lugs are attached to the top of the lid, by a plate on the outside riveted through to two strengthening plates on the interior. Attached to each side of the body, near the top, by short galvanised-iron brackets, are the handles which are of galvanised-iron wire run through a short tube of galvanised-iron.*

§ 9233. The latest C pattern cylinders have a strip of zinc soldered round the inside of the mouth, to give a greater bearing surface for the dermatine washer. Existing cylinders will be altered when sent in for repair and a * will be added to the mark when so altered.

§§ 9317, 9851. The lids of certain cylinders were originally fitted with the plug for "air test." It was afterwards determined not to apply this test to cylinders, and the interior projection of the closing plug was found in some cases to interfere with the packing of the cartridges. This interior boss will, therefore, be cut off flush with the heads of the rivets through the strengthening plates. This will be done, locally, in a lathe as opportunities occur. Where no lathe is available, the lids will be forwarded to Woolwich for alteration.

To open or close the cylinder, the lugs on the lid are turned upright, the "Bearer, cartridge, cylinder" laid between them and a smart wrench given.

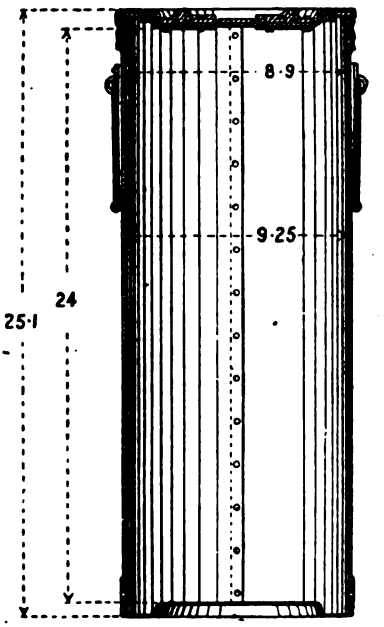
Discs. §§ 7902, 8055, 8113, 8179, 8728, 9265, 9513. It has been found that there is a liability to injury to cartridges,

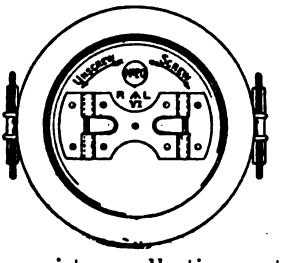
* These cylinders formerly had copper wire handles covered with leather, and many are still likely to be met with, but owing to their liability to corrosion, the handle above mentioned was adopted.

Cylinder, Cartridge, No. 20, Mark VI | C | .

Zinc; 8·9 × 24 inches.

Scale, ½.





when in zinc cylinders, from moisture collecting on the bottom of the cylinder and the silk cloth adhering to the latter.

To remedy this defect, a circular disc of varnished wood will, in future, be placed at the bottom of each cylinder, so as to prevent the cartridge coming in contact with the bottom of the cylinder.

Patterns of the undermentioned discs have been sealed to govern manufacture.

Cylinders, Cartridge.

Discs—						Wood, varnished.
6·25	inches	diameter,	Mark I	..	C	
6·75	,,	,,	,,	..	C	
8·5	,,	,,	,,	..	C	
9·5	,,	,,	,,	..	C	
10·5	,,	,,	,,	..	C	
12·25	,,	,,	,,	..	C	
15	,,	,,	,,	..	C	
17	,,	,,	,,	..	C	
20	,,	,,	,,	..	N	

Dimensions.

Diameter.	Thickness.
6·25-inch	·25-inch.
6·75 „	·375 „
8·5 „	·375 „
9·5 „	·25 „
10·5 „	·25 „
12·25 „	·1875 „
15 „	·25 „
17 „	·25 „
20 „	·5 „

At annual inspections at stations abroad, where cartridges are found to have deteriorated from the above-mentioned cause, if the station is provided with a suitable laboratory, the whole of the cylinders in the magazine, or cartridge store, where the defect is found, will be opened and fitted with discs, locally; for which purpose officers concerned will put forward demands for such discs as are required. Cylinders fitted with discs will have the word "disc" stencilled on them to distinguish them from cylinders not so fitted. If the station is not provided with a suitable laboratory, the condition of the cartridges examined will be reported, but the remaining cylinders will not be opened pending instructions.

Particular care will be taken in connection with this service that the instructions, p. 452, are attended to.

Packing pieces. §§ 9647, 9718, 9764.

Certain cylinders, at present Nos. 18, 20, 22 and 28, have packing pieces to prevent certain cartridges from shaking about. These packing pieces consist of a varnished wood disc, to the back of which two wooden cross pieces are screwed. When one of these packing pieces is used, it would take the place of the disc. No. 18 cylinder requires a packing piece, $5\frac{1}{8}$ inches in diameter, and $2\frac{1}{4}$ inches deep, when packed with B.L. 8-inch 14-lb. 2-oz. cordite cartridges. No. 20 has three packing pieces, each $8\frac{5}{8}$ inches in diameter, and $5\frac{3}{8}$ inches deep for 9-inch R.M.L. 14-lb. cordite cartridge; $4\frac{3}{4}$ inches and $5\frac{7}{8}$ deep for R.M.L. 12·5-inch 29-lb. 8-oz., and 24-lb. cordite cartridges. No. 22 cylinder requires a packing piece $7\frac{3}{4}$ inches in diameter and 5 inches deep when packed with B.L. 8-inch $22\frac{1}{2}$-lb. E.X.E. cartridges, and a packing piece $7\frac{3}{4}$ inches in diameter, and 7 inches deep when packed with B.L. 9·2-inch $26\frac{3}{4}$-lb. and 21-lb. cordite cartridges. No. 28 has two packing pieces, $8\frac{3}{4}$ inches in diameter, and $3\frac{1}{4}$ inches deep for 11-inch R.M.L. 25-lb. 4-oz. cordite cartridge; and $3\frac{1}{2}$ inches deep for 10-inch R.M.L. 20-lb. 6-oz. cordite cartridge.

Securing lids.

The lids of the B and C pattern zinc cylinders are secured as follows:—

Screw on the lid by hand from left to right and tighten by means of the bearer, giving it a few taps with a wooden mallet, until the washer bears hard upon the top edge of the cylinder.

Apply a coat of gum shellac dissolved in sufficient methylated spirits to be of a workable consistency, to the junction of the case and lid, then fasten round the junction a tape band $2\frac{1}{8}$ inches wide, well coated with shellac and of sufficient length to overlap about 4 inches, the end being turned under to form a loop of about 1 inch; the tape should be placed so that the edges may be protected as much as possible by being in the hollows of the corrugations; work it, except the loop, well into the corrugations with the hand, and, when set, give it a coating of thin shellac, and when dry a coat of stone colour paint if available.

$1\frac{1}{4}$-inch tape may be used for No. 22 and No. 25 cylinders, if available.

In order to open the cylinder tear off the tape band and pass the cylinder bearer through the handles or between the lugs on the lid when the handles are on the body, and give a smart wrench in the required direction. A label bearing the above directions is pasted on the lids of each cylinder.

Testing.

After closing the lid of any case or cylinder except metal-lined cases, the joint may be tested by immersion in warm water (90°—100° F.). If air bubbles escape at the joint the case or cylinder must be re-closed and re-tested; if elsewhere the case should be put aside for repair.

Painting.

New zinc cylinders are not painted.

§ 4869.

Repaired cylinders are painted stone colour on the outside only.

Marking. §§ 7901, 9570, 10085.

The stencilling and labelling of zinc cartridge cylinders, and the information to be given, are the same as laid down for the Naval cases, p. 84, except that for *Land service* cylinders the stencilling is in *black* paint and the letter "N" is omitted. The word "Cordite," however, is in *red* paint for Land service as well as Naval.

The word "disc" where one has been used, is also stencilled on the cylinder.

The Packers label is fixed inside the lid for Land service, and for Naval service is loose inside the lid, one for each cartridge which may afterwards have to be repacked into brass cases.

The stencilling should allow room for the group and explosive labels and should be in the following positions, viz.:—

Circumferentially on the raised rim of the lid; except particulars of powder or cordite, the tare and gross weights, the word "disc," date, and monogram, which are placed on the body.

The explosive and station labels are placed across the junction of lid and body so that they must be torn if the lid is opened.

Lime to be put in cylinders and cases.

Zinc cylinders and brass cases, when stored empty, are to contain a lump of quick-lime in a calico bag to absorb moisture, which will be removed when the cylinders or cases are filled.

Stacking.

Where storage accommodation permits, zinc cartridge cylinders will be stacked vertically in columnar form (*i.e.*, one immediately above the other), each column not to exceed five cylinders containing a quarter charge each, four containing a half charge each, and three containing a complete charge each. Brass and metal-lined cases will be stacked on their sides to a height not exceeding 11 feet.

Thin battens of wood will be placed on the cartridge cylinders which have their handles on the top of the lid, to prevent the handles injuring the bottoms of the cylinders placed above them; cartridge cylinders having their handles at the side will not need this protection. Battens will also be placed under the bottom cylinders when the floor is of stone or concrete.

In the case of No. 25 cylinders, the top tier will be stacked in such a manner as to break the joint, in order to make the whole pile more stable.

Where the chambers are sufficiently lofty to admit of more than one stack, the second stack will be placed on skidding supported by frames.

Care should be taken that the cylinders or cases do not touch the walls when stacked.

A.O.R. 1900.

The battens under cylinders are to keep the cylinders about 4 inches from the floor to allow free ventilation underneath.

Where cylinders cannot be stored vertically, they will be piled on

their sides, and the number of tiers in each stack will be limited as follows:—

Cylinders containing	over 100 lb.—not to exceed	3	in height.
	60 to 100 lb. „	4	„
	less than 60 lb. „	5	„

Care against damage to cylinders.

Great care will be taken in transporting zinc cartridge cylinders, whether filled or empty, between laboratories, magazines, &c., in order to prevent their being damaged by accidental blows or from any shaking loose of the lids which might affect their air-tightness.

Wooden cases for protecting cylinders.

When zinc cylinders are issued containing filled cartridges, they will be protected by wooden skeleton cases which will be made up locally as required, brass screws being used. Serviceable zinc cylinders, when issued empty, will be similarly protected. Heavy natures of cartridges will require a case for each, but those under 50 lb. may be packed two or more together.

Bearer, cartridge, cylinders. §§ 2120, 2944.

Bearer, cartridge, cylinders.—This is an ash stave 3 feet 6 inches long, 1 inch thick, 2¼ inches broad in the centre, and tapered off to each end to 1½ inches.

Mark I was intended to carry 12-inch cartridge cylinders only, and had one small groove on one side in the centre to receive the handle of the cylinder.

Mark II is for use with all natures of zinc cylinders up to 12-inch, and differs from Mark I only in having two additional grooves on the side. It will take one large, two medium, or three of the smaller cylinders.

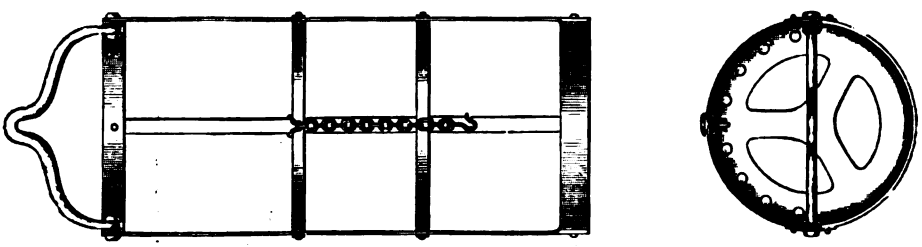
§ 3959.

Mark III is for 12·5-inch R.M.L. guns and future manufacture of all natures. It is 6 inches longer and about ¼ inch wider than Mark II, which is to be used up for smaller natures.

§§ 2218, 2799, 3402.

Cages, cartridge, cylinders.—These are of three sizes. They are made of gun-metal, and are used for hoisting zinc cylinders containing

"*A*" *Cage, Mark I.*



cartridges up the powder lifts of magazines. The smaller size, stamped "A," is for cylinders for 12 inches (25 tons), and under; it weighs about 14¼ lb. The next size is for cylinders for 12 inches of 35 tons. It is stamped "B," and weighs about 17 lb. 14 oz.

The largest size is stamped "C," and is for use with cylinders for 12·5-inch guns. It takes one full charge in two half-charges of 82½ lb. each. It weighs about 20¾ lb.

§ 2175.

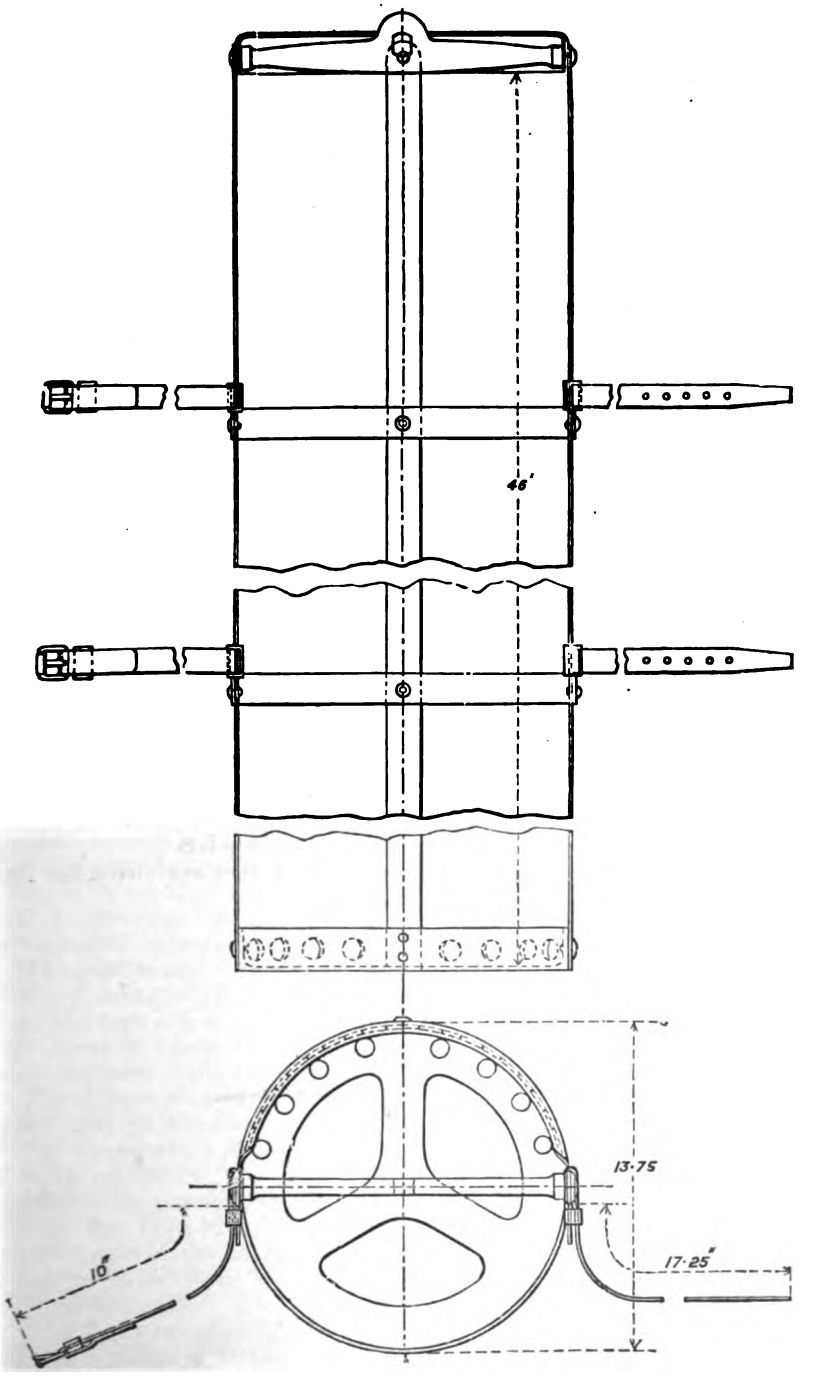
Mark II of "A" cage has the top band made broader and carried inwards to prevent jamming when being hoisted up the lift of a magazine.

§ 5900.

The "C" cage Mark II differs from the previous pattern in being made higher, to take two cylinders with screw lids; and the chains

Cage, Cartridge, Cylinder C, Mark II.—Lifting, Metal, with Leather Straps, 12·5-*inch.*

Scale, $\frac{1}{4}$.



for securing the cylinders in Mark I are replaced in this pattern by two leather straps with brass buckles.

§ 6211. All Mark I cages will be altered to Mark II locally.

§§ 2293, 2548. §§ 4062, 6310. A 2-inch white rope about 30 feet in length with a hook at one end and a counter-weight zinc ball $1\frac{3}{8}$ lb. weight fixed above the hook is issued for use with the lifts for 12-inch 35-ton guns and under. For 12·5-inch R.M.L. cartridge lifts, a steel wire rope $\frac{7}{16}$-inch in diameter is supplied. This rope is bound with tarred hessian and seized with tarred line. It is provided with a hook and zinc counter-weight, and is to be made of a suitable length for the lift in which it is employed, and a stouter hook has been introduced

§§ 4263, 4522.

§ 3811. *Cases, cartridge*, made of leather or of Clarkson's material, are use to convey cartridges from the magazine to the gun.

The leather cases are used in the L.S. for the cartridges for such ordnance as do not have them contained in zinc cylinders, *i.e.*, for natures below 7-inch R.M.L. gun. They are not, however, issued for field service in L.S. They are used in the N.S. for the same guns as in the L.S.

The Clarkson's material cases are used in the N.S. for cartridges for R.M.L. guns of 7 inches and upwards.

The Clarkson's material cases are made of strips of cork cemented together between two layers of canvas, and strengthened on the outside by cork bands. The whole is covered with split leather, specially prepared. The cement used is india-rubber solution.

§ 933. Mark II have stronger bottoms, and those which have side handles have them lengthened, made round, and riveted to leather bands. In 13 to 16 inclusive the handle on the lid is made round instead of flat.

Cases of both these materials are distinguished by consecutive numbers. Those numbered 1 to 7 and 25 are of leather; those numbered 8 to 36 are of Clarkson's material, Nos. 30 and 37 are made of canvas.

Cases Nos. 12 to 18 inclusive have side handles so that they can be carried in a horizontal position.

§ 7420. Certain cases, Nos. 1 to 7, No. 25 and A, B, C and D, will in future be painted lead colour, with the distinguishing number of the case on the side in *red* for the Navy, and *white* for L.S.

A list of these cases, with the cartridges they are intended for, will be found in the table 12, p. 485.

CHAPTER VII.—ELECTRIC FUZES AND DETONATORS.

DEFINITIONS.—DESCRIPTION OF THE SERVICE DETONATORS AND ELECTRIC FUZES.—GENERAL NOTES.

In the present chapter will be described the means of firing charges of gun-cotton, and charges of gunpowder at rest other than in cartridges.

Definitions.

Electric fuzes are used for firing the powder charges of L.S. mines, the bursting charges of shells at rest, for experimental purposes, &c.

Detonators, as their name implies, are always used for detonating charges of gun-cotton. They may be fired by electricity or otherwise.

Numbers.

All these are arranged in a series numbered from 8 to 20 without reference to their object or use, that last introduced having the highest number. Nos. 10, 10A, and 11 will be described in Chapter VIII, Nos. 1 to 7 and 17 are obsolete.

High tension tube.

A *high tension* tube is one in which the wires from the battery terminate in two copper poles having no metallic connection with each other, and separated by a short interval which is filled with a combustible priming of great resistance. The priming employed in the Service is a mixture of cuprous sulphide, cuprous phosphide, and potassium chlorate. On completing the circuit, this priming is inflamed by the passage of a spark or current of electricity having considerable tension. There is no tube of this description now in the Service.

Low tension fuzes.

Low tension fuzes are constructed on a different principle. When a continuous current of electricity of sufficient strength passes through a thin wire of high resistance, the temperature of the wire is raised until it becomes incandescent and capable of igniting any easily inflammable substance in contact with it.

The resistance of the fine wire, though great in reference to that of the thicker copper wires through which the current is brought from the battery, is small compared to that of the priming in the high tension fuzes. Hence the terms "*wire*" and "*low resistance*" are sometimes applied to the Service low tension fuzes.

These remarks apply to all electrical stores such as vent sealing tubes, &c., in the Service. Electric fuzes, tubes, and detonators in the Service are now all "low resistance." The great advantage of "low resistance," or "wire" stores of this nature, is that it is possible at any time to test the continuity of the circuit, including that of the fuze, tube, or detonator, by passing a current so weak as not to heat the bridge to the firing point. This is especially useful in mine fields which may be laid out long before they are required for use.

Bridges.

The fine wire which is raised to incandescence by the passage of the current is called a "*bridge*," and in all electrical stores made in the

R.L. is ·25 inch long, except the electric T tube in which the bridge is ·2 inch long. It is made of an alloy of platinum, a ductile metal not easily corroded, of considerable resistance and low specific heat; but the difficulty which has been experienced in procuring the pure metal of uniform electrical resistance has led to the employment of its alloys, the bridge for all N.S. fuzes, &c., being made of platinum and silver, which is very fuzible, and consequently broken with certainty when fired. For land and submarine services an alloy of platinum with iridium is employed. The latter metal increases the resistance and thus allows the bridge to be made rather thicker and stronger without altering its electrical properties.

Different thicknesses of wire are used for land and submarine services, the thicker giving less resistance and requiring greater battery power to fire the fuze. The three resistances employed in Service articles are:—

Bridge.	Calculated mean resistance.	Manufacturing limits.
Naval..	1·65ω	1·5ω to 1·8ω
Field and siege ..	1·05ω	·95ω to 1·1ω
Submarine	·325ω	·3ω to ·35ω

The above are the resistances of the bridges at ordinary temperatures, but when the bridges are on the point of fuzing the resistances rise to about 2·9ω, 2·6ω, and ·74ω.

Firing currents.

A current of ·48 ampere will fuze a Naval bridge, a current of ·8 ampere will fuze a land service bridge, and a current of 1·65 amperes will fuze a submarine mining bridge. Smaller currents, however, will fire detonators made up with these bridges. Detonators with Naval bridges should fire without appreciable delay with a current of 1 ampere but should not fire when a current of ·32 ampere is applied for 4 seconds; those with L.S. bridges with a current of 1 ampere, but should not fire with a current of ·4 ampere for 4 seconds; while the S.M. detonators are tested, all for over-sensitiveness with a current of ·8 ampere for 4 seconds, and two per cent. for under-sensitiveness with a current of 1 ampere for 4 seconds.

Improvised fuzes.

A fine steel or platinum wire connecting the projecting heads of two copper nails, and whose points are connected with wires leading to a battery will form a low tension fuze if the fine wire be surrounded by any readily inflammable priming. A high tension fuze may be thus made, two copper nails are driven into a piece of hard wood until they are flush with its surface and about 0·5 inch apart. This intervening space is then thickly marked with a black lead pencil and covered with inflammable priming, kept in close contact with the graphite by a paper cap or similar means. The points of the copper nails, which must on no account touch one another, are connected with the exploder, and on completing the circuit the fuze is fired.

Improvised batteries.

The boat battery formerly used in the R.N. may be easily constructed. It consists of about 120 couples of copper and zinc, separated by pieces of blanket dipped in sea water. The metals, in the form of squares about 2·5 inches side, may be cut from sheets of any thickness, and the couples may be arranged in any convenient way, care being taken that the current always passes in the same direction. Such a battery may be relied upon to fire high tension tubes; if it is required to fire low tension ones, the plates must be cut larger, say, in squares of 6 inches side.

The colours with which they are painted have a special significance in the case of electric fuzes and detonators, thus :— Colours.

Red denotes presence of fulminate of mercury.
Yellow denotes that the fuze, &c., is for Naval service.
Blue denotes that the fuze, &c., is for submarine mines.
White denotes that the fuze, &c., is for L.S. and "low tension."

The cylinders containing the fuzes, &c., are now coloured to correspond with their contents. § 3488.

Detonator, No. 8, Mark III.—This detonator is non-electric. It consists of a tin tube containing fulminate of mercury, about 3½ grains; to the tube is attached a thin brass socket, of diameter sufficiently large to allow of the easy introduction of a piece of safety or instantaneous fuze into it. Mark III instantaneous fuze only can be used with No. 8 detonator. On the top of the fulminate of mercury is a small plug of wood secured by four indents, and through which passes a strand of quickmatch into the fulminate of mercury. The other end of this strand extends about a couple of inches up the brass socket, and is intended to convey the flash from the safety fuze to the fulminate of mercury. The top is covered with a twisted paper cap which is torn off before inserting the fuze. Great care should be taken to pinch the brass socket well down on the fuze, as otherwise it may fail to fire. It may be pinched with the fingers or any stronger appliance. It is painted red all over. No. 8 detonator. § 6548. Paint.

This detonator is intended for hasty demolitions in the Land Service in conjunction with safety or instantaneous fuze, and is issued in different ways: (1) in a tin cylinder containing 25 detonators without a rectifier to R.E. as ordinary equipment of field companies; (2) with 2 feet of safety fuze attached as follows:—

For siege train, eight No. 8 detonators, with 2 feet of safety fuze attached, are packed in a long tin cylinder lined with wood, both ends of which form lids attached by bayonet joints. One end of the cylinder contains the detonators and fuze, the other the rectifier.

To cavalry pioneers, eight No. 8 detonators, with 2 feet of safety fuze attached, are issued in a cylinder which is similar to the above, but shorter, having no rectifier, and only one lid.

All cylinders containing No. 8 detonators are painted red all over the exterior.

Marks I and II are obsolete. § 6548.

Some Mark II detonators were converted and issued as Mark II*. They may be known by the socket being coated with shellac varnish. They are to be used for instruction only. § 8352.

Detonator, Electric, No. 9, Mark IV.—The head is of ebonite,* with a hemispherical top. The lower part of the head receives a brass socket attached to a tin tube. The conducting wires are of three strands of tinned copper, which are easier to manipulate than a thicker single wire. To the ends of these, which fit into the head of the detonator, are soldered two short tinned copper poles, flattened to prevent them from turning round after they are fixed and so breaking the bridge. No. 9 detonator. § 5212.

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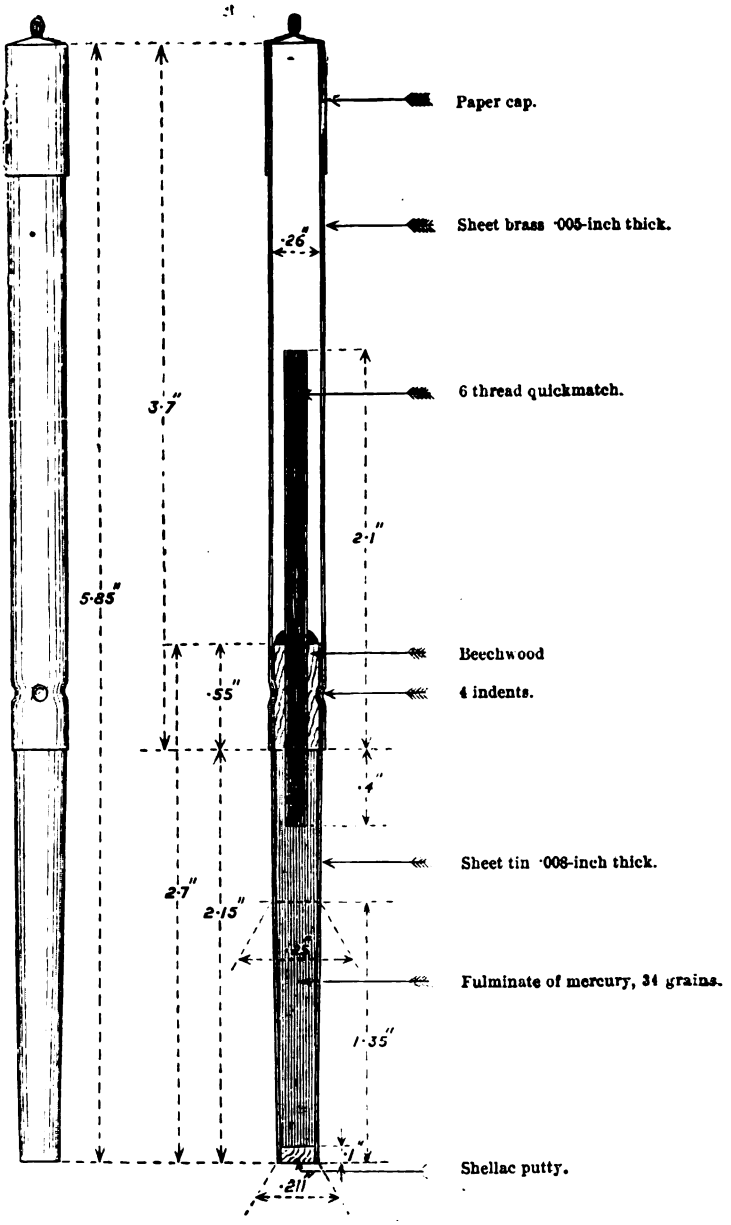
* When a sheet of caoutchouc, or india-rubber, is allowed to remain for some time in fuzed sulphur at 250° F., it absorbs 12 or 15 per cent. of that element, without suffering any material alteration; but if it be heated for a short time to 300° F., it becomes *vulcanised*, and when still further heated is converted into the black horny substance called *vulcanite*, or "ebonite."—Bloxam's "Chemistry."

Detonator No. 8, Mark III.
For Instantaneous and Safety Fuze, Land Service.

Scale, full size.



The two solid poles thus treated are dipped into hot gutta-percha cement, and forced down into the holes prepared for their reception in the ebonite head. When cool the conducting wires are twisted together above the head, and whipped near the head with black thread. The two poles above-mentioned, project about ·1 inch beyond

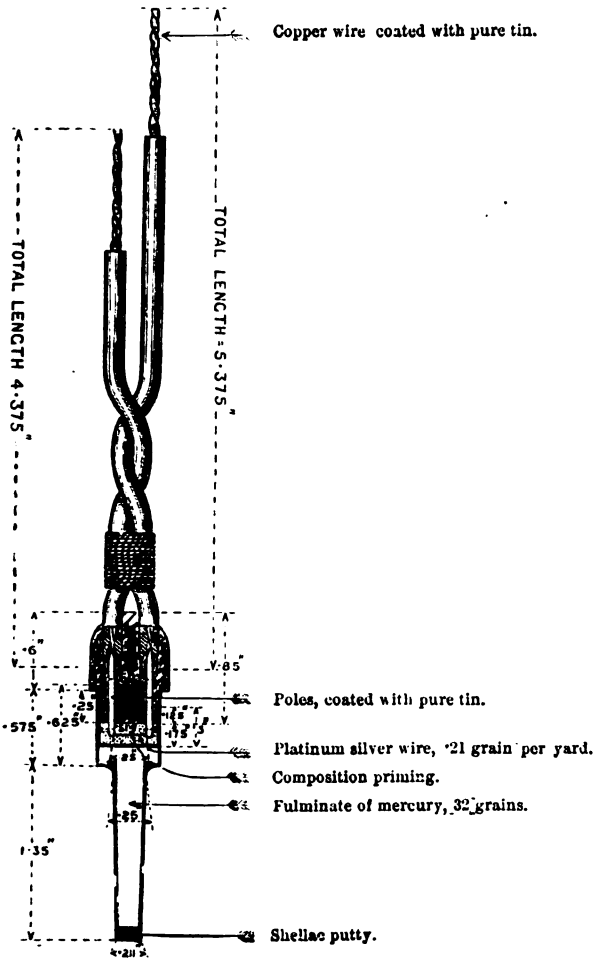
the bottom of the head, and are ·25 inch apart at the ends. They are connected by a bridge of fine platinum-silver wire (·21 grains to the yard); the ends of the bridge, which has the usual Naval resistance, being carefully soldered with pure tin on to the flat ends of each pole. Round the bridge is a priming composition, prepared by mixing intimately two parts by weight of gun-cotton dust and three parts of mealed powder. This composition is separated from the fulminate by a thin brass cup having a small hole in the base covered with paper attached by shellac.

The tube contains about 32 grains fulminate of mercury.

The head and shoulders are varnished yellow, the tube red. Colour.

Detonator, Electric, No. 9, Mark IV.—Low tension, Naval.

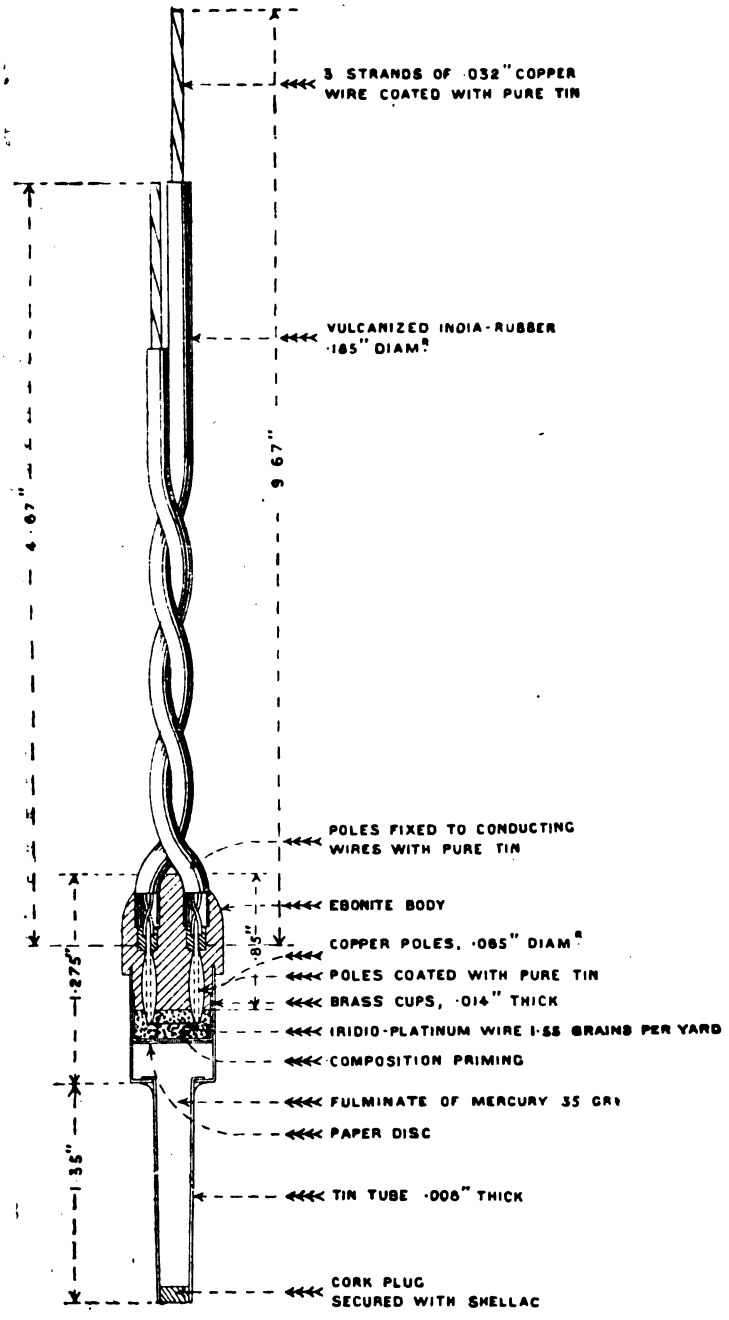
Scale, ½.



Mark III differs from the above in having the wires and poles not coated with tin, and in having the bridge attached with ordinary solder, which was found liable to set up chemical action, causing the bridge to become disconnected electrically from the poles. §§ 3614, 1086.

Detonator, Electric, No. 12, Mark IV, L, Low Tension, Submarine.

Scale, full size.



Marks I and II are obsolete.

§ 5242. No. 12. *Detonator, Electric, No. 12, Mark IV.* (*See* cut.)—This detonator resembles Detonator Electric, No. 9, Mark IV, in construction. The

general electric arrangements are sufficiently shown in cut. It contains about 35 grains of fulminate of mercury. detonator. § 7007.

The wire bridge is made of an alloy of 10 Ir. to 90 Pt. and has the usual resistance for submarine fuzes of ·325 ohm.

The head is painted white, the shoulder blue, and the tube red. Colour.

In the Mark III the fulminate of mercury and priming composition were separated by a calico diaphragm. In the Mark II the wires and poles were not coated with tin, and the bridge attached by solder. § 5242. § 3446.

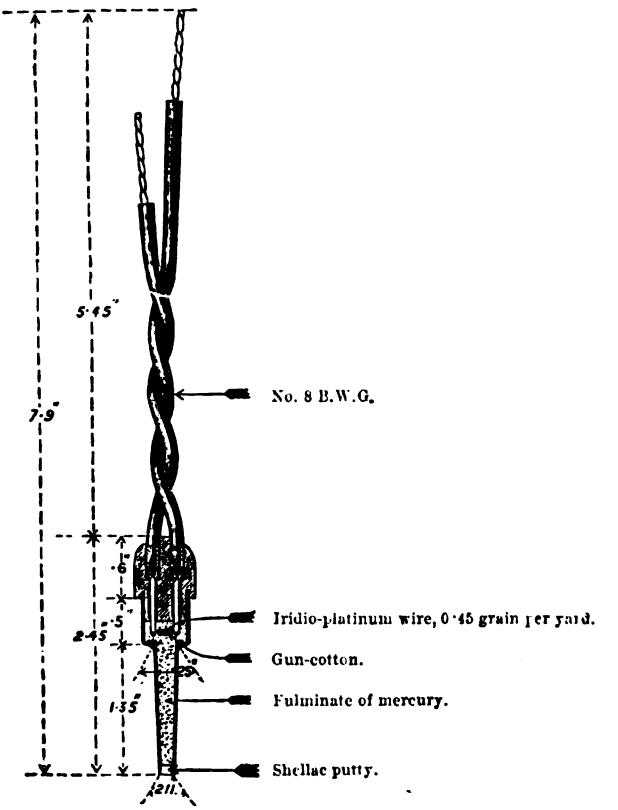
A number of detonators, made to meet urgent demands, are known as *Mark I*, and differ from the pattern above described in having a small piece of gun-cotton yarn tied round the bridge; the latter is surrounded by fulminate of mercury, no priming composition being used. This made the detonator too sensitive for use with the disconnecting apparatus: *see* No. 16 Fuze. § 3446.

The existing store of this pattern will, therefore, be used up for observation mines; that is, those mines which are fired by the action of an operator, as opposed to those which are fired automatically.

Detonator, Electric, No. 13, *Mark II.*—This detonator is used in field and siege operations in conjunction with low tension exploding apparatus, for exploding charges of gun-cotton. No. 13 detonator. § 5242.

No. 13, *Mark II* (*Land Service*).

Scale, ½.



It consists of an ebonite head and body, tin tube with brass shoulder, and two insulated wire terminals. The head is hemispherical, and two holes are bored through it to receive the conducting wires; these are of tinned copper, three-stranded, being easier to manipulate than a thicker single wire. To their ends, which fit into the head of the detonator, are soldered two short copper poles, the latter being flattened to prevent them turning round after they are fixed, and so breaking the bridge. The two solid poles thus treated are dipped into hot gutta-percha cement, and forced down into the holes prepared for their reception. When cool, the conducting wires are twisted together above the head, and the ends bared for the attachment of the wires from the battery. The poles above-mentioned project ·1 inch beyond the bottom of the head, and are ·25 inch apart at the ends. They are connected by a bridge of thin iridio-platinum wire, which has the mean resistance of 1·05ω laid down for Field Service. A small piece of loose gun-cotton yarn is tied on the bridge. The tube is filled with 37 grains of fulminate of mercury, which also extends into the shoulder and completely surrounds the bridge. The bottom of the tube is closed by shellac putty. (*See* cut.)

Paint. § 3446.

The head and shoulders are painted white, and the tube red.

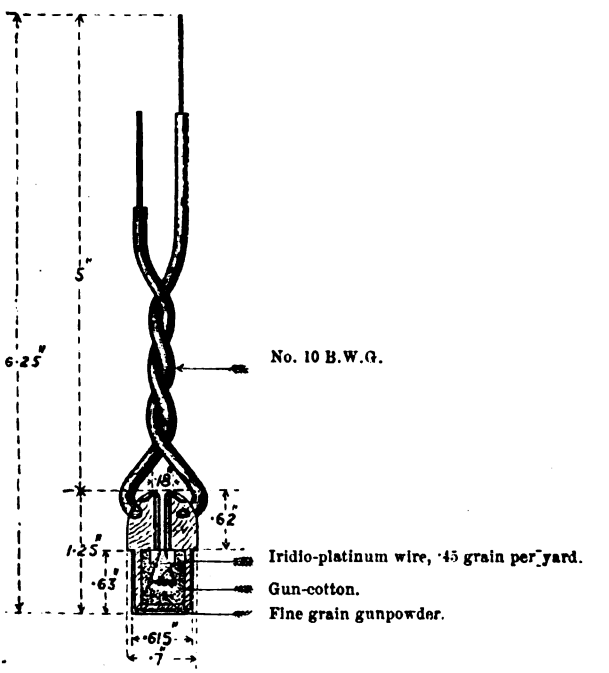
In the Mark I, the wires and poles were not tinned, and the bridge was attached to the poles with ordinary solder.

No. 14 fuze § 5242

Fuze, Electric, No. 14, *Mark II.*—This fuze is used in field and siege operations for exploding charges of gunpowder, and for instructional purposes.

No. 14, *Mark II* (*Land Service*).

Scale, ½.



The fuze consists of body, primer, and two insulated wire terminals. The body is made of beechwood, fitted with two copper tubes or eyes, passing laterally through the head. Into these eyes are fitted the bared ends of the insulated wires; they are jammed in position by two small copper wedges. The eyes communicate with the interior of the body by means of two small copper wires which pass over the head and down through a plug of gutta-percha in the axis of the body, being thoroughly insulated from each other throughout. The ends, which project ·3 inch at the lower part of the body, are connected by a bridge of iridio-platinum wire, which has a small piece of gun-cotton yarn tied upon it. The fine wires are passed diagonally through a small piece of cork, so as to keep the poles, between which the bridge passes, ·25 inch apart. The lower half of the body is hollowed out, and slightly decreased in diameter on the outside to receive a brass cap, which closes the bottom. In the cavity is placed fine grain gunpowder.

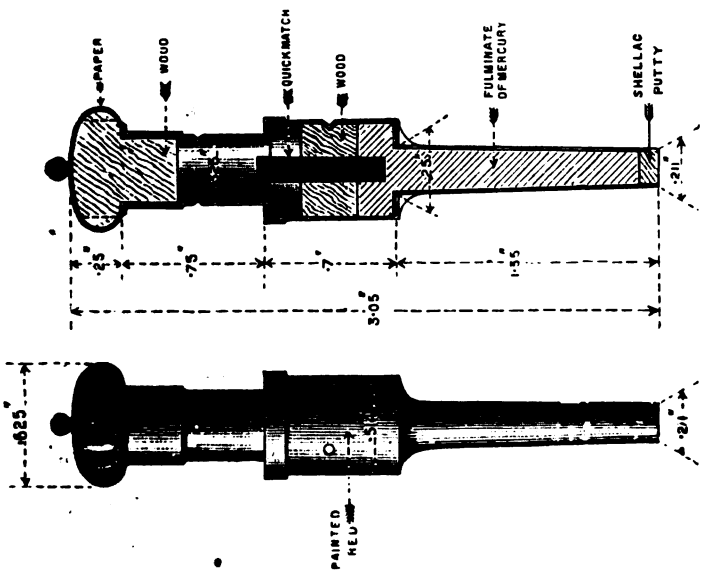
White all over. Paint.

For Mark I, *see* No. 13, Mark I above. § 3446.

Detonator, No. 15, *Mark II, for Safety Fuze*, is intended for use in the Royal Navy, with safety fuze. It consists of a tube, body, and neck, as shown in the sketch. The tube and body are of the same diameters as in No. 9. The former is filled with about 33 grains fulminate, which extends into the body, the central part of which is filled with a wooden plug through which passes a strand of quick-match connecting the fulminate with the space in the neck above the body. No. 15 detonator. § 4557.

No. 15, *Mark II* (*Naval Service*).

Scale, full size.



The neck is intended to receive the end of the safety fuze. It has four indentations, so that when the fuze is inserted, and the neck compressed round it, the points of the indentations will grip the fuze.

A small wooden plug with milled head and covered with paper is inserted in the neck to protect it during transit.

Paint.
Mark I.
§§ 3388, 3416, § 4557.
No. 16 fuze.
§ 5242.

Red all over.

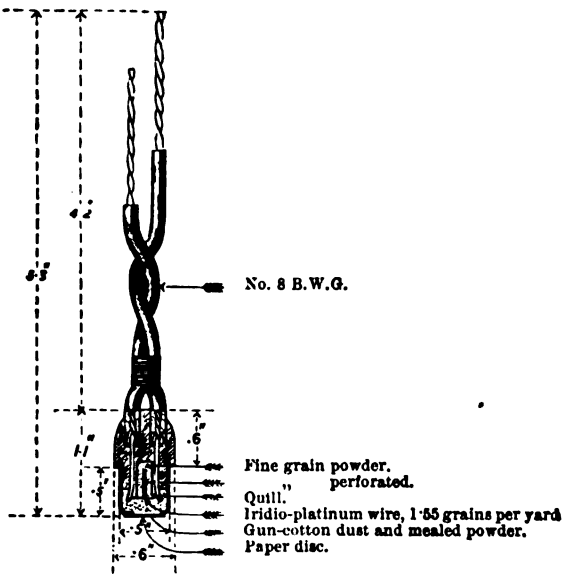
Mark I, which was of a different shape, contained less fulminate, and was for use with instantaneous fuze only, is obsolete.

Fuze, Electric, No. 16, *Mark II.*—This fuze consists of an ebonite body, and the general arrangements are shown in the cut.

The bridge is of iridio-platinum wire, and has the same resistance as those of other submarine electric stores. The centre of the lower part of the body is recessed out, between the wires, to form a cavity of ·2 inch diameter. This hole contains a small quill driven and pierced in the ordinary way. Above the quill is a small quantity of fine grained powder. Immediately below the quill is the bridge, the object of this arrangement being to ensure the breaking

Fuze, Electric, No. 16, *Mark II. Disconnecting (Submarine).*

Scale, 1.



of the bridge and consequent interruption of the current when the fuze is fired.

The head fits into a short brass socket whose base is closed with a disc of paper, secured with shellac. The socket is lined with paper to prevent contact with the poles. The use of this fuze is to disconnect each one of a series of electro-contact mines when fired, without injuring the current to the other mines yet unfired. The details do not come within the scope of this work.

Paint.
§ 3446.

The head of the fuze is painted white and the body blue.

For Mark I. *See* No. 13, Mark I.

No. 18 Detonator.
§ 9448.

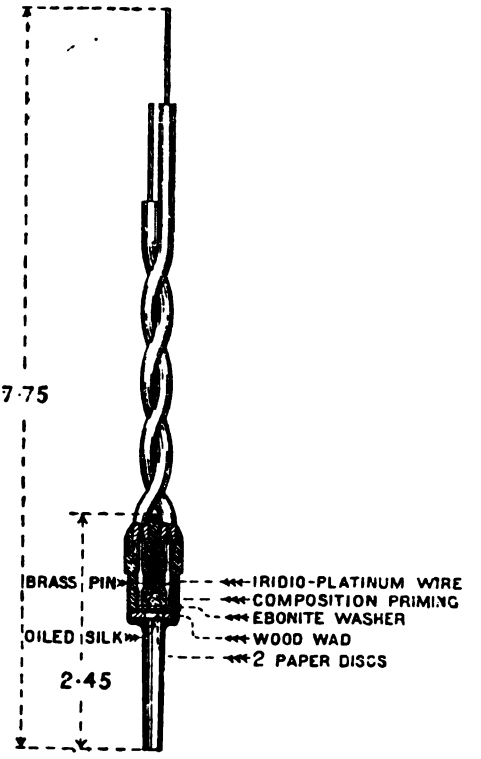
Detonator, Electric, No. 18, *Drill, Mark IV* is the representative for drill purposes of No. 12, which it resembles in dimensions. The tube is empty and is not closed at the bottom. A small disc of beech, having a ·2-inch hole in the centre, fits in the bottom of the brass socket. An ebonite washer and two white fine paper discs are

placed over, and an oiled silk disc under this wood disc. The usual priming composition, 2½ grains, is placed in a recess in the body between the poles, and surrounds the bridge, which is identical with that of No. 12. The body fits into the brass socket, and is secured by a brass pin, passing through it and the socket, which can thus be removed when necessary for rebridging and repriming. These drill detonators are to be packed and treated as explosives.

The head is painted white, the shoulder blue, and the tube white; the object of the latter being to distinguish it from the Service detonator, which has a red tube. Paint.

Detonator, Electric, No. 18, *Mark IV* | *L* | . *Drill, Low Tension.*

Scale, ½.



Mark III differs from Mark IV in having no recess for the priming composition between the poles, and in the top of wood disc being covered by a white fine paper disc, and the bottom by a disc of calico covered with shellac. § 5242.

Mark II differs from Mark III in having the wires and poles untinned, and the bridge attached to the poles with ordinary solder. § 4412.

Mark I differed from Mark II, in having no shellaced calico disc under the wood disc, which was afterwards added to prevent deterioration of the composition. It also had the tube painted red, but can be distinguished from No. 12 by the tube not being closed at the end. § 3856.

Fuze, Electric, No. 19, *Mark III.*—As it is essential that the resistance of the bridge in the disconnector and the detonator should be No. 19 fuze. § 5388.

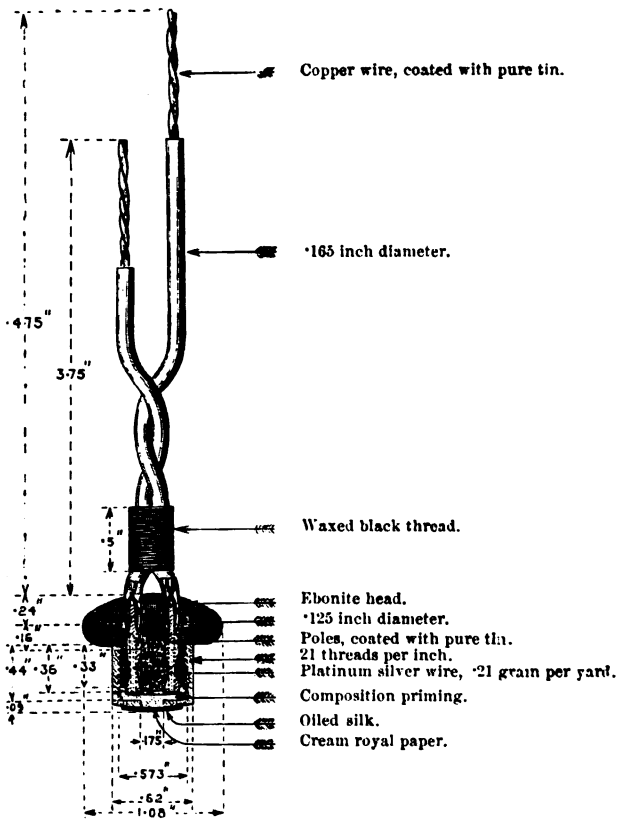
nearly identical, this fuze has been introduced to perform the same service for the Naval mines as No. 16 does for the submarine ones.

The mushroom-headed body is of ebonite, and through it pass the conducting wires, which are three-stranded; to reduce the liability of the bridge being broken, the poles have a double flange to prevent their turning in the ebonite. *See* cut.

The bridge is surrounded by 2½ grains of the usual priming, retained by a brass socket, which screws on to the body of the fuze and is milled on the outside for convenience of handling.

Fuze, Electric, No. 19, Mark III, Disconnecting, Naval.

Scale, ½.



In the bottom of the brass cap is a central hole ·175 inch diameter, covered on the outside by a piece of oiled silk shellaced on, and covered by a disc of cream royal paper.

§ 5242. Mark II differs from the above in having the conducting wires made from a single strand of copper, and the poles are not flanged as in Mark III.

§ 4945. The conducting wire and poles in Mark I were not tinned, and the bridge was secured to the poles by ordinary solder only.

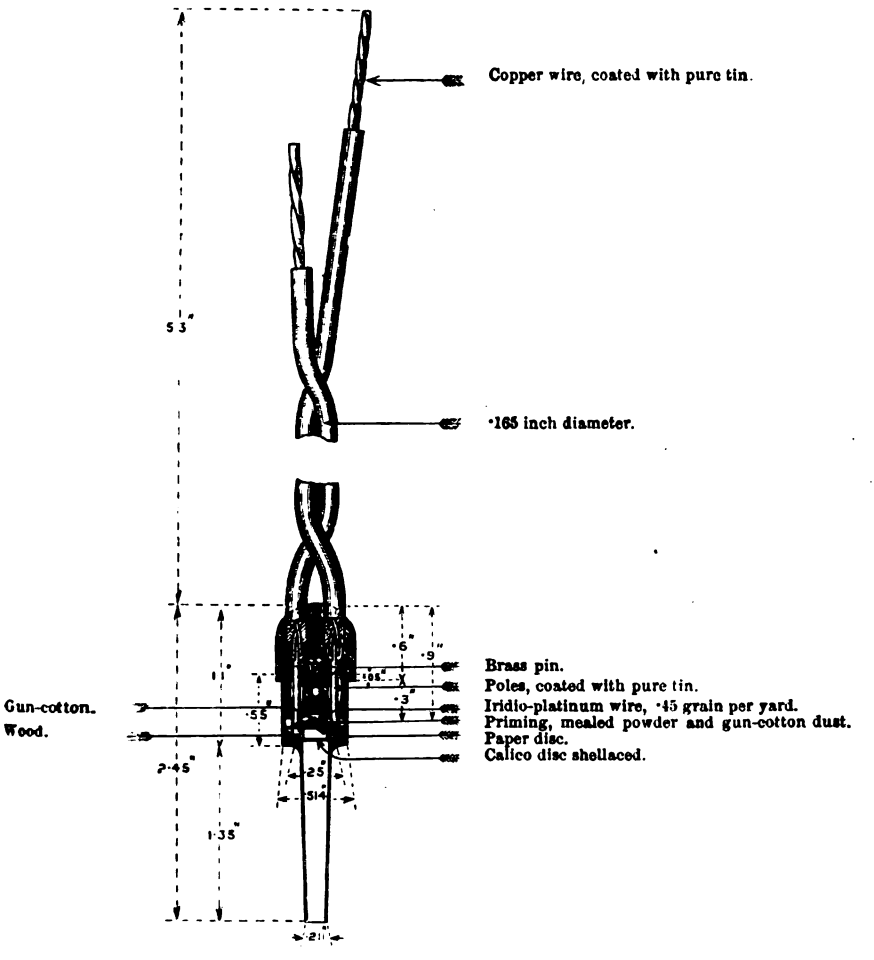
§ 5407. *Detonator, Electric, No. 20, Mark I, Drill*, is the representative for drill purposes of No. 13, which it resembles in dimensions. The tube

is empty, and in other respects it is very similar to No. 18, Mark III, except resistance.

White all over. Paint.

Detonator, Electric, No. 20, Mark I, Drill, Land Service.

Scale, $\frac{3}{4}$.



General Notes on the above Detonators.

It is especially important to remember that detonators contain a large proportion of fulminate of mercury, and that it is most dangerous to treat them roughly, or to entrust them to unskilled persons. They should be handled with care, and only by persons well conversant with their properties. In testing detonators for continuity they should always be either removed to some distance, or strongly confined, in case of one being accidentally fired. The consequences of one being fired by carelessness or rough treatment when in a gun-cotton primer are obvious.

Packing. §§ 2975, 9951.

All the detonators except No. 8, are packed in tin cylinders containing 25, round the rectifier. The latest cylinders have a central tube for the rectifier, so that it is easily got at without disturbing the detonators. These cylinders are closed by a tin band soldered on, and have their bodies and lids lined with sheet asbestos, which extends down the bodies as far as the tin diaphragm, which supports the detonators. This lining is to prevent heat from the soldering iron reaching the contents of the cylinder.

§ 10706.

A *Case, Transport, Detonators, Mark I*, of steel and gun-metal, has been introduced. It is made of sheet steel with angle pieces of gun-metal, and a gun-metal framework riveted to the top. The lid of steel is secured to the framework by 10 screws and the joint is made by asbestos attached to the lid. A galvanized iron wire handle is attached to each end of the case. It is painted red, dimensions 26·4″ × 20·4″ × 15·35″.

The electrical fuzes are also packed in tin cylinders containing 25, except No. 19, which are packed 15 in a cylinder. The packing of No. 8 is given with the description, p. 97. All these detonators and fuzes are carefully arranged in the cylinders by tin loops and cotton wool, or other soft packing, so as to obviate any risk from rough usage in transit, &c., as far as possible.

Rectifier, gun-cotton primers. §§ 9572, 10090.

The *Rectifier, Gun-cotton, Primers Mark IV* consists of a piece of lignum-vitæ, with a flat handle, the lower part being of the same form and dimensions as the body and tube of the detonator. This portion is inserted in the perforation made in the primer to receive the detonator, and "rectifies" the hole. It is to be used *in all cases* before inserting a detonator, and can be used for every detonator in the Service.

§ 10090.

Previous patterns differed in dimensions and are all declared obsolete.

§ 10708.

The *Rimer, Rectifying Gun-cotton, Primers Mark I | L |* is made of hard wood, and is for use in enlarging the perforations of the "charges priming 2¼ lb. and 4½ lb." Care must be taken to use the rimer carefully and slowly, and to see that it is not applied too vigorously for too long a period, as otherwise there may be a danger from heating. The Mark IV rectifier will still be required to press the rough edges into shape.

Labels.

Cylinders containing detonators have a brownish-red label on the top giving the contents of the cylinder, and those containing electric fuzes or tubes a white label.

Each cylinder of detonators, except No. 8, has the following label:—

"CAUTION.

"These detonators must *on no account* be *forced* into gun-cotton slabs or primers by screwing or twisting.

"Before inserting a detonator, force the rectifier into the hole for the detonator, up to the full extent to which the detonator should enter, and then withdraw it by twisting.

"On no account is any detonator to be taken to pieces for examination or any other purpose.

"Any detonator that may have missed fire, or that may be found distorted or injured in any way that would appear to render it unfit for use, should, if means are available, be carefully retained for

examination by properly appointed persons, or should at once be destroyed by immersion in water.*

"This cylinder of detonators contains a rectifier, Mark IV."

The cylinders (except the special ones for No. 8 detonators) are closed with a tin band soldered on in the ordinary manner, and the ordinary printed directions for opening are attached to each cylinder.

The top label has printed on it the number and nature of the fuzes, &c., contained in it, their distinguishing numeral, and in MS. the date of packing. Cylinders containing detonators have the words "With Care," printed in large letters on the labels. The cylinders are not to be opened until required for use or for special inspection.

The cylinders containing detonators are "*Not to be placed in the magazine on any pretence whatever.*"

There is a special label on the cylinders containing No. 12 detonators, as follows:—

"DETONATORS, ELECTRIC, No. 12, MARK IV. Bridge—Nature of—Iridio Platinum, Resistance between 0·3 and 0·35 ohms when traversed by a measuring current not exceeding $\frac{1}{6}$ ampere.

"These detonators, before use for Submarine Mining, are to be tested as directed in the Manual for Submarine Mining, Part II. If used for any other purposes, and it is not possible to test them in accordance with the above directions, the maximum safe current that may be passed through any one of them is to be taken as $\frac{1}{10}$ of an ampere.

"A detonator must never have a testing current passed through it when any one is so placed as to be liable to injury from its ignition."

There is a somewhat similar caution issued with cylinders containing No. 13 detonators, and No. 14 fuzes. It runs thus—

"These detonators (or fuzes) are only to be tested with the test cell specially made for the purpose, unless it is known for certain that a current not exceeding one-twentieth of an ampere is used."

For details of patterns, &c., *see* tables, p. 486, *et seq.*

Storage. All detonators for storage are classed as Group II, Division IV, electric fuzes are classed as Group II, Division I.

Proof. Instructions for the inspection of detonators, &c., will be found in the Regulations for Army Ordnance Services, 1900.

* It must be remembered that no amount of immersion in water will *destroy* fulminate of mercury. When wet it is harmless, but when dried again it is as active and dangerous as ever. Hence a detonator should be thrown into deep water.

CHAPTER VIII.—TUBES AND STORES CONNECTED WITH THEM.

USE OF TUBES.—FRICTION TUBES, COPPER AND QUILL.—ELECTRIC TUBES.—MISCELLANEOUS TUBES.—VENT-SEALING TUBES.—PRIMER VENT CORDITE—DRILL TUBES.—STORES USED WITH VENT-SEALING TUBES.—LANYARDS.—VENT SERVERS, ETC.

Use of tubes.

THE use of tubes is to provide a safe and handy method of igniting the charge of a piece of ordnance.*

The tubes used for firing radial vented guns, except those with steel cone or T vents, are copper and quill friction and electric tubes.

Tubes for radial vented ordnance.

Copper friction tubes are used in the L.S. They are stronger and better suited generally for their purpose than quill ones and keep better. Tubes, however, made of the latter material are used by the Navy, as the exploded copper tubes blown out of the gun on the ignition of the charge are dangerous on the decks where the men are working with bare feet. Moreover, the copper tubes rebounding from the upper deck beams, or the roof of a turret, &c., are apt to cut men's faces or other exposed parts of their bodies. There was, however, a special copper tube issued for Naval Service, which did not fly about.

Copper friction tubes.

Either copper or quill tubes can be used with guns vented for N.S., but as the quill tube requires special fittings for its support, it is not suitable for use in an unaltered L.S. gun. On an emergency, however, any armourer could fit up a support for the loop.

The copper friction tubes in the Land Service are the *solid drawn* and *solid drawn special* for guns, and the *short* for use with war rockets only. Other copper tubes which may met with are: L.S. *long* and *7-pr.*, and N.S. the special long with loop. These are obsolete for future manufacture.

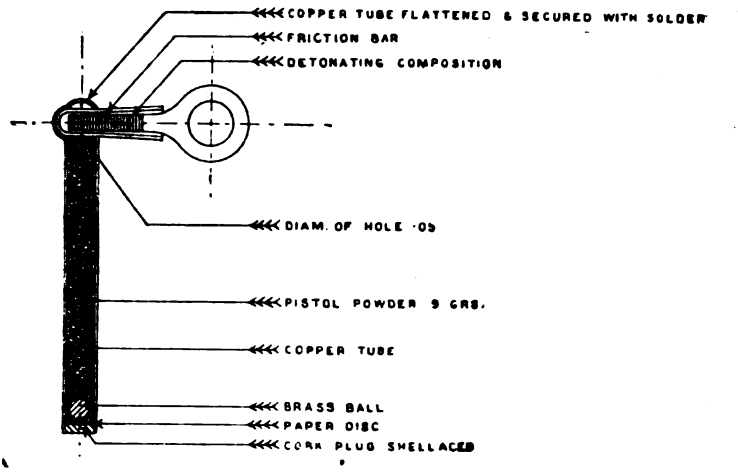
§§ 7161, 7866.

Tube, friction, copper, solid drawn, with ball, Mark II.—The body of this tube is made from solid drawn copper, brought up to shape by a succession of punchings and annealings. The head is solid; it is about 2 inches long and ·2 inch in diameter, and is lacquered both inside and out. About a quarter of an inch below the head a small hole is bored through one side, a bulge is made on the inside opposite to it, forming a seat for the crown of the solid-drawn copper nib piece, which is inserted and soldered, a small hole is bored through the underside of the nib piece inside the body to enable the flash from the detonating composition to ignite the powder.

* For history of means of firing the charge, *see* the late Colonel Majendie's "Treatise on Ammunition," p. 187, &c.

Tube, Friction, Copper, Solid Drawn, with Ball, Mark II.

Full size.



The nib piece contains a copper friction bar roughened on both sides and smeared with a detonating composition composed of chlorate of potash, sulphur, and sulphide of antimony. This composition is damped with shellac varnish, while it is being smeared on. The nib piece is pressed down on to the sides of the friction bar. The projecting part of the friction bar has a vertical eye, into which the hook of the lanyard fits; the junction of the nib piece and friction bar is sealed by shellac varnish. The body of the tube contains 9 grains of pistol powder, and a brass ball ·12-inch diameter, and the bottom is closed by a cork and paper disc secured with shellac.

This tube is used for all radially vented ordnance in the Land Service, except those with steel-cone and T vents and R.B.L. other than 40-pr., side-closing, and consequently no more long, short, nor special 7-pr. tubes will be made for guns; the short tube is retained for use with war rockets as the solid drawn is too short. § 5598. Use.

On pulling the lanyard (which should be stretched and then sharply pulled) the friction bar is drawn out, igniting the composition and firing the tube. The gas from the exploded cartridge drives the tube out of the vent.

Mark I differs from the above in that there is no brass ball, and the nib piece is of sheet copper, secured by a woolding of wire and solder. This tube will be used with all R.B.L. guns other than 40-pr. side-closing. § 5371.

Tube, friction, copper, solid drawn, special, Mark I, is similar to the solid drawn Mark II tube, but has no brass ball, contains about 6 grains of powder, and is 1·6 inches long. It is used with blank charges in radially T-vented field guns. § 8316.

The general construction of the *Long*, *Short*, 7-*pr.*, and *Naval Long* copper tubes is the same.

A description of the *short* will be found in the edition of 1897.

All copper friction tubes, except the solid-drawn special, are issued in hermetically sealed tin cylinders containing 25. Issue. § 2217.

There is a rack round the inside of the cylinder made by a strip of tin corrugated so as to form a loop for each tube. At the bottom

of the cylinder is a disc of felt, and at the top are three felt discs of different sizes sewn together, which cover the tops of and fill the space between the tubes, and prevent them shaking about in transport.

The cylinder is secured in the usual way by a tin strip soldered round the junction of the lid and cylinder.

§ 9338. The solid drawn special tubes are packed 25 in a rectangular tin box, the lid being closed by a tin band soldered over the joint.

It is fitted internally with racks to take the tubes. The box, being longer than the tubes, is fitted with a false bottom, covered by a slab of cork, on which the tubes rest; a loose felt pad fits over the tops of the tubes, under the lid, to retain them in position. The box is painted black. These tubes have a special box because they are used with the blank charges of field guns having radial T vents. The box must, therefore, be of the same size and shape as that in which the T tubes are packed, so that it will fit into the compartment in the limber.

A.C. 1881, Cl. 249. If the tubes are issued for home service, eight cylinders of solid drawn or four cylinders of other tubes are packed in a wooden case; if for foreign service, the cylinders are packed in a metal-lined case, from which they are not to be taken until the tubes are required for use.

When issued to the Royal Navy, the cylinders are packed in wooden boxes, which are to be made locally.

On each cylinder will be found labels, one on top showing the nature of its contents and date of packing, and directing that the cylinder is "*not to be opened until required for use or special inspection*"; and one on the side giving directions that it is "*not to be placed in the magazine on any pretence whatever,*" and also directions as to method of opening and re-closing the cylinder. On the top, a space is left for the date of re-packing, in case the cylinder has to be re-closed in accordance with A.O.R.

Storage. These tubes for storage are classed as Group II, Division I.

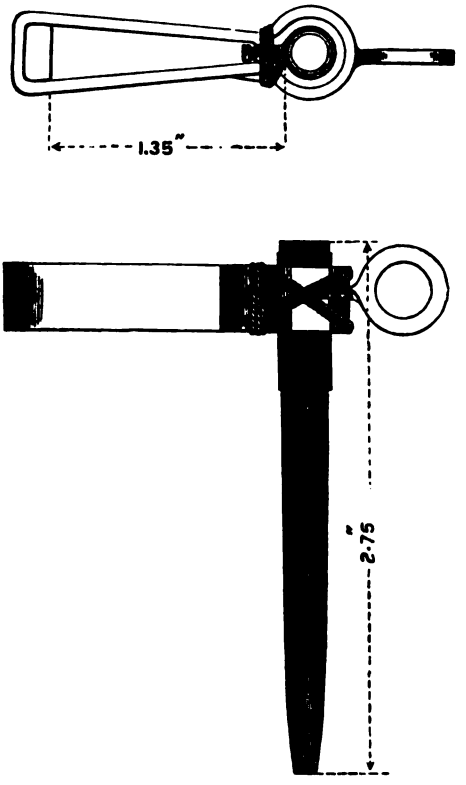
§ 2405. The Navy use quill friction tubes in two sizes, viz., Long and Short.

Quill friction tubes. The general action is the same as that of the copper tubes. There are several patterns of each size, differing in minor details. The cut (p. 113) gives the general appearance of these tubes.

§ 3867. *Tube, friction, quill, short, Mark VI.*—This tube is about 2·75 inches long. The greatest diameter of the quill body for a length of 1 inch from the under side of the leather loop is not to exceed ·22 inch. The detonating composition is on one side and on the edges only of the friction bar, which passes completely through the quill, and is slightly bent downwards at the point. A woolding of fine copper wire extends for about ·75 inch from the top of the tube, and serves to strengthen and support the top when in the vent of a gun, and also to secure the friction bar in its place. The composition contains in addition to the ingredients used in the composition for copper tubes, a little mealed powder; and also ground glass to render it more sensitive. (*See* table, p. 554.)

To support the tube when the pull of the lanyard comes on it, a leather loop is attached to the head, and kept in its place by a frapping of silk thread. The loop slips over a crutch or pin screwed into the gun near the vent. The loop is kept open by a small wad of leather secured inside it by wire. The head of the tube is closed with shellac putty. The tube has its body varnished black, and the head and friction bar varnished with shellac.

Tube, Friction, Quill, Short, Mark VI.



The *Tube, friction, quill, long, Mark IV*, differs from the short one in length only, being four inches long instead of 2·75 inches. The increased length is given by cementing two quills together. § 3067.

The short quill friction tube is used in the N.S. for all ordnance below the 64-pr. guns; the long one for 64-pr. guns and higher natures, and for firing 24-pr. Hale's war rockets. Use of quill friction tubes.

A list of the earlier marks of quill friction tubes will be found in former editions of this treatise.

Quill friction tubes are packed on their sides by 25, in tin cylinders. Issue.

On each cylinder will be found labels, one on the top, giving the nature of the contents and date of packing, and having a space left for the date of re-closing; and one on the side directing that it is "*Not to be placed in the magazine on any pretence whatever*," with instructions for opening the cylinder, using the tube and fitting the lanyard.

These tubes for storage are classed as Group II, Division I. Storage.

Two boxes are made locally to contain cylinders of friction tubes when issued for Naval Service. There is a large and a small size of box. § 3059.

Friction tubes of four years old and upwards are not to be supplied to His Majesty's ships when fitting out, the age to reckon from the date of last issue from the R.L. A.C. 1881, Cl. 249. A.C. 1882, Cl. 12.

§ 3744. Tube, friction, quill, time gun.

There is a special *Tube, friction, quill, time, gun, Mark III*, for use at Edinburgh, where the time gun is fired by a falling weight released by electrical agency. It is of the same general construction as the short quill tube, but has no leather loop, and has a more sensitive priming composition. The head is strengthened by a stout cap of paper.

Proof, etc.

The instructions for examination and proof of friction tubes, will be found in the Regulations for Army Ordnance Services, 1900.

§§ 943, 9394.

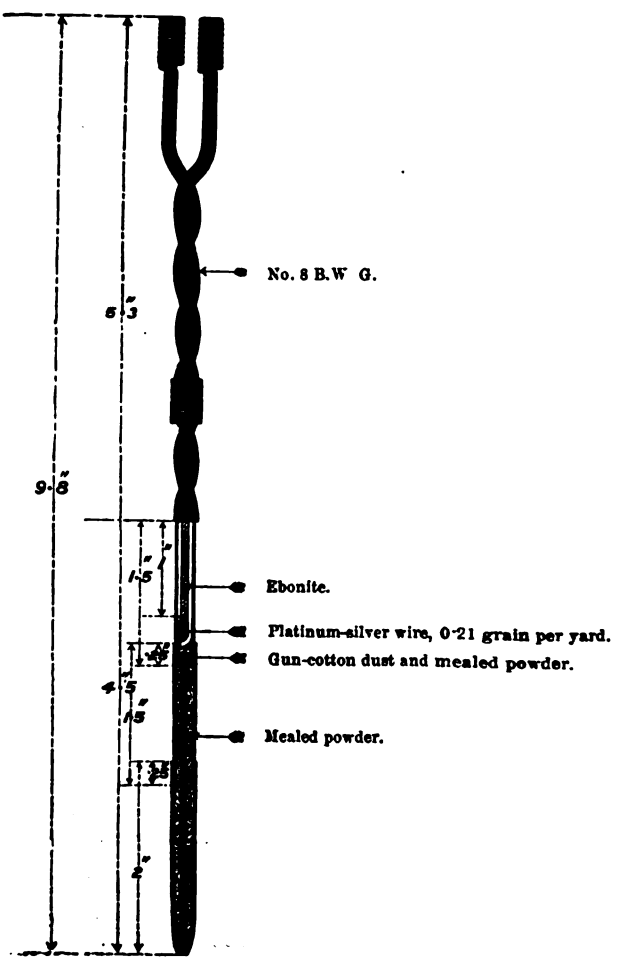
Primers, Vent Piece have been declared obsolete for future manufacture in L.S. and obsolete in N.S. They were used with 7-inch and 40-pr. R.B.L. guns, to convey the flash from the tube to the cartridge, but are not required with solid drawn tubes.

Electric tubes. No. 10 tube. § 5242.

Tube, Electric, No. 10, *Mark IV.*—This tube is used for firing radial vented R.M.L. guns by electricity. The tube is made up from three quills cemented together. The two lower quills are filled with

No. 10, *Mark IV.*

Scale, ½.



mealed powder, as with the old copper friction tubes; the upper quill contains an ebonite plug, about 1 inch long. In it two longitudinal grooves are cut along which pass the bared ends of the insulated wire terminals. The ends of the wires are joined by the Naval bridge of platinum silver wire ·25 inch long, and the cavity between the ebonite plug and the top of the mealed powder contains a priming composition of gun-cotton dust and mealed powder, packed closely round the poles and the bridge. On the top of the mealed powder, in the tube proper, is a small wad of gun-cotton about ·075 inch thick, placed there so as to prevent any of the priming falling into the central hole in the tube, and thereby possibly leaving the bridge bare. To prevent the tube being inserted too far into the vent a frapping of thread, about ·3 inch in diameter, is made on the wires, about 1 inch above the top quill. The upper end of each wire terminates in a spiral ·6 inch long, and about ·08 inch in internal diameter. The spirals are covered with sarcenet secured by shellac varnish. The tube is varnished with shellac, which gives the yellow colour signifying Naval Service, for which this tube was originally intended.

Mark III differs from the above in having the wires and poles not coated with tin, and in having the bridge attached with ordinary solder, which was found liable to set up chemical action, causing the bridge to become disconnected electrically from the poles. § 3661.

Mark II tube differed from Mark III only in having the priming not so closely packed round the bridge and poles, and in having no gun-cotton wad between the priming and the tube proper. The store of Mark II tubes will be altered to Mark III as opportunities offer. § 3446.

Mark I is OBSOLETE. §§ 2926, 3661.

These tubes being of weak construction must be handled with care, when joined up, and lowered gently into the vent as far as the projection on its own head will allow, as, should the head project and be unsupported, the top joint is liable to be broken off without igniting the mealed powder; should a vent be too short to take the entire tube, the lower joint may be removed. A turn should be taken with the leads round the lanyard guide or cascable to relieve the head from the strain caused by the weight of the wires; should it be necessary to remove an unfired tube it must be done carefully, as the upper quill containing the electric bridge easily becomes detached. Should this happen, and any of the lower joints be pulled off and remain in the vent, either one or more of the lower joints must be removed from the next tube, to allow it to enter to the full extent.

In a black cylinder holding 25, with wool or other soft material on top. Issue.

For storages, these tubes are classed in Group II, Division I. Storage.

For examination and proof *see* Regulations for A.O. Services, 1900. Proof.

Tube, electric, No. 10*a*, is for time guns. § 10897.

This tube differs from No. 10, Mark IV, in having shorter wires with an extra frapping of coarse black thread; there are only two quills, the ebonite is shorter, and a disc of sarcenet prevents the priming composition falling down the central hole in tube.

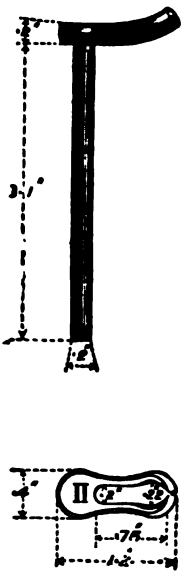
The issue and storage are the same as for No. 10.

Tube, Friction, Drill Mark II is issued for drill with radial vented R.M.L. guns, except steel-cone vents, and consists of a steel pin which fits the vent, with a head formed of two spring clips, which represent the eye of the friction bar of the Service tube, so that the

ordinary Service lanyard can be used with it. The strength of the clips is so adjusted that it requires a pull about equal to that necessary to fire a Service tube to draw the hook of the lanyard between them.

Mark I has the head fitted with a prong, into which a V-shaped spring fits, representing the friction bar. The lanyard is spliced to the spring, which can be drawn through the prong.

Drill, Mark II.



Tube, electric, No. 11, drill, §§ 5242, 9675.

Tube, Electric, No. 11, Mark IV.—This is for drill purposes only. The body is of brass. Into the top is screwed an ebonite plug which has a deeply milled shoulder to give a good purchase to the fingers in screwing or unscrewing it, which can be done at pleasure. The electrical arrangements are sufficiently shown in the cut. The brass pin representing the tube proper has a milled shoulder and can be readily unscrewed from the body so as to allow fresh priming to be introduced when necessary at the bottom. This avoids the necessity of disturbing the ebonite head and wire bridge.

In the body are two side holes covered with discs of thin paper. These discs are shellaced on before the tube is issued and replaced by gummed ones, when the tube is reprimed, which can be done as often as desired, the wire bridge, which is of the usual Naval construction and resistance, being replaced if necessary.

§ 2866. The priming is supplied in glass bottles holding 2 oz. each, and spare wire for making new bridges is issued on card to ships in which these tubes are used.

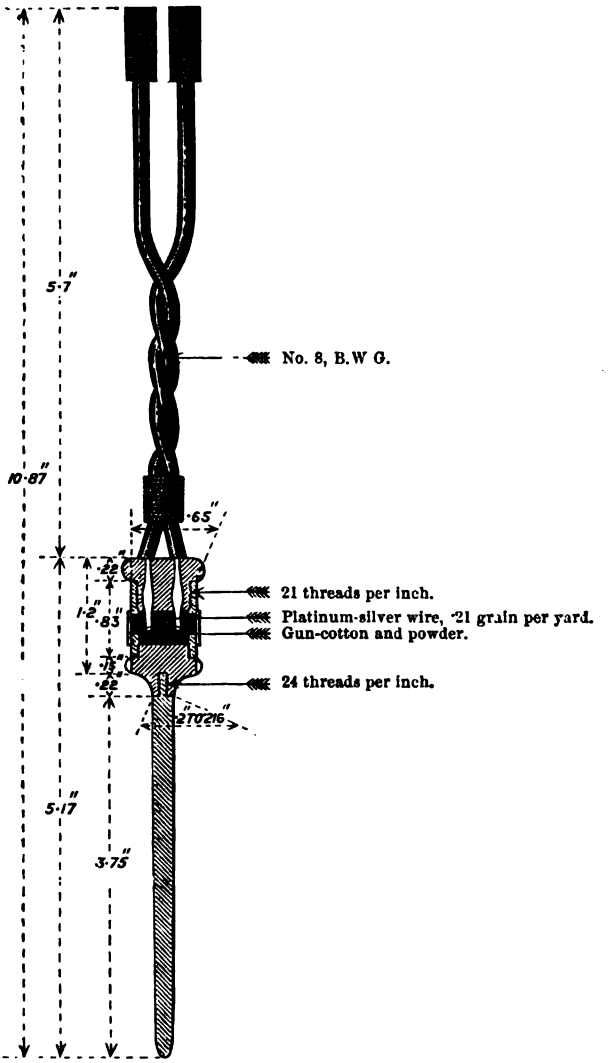
Action. When the circuit is completed the bridge fires the priming, the flash from which escapes through the side holes and gives ocular evidence of the action of the tubes.

§ 4342. As these tubes contain a certain amount of priming composition, they must be treated as explosives.

Colour. The Naval colour is obtained by lacquering the brass body. The pin is painted black.

No. 11, *Mark IV.* | N. |

Scale, ½.



25 in a tin cylinder. Issue.

These No. 11 tubes for storage are classed in Group II, Division I. Storage.

Mark III differs from the above only in having the wires and poles not coated with tin, and the bridge attached to the poles with ordinary solder. § 3547.

In Mark II the priming was introduced before the head was screwed in. Consequently, if the priming was pressed tightly, the bridge, having to be screwed round in it, was liable to break. If the priming was loose enough to avoid the risk of this occurring, it was liable to set down in transit, &c., away from the bridge altogether, and thus to make the tube blind. § 3446.

Mark II differs from Mark III mainly in the point above noted, though it has a comparatively small screw hole into which the brass pin screwed, and which affords a certain amount of communication with the interior of the body. It also differs slightly in dimensions.

§ 2832. *Mark I* differs from Mark II only in having the head varnished black.

Common quill tube. There are some tubes fired by portfires which though not now manufactured are not formally abolished and might be made on emergency. They are as follows:—

Common Quill Tube, about 3 inches long, and is made as follows. The point of the quill is cut off and a head is formed by slitting the top into 7 prongs and passing a piece of worsted alternately over and under each prong, so as to form a small cup about $\frac{1}{8}$ inch in diameter. The tube is driven with mealed powder, damped with methylated spirits, and a hole pierced by a wire, the cup filled with a priming of mealed powder, gum, and water, made into paste, and sprinkled on the top with dry mealed powder. A paper cap is twisted on to the head of the tube, and the wire passed up again after capping to ensure the hole not being choked up. The tubes should be thoroughly dried. They require to be uncapped before firing.

Match, or Fynmore's tubes. *Match, or Fynmore's Tubes*, have been used as primers for R.B.L. guns. They are the same as common quill tubes, having in addition 8 strands of worsted covered with a paste made of mealed powder, gum-arabic, and methylated spirits fastened to the cup.

Paper tube. *Paper Tube*, about $2\frac{1}{2}$ inches long. A strip of paper rolled into a cylinder of ·2 inch diameter; on the top of the tube another piece of paper is rolled spirally, so as to make a cup. The tube is driven with mealed powder, damped with methylated spirits, and pierced, and the cup filled with priming of mealed powder and water. The tube is capped by a piece of paper soaked in saltpetre and water, and tied on by silk. After capping, a wire is passed up to ensure the hole not being choked. The tubes should be thoroughly dried. The cap need not be removed before firing.

Coated with black varnish: shellac dissolved in methylated spirits would answer.

Storage. The above primers and tubes for storage are classed in Group II, Division I.

Vent-sealing tubes. The obvious advantages of axial vents, especially in heavy guns, on the score of convenience and the ready ignition of reduced charges, have caused their adoption for all B.L. guns, with the exception of the 15-pr. Mark I and 4-inch jointed guns; and they have also been fitted to the heaviest R.M.L. guns.

The ordinary tubes, hitherto dealt with, cannot be used with these vents, since on firing they would be projected to the rear and so would be a fruitful source of accidents to the detachment. There would also be a great rush of gas through the vent which, apart from the disadvantage of loss of pressure, might cause an accident and certainly causes great wear in the vent, which shortens the life of the vent considerably, especially with heavy cordite charges.

For these reasons tubes are employed which fit a seating in the vent accurately and are held in the vent by the lock or other means attached to the outer end of the vent or breech screw. The heads of these tubes are closed in such a manner as to prevent the passage of gas through them, while the tube itself is expanded against the walls of the seating and so prevents escape of gas past it.

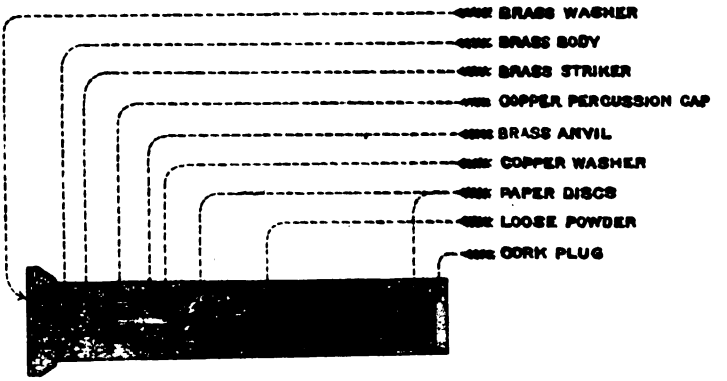
These tubes are known as Vent Sealing Tubes, and there are in all nine different tubes, though only four distinct patterns.

TUBES VENT SEALING PERCUSSION.

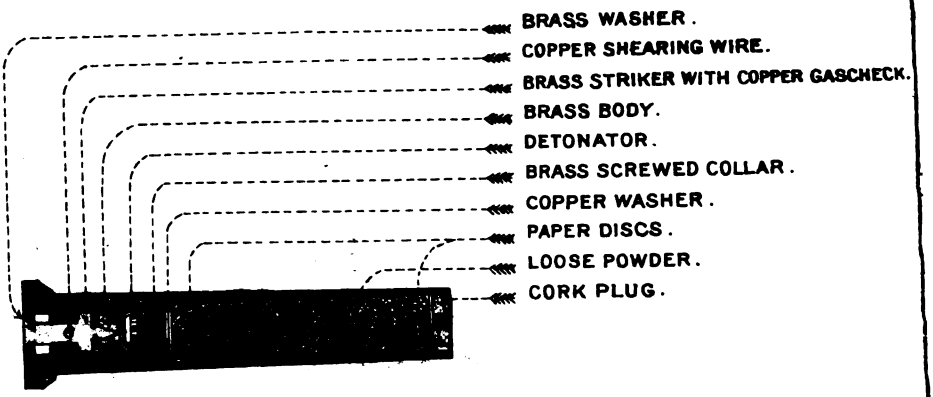
BRASS.

FULL SIZE.

MARK IV |C|



MARK VI |C|



678.8.1900 E.Weller & Grahams, Ltd Litho. London

These four patterns are distinguished by the letters P, V, M and T. Their uses are given in the detail below.

There are three different "P" tubes; the percussion, electric "P," and wireless electric "P."

The percussion and electric "P" tubes are used with B.L. guns having percussion locks.

The electric "P" tube is also used with guns having steel cone vents (the High angle fire guns).

The wireless electric "P" tube is used with B.L. guns having wireless locks.

There are two "V" tubes, the electric and the friction; both are used for all guns having tube holders, which include the R.M.L. guns 17·72-inch, 16-inch, and 12·5-inch, Mark II.

There are also electric and friction "M" tubes, used with guns having vent masking slides; only to be found with the B.L. 4-inch, Mark II, and 5-inch Mark I guns which have not been already converted to take percussion locks.

The "T" tubes are friction and electric, and are used with guns and howitzers having "T" vents; these are field and siege B.L., 12-pr. of 6-cwt., 15-pr. and 30-pr. guns, and 5-inch, 5·4-inch, 6-inch of 30-cwt. and 8-inch howitzers. Since the use of cordite causes unsealed vents to erode quickly and because these guns except the 15-pr. Mark I have axial vents, the "T" tube was introduced, which seals the vent and also avoids lock complications, being held in by a bayonet joint at the end of the vent itself.

In all the electrical tubes the Naval bridge of platinum-silver is used, 0·25 inch long, except for the "T" electric tube which has a bridge only 0·2-inch long, resistance from 1 to 1·3 ohms. Particulars of the usual Naval bridge are given in the previous Chapter. Bridges.

A full description of these various tubes follows.

The Tube, Vent-sealing, Percussion, Mark VI, C., for guns with percussion locks is made from solid drawn brass by a series of punchings and annealings, the head being stamped up into shape, and enlarged to prevent it being forced too far into the vent. The head underneath is chamfered to facilitate extraction. It is 2·19 inches in length over all, and ·4 inch in diameter across the widest part of the tube. It tapers slightly towards the front end, and is made to fit the vent with great accuracy. Through the centre of the head a hole is bored to receive a brass striker, through which the blow is given to the detonator. (*See* Plate VI). § 10406, 10500.

A small hole is bored through the body and striker, at right angles to the axis, and about a quarter of an inch from the head, for a copper shearing wire which helps to support the striker.

The front end of the striker is enlarged and fits against a shoulder in the interior of the body; on this end is formed a needle point, round the base of which a groove is cut and a copper cup is snapped on to act as a gas-check. The outer end is reduced in diameter to receive a brass disc, which is riveted to it. This disc fits into a recess formed for it in the head of the tube, and is flush with the exterior surface; the recess is deepened and a space is left below the disc into which it is forced by the striker of the percussion lock. Striker,

The shearing wire is a fine copper wire, which prevents the tube being fired by a jar or light blow.

In the interior of the body is screwed a brass plug or "collar" which supports a small detonator immediately under the point of the striker. The detonator is similar, except in dimensions to the R.L.

cap (*see* p. 160) and is spun into a recess in the end of the screw plug.

The screw plug has a conical fire-hole through the centre, the largest part of the cone being next the detonator; the plug is prevented from unscrewing by a copper washer, which is inserted in a cup-shaped form and expanded into the screw threads. Next to the copper washer is placed a disc of paper to prevent the powder working up into the plug, and the body of the tube is filled with pellet powder,* the end being closed by a paper disc and cork plug secured with shellac.

The tube is lacquered inside and out.

Action. The striker of the tube is forced by the action of the percussion lock in upon the detonator, which the needle point pierces. The shearing wire is broken. The flash from the detonator passes through the screw plug, fires the pellet powder and the charge. The explosion expands the tube against the sides of the vent, in which it is retained by the percussion lock, while the enlarged head of the striker fits against the shoulder in the tube and the gas expands the copper cup round the needle against the interior of the tube and so prevents any escape of gas through the interior.

§ 10091. The Mark V tube differed from the above in having no copper cup round the needle point, but a groove formed in the striker head instead. Very few were made.

§ 8655. The Mark IV tube differs somewhat from the Mark VI, and as most tubes at present in the Service are of this pattern, a full description of it is given. The external dimensions are identical with those of Mark VI. Through the centre of the head a hole is bored to receive a brass striker. This striker has an enlarged head, which fits against a shoulder in the interior; and its outer end is riveted in a brass disc let into a recess in the exterior surface of the head. The tube is lacquered both inside and out. (*See* Plate VI.)

Underneath the head is screwed a brass anvil carrying a percussion cap of special manufacture, and retained in position by a copper washer at its base. There are three fire-holes in the anvil to allow of the flash passing from the cap to the powder in the body. A disc of fine white paper is placed outside the copper washer. The body is filled with pellet powder. The end is closed by a varnished cork and paper disc shellaced in.

Action. The striker in the head of the tube is forced by the action of the percussion lock in upon the cap, firing it, the pellet powder and the charge. The explosion of the pellet powder expands the tube against the sides of the vent, in which it is retained by the percussion lock, while the head of the striker prevents any escape of gas through the interior.

§ 6102. Mark III in general construction resembles Mark IV, except that the end is closed with a sulphur pellet in which is embedded a brass ball. *And must not be used unless the range is clear.*

§ 5802. Mark II in general construction resembles the above, except that the body of the tube is completely filled with powder, and closed with a varnished cork and paper disc, secured with shellac. There is only a single central fire-hole in the anvil.

§§ 4622, 6626. Mark I is obsolete.

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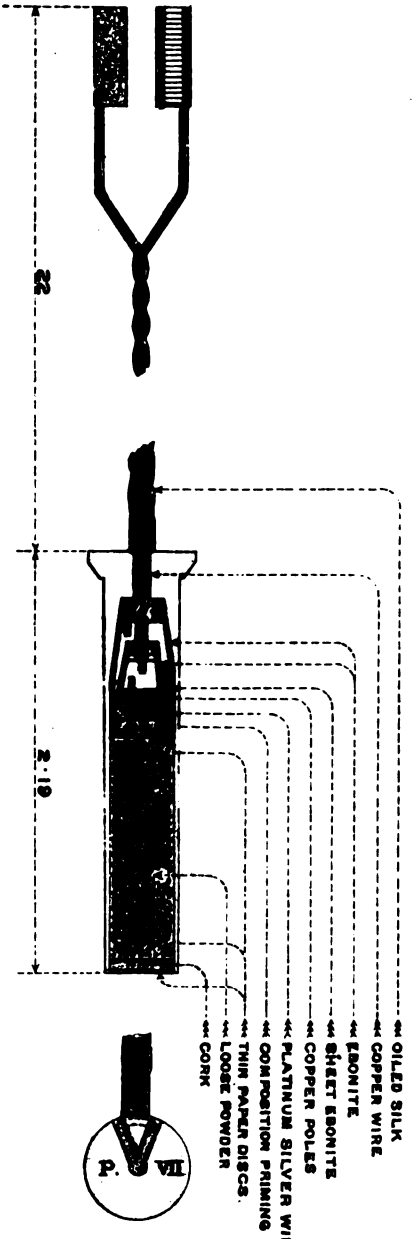
* Pellet powder is composed of siftings of R.F.G.[2] powder (24–32 mesh); it was originally used for the powder charge of ·303-inch cartridges, which was pressed into a pellet.

TUBE VENT SEALING ELECTRIC P MARK VII |C|

BRASS.

FULL SIZE.



E. Weller & Grahams. Ltd Litho. London

The advantages of the percussion tubes over ordinary copper friction tubes are simplicity, economy, and durability, and they lend themselves better to a safety arrangement for preventing the accidental firing of the gun.

The Tube, Vent-sealing, Electric, P, Mark VII, resembles the last in exterior form, dimensions and material. The interior of the body near the head is conical, and a small hole is drilled through the head, through which pass two tinned copper wires twisted together and insulated by varnished silk, on the exterior the wires are parted and led through a V-shaped groove across the head, the metal between the grooves on the head being routed out, they are then twisted together again and wrapped with oiled silk for a distance of 5 inches commencing at the head, and terminate in spirals 22 inches from the tube, the spirals are covered with sarcenet. In the interior near the head are two cones, the larger one fitting in the conical recess in the body, the small cone fitting into a conical recess in the large cone, the cones are insulated from each other and from the body by ebonite; the front end of one of the wires is attached to the rear end of the large cone, and the front end of the other wire passes through the large cone, is insulated from it, and is attached to the rear end of the small cone. One pole of copper is attached to the front end of the large cone, and the other pole to the front end of the small cone, these poles are connected by the usual platinum silver wire bridge, resistance 1·5 to 1·8 ohms, which is embedded in a priming composition of gun-cotton dust and mealed powder, contained in an ebonite cylinder closed at the end by a paper disc. The remainder of the tube is filled with pellet powder, and the end is closed by a paper disc and varnished cork disc, secured by shellac. On the outside of the cork disc is a second paper disc, to prevent the shellac on the outside of the cork, sticking to the packing pieces of the box in which the tubes are issued. The tube is lacquered inside and out. (*See* Plate VII). §§ 8655, 9763, 10500.

The wires from the battery are connected to the wires of the tube, and on a current of electricity being passed through the wires the bridge becomes incandescent and fires the tube. The cones are jammed into each other and the coned part of the body, and so prevent any escape of gas through the head. Action.

Mark VI in construction is identical with Mark VII, but the wires are led through a groove across the head, instead of the V-shaped groove, and it is without the extra 5 inches of oiled silk wrapping. § 8655.

Mark V in construction is identical with Mark VI, but the end is closed with a sulphur pellet in which is embedded a brass ball. *And it must not be used unless the range is clear.* §§ 7204, 7487.

In the Mark IV the wires, which were laid in two slots in the head, passed through it by separate holes. The wires then passed through an asbestos plug and a small air space, and were soldered to two brass poles embedded in a conical ebonite plug. § 6071.

In the Mark III the cylindrical portion of the body was entirely filled with powder, the end being closed by a cork and paper disc shellaced in; the wires were also 1 inch shorter than in the Mark IV. § 6071.

The Mark II was in construction similar to Mark III, but the wires were only 18 inches long. § 5352.

The Mark I, like the Mark II, but the wires were not tinned over, and the bridge was attached to the poles with ordinary solder. §§ 4622, 8182.

A *Tube, Vent-sealing, Electric, 6-inch B.L., with Needle Holder, Mark I,* has been approved for use in Victoria. It is almost identical,

in construction with Tube, Vent-sealing, Electric, P, Mark VII. It differs only in the conducting wires passing straight through the head instead of into a groove across it. The wires are whipped with thread above the head similar to the V and M electric tubes.

§§ 10234, 10352, 10500. *Tube, Vent-sealing, Electric, Wireless, P, Mark II, C.*—This tube in exterior form and dimensions is identical with the other P tubes. The interior cavity terminates in a cone into which fits a conical brass plug at about ·25-inch from the head; this is insulated from the body by an ebonite cone, the front end of the cone is cupped out to form a gas-check, and a hole is bored in the centre, into which screws an ebonite plug. Into the centre of this plug fits a tinned copper pole which extends the full length of the tube. This pole is bent, and attached to the body of the tube at the mouth with pure tin. The pole and edge of the brass cone are connected by the usual platinum-silver bridge attached with pure tin. At the rear end of the cone a small hole is drilled, a little out of centre, to receive the bared end of an insulated copper wire. A turn is taken in this short wire and it is passed through a hole in the head, also drilled a little out of centre and communicating with a recess, into which screws an ebonite plug. This plug is recessed in the centre and undercut and the end of the wire passes into the recess. It is bared and coiled down upon a disc of pure tin ·025-inch thick at the bottom of the recess, the remainder of which is then filled in with molten tin. This is kept in by the undercut and forms the contact piece; its surface is slightly below that of the head of the tube. The tube is primed with the usual priming composition of gun-cotton dust and mealed powder, over which is placed a disc of paper, the remainder of the tube being filled with pellet powder. The end is closed by a cork and paper disc shellaced in, and on the outside of the cork is a second paper disc to prevent the shellac sticking to the box in which the tubes are packed. The tube is lacquered inside only. (*See* Plate VIII.) Some of these tubes have contact discs of solder. Those whose contact discs are of pure tin have the letter T stamped on the head.

Action. On contact being made the current passes from the battery through the striker which is in contact with the tin, through the short wire, cone, the wire bridge, the long copper pole, the body of the tube, and the metal of the gun back to the battery again. The wire bridge becomes incandescent, fires the priming and the powder, the gas expands the cupped-out portion of the cone, and prevents any escape of gas through the head, the body expanding prevents any escape between it and the vent.

§§ 8182, 9676, 9768. The Mark I tube differs from Mark II in having two bridges, giving a resistance of from ·6 to ·9 ohm. In the majority of Mark I tubes also the ebonite insulating plug is not screwed into the head, and the paper disc on the outside of the cork closing plug is absent.

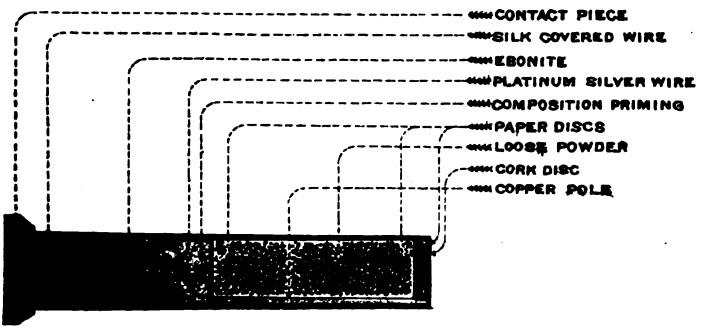
§§ 8914, 10500. The *Tube, Vent-sealing, Friction, V, Mark VII, for Guns with Tube Holders*, is made of cast brass, bored and turned. It consists of a tube proper about 3 inches long, with head and projection, and a copper draw wire projecting from the head of the tube in prolongation of its axis and terminating in a twisted loop, the complete length of the wire being about 4 inches (*see* woodcut).

The tube, which is made to fit the vent with great accuracy, is 0·4 inch diameter at its thickest part, and tapers very slightly towards the point. The head forms a circular projection which prevents the tube being forced too far into the vent, and assists the obturation; while a slot all round its exterior permits the use of the extractor.

TUBE VENT SEALING ELECTRIC WIRELESS P MARK II C

BRASS.

FULL SIZE.



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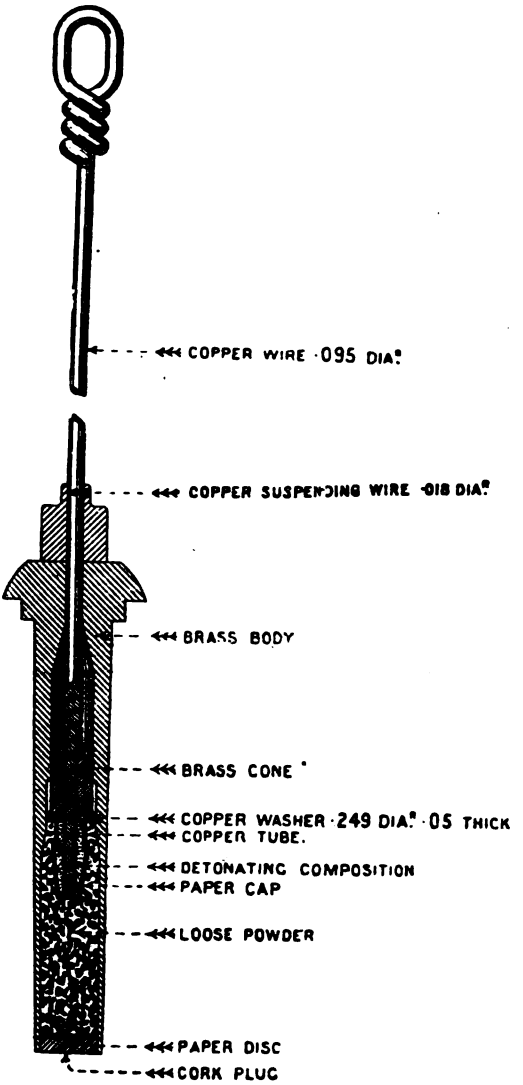
E.Weller & Grahams. Ltd Litho. London.

On the exterior of the head in prolongation of the tube is a large cylindrical projection cut completely through by a slot parallel to its axis. This projection acts as a spring, and enables the vent-sealer to be securely fixed in the tube-holder, while the latter is being inserted in the gun. On the top of this projection is a smaller one, through which passes a fine suspending wire, which also passes through the draw wire, retains it in its proper position and prevents premature action. The interior of the tube is bored out in two cylindrical cavities of different diameters, the larger being nearer the point. Between the two cylinders is a shoulder, and the smaller one

Tube, Vent-sealing, Friction, V, Mark VII, | C. |

Brass, for Guns with Tube Holders.

Scale, full size.



terminates in a coned seating. The draw wire passing through the head is screwed through a brass cone, which is free to move along the smaller cylindrical boring, and which, when pulled back, fits exactly into the seating at the end. The front end of the draw-wire, projecting beyond the brass cone, forms the friction bar, roughened as usual, which passes somewhat loosely through a copper washer, rather larger in diameter than the smaller cylinder in the finished tube; this washer is about ·15-inch beyond the shoulder. Beyond the washer the friction bar is covered with quill detonating composition (p. 554), which is retained in its position on the bar by a short copper tube and a disc of shellaced paper. The front portion of the tube is filled with pellet powder. The end is closed by a varnished cork and paper disc shellaced in.

Action. On pulling the lanyard the suspending wire is sheared, and the draw wire, cone, &c., move to the rear until the washer is brought up by the shoulder. This checks the tube through which the friction bar is drawn, firing the detonating composition. The explosion of the pellet powder fires the charge, and at the same time expands the tube and makes it fit very tightly against the sides of the vent, in which it is retained by the tube-holder, while any escape of gas *through* the tube is prevented by the cone being firmly wedged in its seating.

§§ 8655, 9768, 10500. The *Tube, Vent-sealing, Electric, V, Mark VII*, is of similar shape and made of the same material as the above, but there is no projection for the shearing wire, and the draw wire is replaced by two insulated tinned copper wires twisted together, about 21 inches long, and terminating at the end remote from the tube in spirals, which are covered with sarcenet on the exterior, and form convenient means of attachment to the wires from the battery. The wires pass through the head of the tube to which they are secured by cobbler's wax, and by a small ebonite toggle which prevents any play; while the insulation is protected outside the tube by frappings of oiled silk and thread, the bared ends of the copper wires are respectively soldered into two halves of a brass cone, which is split longitudinally and insulated, the two halves from each other by asbestos paper, and both from the body by an ebonite tube which is prolonged beyond the cone, contains the priming, and is closed by a paper disc. From the front of the two half-cones project two short copper terminals of unequal length, connected by a diagonal bridge of platinum silver wire of the usual resistance for Naval stores (*see* p. 96). To prevent any movement which might break the bridge, these terminals pass through two millboard washers placed next the cone. The priming which surrounds the bridge consists of mealed powder and gun-cotton dust. The larger chamber of the tube is filled with pellet powder, the end being closed by a varnished cork and paper disc, secured by shellac. On the outside of this disc is a second disc of paper to prevent the tube sticking to the box.

Action. The action is the same as that of the electric P tube.

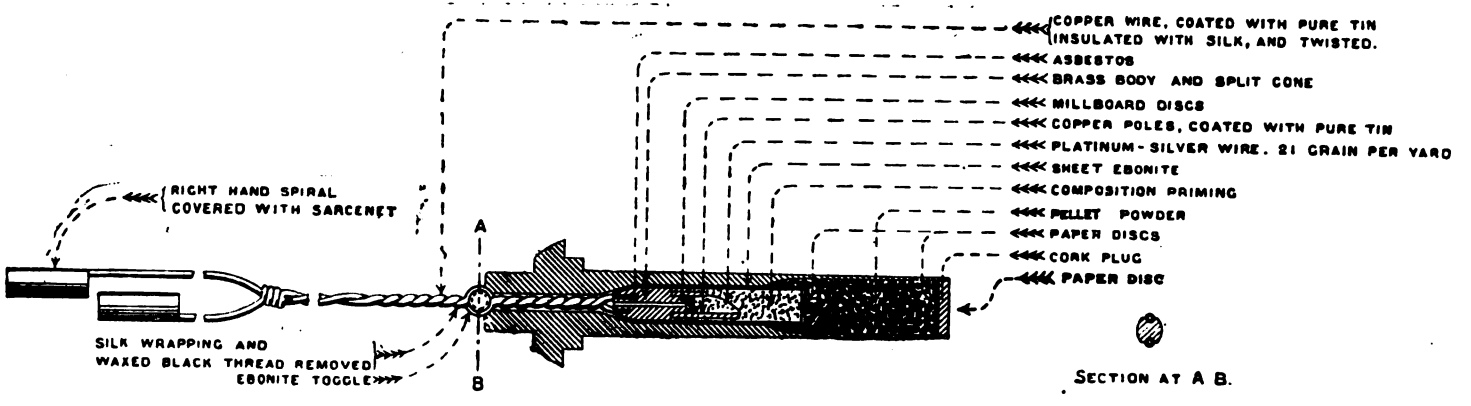
§ 8655. The friction V, Mark VI differs from Mark VII in having the draw wire screwed into one end of the brass cone, and a separate friction bar fastened into the other end.

§§ 4604, 6072, 6524. The Friction, V, Mark V, differs from Mark VI in having its end closed with a sulphur pellet in which was embedded a brass ball. Mark IV is similar to Mark VI, but the friction bar is weaker.

§§ 6072, 6524, 7487. The Electric, V, Mark VI, differs from Mark VII in having no toggle, and its end closed with a sulphur pellet in which is embedded a brass ball. Mark V is similar to VII, but has no toggle.

Tube, Vent-sealing, Electric, V, Mark VII, C, Brass, for Guns with Tube Holders.

Scale, full size.



The Electric, V, Mark IV, had the wires only 18·2 inches long. In the Mark III the wires were not tinned, and the bridge was attached to the poles with ordinary solder.

§§ 6072, 7487. The *Tubes, Vent-sealing, Friction, M, Mark IV, Electric, M, Mark VI,* §§ 8264, 8913. 9768. *for Guns with Vent-masking Slides.*—The material and the general construction of the M pattern are nearly identical with those of the V tubes. (Illustrations of them will be found in the previous edition.)

The differences are:—

1. In the friction tube the draw wire is much shorter, its total length being 1·3 inches, and it terminates in a loop of cast copper screwed on to it instead of in a twisted loop.

2. There is no large projection on the head of either the friction or electric tube.

3. The head is made more rigid by a steel disc let into the face of it.

§§ 4829, 5352, 6405. The Friction, M, Mark III, differs from Mark IV in having a weaker friction bar. The Electric, M, Mark V, had no ebonite toggle. For the differences in the Electric, M, Marks III and IV, from latest pattern and from each other, *see* Electric, V, Marks III and IV above.

All patterns of V and M tubes, both friction and electric, other than those mentioned above, may be considered OBSOLETE.

§§ 5939, 6384, 6503, 8559, 8651. P, V, and M tubes are packed in tin boxes, painted black on the outside, and secured by a tin band soldered over the joint.

Percussion tubes are packed, 10 in a flat box, heads and tails, steadied by a tin rack and pieces of paper placed over them.

Electric, wireless P tubes are also packed 10 in a flat box, heads and tails. The box is lined with cork, the bottom piece having recesses for the tubes to rest in, while movement is prevented by a second piece of cork placed over the top.

A new box has tin fittings, to which pieces of calf skin are attached, which steady the tubes and prevent movement.

The earlier boxes were lined with felt instead of cork.

Electric P, V, and M tubes are packed, 5 in a box, which is almost square. The tubes are separated by tin partitions, and movement is prevented by two end and one top packing pieces of cork. The wires of the tubes are coiled up tightly close to the head. A piece of tape is placed under one of the tubes to facilitate extraction from the box. This pattern of box is Mark III. Marks I and II were longer and wider, had tin racks for the tubes and no cork packing pieces, and the wires were not coiled so tightly. Mark I box also was sealed by a tape instead of a tin band.

Friction V and M tubes are packed, 5 in a flat box, lined with felt. Each tube fits in a felt loop, the draw wire resting in a slit made in a cross piece of felt to prevent movement. This box is Mark II. Mark I differs in having tin fittings and in being sealed by a tape instead of a tin band.

On the exterior of each box is a label giving the contents and directions for opening and reclosing the box, with instructions that it is not to be opened until required for use or special inspection. These labels are printed in red for the percussion and friction tubes, in black for the electric tubes.

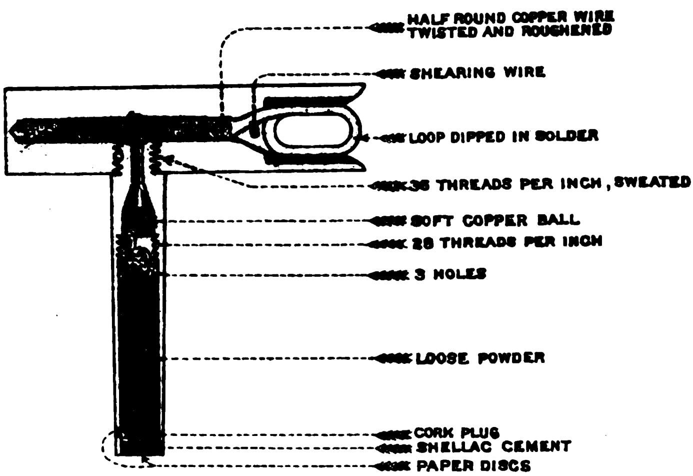
Instructions for use. § 4436. In the interior of the lid is a label giving the following "Instructions for use":—

"If there is any appearance of fouling, the vent must be carefully cleaned with the rimer supplied for the purpose.

TUBE FRICTION T MARK IV |L|

BRASS, FOR USE WITH CORDITE.

FULL SIZE.



876 E. 1900

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"The vent-sealing action of the tube depends upon an accurate mechanical fit, and consequently a very slight amount of fouling in the vent will derange it.

"Vent-sealing tubes are sometimes considered to be too high to gauge, when, in fact, the only defect is that the vent has not been properly cleaned."

These instructions, which are given with all the Service tubes, are most important. To them is added, in the case of the friction tubes—

"The pull of the friction vent-sealing tubes is rather different to that of the copper friction tubes, requiring a more sudden application of power. In firing these tubes care should be taken that the lanyard is always held as nearly as possible *in prolongation of the axis of the gun*, so that it is not pulled at an angle with the draw wire of the tube."

And in the case of the electric tubes—

"The weight of the bodies of these tubes being so great in proportion to the strength of the conducting wires, great care should be taken in handling them, so that no undue strain may be given to the wires, and thus affect and perhaps break the fine wire bridge.

"As much as possible these tubes should be handled by their bodies, and not by their conducting wires."

For storage these tubes are classed in Group II, Division I. Storage.

Instructions for proof of these vent-sealing tubes will be found in the Regulations for Army Ordnance Services, 1900. Proof.

Tube, friction, T, Mark IV, brass for guns with T vents, consists of the following parts:—Body, head, friction wire, shearing wire, brass pin, copper ball, screw plug, gutskin disc, and two cork plugs. (*See* plate IX). The body is made of solid drawn brass, slightly coned to fit the vent, and bored out to receive 8 grains of pellet powder, above which it is screwed to receive a screw plug having three fire-holes on top of which rests a small copper ball, and the upper part of body above the ball terminates in a cone, a small hole is bored through the upper part from the end of the cone to admit the flash from the detonating composition, and the exterior is screwed to fit into the head. The head is made of gun-metal, rectangular in form, and screws on to the body, and is secured by a brass pin, a hole is drilled into the head at right angles to body to receive the friction wire, and one end is countersunk, as shown in the plate. The friction wire is made of half round copper wire twisted and roughened. A large loop is formed at one end by two turns of the wire, which are fixed together by dipping the loop in solder. The wire does not extend through the head, and is retained in place by a shearing wire of tin and antimony, passing through the head and friction wire, near the loop. A hole is bored into the side of the head at right angles to it, so as to come over the fire-hole of the body, and is screw-threaded at the end. Detonating composition is pressed into this hole, surrounding the roughened part of the friction wire, and the hole is closed by a gut-skin disc, a cork plug shellaced, and shellac cement outside it. §§ 5904, 9768, 10025.

The bottom of the body is closed by a cork plug, shellaced in, and filled up flush with shellac. A disc of paper is placed on the outside of this to prevent the shellac sticking to the box in which the tubes are packed. The tube is lacquered inside and out.

The strength of the shearing wire is tested in an instrument in which the weight of 3 lb. falling 7½ inches must fire the tube, while a drop of 2½ inches must not fire it.

The tube being held in the T vent, when the friction wire is withdrawn the flash from the detonating composition passes down Action.

the small hole in top of the body over the copper ball and through the fire-holes in screw plug, and ignites the powder, the gas from which forces the ball into the cone seating and so prevents any escape of gas through the head, it also expands the body, and so prevents any escape of gas between it and the vent, the flash ignites the charge.

§§ 9054, 9768. Mark III differs from Mark IV only in the loop of the friction wire, which is smaller.

§ 8560. Mark II differs from Mark III in having the hole for the friction wire bored completely through the head; the end of the hole enlarged and the ends of the friction wire splayed out in the enlarged part. The hole is then closed by a cork plug.

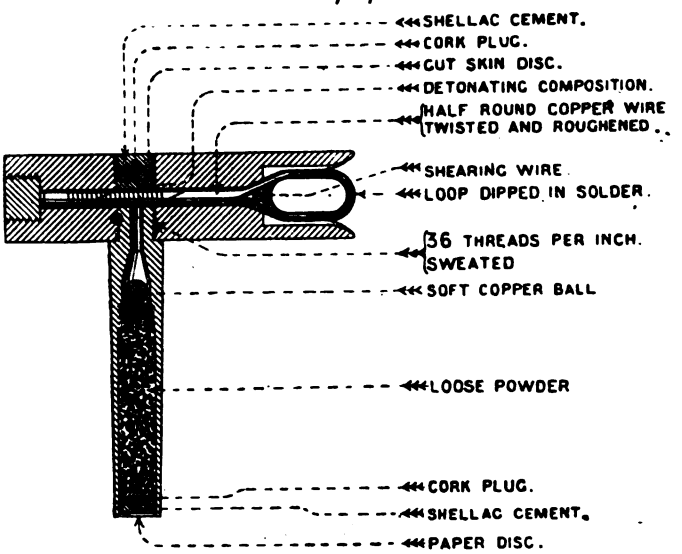
§§ 9520, 9768, 10269. These tubes are being converted to Mark II,* by being made as nearly as possible like Mark IV. The end of the hole is closed by a screw-plug and a shearing wire is inserted through the friction wire, which has the large loop, the head being further slotted out to receive it. (*See cut*). A paper disc is also placed outside the plug closing the body.

Mark I differs from Mark II in having the friction wire made of ordinary twisted wire, and in the detonating composition being pressed into a hole in the head in prolongation with the body instead of at the side. The hole for the friction wire was not closed by a cork plug.

Tubes, Friction T.

Brass, for use with Cordite. Scale, full size.

MARK I*/L/.



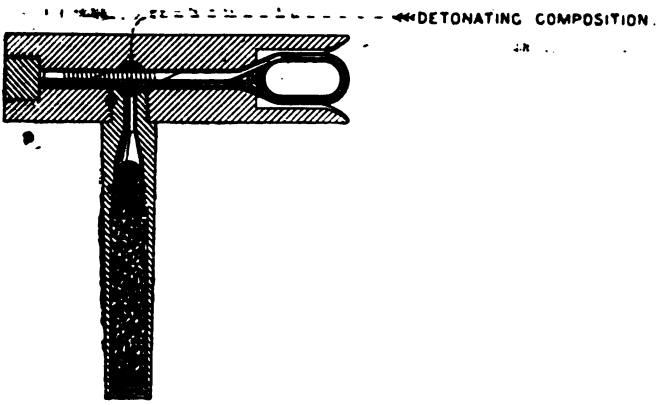
§§ 9573, 9768, 10269. It also is being converted to Mark I* in the same way as Mark II, having the half round friction wire, hole closed by a screw plug, shearing wire and paper disc over closing plug of body (*See cut*).

§§ 8839, 9786. *Tube, vent-sealing, electric T, double wired, Mark I*, resembles the last in exterior form, dimensions, and materials.

It is furnished with two tinned copper wire terminals, insulated with silk, one coloured green and one red. The red terminal is

Mark II | L | .*

Full size.



called the "ground" wire and is merely attached to the head of the tube. The green terminal passes through a hole in the head and is secured with tin to a copper pole. This copper pole has a ball formed on it, immediately below which it passes through an ebonite plug. The ball and upper part of the pole are insulated from the body by silk and an ebonite cone. A strip of brass with two projections, one long and one short, is bent round the lower part of the ebonite plug. The short projection forms the second pole, while the long one is attached to the end of the body by tin. The two poles are joined by a platinum-silver bridge, ·2-inch long, resistance 1·0 to 1·3 ohms. The bridge is surrounded by a priming of 1 grain of mealed powder, separated by a disc of paper from about 5 grains of pellet powder. The tube is closed by a cork plug and shellac cement, to which is attached a paper disc to prevent sticking to the box. If this tube is used with an "earth return," it is necessary to connect the green terminal to the battery. The terminals are twisted together above the head, wrapped with oiled silk for about 1 inch, and terminate in spirals covered with sarcenet the same colour as their insulation.

Action. The current passes through the terminals, head and body, the poles and bridges, raises the latter to incandescence and so fires the priming and powder. The gas forces the ebonite plug and copper ball into the coned seating, thus sealing escape of gas.

Use. 5-inch and 6-inch (30 cwt.) B.L. howitzers, and 3-pr. Q.F. Hotchkiss and Nordenfelt guns connected with position finder for instructional purposes.

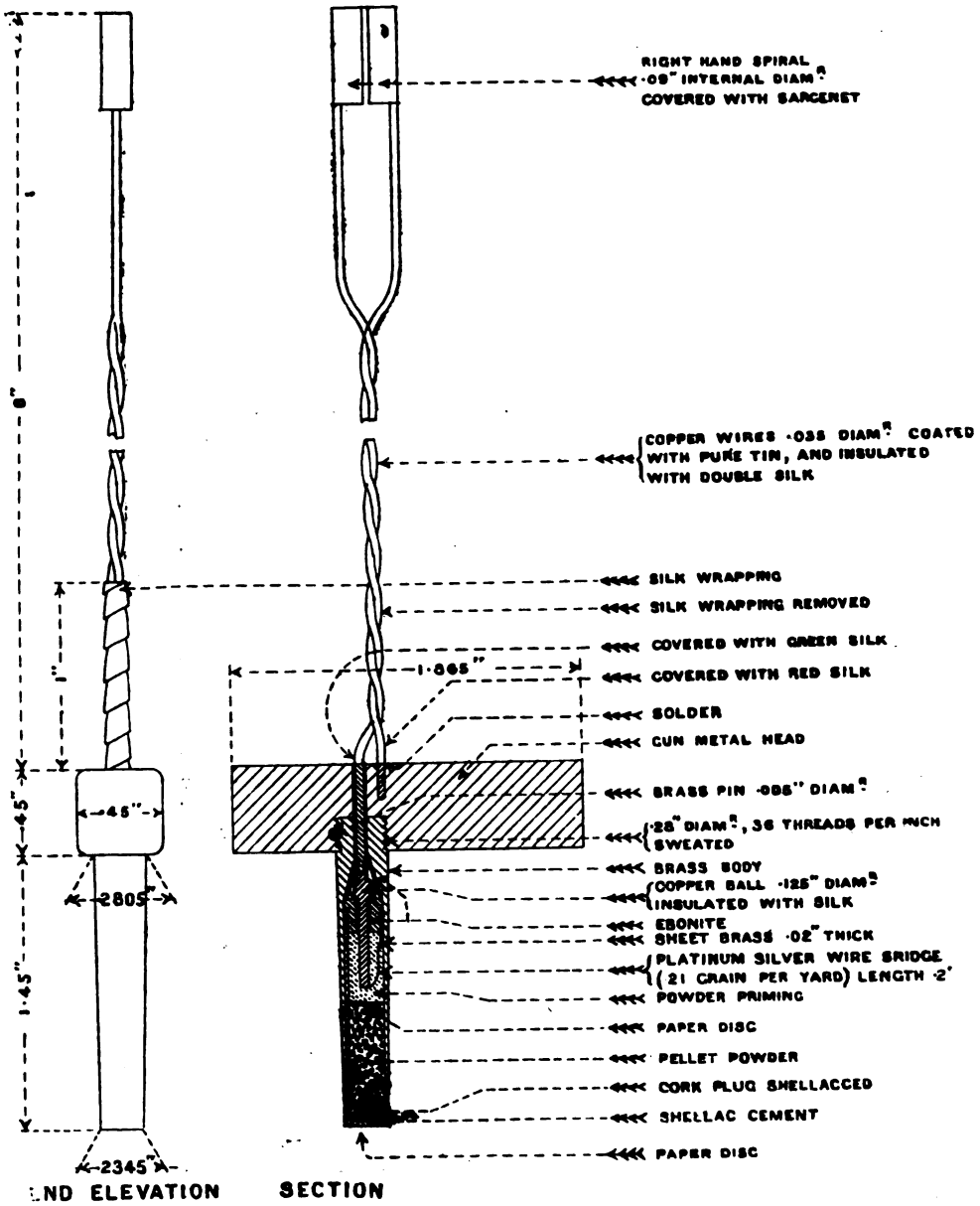
§ 7867. T friction tubes are packed 10 in a square tin box, painted black, and having both top and bottom removable; secured by tin bands soldered over the joint. Inside the box at each end there is a partition, with a corrugated strip for holding five tubes. Movement of the tubes is prevented by a cork packing piece and a felt wad on top. There is a tape band under the fifth tube to facilitate removal. This makes a neat package, and if only one or two tubes are required, five out of ten remain hermetically sealed.

§ 8839. T electric tubes are packed ten in a similar, but larger box. The tubes are kept apart by tin partitions and are steadied by cork packing pieces. These boxes have the usual labels as to opening, reclosing, &c.

For storage these tubes are classed in Group II, Division I.

Tube, V.S., Electric, , Double Wired, Mark I, L, Brass.

Scale, full size.



Proof.
A.O. 52, March, 1896.

Instructions for proof will be found in the A.O. Regs., 1900.

T-friction tubes will as soon as possible, and not later than 24 hours after firing, be immersed in ordinary mineral oil for 24 hours, and, after removal, be allowed to drain.

§§ 6286, 8731.

Primer, Vent, B.L., Mark I.—This primer is intended for use with

9·2-inch B.L. guns and upwards, when miss-fires occur with vent-sealing tubes without ball, and also for second proofs of the same tubes by Inspectors of Warlike Stores, when first proof has failed to ignite the puff.

It consists of a brown paper tube 4·5 inches long, and ·18 inch in diameter, filled with fine grain powder, the ends being closed by discs of fine white paper fastened on with shellac.

They are issued 50 in a tin box. These primers are to become obsolete as soon as the existing stock is used up. Issue.

Primer, Vent, Cordite, Mark I, is for use with vent-sealing tubes without ball, in B.L. guns, 8-inch and upwards, with powder charges only, and is put in the vent after the breech is closed and before the tube is inserted. § 8103. § 8227.

It consists of a stick of cordite, size 20, cut 4·75 inches long.

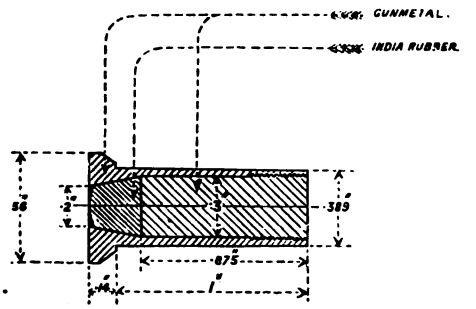
The primers are packed 10 in a box, which is lined with felt, and closed with a tape band shellaced on.

For each pattern of Service vent-sealing tube there is a corresponding drill tube, except for the electric M-tube, which has no drill representative. Drill tubes.

The *Tube, Vent-sealing, Percussion, Drill, Mark I,* which is used for drill with guns having percussion locks, is of gun-metal and hollow. Into the head is fitted a coned india-rubber plug, as shown in the woodcut, and the lower part is closed by a gun-metal plug. § 4780.

Tube, Vent-sealing, Percussion, Drill, Mark I.

Scale, full size.



The *Tube, Vent-sealing, Electric, P, Drill, N, Mark VI,* is of gun-metal, and for use with guns having percussion locks. It is in three parts, screwed together and milled outside. The insulated copper wire terminals pass through a slot in the head, and are continued at right angles into the interior, the holes bored for their reception in the head being lined with ebonite. The slot in the side of the head is covered with a small brass plate let in; this affords the wires more protection from friction against the percussion lock. The wires are whipped together near the head with black thread, and terminate in spirals 22 inches distant from the tube. The ends of the wires which project into the interior are connected by the usual Naval bridge. In this tube there is an extra wrapping of oiled silk, 5 inches long, on the leads, commencing at the head. §§ 10234 10312.

The central portion of the tube is filled with the usual priming composition of gun-cotton dust and mealed powder, and the end closed

by a paper disc. The body of the tube is strong, and contains a charge of pellet powder; the end is closed by a paper disc.

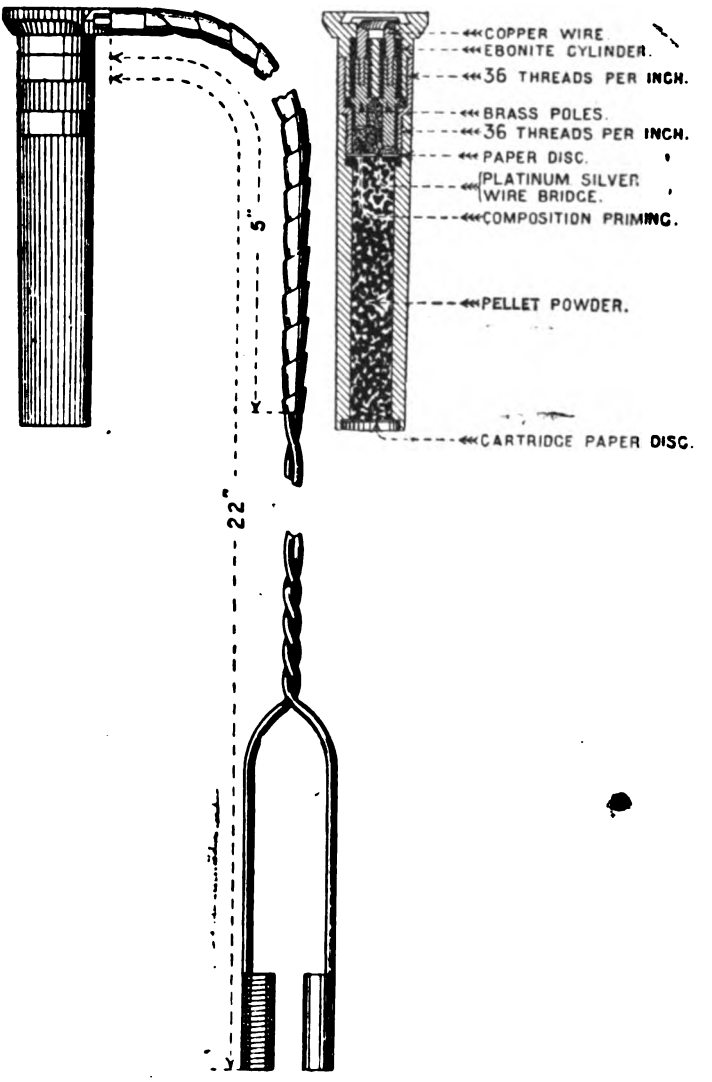
§ 8112. The Mark V tube only differs in having a double bridge, resistance ·6 to ·9 ohm, and has a tuft of gun-cotton laid on the bridges.

§ 7601. Mark IV differs from Mark V in not having the extra wrapping of oiled silk on the leads.

Tube, Vent-sealing, Electric, P, Drill, Naval, Mark VI, N.

Metal.

Scale, full size.



§§ 6072, 6143, 9675. The Mark III is a Land Service tube and is to become obsolete when the stock is used up. It is much shorter and has a solid body. Two holes are bored through the head for gas escape, which are lightly stopped with luting. There is no pellet powder charge, and

the tube has a single bridge. A drawing of this tube is given in the previous edition.

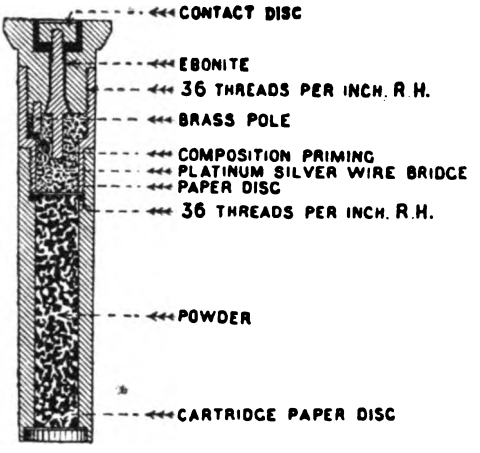
Mark II had the conducting wires only 18 inches long, otherwise it is similar to Mark III. § 5869.

In the Mark I tubes the wires in the grooves in the head were not protected by the brass plate referred to above, and consequently were liable to injury in use; and the conducting wires terminated in brass spring sockets instead of spirals. § 4870.

The *Tube, Vent-sealing, Wireless, Electric, P, Drill, Mark II, N.*— In external appearance this resembles the Service percussion tube, but it is milled on the exterior. The body is in three portions— §§ 1025c, 10312.

Tube, Vent-sealing, Electric, Wireless, P, Drill, Mark II, N, Brass.

Scale, full size.



head, middle piece, and bottom—which screw together. A hole is bored through the head, coned at the bottom, into which fits a brass pole insulated by ebonite. This central pole is joined to a brass pole let into the head by a single bridge of platinum silver wire (resistance 1·5 to 1·8 ohms). The outside end of the central pole is screwed into a tin disc, and insulated from the head by ebonite. The middle piece is filled with priming composition, and the bottom part with pistol powder. A paper disc separates the priming composition and the powder, and a paper disc secured by shellac closes the end of the tube. In some of these tubes the contact disc is of lead and tin. Those with pure tin discs have the letter T stamped on the head.

Action.

The action is identical with that of the Service tube.

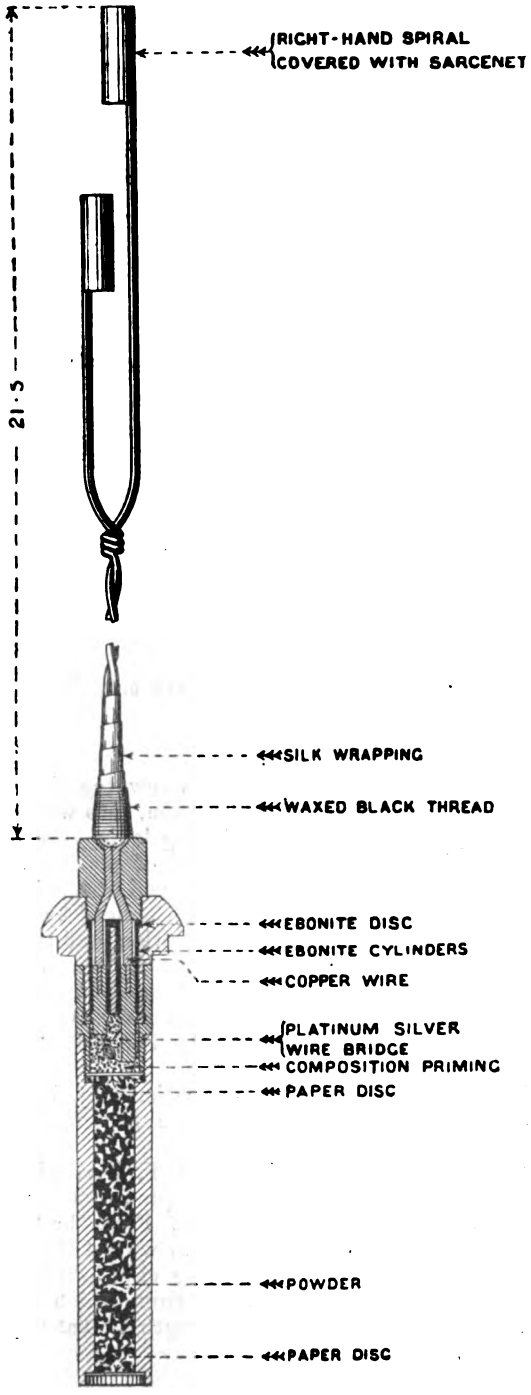
The Mark I differs in having a double bridge, resistance ·7 to ·9 ohm. § 10256.

The *Tubes, Vent-sealing, Friction, Drill, V, Mark II, and M, Mark I*, are similar, and consist of a gun-metal plug of the same exterior form and dimensions as the Service article. From the head protrudes a steel wire of the same length as the draw wire of the corresponding friction tube, which terminates in a spring clip, into which the hook of the lanyard is inserted at drill, and from which it can be withdrawn by a pull of about the same strength as that required to fire the Service tube. § 4702.

Tube, Vent-sealing, Electric V Drill, Mark IV | N. |

Brass, for Guns with Tube-holders.

Scale, full-size.



The *Tube, Vent-sealing, Electric, V, Drill, Mark IV*, generally resembles the Service tube in shape; its construction is shown in the woodcut. §§ 10234, 10312.

Mark III only differs in having a double bridge. Mark II is described in former editions of the treatise. Mark I had wires 3 inches shorter than Mark II. § 4762.

Tube, Friction, T, Drill, Mark I, as its name implies, is for drill purposes, with guns fitted with T vents. It is made of hardened steel, and resembles in form the Service tube; the head is slotted out and a lip formed on lower part, a curved spring is fitted into the slot in the head, which offers about the same resistance to the pull of lanyard as the friction wire in Service tube. §§ 7867, 10539.

Fired service T tubes which are unsuitable for refilling are rectified, bronze lacquered, fitted with a wooden plug and issued for drill to batteries equipped with B.L. 12-pr. or 15-pr., Marks II to IV guns. § 10667.

Vent-sealing drill tubes are all issued in tin boxes containing 10. Issue.

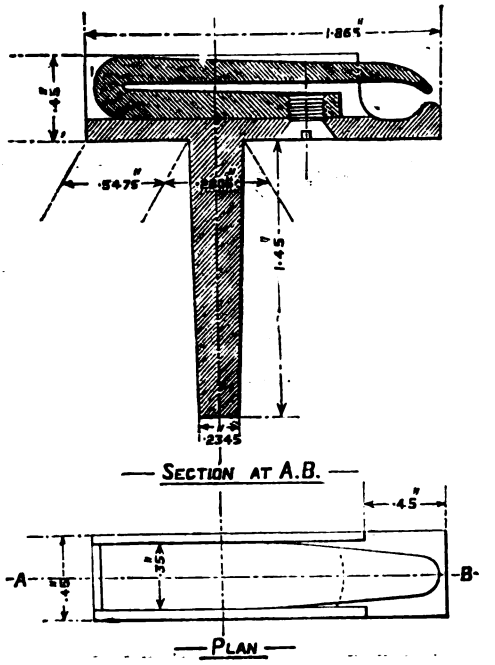
When filled, electric drill tubes are treated as explosives of Group II, Division I. Storage.

To refix bridges and reprime drill vent-sealing tubes:— Instructions for refixing bridges.

1. Unscrew the centre and bottom portions from the head.
2. Clean the tube with a hog's hair brush, dipped in methylated spirit.
3. Clean the ends of the poles with a smooth file, taking care not to remove more of the metal than necessary.
4. Tip the poles with a small quantity of pure tin; using resin as a flux.

Tube, Friction, T, Drill, Mark I.

Scale, full size.



5. Solder one end of the wire (platinum silver ·21 grain per yard) to one pole with pure tin, and stretch the wire across a piece of wood as a support, and solder it to the other pole, then cut off the loose end with a pair of scissors.
6. Test the bridge with a Menotti test battery; a good deflection of the needle should result.
7. Stop the holes in the head of the P tube (except Marks IV and V and wireless electric P) with luting; or the holes in the middle portion of the V tube with white fine paper.
8. Screw on the middle portion of the tube, and fill it with priming composition, tapping the tube to ensure the priming being in contact with the bridge.
9. Screw on the bottom end of the tube.
10. Pack in tin boxes, close with a tape band and shellac, and mark the labels "Refilled," with station and date.

Stores used in connection with vent-sealers.

Rimer. § 9761.

To keep the vent properly clean and free from fouling, a *Rimer, vent, axial, short, Mark IV*, made of bronze, is supplied. It forms the frustum of a cone accurately fitting the vent on one side, while the removal of three faces from the opposite side leaves it in the form of a frustum of a hexagonal pyramid, the angles of which remove the fouling or dirt without injuring the steel vent.

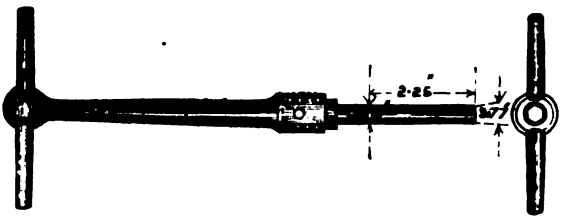
The rimer has a cross handle with a long shank, so that it may be used in the guns fitted with tube-holders as well as others fitted for vent-sealing tubes. It is suitable for all axially vented guns, except those having T-axial vents; also for adapter, cartridge, Q.F. or Q.F.C.

§ 6400, 8727.

The Mark III rimer only differs from Mark IV in length, which is shorter. The handle of Mark III fouls certain fittings in the B.L.

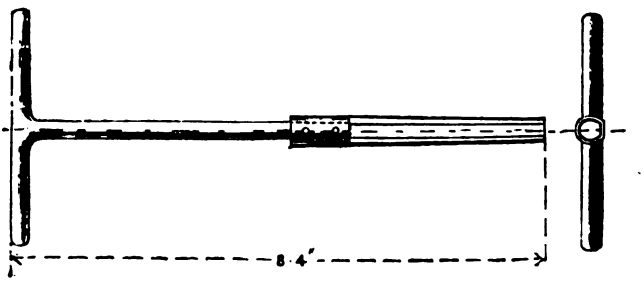
Mark II.

Scale, ½.



Mark III.

Scale, ½.



6-inch, Mark VII, and so it is only suitable for other axially vented guns; it is also suitable for adapter cartridge Q.F. or Q.F.C.

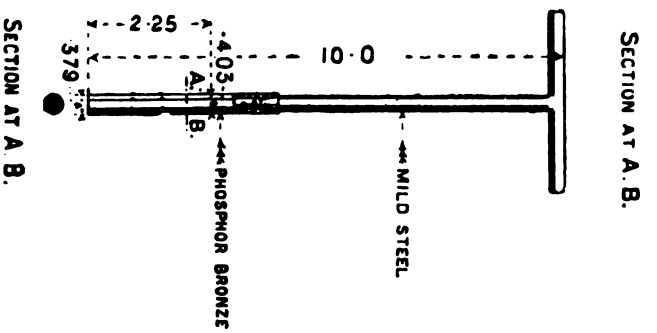
Mark II differs from Mark III in a shoulder on the handle, where the bronze coned portion is attached. This shoulder fouls the chamber for striker in the D-pattern lock. Mark II is consequently suitable for axially vented guns (except those having T axial vents, or percussion locks D, 12-inch Mark VIII and IX, and 9·2-inch Mark VIII, IX, and X), also for adapter, cartridge Q.F. or Q.F.C. § 4595.

Mark I rimer is obsolete. §§ 4225, 4595.

Rimer, Vent, Axial, Short, Mark IV | C. |

Bronze, for Axially-vented Guns, excepting those with T axial-vents, also for Adapter Cartridge Q.F. or Q.F.C.

Scale, ½.



Rimer, Vent, Axial, long, Mark I, for use with guns using cordite primers, resembles the Mark III, but the bronze portion is 6 inches longer, which is reduced in diameter to ·21 inches, and for a length of 4·4 inches is grooved spirally for removing the fouling of the primer vent cordite. § 8096.

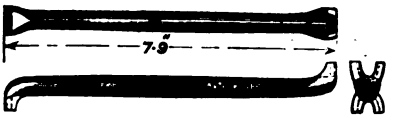
Rimer, Vent, T, Mark I, is identical in construction to rimer, vent, axial, Mark III above, but smaller to suit the diameter of the T vent. §§ 7860, 10456.

There are two patterns of Extractors, tube, P, viz.:— Extractors.

Extractor, Tube, Special, box slide, "A," Mark I | C |, is for use with B.L. 12-inch Mark IX; 9·2-inch Marks X and IX; 6-inch Marks VII and VIII; and B.L. "C" 5-inch, when the vent-sealing tube is so tightly jammed in the vent that the extractor in the slide box fails to remove it. It is generally similar to the "Extractor, tube P special," described below, from which it differs principally in the sheath at the front end, which is arranged to suit the recess in the slide box when the electric and percussion lock is withdrawn as far as the jammed vent-sealing tube will admit. § 10887.

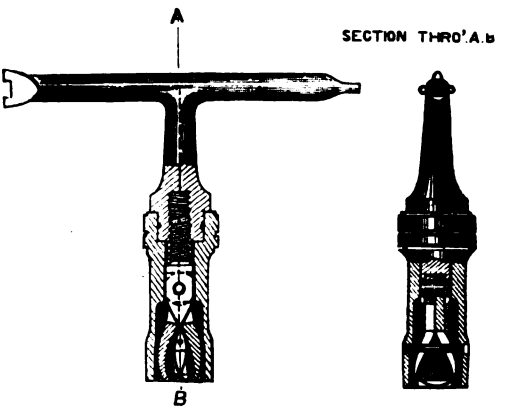
Extractor, Tube, P, Mark I, is of the form shown in the woodcut, and is intended for extracting vent-sealing tubes from the vents of guns fitted with percussion locks other than those fitted with D locks. § 4872.

When the tube is so tightly jammed that it cannot be extracted by means of this instrument the extractor, tube, P, special, must be employed. In all cases the lock must be first removed before this extractor can be applied. §§ 4873, 7228.



It consists of a sheath containing a bolt with a screw thread on the inner end, and two small levers hinged to the outer end. A revolving cross-handle actuates the threaded portion of the bolt, a small bar between the levers causes them to diverge on passing out of the sheath; and their outer ends, which are semi-circular in form, are lipped so as to clip the head of the tube.

Scale, ½.



The cross-handle is then turned till the ends of the levers protrude sufficiently to admit of their being placed over the head of the tube. On turning the handle in the opposite direction the tube is gripped and forcibly extracted.

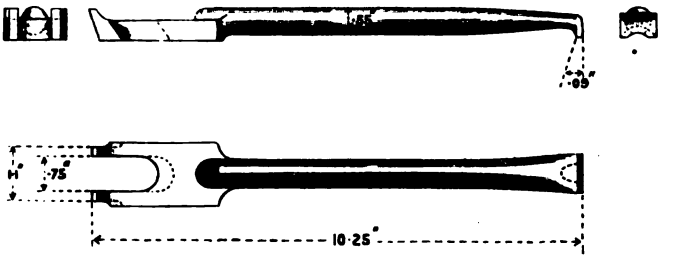
§ 6037. *Extractor, Tube, F, Special, Mark I,* is intended for special use with R.M.L. axially-vented guns. It is made of steel similar in construction to the extractor, tube, P, special, described above, with the following exceptions:—The sheath is prolonged beyond the levers, and is furnished with a projection on the side, which fits into the groove prepared for the guide-tube holder, and prevents it revolving while the tube is being withdrawn. The ends of the revolving cross-handle are rounded.

§§ 7080, 7228, 8908. *Ordnance, B.L., Lever Extractor,* consists of a steel rod about 9 inches in length, having toe pieces at either end, which may be inserted in the loop of the extractor to which the lanyard is attached, the sides of the lock frame affording a fulcrum. It is intended for use in the extraction of vent-sealing tubes, in the event of the latter being found to be jammed in guns fitted with electric B, and percussion D locks, and also with the 12-inch Marks VIII and IX, 9·2-inch Marks VIII and IX, and 13·5-inch guns.

§§ 4218, 4330, 4595. There are also two patterns of *Extractor, tube,* for use with V and M tubes, both consisting essentially of a bent lever with one long arm which forms the handle, and one very short arm which fits into the slot under the head of the tube. They are made of steel, and the other extremity of Mark II is formed into claws which are used for

starting the slide in guns which take the M pattern tubes, Mark I is without these claws, and will be withdrawn. § 4874.

Scale, ½.



A *Box*, *Tubes*, *Vent-sealing*, *Garrison*, *Mark I*, is supplied to hold the tin boxes of vent-sealers in the works stated in its name when opened for use in action. They are painted red, and are intended to be suspended against the walls in the most convenient position. §§ 4514, 5402.

For Naval Service the vent-sealing tubes are carried in a leather pocket, strapped round the waist of one of the gun's crew. The rimer is carried in a leather case and the extractor in a frog similarly attached. § 4724.

Lanyards are used with friction tubes, with percussion locks, and with Q.F. guns. Those for the L.S. are made of white line tarred; the Naval lanyards are made of white line untarred, and have a loop to allow of half cocking. The rocket machine lanyard, although for Naval Service, is tarred, as also are the 6-inch and 3-pr. Q.F. lanyards. Lanyards.

The following is the present nomenclature of lanyards:—

Lanyards, friction tube	White line tarred.	Land Service.
Field Mark III	5 feet 5 inches.	§§ 6742, 6826.
„ T, Mark I	White line tarred, with extractor, 4 feet 9 inches, for guns with T vents.	7049, 7865.
„ „ „ II	With extractor, 4 feet 9 inches for guns and howitzers with T-vents.	§ 10405.
Siege, No. 1, Mark IV	With toggle, 5 feet 5 inches, for R.M.L., and R.B.L. siege guns and howitzers.	§ 10145.
„ No. 2, „ II	With toggle, loop and auxiliary lanyard, 15 feet, for B.L. siege guns.	
Garrison, No. I, Mark III	Without toggle, 11 feet 10 inches, for 16-inch, 12·5-inch, Mark II.	§§ 6742, 7049.
No. 2, „ V	With toggle and loop, 11 feet 10 inches; for B.L. 6-inch guns on disappearing carriages, when using shield sights; B.L. 10-inch and 9·2-inch guns on disappearing carriages, when using gun sights; also Moncrieff mountings.	§§ 6826, 7049, 7179, 9857.
„ No. 3, „ IV	With toggle and loop, 8 feet 8 inches; for R.M.L. guns, 12·5-inch, Mark I, and under, and for S.B. guns; B.L. 6-inch guns (including those on disappearing carriages only when using gun sights); B.L. guns above 6-inch, except those on disappearing carriages, or Moncrieff mountings.	§§ 6742, 6826, 7049, 9857.
„ No. 4, „ II	Without toggle, 15 feet, 17·72-inch R.M.L. guns.	§§ 6742, 6826, 7049
No. 5, „ I	With toggle, 16 feet; for B.L. 10-inch and 9·2-inch guns on disappearing carriages, when using shield sights.	

§ 9449.	Garrison, No. 6, Mark I	With steel standing line; for R.M.L. radially vented guns on garrison carriages with rear sighting steps.
§§ 8656, 9628.	Q.F. Rear Firing	With fork and wood toggle, 3 feet; 4·7-inch, B, and 12-pr.
§ 9104.	Lanyard Firing, Hotchkiss, Mark I	Wire cord, with firing piece. } for 3-pr. Q.F. garrison, recoil, carriage.
	„ „ Nordenfelt, „	Wire cord, with spring clip. } for 3-pr. Q.F. garrison, recoil, carriage.
Naval.	Lanyards, friction tube	White line.
§§ 4391, 7049, 10115.	Long — Turret vessel, Mark III ..	With toggle and loop, 18 feet 6 inches.
	Long — Turret vessel, Mark IV ..	With toggle and loop, 32 feet.
§ 8298.	Long — 64-pr., 64-cwt., „ III ..	With toggle and loop, 9 feet 8 inches.
	Long — 64-pr., 71-cwt., „ III ..	With toggle, 9 feet.
	Short, Mark III	With toggle and loop, 8 feet 8 inches.
	Rocket machine, with pulley and block, Mark III	Tarred, with toggle, two pieces, one 5 feet 5 inches, and one 1 foot 3 inches.
§§ 6847, 6967, 8713, 10236. Quick firing.	B.L. or Q.F. side firing, Mark II, N..	White line with loop, hook, and brass toggle, 4 feet 2 inches, B.L. 6-inch, Marks VII and VIII Q.F., 6-inch, 12-pr., 12-cwt., and 8-cwt. guns.
§ 7745. § 8713. § 8271.	B.L., Q.F., or Q.F.C. rear firing, Mark II, N.	White line with loop, hook, and brass toggle, 8 feet, Q.F. 4-inch, Mark II, Q.F.C. 4-inch, and B.L. guns.
	Q.F. or Q.F.C. rear firing, Mark II, N.	White line with fork and metal toggle, 3 feet, Q.F.C. 6-inch, Q.F. 6-inch, B. 4·7-inch, B, 4-inch, Mark III, and 12-pr., 12-cwt., A, and 8-cwt. guns.
	12-pr., side firing N, Mark I ..	With loop, hook, and brass toggle, 3 feet 6 inches.
	„ rear firing N, „ I ..	White line, with loop, fork, and brass toggle, 1 foot 1 inch.
	6-pr. Nordenfelt, Mark I	For 6-pr. Nordenfelt Mark I gun.
	3-pr. „ „ I	Tarred, with toggle and spring clip, 2 feet.

For details of previous patterns, *see* former editions of this work.

Cocking. §§ 6910, 10145.

Lanyard, Cocking, Mark I, is made of white line, tarred, with toggle and hook, and is intended for use with B.L. guns with percussion locks, except lock D, to prevent injury to the man re-cocking the lock after a miss-fire, by the gun recoiling, should it be accidentally fired during the operation. This lanyard will be made up locally as required. In future this lanyard is to have a spherical toggle, stamped with the letter "C."

§§ 2856, 3207, 3883, 6855. A.C. 1887, Cl. 124.

Vent-Servers are used instead of employing the thumb, as was formerly the practice in serving the vent of a gun; also for plugging the vents of guns mounted in warm climates, the lanyard being removed for this purpose. The present pattern is Mark IV (*see* cut).

It is forged out of Bessemer steel. The lanyard passes through two holes in the head. The body which enters the vent is conical and is covered with a thick conical piece of leather. At the bottom is a screw on which fits a nut, which keeps the leather in position, and can be removed so as to put on a fresh leather when necessary. The nut is riveted over to prevent it unscrewing and the leather cone becoming detached.

For details of previous patterns, *see* former editions of this work, and § Changes in War Stores given in margin of this work.

Use of vent-servers.

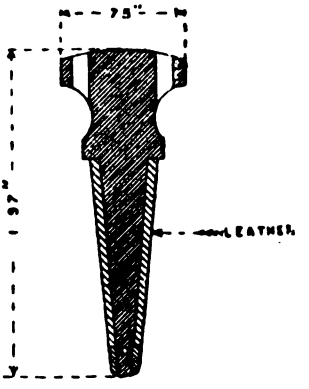
Vent-servers are used in L.S. with all R.M.L. guns and howitzers from 25-pr. gun inclusive; also with S.B. garrison ordnance.

In N.S. they are to be used with all guns.

Vent-servers will be issued complete with lanyards for N.S., and

for siege guns, and batteries of position; but for garrison service the whipcord will be demanded separately, and the lanyards fitted locally; because the loop fits over the hind sight of the gun, and the length is regulated accordingly.

Vent-Screw, Mark IV, L, Steel, without Lanyard.



The length of the whipcord required for each lanyard, so as to admit of a loop of about 2 inches in length being spliced at the end, is as follows:—

	Inches.
12·5-inch gun of 38 tons	45
12 „ „ 35 „	
12 „ „ 25 „	35
11 „	
10 „	
9 „	25
8 „	
80-pr. converted guns	
64-pr. wrought iron guns	
7-inch guns	20
64-pr. converted guns	17
40-pr. guns	
25-pr. „	
9-pr. and 7-pr. guns N.S.	
R.M.L. howitzers	
S.B. ordnance..	27

Plug, Vent, Hayes pattern, Mark I, is a disc of india-rubber and a leather plug to fit the vent.

Plug, Vent, T, Mark I, is made of gun-metal with a cross-head. § 840. The head has a loop screwed in, and a steel spring; the body is covered with leather. It is used up with B.L. 15-pr. Mark I guns with Mark I radial T vent.

Mark II differs from Mark I in having no leather washer covering on stem. A leather washer is provided at the upper end of the stem under the head, to close the tube chamber when the plug is in the vent.

CHAPTER IX.—GENERAL REMARKS ON FUZES.

USES AND CLASSES OF FUZES.—FUZE HOLE GAUGES.—GENERAL REMARKS ON WOOD TIME FUZES.—GENERAL REMARKS ON METAL TIME FUZES.—GENERAL REMARKS ON PERCUSSION FUZES.—BLINDS.—PREMATURES.

Uses and classes of fuzes.

THE bursting charge of a shell is ignited by means of a fuze so contrived as to act at any particular moment during its flight, or upon or after impact.

There are four principal classes of fuzes:—

1. *Time Fuzes*, which are ignited by the shock or flash of discharge, or by the rotatory motion of the shell, and which are so arranged as to communicate fire to the bursting charge at the expiration of an interval of time, this interval being regulated before the shell is fired by boring or setting the fuze.

These may be subdivided into two classes:—

(*a*) Those in which the composition channel is parallel to the axis of the fuze, as in the 15-seconds wood time.
(*b*) Those in which the composition forms a ring near the circumference, as in the sensitive time fuzes.

2. *Percussion Fuzes*, which communicate fire to the bursting charge when the shell strikes or grazes.

These may again be sub-divided into—

(*a*) The fuzes intended to act upon graze; and
(*b*) Those designed to act on direct impact only.

The fuze may or may not be prepared to act by the shock of discharge, according to its construction, *e.g.*, the R.L. Percussion Fuze is so prepared, the Direct Action is not.

3. *Double Action* or *Time and Percussion Fuzes*, which combine in one the properties of the other two classes. That is to say, they can be set as time fuzes, but supposing the time arrangement not to effect its object, they will also act as percussion fuzes.

The time and percussion fuze is an example of this class.

4. *Delay Action Fuzes.*—In these, a percussion arrangement ignites a column of composition on impact. This burns for a short time before igniting the bursting charge, thus giving the shell time to penetrate.

Example. The Direct Action, Delay.

The various fuzes now in the Service, will be fully described in the following chapters. The majority of fuzes fit into a fuze hole at the nose of the shell, and there are now only two sizes of fuze hole in the Service, (omitting the ammunition for Smooth Bore Ordnance, detail of which will be found in former editions of this Treatise).

These two fuze-hole gauges are the General Service and the Armstrong Field Service.

With two exceptions, the "E" Time Fuze and the "B.L. Plain" percussion fuze which fit the latter gauge, all the nose fuzes for rifled projectiles in the Service fit the G.S. gauge.

The Armstrong F.S. gauge is only found in common and segment shells for R.B.L. guns, 9-pr. to 20-pr., except the 20-pr. common for N.S. which has the G.S. gauge.

Base fuzes.

Some fuzes are intended for the base of the shell, instead of the nose, the advantages of this arrangement being: (1) admissibility of a pointed head, giving increased penetration, (2) the fuze is in a favourable position with regard to burster.

Time fuzes on this principle have not hitherto proved successful.

Shell having the obsolete Moorsom gauge can be converted to the G.S. gauge by the use of adapters, details of which will be found in former editions.

General remarks on wood time fuzes.

It is not necessary to give any account of fuzes manufactured for the service prior to 1855.

In that year, General Boxer introduced his time fuzes, which are still used in the Service, and which were greatly superior to the fuzes they replaced, both as to accuracy and facility of preparation.

Wood was the material adopted for the body of the fuze, a hard durable wood with a grain suitable for turning is required; beech is found to answer well. The wood is seasoned, and is afterwards desiccated by artificial heat.

All Boxer fuzes are conical, this shape having a great advantage over the cylindrical form, as there is no risk of the fuze setting back into the shell on the shock of firing, at least not when the angle of the cone is sufficiently great; also, if the wood expands or contracts the fuze will only project or go in a little more, but with a cylinder the result would be either that the fuze would not enter the fuze hole when expanded, or would fall through into the shell when shrunk.

The same pitch of cone is used in all wood time fuzes, being that introduced by General Boxer. The cone increases at the rate of 1 inch in diameter for every 9·375 inches in length. The different sizes are obtained by taking different sections of the cone.

The fuze composition is contained in a channel which is not bored completely through the wood, as it is necessary to support the composition to prevent it from setting back on firing. This channel is placed centrally in the body of the fuze, except in fuzes which have two powder channels, in these the composition channel is eccentric. Powder channels are essential in fuzes for shrapnel shells, having the bursting charge in the base, because if a fuze having no powder channels were bored short, the hole would come in contact with the metal of the shell, and the flame of the composition could not ignite the charge.

In the Service wooden time fuzes, the diameter of each side hole is ·125 inch, consequently there would be no room for those containing ordinary fuze composition, which burns ·2 inch in one second, to be bored so as to read to half seconds if there were only one

powder channel. By increasing the number of channels we are enabled to graduate the fuze more finely. For instance, a fuze with six powder channels can be graduated just six times as finely as a fuze driven with the same composition, but having only one powder channel. With the earlier fuzes, two powder channels were considered to be sufficient, and this number allowed the 5-seconds fuze with its column of quick burning composition to be graduated to quarter seconds, but the same length of slower burning composition in the 9-seconds fuze could, with two powder channels, only be graduated to half seconds, the side holes being precisely the same distance apart in both fuzes, but one composition burning twice as rapidly as the other. When new fuzes were called for, which should burn for a longer time and yet be graduated to small intervals, it was necessary to use a slower composition, so as not to make the fuze too long to fit into the socket of a shrapnel shell; and to increase the number of powder channels so as still to be able to graduate it to quarter seconds. Hence, in the 15-seconds fuze, there are six powder channels, and eight in the 30-seconds fuze.

These two fuzes are practically the only wood time fuzes remaining in the service; consequently descriptions of other wood fuzes must be sought for in former editions.

The increased number of powder channels has a beneficial secondary effect, for they are connected at the bottom by quickmatch, so that the ignition of one causes all to act simultaneously, and to direct a powerful combined flash into the interior of the shell.

In all wood time fuzes the last hole is bored through into the composition to ensure the action of the fuze when fixed in the shell without preparation.

This bottom hole is threaded with quickmatch, while the powder in the other channels is supported by the connecting quickmatch laid in a circular groove in the base, and pressed into the lower ends of the channels. Wood time fuzes are ignited in two ways; either by the flash of the charge which ignites a quickmatch priming in a groove near the head of the fuze, or by the shock of discharge which sets in action a detonator in the head of the fuze. The hammer of this detonator is supported by a "safety-pin" before loading, immediately before which it is withdrawn.

The priming is covered by a copper and tape band, which protects the fuze from accidental ignition by sparks or by a neighbouring explosion, and is torn off before loading. The operation of withdrawing the safety pin in fuzes with detonators answers to this "uncapping" in the case of fuzes protected by the band.

It has been established by experiment that fuzes thus protected are almost absolutely safe against the influence of neighbouring explosions.

Stress is laid in drill on the importance of not uncapping the fuze or withdrawing the safety pin till the moment of loading.

Fuzes for rifled ordnance have their heads closed, otherwise they would probably be extinguished when the shell struck point foremost, they would also burn much quicker on account of the increased pressure of the air when flying point foremost.

It was hoped that this would get over the difficulty of the effect of the pressure, which causes a varying rate of burning in rifled guns. This, however, has not been attained.

A wood time fuze striking a *hard* surface will generally act as a percussion fuze, but a shell grazing is apt to shake the fuze out.

In firing star shells, and in exceptional cases when reduced charges are fired with a M.L. wood time fuze, extra gun-cotton priming is necessary to insure ignition. The gun-cotton is permanently fixed to the "Fuze, 15-seconds, M.L., with special priming." It is well to remember that when a fuze with gun-cotton priming is uncapped it is liable to be ignited by the least spark. § 4686. § 4824.

Later time fuzes have a paper lining in the fuze composition bore.

In hot climates the wood is liable to shrink, and by doing so may leave a space between the wood and the fuze composition, thus exposing the sides of the latter to the action of the flame of the ignited fuze; should this take place, the fuze will have a large surface ignited at once, and will burn very rapidly, so causing premature explosion.

The paper lining prevents this, as it is not liable to shrink; the lining has, however, the disadvantage of injuring the keeping qualities of the fuze, because a porous paper absorbs moisture. The old fuzes keep better; it has already been pointed out, p. 4, that paper in contact with gunpowder is apt to injure it. The ill effects of the presence of the paper were shown in the earlier patterns of wood time fuzes for rifled guns.

The ingredients of fuze compositions are given in the tables at p. 552. These compositions, however, will vary slightly from the proportions given there; no doubt there is always some slight difference both in the purity and the mechanical condition of the ingredients, and so two mixings, though prepared as far as possible in the same way, will not give exactly the same time of burning. The rate of burning of each mixing is ascertained: if it is found too slow, a little mealed powder is added; if too quick, a little more saltpetre and sulphur, until it is brought to burn at exactly the required rate.

The composition for the 15-seconds fuzes burns at the rate of 1 inch in 7½ seconds, and that for the 30-seconds fuze at the rate of 1 inch in 10 seconds.

It is much more difficult to make a slow composition burn regularly than a comparatively quick one.

For the method of preparing and fixing fuzes, *see* p. 382, *et seq.* It will be observed that *all* wood time fuzes are now to be fixed in the shell by screwing in firmly by hand. It is important that this should be done thoroughly, because fuzes insecurely fixed will cause either prematures or blinds. Should there be any doubt upon the point, they may be tightened by the Fuze Extractor for Rifled Shell. Preparing wood fuzes.

The 15 and 30-seconds fuzes are painted black and drab. They have the greater part of the body covered with the index paper, but there is a ring of drab below the black head. The 15-seconds M.L. with special priming has the head and that portion of the body not covered with the index paper painted red. The colouring matter is rather a lacquer than a paint, consisting mainly of shellac dissolved in spirits, and aids to protect the fuze from moisture. Paint.

Besides the numbers of the side holes, each fuze will be found to be marked near the head with the Roman numerals indicating the mark, and figures giving the number of thousand of manufacture,* while on the opposite side the month and year is stamped. Thus $\frac{\text{II}}{140}$ $\frac{7}{85}$ indicates that the fuze is Mark II, that it is one of the 140th thousand Marks.

* The 15-seconds M.L. with special priming is not stamped with the number of thousand.

of that mark, and that it was finished in July, 1885. These marks should always be quoted when reporting on fuzes.

§ 9621. 15-seconds fuzes which pass through ordnance factories for examination will be grouped according to their mean time of burning and each group given a distinguishing letter which will be marked on all cylinders and packages but not on the fuzes themselves. This letter will take the place of the number of thousand for all purposes for which the number of thousand was originally used.

§ 1843. In 1869, the system of packing fuzes, lights, and tubes, and all such combustible stores in cylinders containing small quantities was approved. This method has the advantage of not leaving any large quantity exposed to the action of climate after the cylinders are opened.

§§ 1871, 2055, 2217. In 1870 tin cylinders, with lids secured by a tin band soldered round, and thus hermetically sealed, were introduced, and after a comparative trial with zinc cylinders secured by a tape band, were finally decided on in 1872.

Nearly all fuzes are packed by fives in tin cylinders, and these cylinders are issued in wooden cases, the number contained in the case varying with the nature of fuze. The 15 and 30-seconds fuzes are wrapped separately in brown paper.

When new, these cylinders are tested in the Royal Laboratory by placing them in water. A cylinder properly soldered can be placed under water for some days with safety to its contents.

A.C. 1874, Cl. 159. The cylinders have a label on the top showing the nature of the fuze, the number contained in the cylinder, the mark or numeral of pattern of the fuze, the number of thousand, the date of packing and the service for which the fuzes are intended; also a caution *not to open the cylinder until the fuzes are required for use or special inspection.* When special inspection is required a fixed percentage of fuzes should be examined (*see* A.O. Regs. 1900), only a sufficient number of cylinders being opened to furnish the required number of fuzes. Instructions for use are given on a label on the side of the cylinder, as well as instructions for opening the cylinder. In the case of fuzes containing detonating composition, a caution is added against *placing the fuzes in a magazine.*

They have also directions for re-closing the cylinder (*see* A.O. Regs. 1900), and a blank space for the date on which this has been done.

In addition, 15-seconds fuzes repaired since 3.3.99. will have the distinguishing letter on the cylinder as stated before.

Cylinders containing fuzes are painted black and have their labels printed in black ink, except those containing 15-seconds fuzes which have a white top. Those containing 15-seconds fuzes with special priming have a red top.

Metal time fuzes. The general improvement in artillery material has caused the introduction of a new class of time fuzes made of metal, and having little in common with their wooden predecessors but their object and name. This class of fuze is in general use among Continental nations, and, though the construction is complicated, and the cost considerably greater than that of the older type, it has certain important advantages which more than counterbalance the increased expense, especially when used with shrapnel shell, with which projectile alone it is proposed to use time fuzes in the future, and with which, more particularly when fired from high velocity guns, it is a *sine quâ non* that the fuzes can be set to act at very short intervals.

Advantages. 1. The fuze burns with greater regularity and better practice

results; the liability to premature action owing to shrinkage of wood in hot climates is overcome.

2. It can be set to act at very short intervals.

3. Setting the fuze does not spoil it, as is the case with one which has to be bored; the fuze can, consequently, be re-set or returned to the limber box and used on a subsequent occasion.

4. The setting is open to inspection or alteration after the fuze is fixed, and until the shell is actually loaded in the gun.

5. On account of the construction of the fuze, a longer time of burning is obtained in flight, although a higher velocity and, in consequence, a higher pressure on the head of the shell are maintained in B.L. guns for a longer time than in the old M.L. ordnance.

6. An alternative percussion arrangement can be fitted in the same fuze.

A fuze of this class was introduced into the Service as early as 1860; but it naturally had many defects, which experience has corrected.

It was also employed with segment shell, a projectile to which any time fuze has since been found to be unsuitable; and to this cause is no doubt due some of the prejudice with which it was at one time regarded.

Its use was discontinued in June, 1870, by the Royal Artillery, for which service the Boxer wooden fuze was generally adopted with R.M.L. ordnance; but, after many alterations of pattern, the E. time fuze, which was the form eventually taken by this early metal fuze, still survives in the Royal Navy, and has been partially reintroduced for L.S.

Combined fuzes.

In addition to the time arrangement, most metal fuzes contain a percussion action in the same body, and are then generally called *combined* or *double action* fuzes. The object of this combination is not so much that the fuze may be used indifferently for time or percussion shell as that the bursting of the shell may be secured if it should graze before the time arrangement acts.

Fuze composition.

The composition in the E. time fuze is pit mealed powder. In the other metal time, and time and percussion fuzes, the composition is a mixture of black and brown mealed powders. The rate of burning of each mixing is ascertained, and if too slow a little black mealed powder is added.

Marks.

Metal time fuzes have stamped on them the numeral, number of thousand or lot, date of manufacture, and manufacturer's mark.

Packing.

Metal time fuzes are issued in tin cylinders containing one. The cylinders are painted black with labels printed in black ink. The labels show nature and mark of fuze; number of thousand or lot, date of manufacture, and the time of burning at rest, instructions for opening the cylinders, and a caution against placing it in a magazine and the group and division for storage. The cylinder contains instructions for reclosing and a strip of paper showing the packer's name. Space is left on the top label for the date of reclosing. In addition the newer cylinders have the number of thousand or lot of the fuze stamped on the bottom of the cylinder.

Time of burning.

The rate of burning of a wood fuze is influenced by its age, the climate in which it is kept, and the atmospheric pressure. An old fuze burns longer than a new one. Fuzes kept some time in very dry or very damp climates may burn irregularly, the effect of extreme dryness being to cause faster burning. Each diminution of atmospheric pressure to the extent of one mercurial inch in the

barometer increases the time of burning of all time fuzes by ·03, or what is nearly the same thing, by $\frac{1}{30}$. The barometer falls about 1 inch for an increase of 1,000 feet in elevation.

The effect of varying pressures on the rate of burning explains to some extent the important fact that fuzes burn at sensibly different rates when fired out of different guns; as a rule, they are found to burn quicker in large than in small guns, probably because the projectiles from the former keep up their velocity better.

The earlier metal time and percussion fuzes had escape holes for the gases, given off by the burning composition, in the head of the fuze. The gases escaping from these holes met the resistance of the air directly, when the shell was in flight, and consequently the resistance to their egress varied with the velocity of the shell and so caused the fuze to burn irregularly.

Side-escape. The later fuzes had the head entirely closed and a side escape channel for the escape of the gases. This side channel is directed from the interior slightly towards the rear or base of the fuze, and slants away from the direction of rotation of the shell. There is thus no tendency for the rotation of the shell to force air into the head of the fuze through the escape hole, and so vary the pressure on the burning composition: from its position with reference to the rotation, the pressure met by the escaping gases is more uniform and so greater regularity is obtained.

All time fuzes burn quicker when rotated rapidly than when at rest. In the case of metal fuzes, this increase varies with the direction in which the ring of composition burns with reference to the rotation of the shell, and it has been found that the rate of burning is more rapid, but more regular, when the ring burns in the opposite direction to that in which the shell rotates.

Difficulty has always been experienced in obtaining a long burning fuze of moderate weight, as a slow burning composition usually burns with greater irregularity than a quicker burning one. Therefore a greater length of composition has generally been obtained by increasing the diameter and consequently the weight of the fuze. This is the case with the time and percussion middle fuze, but here it is of less importance since this fuze is used with the heavier natures of guns.

A small slow burning fuze was introduced for field guns in the T. and P. No. 57 fuze (*see* p. 176).

Double-banked fuzes. Two time rings, one placed above the other, are sometimes used in order to obtain a greater length of composition without materially increasing the size and weight of the fuze. Fuzes with this arrangement are known as double-banked fuzes. The fuze supplied with the equipment of the 15-pr. Q.F. gun (fuze T. and P. No. 58) is of this type.

Generally with these fuzes the upper ring is fixed, while the lower ring is graduated and capable of being turned to set the fuze; the composition of the upper ring lights first, and when it has burned the desired amount it communicates with the lower ring, which burns in its turn, in the opposite direction.

The length of the composition is thus nearly doubled.

In manufacturing wood fuzes, it is found necessary to avoid using oil on the tools employed in boring the fuze composition channel, as the oil coming in contact with the composition increases the time of burning.

The time of burning of different fuzes at rest varies with different thousands. The time of burning at rest of a metal time fuze is given on the label of the cylinder.

Wood cannot be used as the material for percussion fuzes, where great nicety of fit is necessary, and where even a trifling alteration of form would prevent the fuze from acting. General remarks on percussion fuzes.

* The metal employed must not be liable to oxidise readily; iron was at first tried and proved to be quite unsuitable. The so-called gun-metal, consisting of copper and tin, to which a little zinc has been added (*see* p. 558), in order to render the metal easier to turn, answers well for the body, which must be strong, as otherwise the fuze will fail with even moderately heavy charges. With base fuzes it is especially important to have a strong material since the fuze body is exposed to the full force of the powder gases. Manganese bronze or other suitable alloy is used.

Brass and phosphor-bronze are used for springs.

Copper wire has been found suitable for suspending any part of the fuze which has to "set back" on the shock of the discharge, while brass, copper, and phosphor-bronze, have all been used for safety pins.

Lead answers well for checking rebounds, owing to its softness and lack of elasticity, but these qualities render it unfit to be the support to the internal parts of a fuze, at least when it has to sustain the shock caused by the jolting motion of a limber; it answers, however, as "feathers" or projections destined to be sheared on the shock of discharge.

Percussion fuzes are employed for two distinct purposes; they are used in shells intended exclusively to act against solid obstacles, such as earthworks, or walls, or ships; and they are also used in shells employed against troops in the field.

For the first purpose it is desirable that the fuze should only act on direct impact, and a very instantaneous action is not required.

For the second purpose, when used against troops in the open, it is necessary that the fuze should act on graze, and that it should act almost instantaneously, as otherwise the shell has time to rise to a considerable height before bursting, and thus its effect against troops is diminished. Such an action is secured in the R.L., in the small, and in the B.L. plain percussion fuzes. This nature of fuze is absolutely necessary to develop the effect of segment shell when used against troops in the field, and good results have been obtained from shrapnel when using such fuzes at moderate ranges, under certain circumstances.

Safety pins are used in the fuzes which act on graze. They serve to protect the "feathers" and shearing wires in the fuze by taking the shock caused by the jolting motion of the limbers. The "feathers" and wires only come into use when the safety pin is withdrawn, and guard against risk while the shell is rammed home. In the small percussion fuze the safety pin prevents the upper retaining bolt unlocking accidentally. Safety pin.

The base percussion fuze has a cylindrical portion threaded with a left-handed screw thread, a hole through the base of the shell being similarly prepared to receive it. As before mentioned these fuzes must be made of a very strong material. It is also of the highest importance that the construction of the fuze should preclude the possibility of powder gas penetrating through the fuze into the interior Base fuze.

* These remarks as to metals apply equally to metal time and combined fuzes.

of the shell, and means must also be adopted to prevent the gas penetrating between the fuze and the body of the shell; the result of either would, of course, be a premature burst in the bore.

A tight joint between fuze and body is now obtained by coating the screw threads with thinned luting ($\frac{1}{2}$ luting Mark III and $\frac{1}{2}$ mineral jelly), and placing unthinned luting under the flange of the fuze. Formerly a lead ring was used under the flange, but the lead was found to "flow" and so after a short time the fuze became loose and required tightening up.

Since a safety pin cannot well be used with a base fuze, the fuze is so constructed that the movable portions are securely locked until after the gun has been fired. The pressure of the powder gas drives in a pressure plate and unlocks a retaining bolt (*see* description of fuze, p. 166).

All percussion nose fuzes in the Service at present (except the B.L. plain, which fits inside the shell), are threaded with a screw thread to fit into the conical fuze hole of the shells. A fuze having its screwed portion conical can be screwed home much more rapidly than when it is of a cylindrical form, as the fuze will enter some distance into the conical fuze hole before the screw bites. There is no necessity for a shoulder, as a conical screw cannot be screwed too far home.

Percussion fuzes are useful when firing trial shell. It is difficult when time fuzes are used to judge whether the shells are bursting short or beyond the object, but when the shells are burst on the ground it is easy to determine on which side of the object they are bursting.

Percussion fuzes are useful where a local action is desirable; they are less effective than time fuzes against an open formation of troops.

A great advantage of this class of fuze is that they require no preparation, beyond withdrawing the safety pin in those fuzes which act on graze.

For Naval Service a fuze was formerly required which would only act upon direct impact, and could be safely carried in filled shell, conditions which were well satisfied by the Pettman G.S. fuze. But advances in gunnery, combined with the comparative inefficiency of an impact fuze for bombarding purposes, have caused a demand for N.S. fuze to fulfil the following conditions:—

1. To act on penetrating a $\frac{3}{16}$-inch steel plate, or on the projectile being fired into a bank of loose sand.
2. To be carried with perfect safety in a filled shell under usual Naval conditions.
3. To act equally well with a full or reduced charge.
4. No part of the fuze to project beyond the rim of the fuze hole.

Pointed common shell taking base fuzes are now very largely used in the Royal Navy. These shell are carried filled and fuzed for N.S. and plugged for L.S.

Issue. The older percussion fuzes are issued five in a tin cylinder, each wrapped separately in brown paper; the newer ones are issued singly in tin cylinders. The labels on these cylinders give the same information (except time of burning) as those on the cylinders containing metal time or combined fuzes.

Causes of blind shell. The chief defects to be guarded against in fuzes are their causing blind shells or premature explosions.

The first defect may fairly be attributed to some fault in the manufacture of the fuze or in its preparation.

The most frequent source of blinds with time fuzes seems to be due to boring or setting the fuze too long. If this is done the shell on striking the earth may shake out a wood time fuze; the velocity of the shell being suddenly checked the fuze has naturally a tendency to fly forward; if the practice is over water the fuze may be extinguished by striking the water. It is to be remarked that such a grazing action is very different to direct impact, which, as before stated, will generally make a wood time fuze act.

A sensitive fuze set too long may also be extinguished on striking water, or it may be distorted on impact and the head together with the composition ring broken off. In a time and percussion fuze, if the setting is too long, and the angle of descent is very slight (say under 2°) the retardation to the shell may be insufficient to cause the percussion arrangement to act.

Practice reports received from out-stations show that blinds are sometimes due to fuzes which have deteriorated by keeping, being bored in accordance with the range tables.

Independent of the fuze, blinds have been caused by the use of Mark I primer in shrapnel shell, but as all these, except those fixed in shell, were withdrawn in 1873, failures due to that cause are no longer probable. Any foreign matter covering the primer would cause a blind, and it has even been supposed that the three thicknesses of paper formerly covering the bottom of wooden fuzes may have caused such an obstruction, and the fuzes made since 6th November, 1884, have only one thickness. When the bursting charge is contained in a bag, it has been found that even those fuzes which contain a considerable quantity of powder, such as the Direct Action, will not ignite the charge with certainty.

To remedy this, a 7 dram primer has been introduced.

At least two* of these primers, which contain fine grain powder, and more if there is room for them, should be put into every such shell, so as to come next the fuze.

The chief causes of blind shells with time fuzes may be briefly summed up thus:—

1. From the fuze being improperly prepared, or set too long.
2. From the time fuze not igniting.
3. From the primer of a shrapnel shell not acting.

With percussion fuzes, a blind may be due to either the fuze not being properly prepared, or to the third of the above-mentioned causes, but as no preparation is required beyond taking out the safety pin, it is less likely to fail from carelessness in this respect. A percussion fuze may, however, cause a blind from—

1. Defects in manufacture.
2. Being used with a shell for which it was not intended.

Blinds may also be caused by the shell being empty or improperly prepared.

"Graze" percussion fuzes will cause blinds if the shell is not sufficiently checked. The most trying conditions for a fuze of this description are a heavy shell with high velocity and small angle of descent, since a heavy body moving at a high rate of speed is more difficult to check than a light one.

Graze fuzes are not used in the heavier shells, but the percussion

* § 10099. The 16-pr. R.M.L. common shell only requires one primer.

portion of the middle time and percussion fuze is of this type, and it has failed occasionally in heavy shell under circumstances when a similar fuze in a light shell would have acted.

With direct action fuzes, actual impact or graze at an angle exceeding 10° is necessary to fire the fuze, because the needle must be actually crushed on to the detonating composition. These fuzes, consequently, will give blinds when the shell grazes at angles less than 10°.

Causes of premature explosions.

Premature explosions are even more serious than blind shells, and it is difficult to overrate the importance of getting rid of them. Our most powerful ships now carry only a few guns, and their armament might be disabled by one or two common shell bursting in the gun. In the Land Service, artillery must frequently fire over the heads of their own troops, and a few prematures might cause disastrous results, not only by actually killing and wounding our own men, but more especially from the moral effect produced. Nothing demoralises troops more than being exposed to the fire of their own artillery.

With high explosive shell the danger arising from a premature in the bore is greatly enhanced.

Unfortunately, prematures may be due to many causes, but frequently all the blame is laid on the fuze. It will be convenient here to state all the most probable causes of prematures, both those due to the fuze and to the projectile and bursting charge.

A premature may be due to a weak shell breaking up in the gun, or to the penetration of gas into the shell through a flaw. It may also be due to the ignition of the bursting charge due to the distortion of the shell, or from friction or shock of discharge. It appears to be conclusively proved that prematures may occur from shell not being properly filled, and also from the great friction due to the rotation of the shell and the powder setting back on shock of discharge. For this reason the insides of shell were lacquered, first with a rough black lacquer which still caused prematures and afterwards with the smooth red lacquer now in use.

As an additional precaution burster bags to contain the charge are used with practically all powder common and armour-piercing shell, except the smallest. The necessity for these bags has been demonstrated on several occasions when shell have been fired without them.

With time fuzes, apart from defects of manufacture, a premature may occur in metal fuzes from the time ring not being clamped down, when the flash of the burning composition could travel round the underside of the ring; or as already pointed out from the wood shrinking away from the composition, when no paper lining is used.

The case of a fuze being bored too short should be distinguished from that of a premature, as it will simply cause the shell to burst short of the object, whereas in the other case it bursts either in or near to the muzzle of the gun.

With graze percussion fuzes a rebound action may be set up by the shock of discharge, which might throw the detonator against the needle. To check this action, a spiral spring is placed in all modern fuzes between the pellet and the body of the fuze.

There is also the fact that a very light shell may be checked by an irregularity in the bore of the gun, sufficiently to set the fuze in action.

With direct action fuzes prematures are less likely, and the cause

if one does occur, is more obscure. Placing a disc of tin-foil under the detonating composition was found to have a great effect in preventing prematures.

Base fuzes have introduced additional causes for prematures from failure due to a weak fuze or from the penetration of gas into the shell between the fuze and the body of the shell, or between the pressure plate and the fuze body.

The latter cause may be due to a pressure plate being damaged by the point of another projectile or by an accidental blow. To guard against this, shells fitted with base fuzes should never be placed point to base and the protectors should not be removed during transport.

It is found that the use of cordite makes the penetration of gas more probable than when powder is used.

To sum up, we may divide the probable causes of prematures into two classes.

Prematures due to causes connected with the shell may arise from :—

1. Bad lacquer, iron or grit in the shell, or in the larger shell from no bag being used.
2. From the shell not being quite filled.
3. From a weak or defective shell.

Prematures due to the fuze may arise from :—

1. A fuze improperly prepared (such as time ring not tightly clamped).
2. Defects in manufacture.
3. Wood shrinking away from the composition where no paper lining is used.
4. A fuze being used in a gun for which it is not intended.
5. With a base fuze from the penetration of gas due to faulty sealing between fuze body and shell or between pressure plate and fuze body.

The fourth cause especially applies to percussion fuzes in high velocity B.L. guns.

Storage.

For storage fuzes are placed in Group II, Division I.

CHAPTER X.—PERCUSSION FUZES.

DIRECT ACTION. — D. A. DELAY. — D. A. IMPACT. — 9,000 M. — PETTMAN'S G.S.—SMALL.—R.L. AND B.L. PLAIN.—BASE FUZES.

§§ 5593, 5788, 6274, 6740, 7635, 9906, 10172, 10322.

Fuze, Percussion, Direct Action, with Plug, No. 3, *Mark III.*—This fuze is employed in the L.S. with B.L. guns, 5-inch to 13·5-inch; R.B.L., 7-inch; and R.M.L. 64-pr. and upwards, and all rifled howitzers. In the N.S. for B.L. guns, 4-inch and upwards; 12-pr. to 6-inch Q.F.; and R.M.L. 64-pr. and upwards.

Use.

This fuze is to be used in both N.S. and L.S. when hydraulic machinery is used for loading. In the L.S. it is used on sea fronts.

The direct action is an impact fuze, but it will act on graze provided the angle of descent is somewhat over 10°.

Description.

The fuze consists of the following parts, viz.:—Body, safety plug, screw collar, needle disc with steel needle, screw plug for needle disc, and bottom plug; all of which are made of an alloy resembling gun-metal, with the exception of the steel needle, and the needle disc which is of copper. (*See* Plate X.)

Body.

The body is threaded throughout on the exterior to the G.S. taper and pitch. The lower part is hollowed out and takes a blowing charge of 75 grains pistol or R.F.G.^{2} gunpowder, and the

Bottom plug.

bottom is closed by a bottom plug screwed in, having a central fire-hole closed on the upper side by a disc of fine white paper, and one of red shalloon. There are two key-hole slots in it for the purpose of screwing it in.

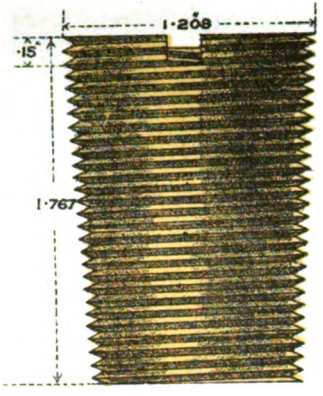
The top edge of the body has two slots cut in it to take the projecting arm of the "Key, fuze, universal," by which it is screwed into the shell. The upper portion is bored out and screwed left-handed to take the screw plug for needle disc, screw collar, and safety plug. Below this the centre of the body is recessed for the detonating composition, and immediately under this recess there are nine conical fire-holes communicating with the blowing charge in the lower part. The conical fire-holes are filled with mealed powder paste, and covered on the underside by a disc of fine white paper, and on the upper side by a disc of tinfoil $3\frac{1}{2}$ grains of cap composition are pressed by 1,000 lb. pressure into the recess provided for it: it is varnished and covered by a thin brass disc, held in position by a copper washer, over which the metal of the body is spun.

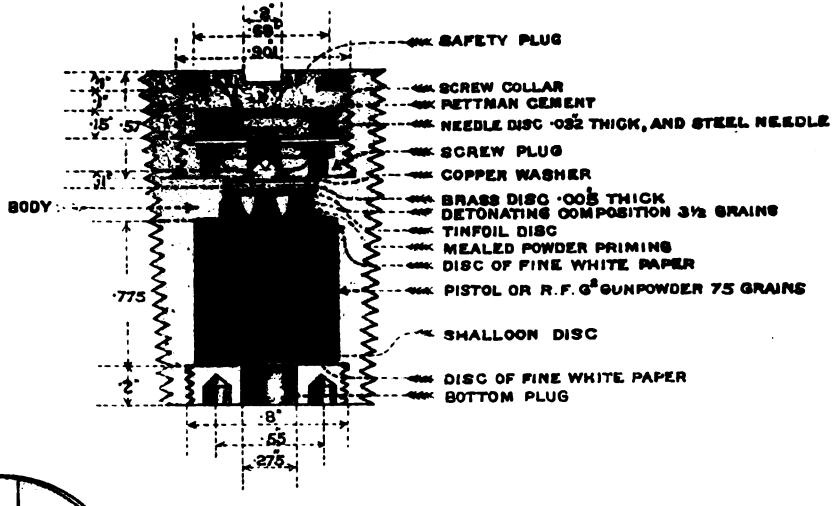
Screw plug for needle disc and needle.

The *screw plug for needle disc* is threaded so as to screw into the body, and is recessed. It is slightly coned at the bottom, and has a hole through the centre. Two holes are drilled in the top so as to screw the plug into the fuze. The needle disc is of copper, with a steel needle snapped on to the centre of it, and soldered. The needle disc rests on a small shoulder made in the top of the screw plug for needle disc.

FUZE, PERCUSSION, DIRECT ACTION, WITH PLUG, No 3. MARK III.

§ 5593.





The screw collar retains the needle disc in position. It screws into the body over the screw plug, having two slots cut in its upper edge for that purpose. Screw collar

The safety plug screws into the top over the screw collar and prevents accidents in transport and storage. It must be removed at the moment of loading; for this purpose a slot is cut across the upper surface of it. The top is marked with an arrow and the word "unscrew," showing the direction to turn. The flat arm of the "Key, fuze, universal" will fit the slot in the safety plug. Safety plug.

The exterior of the fuze is lacquered, and the fuze is carefully waterproofed, by putting a little Pettman's cement on the threads of the plug for needle disc, edge of needle disc, screw collar and bottom plug before screwing them in, and finally painting the top of the fuze, below the safety plug with the same cement, so as to completely cover the needle disc; and also painting the bottom of the fuze completely over. The needle is now soldered to the needle disc to improve the water-tightness of the fuze. Waterproofing.

The weight of the fuze, without safety plug, is about 5 oz., weight of plug, about 6 drs.

Fuzes manufactured or repaired before 27th June, 1894, are without the tinfoil disc under the detonating composition and will, as soon as they are replaced, be withdrawn. § 9906.

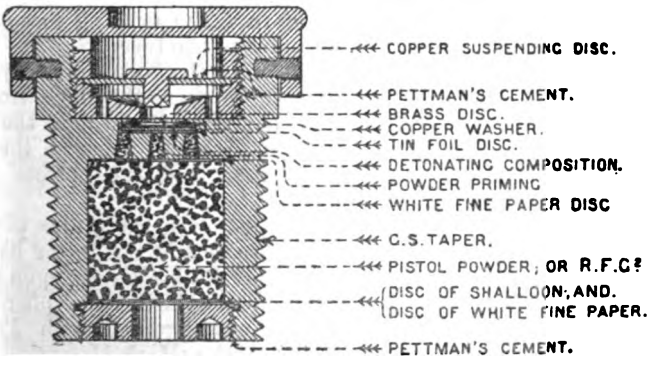
The fuze, being prepared by simply removing the safety plug, is quiescent in all its parts till direct impact takes place, or a graze at such an angle that the nose of the shell enters the ground. When either of these events occurs the needle is crushed down on to the detonating composition, which fires, and ignites the mealed powder in the conical holes and the fine grain powder. The flash therefrom blows down into shell and fires the charge. Action.

The head of the needle being some distance below the head of the fuze, it cannot be touched or forced down on the detonating composition when any ordinary rammer is used for loading.

Fuze, Percussion, D.A., with Cap, No. 1, *Mark II, L.* in general construction is similar to that above described. The body, §§ 5216, 9672, 9906, 10087, 10322. Mark II.

Fuze, Percussion, Direct Action, with Cap, No. 1, *Mark II, Metal, L. Five in a Tin Cylinder.*

Scale, full size.



however, is not screwed throughout its entire length, the upper portion being turned to receive a cap. The latter fits over the top and has a milled edge. On each side a T-shaped slot is cut in it to fit over two brass pins which screw into the body,

and by which the cap is secured to the fuze. A square keyhole is cut in the upper surface to take the flat arm of the fuze key for screwing it into the shell. This fuze requires no preparation beyond removing the cap at the moment of loading. It has been found, however, that if the cap be left on, Marks I* and II will act on a 4-inch vertical wood target.

Weight of Mark II fuze without cap about 6 oz., weight of cap about 2 oz.

This fuze is also waterproofed in the same manner as Mark III, described above.

These fuzes, also, manufactured or repaired before 27th June, 1894, are without the tinfoil disc under the detonating composition, and when replaced will be withdrawn.

The introduction of Mark III was made to enable the fuzes to be carried in filled shells for the Navy covered by a wad.

§ 10173, 10297. Marks I*, I** and II are identical in construction, but the former are conversions from Mark I, while the latter are new fuzes. Mark I are obsolete.

Issue. These fuzes are wrapped singly in brown paper, and issued five in a tin cylinder.

Use. § 10707. These fuzes are used with the same guns as the Mark III already described, but are for L.S. on land fronts. They are also used for lyddite shells in the Land Service when ordered. At present for the 5-inch and 6-inch B.L. howitzer lyddite shell for Service.

§ 8871. *Fuze, Percussion, Direct Action, Delay, No.* 10, *Mark III.*—The construction of the percussion portion of this fuze is very nearly identical with that of the "Fuze, percussion, D.A., Mark II." There are a few minor differences, the brass disc covering the detonating composition is retained in position by a small gun-metal plug which screws in over it. There are five cylindrical fire-holes under the detonator which are not filled with powder. The detonator only contains 1 grain of detonating composition.

The body of the fuze is longer than the D.A. Mark II, and generally resembles it in shape.

The head of the fuze is covered by a cap similar to that used with the Direct Action Mark II.

Two holes are bored in the lower part of the body, parallel to its axis, the smaller forming the delay chamber, and the larger being divided into two by a diaphragm plug. The upper part of this hole forms a chamber for the gas escaping from the burning composition, while the lower part forms the magazine of the fuze.

The delay chamber communicates with the air chamber by a fire-hole which is primed with quickmatch to carry the flash from the detonator to the pressed mealed powder with which the delay chamber is filled. A fire-hole at the bottom connects the delay chamber with the magazine of the fuze, and the bottom of the chamber is closed by a screw plug.

The lower part of the body is filled with 20 grains of M.G.[1] powder, and closed by a bottom plug screwed in, the latter having a central fire-hole closed on the lower side by a brass disc, spun in.

The lower edge of the body is spun over the bottom plug. The fuze is lacquered externally, and is waterproofed with Pettman cement in the same way as the Direct Action Mark II.

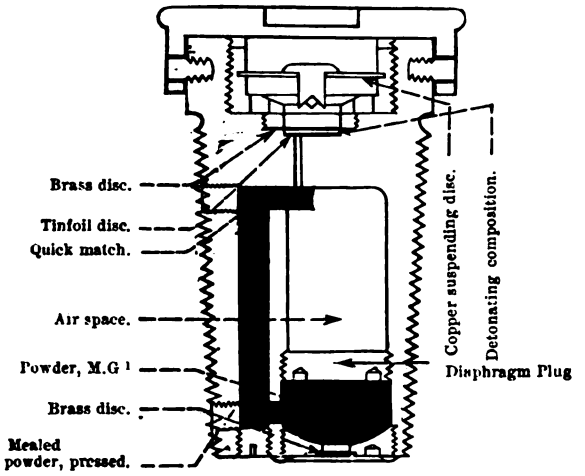
Weight of fuze without cap, about $8\frac{3}{4}$ oz., weight of cap, about 2 oz.

Use. This fuze is intended for use with all rifled howitzers (except 5-inch and 5·4-inch), for high angle fire with common shell.

Action. The safety cap having been removed at the moment of loading,

Fuze, Percussion, Direct Action, Delay, Mark III, L, Metal. One in a tin cylinder.

Scale, full size.



the percussion arrangement, on impact, ignites the quickmatch priming and the column of mealed powder; the latter burns for more than half a second, thus allowing the shell time to penetrate well before bursting.

Issued one in a tin cylinder, wrapped in brown paper.

Marks I and II fuzes differed greatly in length and are obsolete. §§ 6038, 7229, 7635.

The *Fuze, Percussion, Direct Action, Impact, No.* 13, is for use with lyddite shell. There are three Marks. Marks I and III are for Land and Naval services, for B.L. or Q.F. guns. §§ 8482, 8630, 9620, 9673, 9721, 9854, 10172, 10321, 10707.

Mark II is for Land Service only, for use with the 10-inch R.M.L. gun on H.A. mounting. It is also used for practice purposes with lyddite shell. Externally the three marks are similar and resemble the Direct Action, Mark II, being fitted with similar caps. In the earlier fuzes these caps were made of steel, but they are now made of manganese bronze to prevent rust. The caps of the later fuzes are further secured by a safety pin, which passes horizontally through the cap and head of the fuze, and is fitted with a twine becket for use in withdrawing it. The numeral of the fuze is stamped upon the cap, as well as on the fuze body, so that the pattern may always be known without removing the cap. The Mark I fuze is waterproofed by having a disc of foolscap paper attached to the head by an annulus of Pettman cement, the outside of the paper and bottom of the fuze being subsequently coated with the same cement.

The Mark II fuze has the edge of the brass disc in the head coated with Pettman cement before being spun in, while the whole top of the fuze will be afterwards painted with the same cement. All openings made in the bodies of both fuzes are finally painted with Pettman cement. The Mark III has also a brass disc spun in and waterproofed like Mark II. Mark I fuzes are converted to Mark I* by waterproofing like Mark III.

The fuze weighs 10 oz. and the cap 3 oz. Weight.

It is issued one in a tin cylinder. Issue.

Drill Fuze. § 10321.

A solid dummy fuze, fitted with cap and safety pin, is issued for drill purposes. A steel split safety pin is used.

Pettman, G.S. § 3200.

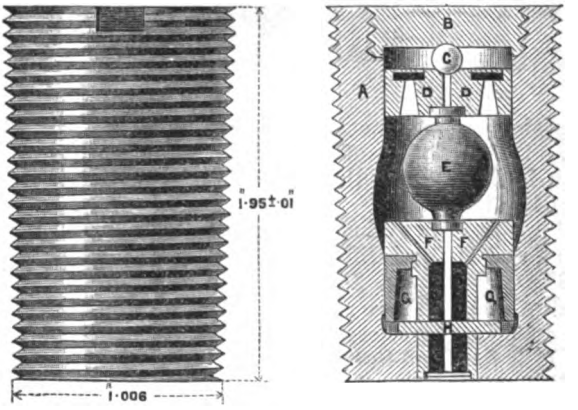
The *Fuze, Percussion, Pettman, G.S., No. 5, Mark II*, is arranged so as to act equally well from a S.B., R.B.L., or R.M.L. gun. Introduced for use in the R.N., its failure to act with reduced charges and slow-burning powders have caused its rejection by that Service, in which, however, it is still retained for present use with R.M.L. guns loaded by hydraulic machinery, the full charges of the gun being employed. It is also retained in the L.S. as the fuze for all common and double shell R.M.L. 7-inch to 12-inch, 35 tons, with full charges only. No more will be made.

It is specially designed so as to act on impact, not on graze; it will not explode on a shell passing through a wave, but will explode on the shell striking a wooden ship.

Its construction is shown in the cut.

The body and top plug are made of gun-metal; the cone plug, detonating ball, and steady plug are also made of gun-metal, but of a

Fuze, Percussion, Pettman's, G.S., Mark II.



A. Body of Fuze.
B. Top Plug.
C. Plain Ball.
D. Steady Plug.
E. Detonating Ball.
F. Cone Plug.
G. Lead Cup.
H. Suspending Wire.

harder alloy, to prevent them from altering their shape; the plain ball made of brass, and the suspending wire of copper.

The construction of the fuze will best be understood by considering its action on firing and impact.

There is a special arrangement to meet the case of firing from a R.B.L. gun when the motion of the shell is so steady that the detonating ball may not be fired. This consists of a plain ball held in position by a cup in the steady plug, and a ring of composition round the latter, which is covered by a thin lacquered copper washer. Through the steady plug are two fire-holes, to convey the flash from the ring of composition to the interior of the fuze. The detonating ball is milled and grooved, and covered with detonating composition, which is protected by one thickness of gut and two of silk, over which are two copper hemispheres covered again by one thickness of gut and three of silk.

The cone plug is pierced by three fire-holes, the central one being enlarged and driven with mealed powder, pierced like a tube. The

base is closed by a cardboard disc, and the cone plug perforated for the copper suspending wire which passes through it.

The lead cup is a hollow cylinder, having a flange on the top to fit into a recess on the cone plug when it is crushed. Weight of fuze about 7 oz.

A label is attached to the top of the fuze, giving the Mark, number of thousand, and date of manufacture.

(1) Suppose a shell to be unsteady in flight, the steady plug, ball, and cone plug set back on shock of firing, the suspending wire is broken, the lead cup prevents rebound, and the stem of the cone plug protrudes through the base of the fuze, the detonating ball being released from its pivots by the slight wobble of the shell; on striking, the ball, now unsupported, is dashed violently against the side of the body, explodes the detonoting composition, and fires the shell, the flash finding exit through the holes in the cone plug to the priming, and thence to the powder in the shell. Action.

(2) When a shell is steady in its flight, the steady plug may not disengage, and in this case the detonating ball will not act; the plain ball is released by the steady plug setting back, and is caused by the centrifugal force to spin round the circumference of the body over the ring of detonating composition. On shock of striking the object, the ring is dashed against the plain ball and detonates, exploding the shell though the fire-holes.

Five in a tin cylinder, each fuze wrapped separately in brown paper. Issue.

Fuzes which Act on Graze.

We now come to the fuzes which act on graze. Next to safety from prematures, quickness of action is the most essential quality, as the effect is lost if a shell has time to rise to any height before bursting.

A short range and a heavy shell are the most trying conditions, as the velocity of the shell is but little checked by grazing, and for the same reason, soft ground increases the chance of failure.

The Small Percussion Fuze is found to act well in B.L. guns up to and including the 5-inch at small angles of elevation, and this fuze supersedes the R.L. percussion, which answered well for the R.M.L. ordnance 80-pr. and lower calibres, but was found to give prematures with the high velocity B.L. guns. The cause of these prematures was not very clear, but was probably due to the pellet rebounding forward on to the needle after setting back on discharge.

In the Small Percussion Fuze the pellet does not set back on discharge, and is further delayed in any tendency to move forward by a retaining bolt, which is only released on rotation of the shell. A second advantage due to this retaining bolt is that, even after the safety pin is withdrawn, and before the shell is loaded, the immunity from accidental firing does not rest solely on a shearing wire (or lead "feathers" as in the R.L. fuze). The tendency of the pellet to move forward after discharge, and to cause a premature, has been further reduced in the Small Percussion, Marks II to IV, by the introduction of a spiral spring placed in front of the detonator pellet.

The Base Fuze, which is used with pointed common and armour piercing shells, is made on much the same principle. It is, however, not so sensitive owing to a very strong spiral spring between the needle pellet and fuze body. The shells, in which it is used would hardly be required to act on graze, though the fuze will act provided the angle of descent is 5° or over.

§§ 7230, 7635. Use 8807, 10172.

Fuze, Percussion, Small, No. 8, Mark IV.—This fuze is used for B.L. guns, 30-pr. and 4-inch, and R.M.L. 2·5-inch and 7-pr. in L.S. It is obsolete for Naval Service.

It will also supersede the R.L. percussion fuze, as soon as the existing stock is used up, for the R.B.L. 40-pr., and R.M.L. 25-pr. and under, in the Land Service.

The general construction is shown in Plate XI.

It consists of the following parts, viz., body, detonator pellet with cap, and two retaining bolts with spiral springs, phosphor-bronze spiral spring, needle plug with steel needle, safety pin, closing pellet with spiral spring, and magazine.

Material. The body, detonator pellet, and needle plug are of gun-metal; the retaining bolts, closing pellet, and fine spiral springs are of brass, and the safety pin of copper.

Body. The body is threaded nearly throughout to the G.S. taper and pitch. The lower end for a length of ·3 inch is reduced in diameter and left plain. In the top edge there are two key-hole slots to take the projecting arm of the "Key, fuze, universal," by which it is screwed into the shell. Two holes are bored through the side of the body for the smaller ends of the retaining bolts; these are closed on the outside by brass discs cemented over.

The fuze is bored out from the top to take the detonator pellet, and two grooves are cut down the side of the body to allow of the retaining bolts being spun out of their recesses.

Two fire-holes are bored through the bottom to communicate the flash from the pellet to the magazine in the lower part.

Detonator pellet, &c. The detonator pellet rests inside on the bottom. It is recessed at the top to take the R.L. percussion cap, the latter being retained in position by a brass washer having the metal of the detonator pellet spun over it. The pellet has two fire channels leading from the cap to the magazine. These are filled with F.G. powder, the bottom of each being closed by a papier-mâché disc.

R.L. cap. The R.L. cap is of copper, the top is cut out and the opening closed by a thin brass disc. It contains about 3½ grains of cap composition pressed and varnished, the bottom is closed by a disc of copper pierced with four fire-holes and secured in position by six lugs on the cap proper bent down on it; under the composition is a tinfoil disc.

Two retaining bolts pass transversely through the pellet; their smaller ends project into holes in the body, where they are retained by fine spiral springs. The retaining bolts prevent the detonator pellet moving forward against the needle until they are spun out by the rotation of the shell. There is a small longitudinal groove in the side of the pellet, into which a screw projects from the side of the body. This prevents the pellet from turning round during flight.

Spiral spring. The top of the pellet is reduced in diameter, forming a shoulder, on which rests a spiral spring of phosphor-bronze, the object of which is to prevent the pellet working forward during flight, and so causing a premature.

Needle plug. The needle plug has a steel needle projecting from its under surface. It screws into and closes the top end of the fuze. Before screwing in, its edges are coated with waterproof cement.

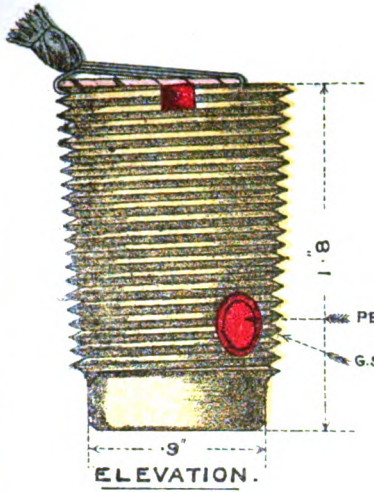
Safety pin. The safety pin, of twisted copper wire, passes through the needle plug, down one of the longitudinal grooves in the body, behind the head of one of the retaining bolts, and is bent over at the top into a groove in the needle plug. An eye is formed on the outside end

FUZE PERCUSSION SMALL Nº 8 MARK IV L

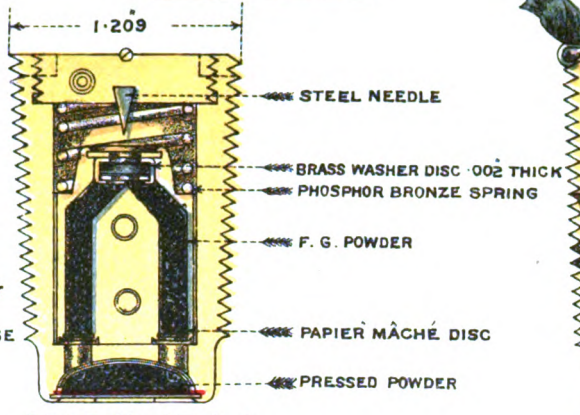
METAL I IN A TIN CYLINDER.

§ 7230

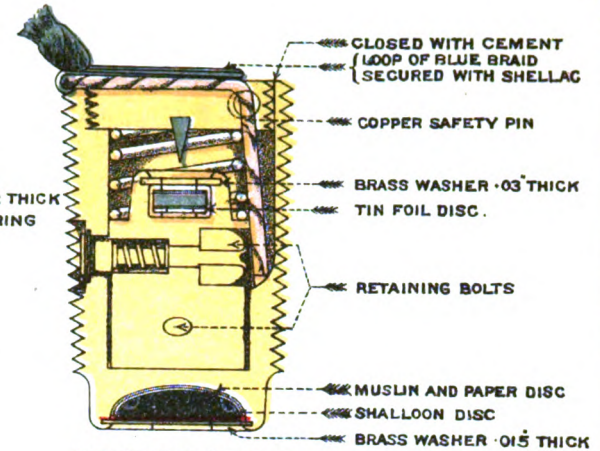
SCALE 1/1.



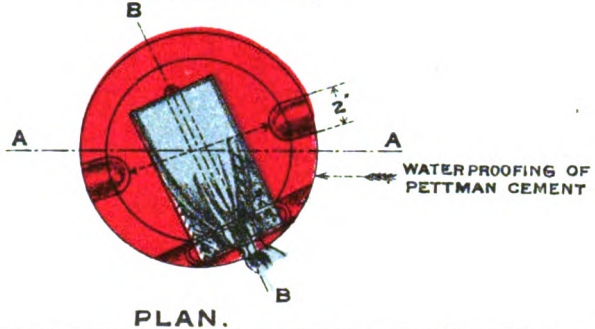
ELEVATION.



SECTION AT A.A.



SECTION AT B.B.



PLAN.

E. Weller & Grahams, Ltd Litho. London.

of the pin, to which is attached a loop of blue braid for withdrawing it. This loop is fastened down upon the top by shellac or glue.

A hole through the side of the fuze into the needle plug contains a brass pellet, with spiral spring behind it, for closing the safety pin-hole. Closing pellet.

The magazine consists of a pellet of pressed powder; on the upper surface an annular groove is formed to facilitate ignition, and it is secured in the lower end of the body by a brass washer, over which the metal is spun. Between the magazine and the bottom proper there are two discs, one of muslin and one of fine white paper, and between it and the brass washer is a disc of shalloon. Magazine.

The fuze is waterproofed by having the safety pin-hole and plug for the same closed by Pettman cement. The top and bottom of the fuze are painted with Pettman cement, and all openings made in the body of the fuze are finally painted with the same cement.

To open the fuze for examination, the safety pin and closing pellet must be withdrawn before the needle plug can be unscrewed.

The safety pin being withdrawn at the moment of loading, the hole is closed by the closing pellet. On discharge, the centrifugal motion of the shell causes the retaining bolts to fly outwards, leaving the detonator pellet free to move forward. On impact, the pellet compresses the spring in front of it, and moves forward on to the needle, which ignites the detonator, and so fires the fuze. Action.

Mark III differs from the above in having a screw plug instead of a brass washer over the detonator; this screw plug was found liable to work loose. There was no tinfoil disc in the R.L. cap, and the pellet of pressed powder had a hole through its centre, and no annular groove. § 6114.

Mark II differs from Mark III only in the strength of the phosphor-bronze spiral spring. In Mark II the wire is ·06 inch thick, in Mark III it is only ·056 inch thick; this renders the latter somewhat more sensitive on graze. § 5824.

Mark II fuzes will be returned to Woolwich, and fitted with the weaker spring; they will then be re-issued as Mark II*. Mark II*. § 6114.

Marks I and I* are OBSOLETE. §§ 5131, 6550.

This fuze is very quick in its action, and being contained entirely within the fuze hole, it is not likely to be fired by an accidental blow unless strong enough to crush in the head of the shell. The fuze weighs 5·8 oz. Remarks.

The small percussion fuzes are wrapped in brown paper and packed one in a tin cylinder. Issue.

Fuze, Percussion, R.L., No. 7, Mark IV.—This is the percussion fuze formerly used in field service for R.M.L. guns; no more will be made. R.L. percussion §§ 7175, 7635, 8807.

This fuze is used in the L.S. with the 40-pr. R.B.L. gun, and the 7-pr. to 40-pr. (except 2·5-inch) R.M.L. guns. Use.

In the N.S. for R.M.L. guns, 7 and 9-pr.

It will become obsolete when the existing stock is used up, and will be replaced by the Small Percussion Fuze for the R.B.L. 40-pr. gun, and the R.M.L. 25-pr. and lower natures, in the Land Service.

Its general construction is shown in the woodcut.

It consists of a body, needle, guard, pellet, cap, bottom plug, safety pin, and copper shield. Description.

The body is of gun-metal; it is tapped on the exterior to the G.S. pitch and taper, and on the interior at the bottom to receive a screw bottom plug also of gun-metal. On the top is a square keyhole slot of the proper size to take the G.S. key. Body. Bottom plug.

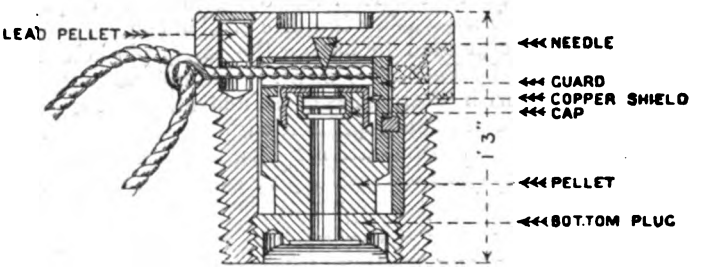
Needles Guard.

From the lower surface of the head projects a steel needle.

Inside the body is a gun-metal guard recessed as shown in the cut, and supported in position by two "feathers" on the exterior circumference of a pellet made of lead and tin in equal proportions.

Fuze, Percussion, R.L. No. 7, Mark IV, C.

Metal, 5 in a tin cylinder. Scale, full size.



The guard has a feather on it fitting into a slot in the side of the body, so as to prevent the pellet and guard screwing forward during flight. In the earlier patterns it was found that the pellet and guard worked forward and the needle bored a hole in the cap; this caused blinds.

Pellet.

There is a bevelled edge on the pellet above the feathers corresponding to a similar recess in the interior surface of the guard.

The pellet is hollow, and is cupped out at the top to receive the R.L. cap. (*See* Small Percussion Fuze, p. 160.) The cap is retained in the top of the pellet by a copper shield secured over it. The safety of the fuze in transit, &c., is ensured by a safety pin made of twisted brass wire which has a small tarred twine becket wherewith to pull it out at the moment of loading. The safety pin passes through one side of the head, through the space between the pellet and the head, passing through the guard, and into the other side of the head, where it is secured by the ends being opened out into a recess, as shown in the section. This recess, which has to be left open during manufacture so as to allow the ends of the wire to be opened out, is closed by a brass plug screwed in. The pin passes to one side of the needle.

Safety pin.

Coppershield.

A copper shield having a central fire-hole fits over the top of the lead pellet, to which it is attached by three indentations. This is to prevent the safety pin cutting into the soft metal, and thereby allowing the detonating composition to approach dangerously near to the point of the needle.

When the safety pin is withdrawn, the hole through which it passed, if left open, might admit of the passage of the flash from the discharge of the gun into the interior of the fuze, and so a premature burst might take place. To guard against this a small lead pellet slides freely in a recess cut in the head and closed by a brass disc with bevelled edges, secured by pressing the metal of body round the bevelled edge. When the shell is rammed home the pellet sets back and so closes the safety pin-hole.

Small lead pellet.

Bottom plug.

The bottom plug screws in the bottom of the fuze and is soldered.

It has a fire-hole drilled through its bottom, which is closed by a thin brass disc secured by spinning over.

The fuze is lacquered externally. Paint.

The fuze being screwed into the shell with the proper key, the safety pin is withdrawn with R.B.L. guns just before entering the shell into the breech, with R.M.L. guns when the shell is entered into the muzzle. The small lead pellet acts as described above. On the shock of discharge the guard sets back shearing off the two feathers of the pellet and locks itself on to the pellet by means of the projection on the latter wedging into the undercut recess in the guard. On graze or impact the pellet and guard fly forward and drive the cap against the steel needle, which pierces the thin brass disc and ignites the detonating composition. The flash passes through the fire-holes in the copper disc of the R.L. cap and down through the hollow in the pellet, blows out the brass disc closing the fire-hole in the screw plug, and so into the shell. Weight of fuze, about 6½ oz. Action. § 3822.

In Mark III fuzes there was no feather on the guard, and the disc in the R.L. cap was thinner. § 5270.

In the Mark II fuzes the cap was secured in the top of the pellet by the metal of the latter being spun over it, and there was no copper shield. The alteration to Mark III was made in consequence of the excessive jolting to which the fuzes were subjected in the limber boxes of the 13-pr. R.M.L. batteries. § 2621. Mark II.

The Mark II will be used up with any of the guns detailed above, except the 13-pr. § 5270.

A certain quantity of Mark II fuzes have been fitted with a copper shield over the pellet. They are designated Mark II*, and will be issued indiscriminately with Mark III. Mark II*.

Marks II, II*, and III fuzes, altered to conform with the Mark IV, will be marked and known as Mark III*. § 7175.

The Mark I R.L. fuzes may possibly still be met with; but they are only available for use with the 7 and 9-pr. R.M.L. guns, not being strong enough to withstand the shock of discharge in guns of heavier calibre. They may be distinguished by their having a projecting shoulder formed on the outside. The safety pin has a blue braid attached to it. § 2191, 2620. Mark I.

The R.L. fuzes, are wrapped individually in brown paper, and packed five in a tin cylinder. Issue.

Primer, Fuze, Percussion, R.L, No. 7, Mark I, is for use with that fuze with projectiles over 16 lbs. weight in the L.S. It resembles the G.S. plug without loop, but is smaller so as to fit the bottom of the G.S. fuze-hole. It has a small blowing charge of M.G.[1] powder, there are four fire-holes on top, one at each corner of the recess for the key, under which is placed a disc of paper and shalloon, and a disc of paper and one of shalloon between the powder and bottom plug; the latter has one fire-hole. § 8807.

Fuze, Percussion, B.L., Plain, Mark IV.—This is used with R.B.L. common and segment shells having the Armstrong field service gauge. B.L. plain. §§ 1983, 2292, 2620.

The body of the fuze is plain throughout, this necessitates the bush of common shells, which take it, being fitted with a flange at the bottom for its support. Use.

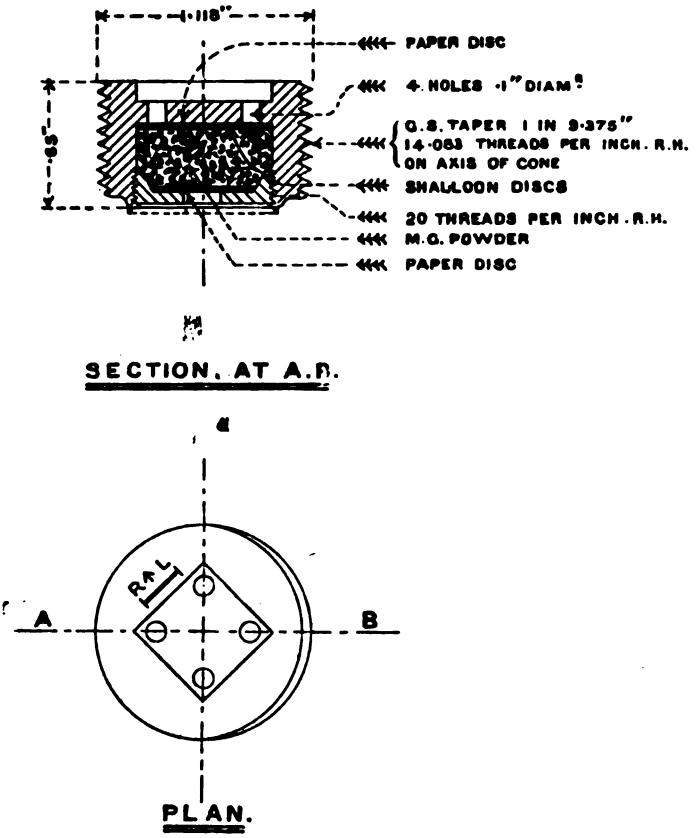
In segment shells it rests on the top of the iron burster. It is retained in position in the shell by the fuze hole plug, which screws in over it.

The parts of the fuze are:—Body with needle, pellet with cap, guard, safety pin, and bottom plug. Parts.

Description. Body.

The body is of gun-metal, and has a projecting rim at the top, which ensures its being placed in the correct position in the shell. From the under surface of the head projects a steel needle; four fire-holes are bored through the top to allow of the action of the Armstrong E. time fuze, these holes are closed by a thin brass washer underneath.

Primer, Fuze, Percussion, R.L., No. 7, Mark I, L, Gun-metal.



The body is bored out from the bottom to take the pellet and guard, and is threaded for the bottom plug.

Pellet.

The pellet is of equal parts of lead and tin, and is recessed at the top to receive the cap. The latter is of copper, and contains detonating composition pressed in and varnished, and covered with a thin brass disc; it is secured in the top of the pellet by the metal of the latter being spun over it. The pellet has four feathers, which form a support to the guard; above the feathers there is a bevelled edge which fits into a corresponding recess in the guard, and locks them together when the fuze is put in action. It is hollowed out in the centre and driven with mealed powder, pierced and roughened to

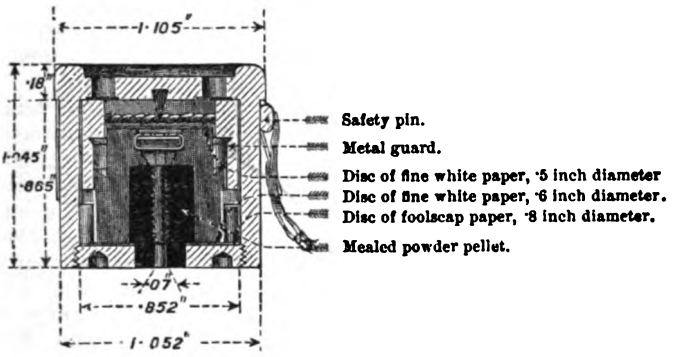
Cap.

ensure ignition; the top and bottom of the pellet are covered with thin paper discs.

The guard is of gun-metal, and rests on the feathers of the pellet, preventing the cap from moving forward against the needle; it has an undercut recess into which the thin edge of the pellet fits. Guard.

Fuze, Percussion, B.L., Plain, No. 2. (Mark IV.)
Metal. Five in a tin cylinder.

Scale, full size.



The safety pin is made of twisted brass wire; it passes through the side of the body, through the space between the pellet and the head, and through the guard which it supports, thus ensuring the safety of the fuze in transport. The feathers only take the weight of the guard in ramming home. To the safety pin is attached a braid loop for withdrawing it; a little beeswax seals the safety pin hole, and the braid is secured by a paper strip shellaced round the fuze. Safety pin.

The bottom is closed by a bottom plug screwed in, having a central firehole containing a pellet of pierced mealed powder, and closed by a brass disc spun over. A loose paper disc is inserted between the pellet and bottom plug to prevent them sticking together. Bottom plug.

Weight of fuze about 3½ oz.

The body of the fuze is varnished black on the exterior. Paint.

Remove the safety pin and drop the fuze into the shell, rim uppermost; replace the plug in the shell, except for Naval Service, when the E. time fuze is used. Preparation.

The action is the same as that of the R.L. fuzes. Action.

This fuze may be depended on to act on graze, even on wet boggy ground or on water, and will act at 400 yards, where case ceases to be effective.

The B.L. plain fuzes were formerly issued packed two in a tin cylinder, 80 cylinders in a deal case; but in future they will be issued five in a tin cylinder. Issue

A label on the top of the fuze cylinders gives the number, nature, and date of issue, number of thousand of the fuzes, and a caution that the cylinder is not to be opened until the fuzes are required for use or special inspection; while on the side are two labels, one conveying instructions for opening and closing, the other for using the fuze. Labels.

Base Fuzes.

§§ 8099, 8315, 8652, 8653, 8788, 9374.

Fuze, Percussion, Base, Large No. 11, *Mark II* is used with B.L., Q.F., or Q.F.C. guns, 6-inch and upwards, for all pointed common, and armour-piercing shells, and with R.M.L. guns, 9-inch and upwards, for pointed common and Palliser shells.

The principal parts of the fuze are:—Body, needle pellet, centrifugal bolt, pressure plate with spindle and nut, screwed cap with detonator and magazine, phosphor-bronze spring, brass spiral spring, and four screws. The body and screwed cap are of manganese bronze, spiral spring of phosphor-bronze, needle pellet of gun-metal, spindle, and centrifugal bolt of Bull-metal, pressure plate of copper, and a few minor parts of brass.

The general construction of the fuze is shown in the Plate XII.

Body.

The body is screwed nine threads per inch left hand for a length of 1·65 inch, the remainder above the screwed part being left plain, it has a flange below the screwed part which is coated with Mark III luting to make a gas-tight joint with the shell. The interior is bored out to receive the needle pellet, and threaded at the top to receive the screwed cap, a hole is bored in the base through which passes the pressure plate spindle; and a recess is made in the base into which fits the pressure plate. A hole is bored through the side of the body, and is closed by a brass screw plug, the end of which is reduced in diameter, and on it fits a fine brass spiral spring, this keeps the bolt in position till acted upon by centrifugal force; a recess is also made in the opposite side of the body, which the small end of the centrifugal bolt engages, two elongated holes are made in the base for screwing it into the shell, it is also stamped with an arrow showing the direction to turn when screwing it into the shell, and with the number of thousand of fuze and manufacturers' initials.

Needle pellet.

The needle pellet is cylindrical in form, and rests on the bottom, inside the body, it is reduced at the top end, forming a shoulder over which fits the phosphor-bronze spiral spring, the object of which is to prevent rebound and the pellet working forward during flight, and so causing a premature. A hole is bored at right angles to the axis, in which fits the centrifugal bolt, and another along the axis, from the top, in which works the nut of the pressure plate spindle; the upper part is threaded to receive the needle plug, after the needle plug is screwed home, the metal of the pellet is spun over it to prevent the possibility of its unscrewing; a small hole is bored in the bottom of the pellet through which passes the spindle. There is a small longitudinal groove in the side of the pellet, into which a screw projects from the side of the body, this prevents the pellet from turning round.

Centrifugal bolt.

The centrifugal bolt is also cylindrical in form, and fits in the hole in the needle pellet, one end is reduced in diameter to fit in the hole inside the body made to receive it. A hole is bored through it from top to bottom, the upper surface on one side of this hole is recessed for the nut on the spindle to grip, this locks the bolt, and makes the fuze perfectly safe till set in action.

Pressure plate.

The pressure plate has a boss on one side, into which screws the spindle; it fits in the undercut recess made in the base of fuze, and when in position the metal of the body is spun over it.

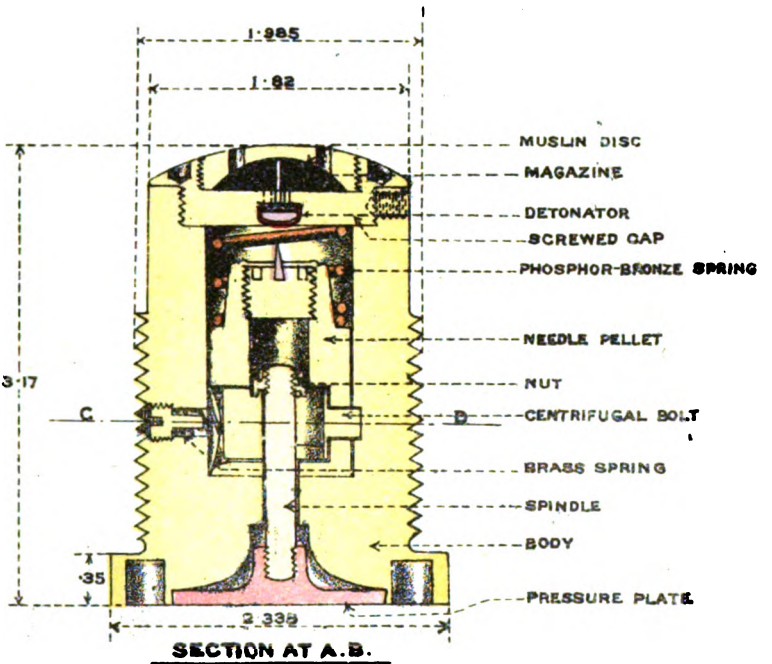
Pressure plate, spindle, and nut.

The pressure plate spindle is threaded at both ends, one end

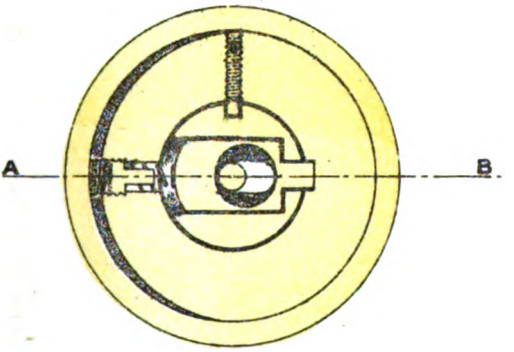
FUZE PERCUSSION BASE LARGE No. II MARK II |C|

METAL.

SCALE 3/4.



SECTION AT A.B.



SECTION AT C.D.

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screws into the boss on pressure plate, and the other receives the nut on top of centrifugal bolt, the end of the spindle is riveted over the nut when screwed home.

By this arrangement the centrifugal bolt is securely locked until the pressure plate is forced inwards, thus raising the nut by the pressure on the base of the projectile on discharge. The safety of the fuze during transport, and, in fact until the gun is fired, is thus ensured.

Screwed cap, with detonator and magazine.

The screwed cap is in two parts, screwed together and prevented from unscrewing by a locking screw, the two parts together forming a magazine holding a pressed pellet of R.F.G.^{2} powder with a hole through the centre, a disc of muslin is shellaced between the powder and the upper part of cap to prevent the powder working through the four fire-holes, through which the flash passes into the shell. A recess is made in the under side to receive the R.L. cap, *see* p. 160, and six fire-holes to convey the flash from it to the powder, the metal is spun over the R.L. cap to keep it in position. After the screw cap is home in the body, it is prevented from unscrewing by a locking screw from the side of the body.

Before issue the top and bottom of the fuze are painted red with Pettman cement.

These fuzes originally had a lead washer under the flange of the body to make a tight joint between the fuze and the shell. These washers did not act quite satisfactorily, and are ordered to be removed from all loose fuzes. The place of the lead washer is taken by Mark III luting (*see* p. 73) unthinned; the present orders being that fuzes before being screwed into shells will be lubricated with thinned luting (half Mark III luting, half mineral jelly) on the screw threads, and unthinned luting under the flange.

Cylinders of fuzes will not be specially opened to remove the lead washers, but whenever a cylinder is opened for any reason, the lead washer will be removed from the fuze.

Similarly, fuzed shell will be altered by removing the washer from the fuze, only when passing through laboratories for examination or repair.

Weight of fuze 2 lb. 8 oz.

Issue.

One in a tin cylinder, wrapped in brown paper.

Action.

On discharge, the pressure plate is crushed in, carrying forward the spindle and nut, thus releasing the centrifugal bolt. The rotation of the shell causes the centrifugal bolt to fly outwards, leaving the needle pellet free to move forward, which it does on impact or graze, compressing the spiral spring, the needle coming in contact with the cap fires it, the flash ignites the powder in the magazine and explodes the shell.

When this fuze is used with 9-inch H.A. gun, a 1¼-inch hole must be bored in the gas check to allow the pressure of the powder gas to act on the fuze, *see* p. 235.

§§ 8099, 8315. 8788.

The *Mark I* fuze differs from the above only in the form of the recess for the pressure plate, the shoulder of which is not so much cut away. The fuze is less sensitive since the pressure plate offers greater resistance. This fuze is not suitable for use with reduced charges, and it is ordered not to be used with the 9-inch R.M.L. gun on high angle mounting.

§§ 8100, 8315.

Fuze, Percussion, base, medium, No. 12, *Mark I*, is for use in all armour piercing, and common shell having pointed heads for B.L. and Q.F. guns, 12-pr. to 5-inch; and for Q.F. 2·95-inch for double shell.

In material construction and action it is similar to the fuze

percussion, base, large, but is smaller, and is screwed outside twelve threads per inch instead of nine.

Weight of fuze 1 lb. $\frac{3}{4}$ oz.

Issue. One in a tin cylinder, wrapped in brown paper.

Proof. For the proof of all these fuzes, *see* Regulations for Army Ordnance Services, 1900.

Table. For a list of guns and the fuzes used with each, *see* p. 492, *et seq.*

Storage. For storage, fuzes are placed in Group II, Division I.

§ 10742. *Fuze, drill, percussion base :—*

Large, No. 11 | L | } *Metal, burnt out Service fuzes.*
Medium, No. 12 | L | }

These are, as a rule, burnt out Service fuzes, cleaned and refitted with empty screwed caps and plugs, bronzed and stamped "Drill."

CHAPTER XI.—TIME AND COMBINED FUZES.

15 SECONDS WOOD TIME FUZES.—TIME AND PERCUSSION FUZES, NO. 56, MARK IV, 57, 58, AND 60.—TIME AND PERCUSSION FUZES, MIDDLE AND SHORT.—MIDDLE SENSITIVE TIME FUZE.—E TIME FUZE.

THE only wood time fuzes of which descriptions are given are the 15-*seconds*, 15-*seconds with special priming*, and 15-*seconds with detonator*. Descriptions of other wooden fuzes will be found in the earlier editions. § 4045. § 4685. § 9621.

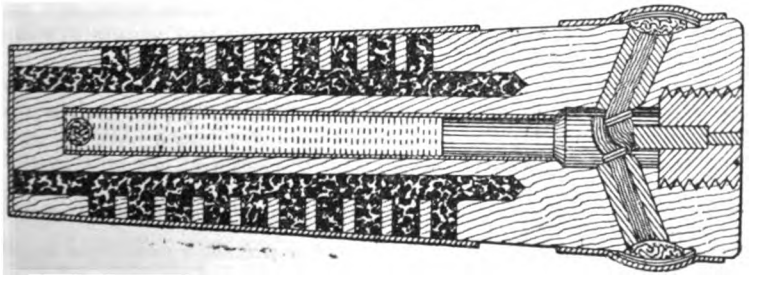
The *Fuze, time, 15-seconds, M.L., No. 41, Mark II*, is no longer made, and becomes obsolete when the stock is expended. It is used in the L.S. with R.M.L. guns, 11-inch and upwards with or without gas-checks, and 10-inch and lower natures when gas-checks are not used. In the N.S. for the 16-inch, 12·5-inch, 12-inch, 11-inch, 10-inch, 9-inch without gas-check, 7-inch, 64-pr., 9-pr., and 7-pr. R.M.L. guns. The body is made of beech wood, bored out as shown in the cut. The head is closed by a gun-metal plug, round the pin of which quick-match is looped and led through two fire-holes to a groove. The priming is protected by a copper and tape band (*see* woodcut).

It has the composition channel in the centre driven with 2 inches of slow burning composition (1 inch in 7½ seconds).

There is a paper lining to prevent the formation of a space between the wood and the composition in event of the wood shrinking, which would cause the fuze to act prematurely. The paper is burnished inside and varnished on the outside, above this is a ·75 inch pellet of mealed powder, having a hole bored down its centre to a depth of ·55 inch. The object of the pellet is to obviate the risk of cracking the composition when boring for short ranges. There are six powder channels bored parallel to the composition channel connected at the bottom by quick-match placed in an annular groove and pressed into the bottom of each channel. The holes (·125 inch in diameter, and ·2 inch from centre to centre) are closed by small

Fuze, time, 15-seconds, M.L., No. 41. Mark II.

Full Size.



pellets of pressed pistol powder. The bottom hole is bored through and threaded with quick-match. The fuze is covered by a varnished index paper.

The numbers on the paper scale are reversed so that they read correctly when the fuze is being bored. Each side hole is marked on the index paper with a dot of yellow paint, and the whole numbers refer to ½-seconds and the decimals to ¼-seconds as usual, the marking begins at 1.

Boring the powder channels parallel to the composition channel commenced with the 122nd thousand. They were formerly bored parallel to the exterior. The change has reduced the amount of wood through which the bit must pass when the fuze is bored short.

§ 3306. *Mark I* of this fuze had the numbers on the index paper so placed that they could be read when the fuze stood upright on its base, but were upside down when it was in the hook borer. The position of the side holes also was not so carefully indicated, and it was possible to bore into the wood instead of through the hole.

§ 4684. This mark is to be considered obsolete in its present form, and is to be returned to Woolwich and converted to Mark II.

This fuze burns at rest about 15 seconds.

In future when these fuzes are passing through the Royal Arsenal for examination they will be grouped in lots according to their mean time of burning. The lots will be distinguished by letters, which will be marked on the cylinders and packages containing them, but not on the fuzes themselves, and such letter will be regarded for all purposes as equivalent to a number of thousand.

§§ 4686, 5061, 6007, 9621. The *Fuze, time, 15-seconds, M.L., special priming, No. 42, Mark I,* is for use with 7-pr. double shell and R.M.L. star shells of R.L. manufacture. It differs from the 15-seconds fuze described above only in having, as additional priming, a strand of No. 4 gun-cotton yarn, about 11 inches long, passed twice round the head of the fuze over the ordinary priming, and fastened with tacks, leaving about 1½ inches of each end of the gun-cotton loose; three projecting loops are formed in the gun-cotton to facilitate ignition. Previously the gun-cotton priming was secured by silk twist; this was found liable to get blown away without igniting the quick-match priming. This alteration commenced with the "U" thousand of these fuzes, and does not constitute a change in pattern.* A patch of waterproof paper is pressed down over the priming, and a copper and tape band wrapped round the whole and secured with shellac varnish.

The head of the fuze is painted red to distinguish it.

The orders regarding the 15-seconds fuze when passing through the Royal Arsenal for examination apply equally to this fuze.

§ 3458. *Fuze, time, 30-seconds, M.L., No. 40, Mark I,* is used for the same shells as the 15-seconds when the range is long, except for the 7-pr. R.M.L. shrapnel. It is generally similar to the 15-seconds, but the lower part of the body is cylindrical. It becomes obsolete when the existing stock is used up.

Action of M.L. Fuzes. When the fuze composition becomes ignited it burns down to the place where the fuze has been bored, when the flame ignites the powder in one of the side channels, which explodes. All the side channels explode together, as they are connected at the bottom, and

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* A letter denotes the thousand of manufacture and not a number as in the case of other fuzes. This letter will be stamped on the cylinders containing these fuzes and printed on the label.

so direct a strong flash into the shell. The gases from the burning composition escape through the two fire holes.

Fuzes with detonators. (B.L. fuzes.)

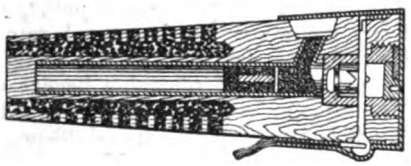
In the R.B.L. guns, where there is no windage, the time fuzes cannot be lighted by the flash of discharge, and the introduction of gas-checks has caused the same result in ordnance of 10-inch calibre and lower natures, when the gas-checks are used. Hence it is necessary to have some means of igniting the fuzes by an arrangement put in action by the shock of discharge.

§§ 3724, 4045, 4496, 4685, 5132, 9961.

The *Fuze, time, 15-seconds, with detonator, No. 43, Mark III*, is to be used with all R.B.L. projectiles having the G.S. fuze hole, and with those for the 10-inch, 6·6-inch, 40-pr., and 13-pr., also 9-inch and 80-pr. with gas-checks in L.S. In the Navy with 9-inch R.M.L. with gas checks, and as a substitute for 15-seconds M.L., except when loaded by hydraulic machinery. No more will be made, and it becomes obsolete when the existing stock is used up.

Fuze, time, 15-seconds, with detonator, Mark III.

Scale, ½.



Construction.

For details of the construction of the fuze, *see* woodcut. Its general construction resembles that of the 15-seconds M.L., except that it has an igniting detonator instead of a quick-match priming. The igniting detonator is arranged as follows:—A cylinder, of an alloy resembling gun-metal, screws into the head of the fuze; this cylinder contains a hammer, supported by a copper wire, below the hammer is a hollow in the cylinder containing a detonating composition.

A steel safety pin passes through the head of the fuze and through the hammer, which it supports and thus prevents the accidental shearing of the suspending wire. This pin is withdrawn by the braid just before placing the shell in the gun.

There are three escape holes, one of which is shown in the section, to allow of the escape of gas. These holes are protected by thin copper discs and papier-maché wads, which are forced out by the gas when the fuze is lighted; quick-match leads up to these holes. The exterior of the head is woolded with copper wire, soldered over, to keep it from splitting when the detonator is being screwed in.

§§ 4496, 5132.

Mark II is to be used up in the 13-pr., 40-pr., 6·6-inch, and 9-inch R.M.L. guns.

§§ 10353, 10104.

Mark II* are Mark II fuzes fitted with a finer suspending wire similar to that in Mark III. They are for L.S. and are used in place of the 15 seconds M.L. fuze except for the 9-pr. and 16-pr. R.M.L. guns, the rammers of which are unsuitable for use with this fuze. They may be used instead of Mark III for R.B.L. guns.

§ 4596.

Mark I is obsolete in its present state, but it is to be returned to the R.L. for conversion to Mark II.

These fuzes are grouped according to their mean time of burning, when passing through the Royal Arsenal, in the same manner as detailed for the 15-seconds fuze.

Action. The ignition is produced by the hammer setting back on the shock of discharge, and thereby shearing the copper wire and falling on the detonating composition; the latter is thus exploded and the fuze ignited.

Packing. All wood time fuzes of G.S. gauge are packed by fives in tin cylinders hermetically closed by a band of tin soldered round the junction of the body and lid. Each 15-seconds wood time fuze is wrapped in brown paper.

Fuzes for instruction. § 10278. When the foregoing fuzes are condemned for service but appropriated for instruction, their cylinders will, for purposes of identification, be marked with a blue band.

Metal, Time, and Combined Fuzes.

§§ 7716, 9088, 9194, 9251, 9809, 9856. Description. *Fuze, Time and Percussion, No. 56, Mark IV.*—The fuze consists of the following parts:—Body, percussion pellet with steel needle and retaining bolt, spiral spring, detonator plug, safety pellet, brass ball, bottom plug, composition ring, dome, brass washer, cap, two safety pins, and two leather washers.

Material. The body, composition ring, percussion pellet, detonator plug, bottom plug, and cap are made of the usual gun-metal or other approved alloy, the dome, washer, ball, safety pellet, and spring of brass, and the time safety pin of phosphor bronze wire, percussion safety pin of half round copper wire. (*See* Plate XIII.)

Use. For Land Service B.L. 10-pr. to 4-inch and 30-pr., Q.F. 12-pr. and 2·95-inch., R.M.L. 2·5-inch to 16-pr. For Naval Service Q F. 12-pr. It will supersede the T. and P. short, No. 55, as soon as the stock of that fuze is exhausted.

Body. The bottom part of the body is screwed on the exterior to fit the G.S. fuze-hole, and is bored out in the interior to take the percussion arrangement, and screwed to receive the bottom plug.

Above this the body is of larger diameter, and fits over the nose of the shell, a leather washer on the underside of the fuze making the joint tight.

Above this, again, the body terminates in a stem, the top of which is threaded to receive the nut, and two grooves are cut in the top end to receive the feathers on a brass washer. A groove is cut in the top face of the body close to the stem and half way round it, and a hole is bored obliquely through the body into the groove at an angle the reverse to the spin of rifling, for the escape of gas.

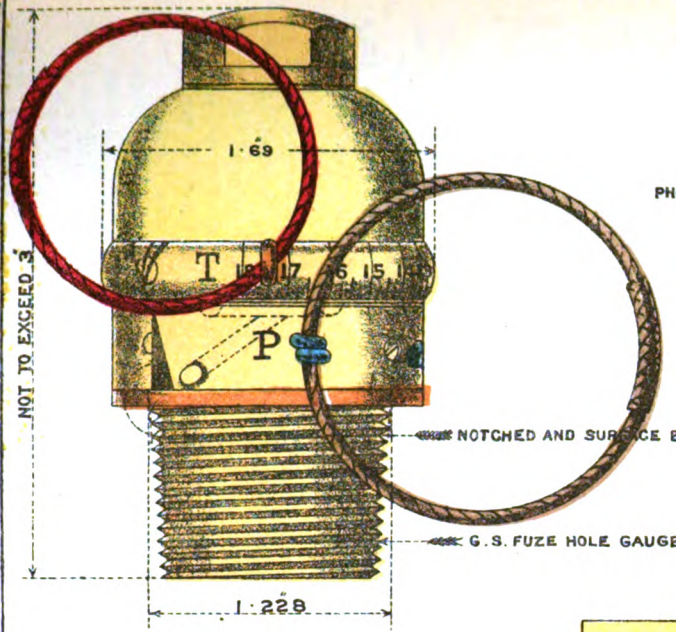
Round the enlarged diameter of the body will be found the safety pin of the percussion arrangement, a hole for the projection on the key by which the fuze is screwed into the shell, the escape hole mentioned above, and a black triangular setting mark, or notch. The notch marks the position of a fire-hole containing a small perforated pellet of powder leading to a horizontal channel filled with fine grain powder, the latter communicating with the detonator plug. A white calfskin washer, beneath which is one of fine white paper, on the flat part of the body, prevents the composition in the ring from exploding. These washers are attached firmly to the body by shellac, a hole being pierced through them so as to leave the powder pellet in the fire-hole exposed. Until recently the setting mark on the body of the fuze was an arrowhead.

Composition ring. The composition ring, which is barrel-shaped on the exterior to give better grip in setting, fits on the top of the body. A channel lined with asbestos paper runs nearly all round its under surface

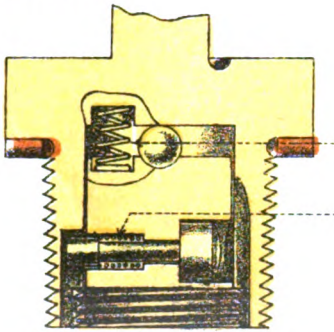
FUZE, TIME AND PERCUSSION No. 56. MARK IV, |C|

METAL.

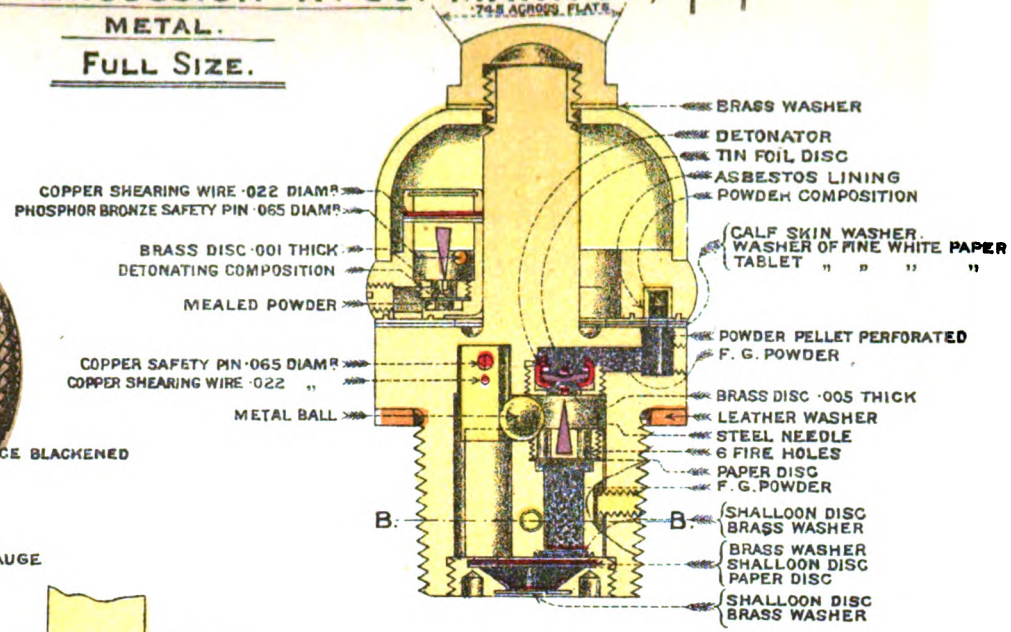
FULL SIZE.



ELEVATION.



PART SECTION.



SECTION.

SECTION AT B.B.

and contains 3·25 inches of fuze composition. On the upper side of the ring there is a small chamber containing the lighting arrangement, which consists of a gun-metal hammer, having a steel needle, suspended by a thin copper wire over ·2 grain of cap composition surrounded by mealed powder, and covered by a thin brass disc; the top of the chamber is also closed with a brass disc.

A strong safety pin of phosphor-bronze wire passes through the ring from the outside, and underneath the hammer, which it supports. The end of this safety pin has a slot cut through it, and the two ends opened out to retain it in position. A loop of whipcord, coloured bright scarlet, and long enough to pass over the top cap, is attached to the pin to facilitate its withdrawal. The letter T is stamped on the time ring near the entrance of the safety pin. When the safety pin is withdrawn, a small brass pellet, having a spiral spring behind it, closes the hole.

A fire-hole leads from the bottom of the chamber to the commencement of the composition, which is indented in order to secure its ignition by the flash from the detonator.

A conical hole is bored into the composition channel, at the side, near its commencement, and an elongated hole at the top. These holes allow of the escape of gas from the burning composition into the dome.

Three projections are formed on the inside of the ring, which keep it central when placed on the stem of the body.

Round the exterior of the ring are divisions marked and numbered up to 18. The divisions are further subdivided by unnumbered lines into quarters.

These divisions are now made more distinct by having the lines for the whole numbers marked completely across the ring.

Safety point. An arrow on the exterior of the ring denotes the position of the centre of the bridge. When this arrow is set opposite the notch on the body the fuze is said to be set at safety.

Dome. The dome is stamped up from sheet brass; it fits over the composition ring, and is retained by the cap. It covers the lighting arrangement of the time ring, and forms a chamber into which the gas escapes, thus making the pressure on the burning composition more regular.

Brass washer. The washer is made of sheet brass with a central hole having two feathers fitting into the grooves in the top part of the stem, which prevent the washer turning: this washer prevents the dome being turned and the setting altered when screwing up the cap.

Cap. The cap is hexagonal in form and fits the small hole in the *Key, fuze, universal*, it screws on the end of the stem of the body and holds the dome and ring in position.

Percussion arrangement. The percussion arrangement consists of a percussion pellet with steel needle, and retaining bolt with spiral spring, safety pellet, detonator plug with detonator, spiral spring, brass ball and bottom plug.

Percussion pellet. The percussion pellet contains on its upper surface the needle plug, with hardened steel needle in centre with six fire-holes around it. It has on the underside a disc of fine white paper secured with shellac, and in a recess under the needle plug are three grains of F.G. powder, this recess is closed at the bottom with a brass washer and shalloon disc. A small recess is made in the underside of the body and a corresponding one in top of pellet, into which fits a spiral spring, this prevents rebound. There is a slot down the side for the safety pellet and ball to fall into, and the percussion pellet is prevented from

turning by a screw in the body which projects into a groove down its side.

Retaining bolt. The retaining bolt is an additional precaution against prematures. It passes transversely through the percussion pellet, and its head projects into a recess in the body, where it is kept by a spiral spring as shown in the plate.

The other end of the bolt is heavy and is caused to fly outwards when the shell is rotated. A slotted recess is formed in the body into which the heavy end of the bolt can move.

In manufacture these bolts are tested by spinning the percussion pellet in a special lathe. The bolt must withdraw between 1,700 and 2,100 revolutions per minute.

Ball. The ball prevents the percussion pellet moving forward so long as the safety pellet is in its place.

Spiral spring. The spiral spring is made of thin brass wire, and fits in a recess in body and percussion pellet and prevents the percussion pellet rebounding or working forward during flight.

Safety pellet. The safety pellet is suspended in the body of the fuze by a thin copper suspending wire.

Safety pin. The safety pin of split copper wire passes through the centre of the body, and through the safety pellet which it supports, its ends being opened out to retain it in its place. The letter P is stamped on the body near the entrance of this pin. The pin is provided with a tarred whipcord loop for withdrawal. The loop is long enough to fit over the top cap.

Closing pellet. A small brass pellet, having a spiral spring in compression behind it, closes the safety pin hole when the safety pin is withdrawn.

Detonator plug. The detonator plug is a small cylinder of gun-metal, screwed on the exterior to fit into the body at the end of the horizontal powder channel, and above the needle, it is recessed to receive the R.L. cap (*see* p. 160), and has a central fire-hole, the cap is held in position against the underside of interior of body.

Bottom plug. The bottom plug is a short cylinder of gun-metal threaded on the exterior to screw into the bottom of the fuze. It has a cavity filled with a perforated pellet of pressed powder, over the top of which is a disc of fine paper, then a disc of shalloon secured by a brass washer over which the metal is spun. The hole at the bottom is closed by a disc of shalloon similarly secured.

The exterior of the fuze is lacquered all over.

Waterproofing. The screw threads of the detonator plug and bottom plug are touched with Pettman cement before screwing in, and the bottom of the fuze is covered with the same cement.

The mark, number of lot, date of manufacture, and manufacturer's initials are stamped upon the plain portion of the body.

Alterations. Certain alterations and improvements have been made in this fuze since it was first made, without any change of mark. These are embodied in the foregoing description, but are given here in condensed form.

Lines denoting divisions on time ring and letters "T" and "P" made more distinct; and lines for whole numbers completely across the ring. These commence with the 207th thousand. Number of lot and manufacturing marks placed clear of setting mark and of safety pins. Percussion pin placed a little to the left. Safety pins strengthened, P pin by being made of a double turn of copper wire soldered together, commencing with No. 152 thousand, and T pin by being made of a single wire of phosphor-bronze, with a loop and split end, commencing with the 461st thousand. Loops of safety

pins made long enough to be turned over the cap when the fuze is in the shell, commencing with No. 215 thousand, and the loop of the time safety pin coloured bright scarlet to distinguish it readily from the percussion safety pin. Finally, the setting mark altered from an arrowhead to a blackened notch, commencing with the 449th thousand.

Weight. The fuze weighs about 13 oz.

Time of burning. The time of burning at rest is printed on the label of the cylinder in which the fuze is packed. It is about 13 seconds; but varies very slightly for different lots.

Preparation. The fuze is screwed into the shell by means of the universal key, the cap loosened by the same means, and the ring turned until the required graduation on the ring is opposite the arrowhead or notch on the body.

The cap is next clamped tightly.

This is a most important point in all such fuzes, for, if it is not securely done, the ring of composition may explode without burning. At the same time, care must be taken that the setting of the fuze is not altered in the operation.

The shell is then brought up to the gun, and, when it is on the point of being loaded, one or both safety pins must be withdrawn according to the use intended. If required to act as a combined fuze, both pins are withdrawn; if as a time fuze only, the percussion safety pin is left in; and, if required to act as a percussion fuze only, the time safety pin should be allowed to remain. In order to prevent mistakes, the letter T is stamped near the time safety pin, and the letter P close to the percussion pin. For the latter purpose it does not appear to be safe to withdraw both safety pins and set the fuze on the bridge.

Safety pins.

The action for time is as follows:—

Action of time part. On the shock of discharge the hammer shears the suspending wire and fires the detonating composition, which ignites the composition ring. The gas from the ring escapes into the dome and thence out through the hole in the side of the body.

When the ring has burned round to the channel, marked by the arrow or notch, it fires the percussion arrangement and the shell.

Action of percussion part. On the shock of discharge, the suspending wire is sheared, and the safety pellet sets back to the bottom of the slot in the percussion pellet, the ball following it on the first movement of rotation. The spiral spring prevents the percussion pellet rebounding.

During flight the centrifugal force of the heavier end of the retaining bolt overpowers the spring and withdraws the smaller end from the recess, so that the percussion pellet is free to move forward, which it does on impact or graze compressing the spiral spring, and the needle striking the detonator fires the fuze.

Issue. Each fuze is packed in a cylinder. The cylinder is fitted with two papier-maché packing pieces, one to fit over the lower screwed part of the fuze, the other over the dome. A tape loop passes through the two packing pieces and under the bottom of the fuze to facilitate withdrawal.

The number of lot of the fuze is stamped on the bottom of each cylinder.

Drill fuze. §§ 9955, 10296. For drill purposes a *Fuze, Drill, T. and P., No.* 56, *Mark I,* is issued.

It is an empty service fuze, fitted with special safety pins, which can be withdrawn and replaced. The dome is bronzed to distinguish

it from the filled fuze, and the washer between cap and dome is made of steel, with the feathers bent up at right angles.

No 57 fuze. § 10174. In response to demands for a longer burning fuze for use with field guns, the *Fuze, Time and Percussion, 22 seconds, No. 57, Mark I,* was introduced for special service. This fuze differs from the T. and P., No. 56, Mark IV, only in the composition of the time ring, which is made to burn for 22 seconds at rest.

In order to distinguish this fuze from the T. and P., No. 56, Mark IV, the dome and the cap are coloured blue, and the cylinder in which the fuze is issued is also coloured blue.

T. and P. No. 58. The *Fuze, Time and Percussion, 20 seconds, No. 58,* is for use with the 15-pr. Q.F. gun. It is a double-banked fuze (*see* p. 148).

In this fuze there are two time rings fitting round a central stem. The lower ring is graduated from 0 to 18 and in halves and quarters, and it has a cross showing the position of safety. This ring can be turned round in order to set the fuze. Above it is the upper ring, which is clamped in a fixed position and cannot turn. This ring carries no graduations. The lighting detonator of the time part and the percussion portion of the fuze are carried in the central stem and body. A safety pin, with scarlet loop, supports the time detonator before loading. The lower time ring is always clamped tightly, and the fuze is set by dragging it round by means of a steel setting key, until the desired graduation is opposite the setting mark on the body of the fuze.

On the shock of discharge the composition of the upper ring lights and burns round until it reaches the zero of the lower ring, when it lights the composition of the latter, which burns in the opposite direction to that of the top ring, until the setting mark on the fuze is reached, when the magazine of the fuze is exploded.

The *Fuze, Time and Percussion, No. 60, Mark I,* is a double-banked fuze of similar size to T. and P., No. 56, Mark IV, already described.

The body of the fuze and the percussion arrangement are the same as those of No. 56.

In the time portion there are the following differences (*see* Plate XIIIA):—

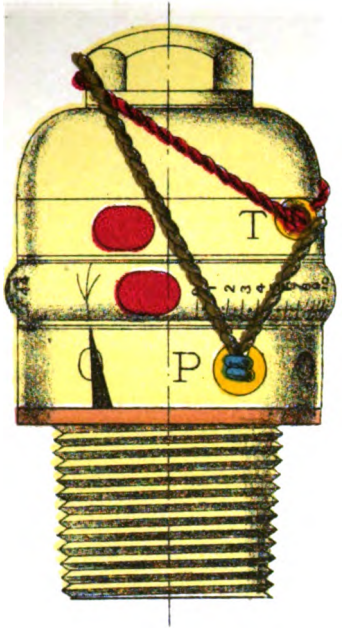
There are two time rings, the lower being barrel shaped and graduated from 0 to 44 in the opposite direction to the ring of No. 56; half graduations are denoted by dots. The gas escape is external, *i.e.*, the gas escapes direct from the ring into the air, instead of into the dome. For this a hole is bored into the ring at the commencement of the composition, and is covered by a thin brass patch which is blown out when the ring lights. This ring is movable for setting the fuze. The upper ring rests upon a calf-skin washer upon the top of the lower ring. At the zero mark of the lower ring is a vertical hole communicating between the two rings.

The upper ring is pinned to the stem so that it cannot turn. It is similar to the time ring of No. 56, but is cylindrical, has no graduations, and has external gas escape, so has no channels leading into the dome. The lighting arrangement is similar to that of No. 56, and the time safety pin passes through this ring.

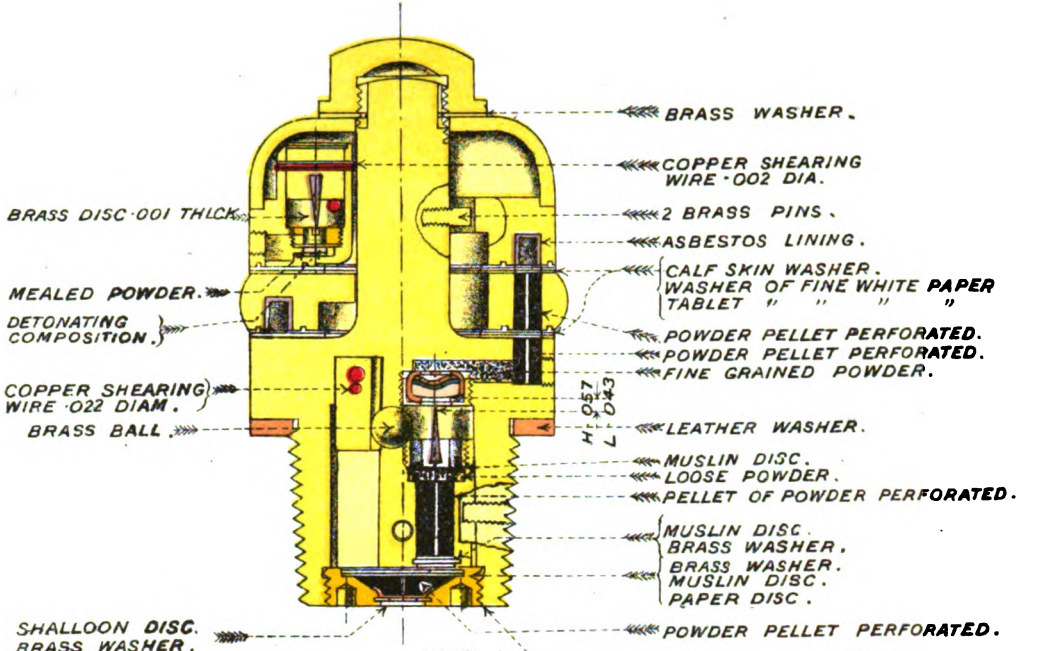
Above the ring a brass dome, washer, and cap are similar to those of No. 56.

Action. The fuze is set by turning and clamping the lower ring as in No. 56. The safety pins are removed in the same way. On shock of discharge the composition of the upper ring lights, blowing out the disc covering the gas escape hole, and burns round until it reaches the zero of the lower ring, which then lights and burns back in the

FUZE T. AND P. Nº 60 Mk I.



ELEVATION
FUZE SET AT SAFETY



SECTION AT A.B

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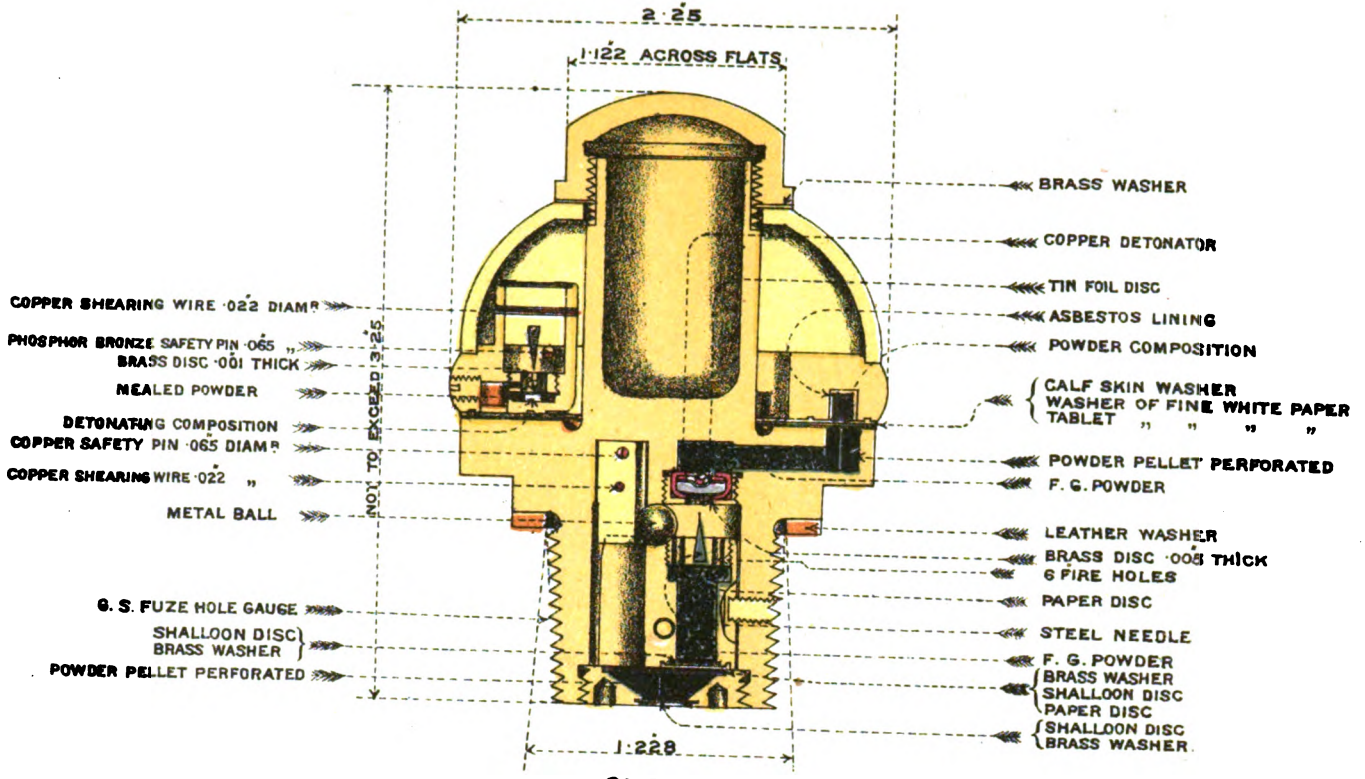
FUZE TIME AND PERCUSSION MIDDLE No 54 MARK III |C|

METAL.

FULL SIZE.



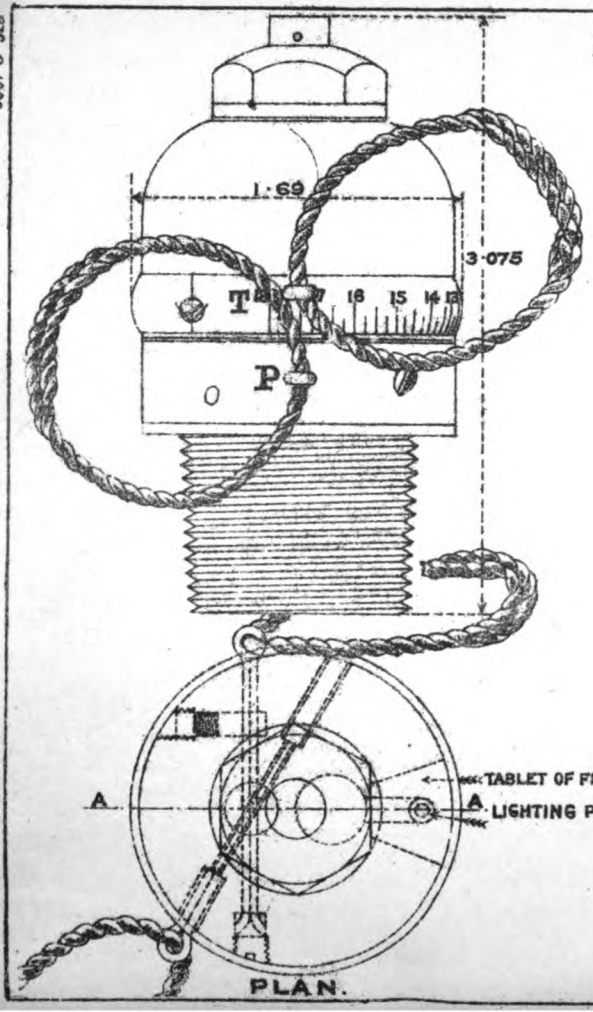
SECTION.

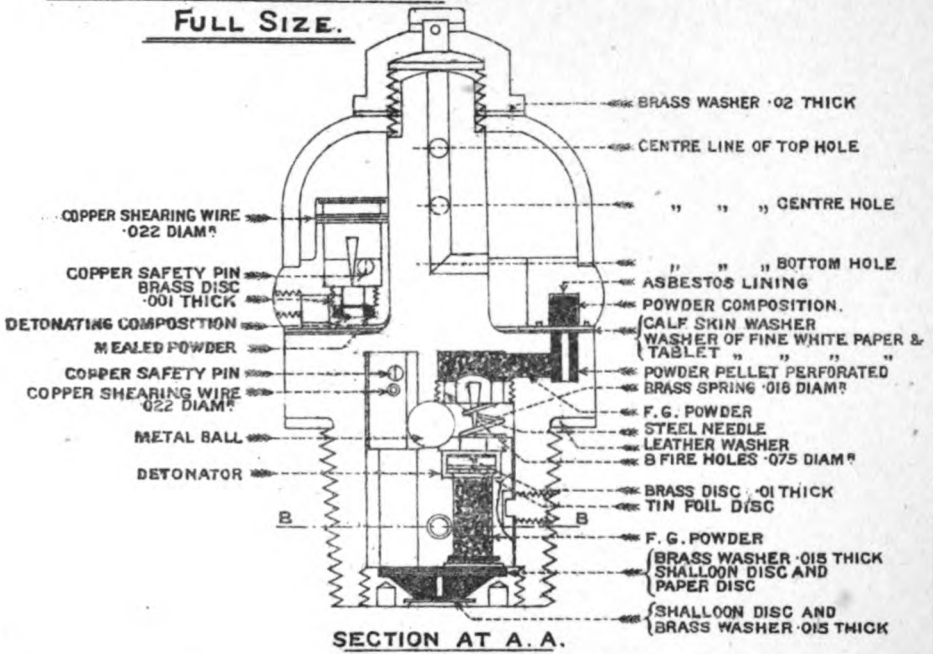
E. Weller & Grahame, Ltd Litho. London

FUZE TIME AND PERCUSSION, SHORT No. 55. MARK III.

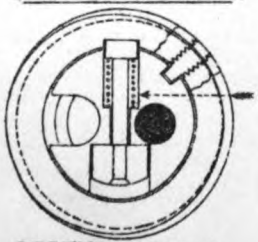
METAL, ONE IN A TIN CYLINDER.

FULL SIZE.





SECTION AT A. A.



SECTION AT B. B.

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E. Weller & Grahams, Ltd Litho. London.

opposite direction until the setting mark of the fuze, when the fuze fires.

The action of the percussion portion is the same as that of No. 56, but the flash is stronger.

The fuze burns for about 20 seconds at rest.

The *Fuze, Time and Percussion, Middle, No. 54, Mark III*, is for use with B.L. howitzers, 5-inch, 5·4-inch, and 6-inch, except for star shell. T. and P. middle, fuze. §§ 8912, 9809, 9956.

It will also supersede the middle sensitive time fuze, except for star shell, for which the latter is retained. When the stock of this latter fuze is exhausted the T. and P. middle fuze will therefore be used with the following:—

Land Service.—B.L. or Q.F. 4·7-inch and upwards; R.B.L. 7-inch and 40-pr.; R.M.L. 25-pr. and upwards, and all howitzers.

Naval Service.—B.L. or Q.F. 4-inch and upwards; R.M.L. 64-pr. and upwards.

In construction the fuze is similar, in all respects, to the T. and P., No. 56, Mark IV, except as to dimensions, weight, marking, and length of composition. (*See* Plate XIV.) The stem is hollowed out for lightness only; the time ring contains 5·1 inches of fuze composition and is graduated up to 30 divisions. Construction.

The lines of the whole numbers do not extend across the ring as in the No. 56 fuze. Like the latter fuze, its setting mark was formerly an arrowhead but is now a blackened notch, and the time safety pin is made of a single phosphor-bronze wire, where formerly it was made of double copper wire. These changes took place with the 63rd and 58th thousands of the fuze respectively.

The loop of the time safety pin is of bright scarlet whipcord.

The fuze burns at rest about 16 seconds, and weighs about 1 lb. 4 oz.

One in a tin cylinder, the fuze wrapped in brown paper. Issue.

The Mark II, T. and P., middle, differs from Mark III chiefly in the percussion portion, which is similar to that of the T. and P., short, No. 55, Mark III. (*See* p. 178.) The time ring also has two extra escape holes for the gas from the burning composition to escape by into the dome. § 8417.

Mark I* has a flat time ring, instead of barrel-shaped. Both these fuzes burn for about 16 seconds at rest.

Mark I resembles the T. and P., short, Mark II, and is to be converted to Mark I*. §§ 5361, 5982.

Fuze, Time and Percussion, Short, No. 55, Mark III, is for use in the Land Service with B.L. guns, 4-inch and 30-pr. R.M.L. guns, 2·5-inch and the 12-pr. Q.F. gun. T. and P. short, No. 55. § 7176.

No more of these fuzes will be made and it will be superseded by the T. and P., No. 56, Mark IV.

The fuze is generally similar in appearance to the T. and P., No. 56, but differs in some essential parts.

In the time portion, the stem of the fuze is hollow and communicates with the interior of the dome by three holes. The top cap is also hollow, and has a small cylindrical projection on the top, through which four gas escape holes are bored.

This projection affords a ready means of distinguishing the fuze from No. 56.

The gas given off by the burning composition of the time ring escapes into the dome and thence into the hollow stem, from which it finds an exit by the holes in the top cap.

The marking of the time ring is not so distinct as in the later

No. 56 fuzes, and the lines denoting whole numbers do not extend across the barrel of the ring. The setting mark is an arrowhead on the body of the fuze.

The safety pins are of the unstrengthened pattern and the loops are short.

The mean time of burning is about 12·5 seconds.

In the percussion portion the chief difference is in the relative positions of the detonator and steel needle. In this fuze the needle plug is screwed into the underside of the body, while the detonator (R.L. cap, *see* p. 160) is placed in a recess in the detonator pellet and retained in its place by a metal screw collar. The needle plug closes the end of the channel communicating with the time portion of the fuze and is provided with 8 fire-holes through which the flash can pass.

The brass spring between the detonator pellet and underside of the fuze body is placed round the needle instead of to one side.

Preparation. It is prepared in the same way as the T. and P., No. 56. (*See* p. 175.)

Action of time part. The action of the time portion is the same as that of the No. 56, except that the escape of gas is through the head of the fuze instead of through the side of the body. (*See* p. 175.)

Action of percussion part. On the shock of discharge, the suspending wire is sheared, and the safety pellet sets back to the bottom of the slot in the detonator pellet, the ball following it on the first movement of rotation.

During flight the centrifugal force of the heavier end of the retaining bolt overpowers the spring and withdraws the smaller end from the recess, so that the detonator pellet is free to move forward on the shell grazing.

§§ 5574, 5982. Mark II differs from the above in the composition ring not being barrel-shaped, and in having no spring over the detonator pellet, or brass washer between the cap and dome.

§ 7176. Mark II fuzes returned to Woolwich will be fitted with the spring and hardened needles and designated Mark II*.

Issue. One in a tin cylinder, with packing pieces as for T. and P., No. 56.

Sensitive time fuze. A fuze depending for its ignition upon the shearing of a suspending wire by the shock of discharge is not quite sensitive enough for use with very low velocity pieces, because if the wire is made so thin as to ensure its shearing, there is a possibility of the fuze proving dangerous after the removal of the safety pin.

To meet the case of these guns the middle sensitive time fuze was designed. In this fuze the detonator is fired by the action of centrifugal force, due to the rotation of the shell, and not by the shock of discharge. The design was also suitable for use with reduced charges, a condition required by the Royal Navy. The fuze, however, has not proved very satisfactory and is to be replaced, when the existing stock is used up, by the T. and P., middle, fuze, except for star shell. The introduction of a suitable fuze for use with star shell will be considered when the present stock of middle sensitive time fuzes is nearly expended.

§ 8788.

§§ 5638, 5982, 7046, 7231, 8417, 8788, Use. *Fuze, Time, Sensitive, Middle, No. 24, Mark I.*—This fuze will become obsolete when expended. It is used in the L.S. with B.L. guns, 5-inch and upwards, R.B.L. 7-inch and 40-pr., R.M.L. 25-pr. and upwards, and all howitzers.

In the Navy it is used for B.L. guns, 4-inch and upwards, and with R.M.L. 64-pr. and upwards.

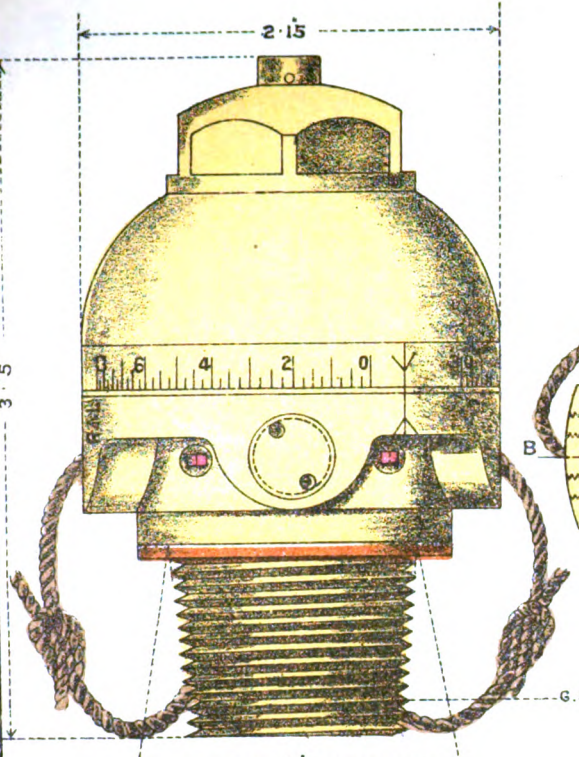
The parts of it are as follows:—Body, composition ring, dome, and nut; lighting pellet, two retaining pellets, with spiral springs,

FUZE TIME SENSITIVE MIDDLE Nº 24 MARK I.

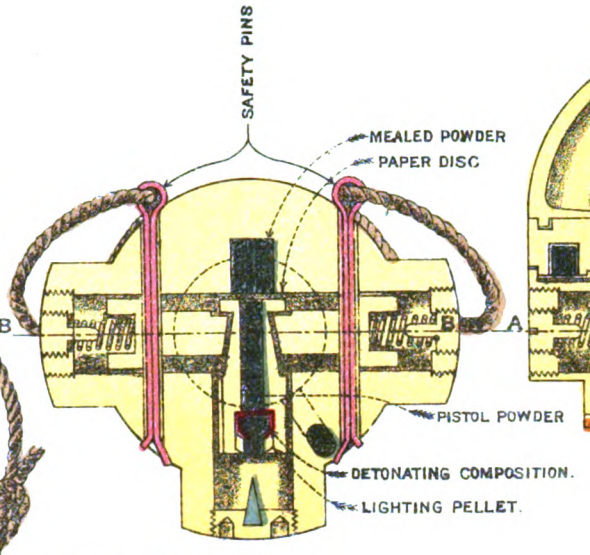
§ 7231

SCALE 1/1.

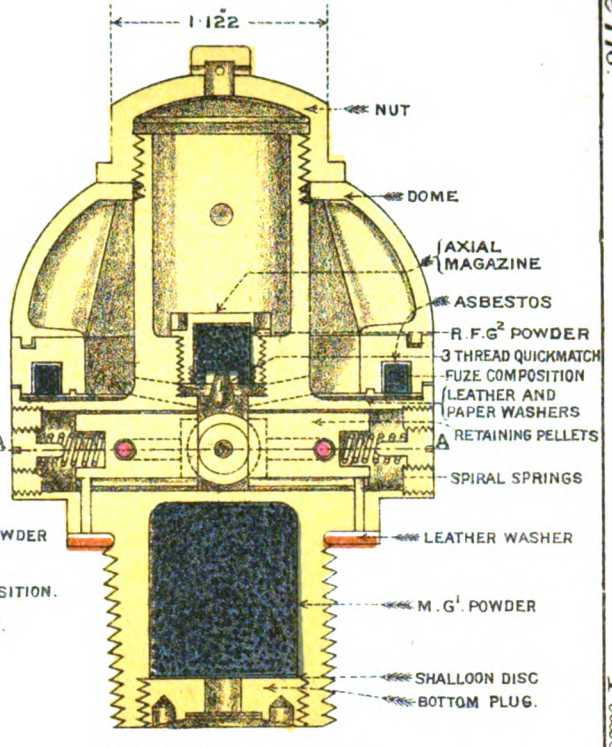
WEIGHT 1 LB. 4 OZ.



ELEVATION SET AT SAFETY.



SECTION AT A. A.



SECTION AT B.B.

E. Weller & Grahams, Ltd Litho. London.

two copper safety pins, steel needle, axial magazine, and bottom plug.

All the parts are of gun-metal, except the composition ring, which is of phosphor-bronze, and a few minor portions. Material.

The body is screwed on the exterior, near the bottom, to fit the G.S. gauge; above this it is enlarged and fits over the nose of the shell, a leather washer on the under surface making a close joint. Description.

The bottom is bored out to receive a large blowing charge of M.G.[1] powder, and closed by a bottom plug screwed in, the latter having a central fire-hole stopped on the upper side by a disc of shalloon and one of fine white paper, and on the under side by a brass disc spun over. Bottom plug.

The centre of the body is bored out to take the lighting arrangement, and the upper surface is recessed to take the time composition ring; a leather washer on the flat portion of the body prevents the composition in the ring from exploding; above this again the body terminates in a hollow stem, through which are bored three escape holes communicating with the interior of the dome. The top of the stem outside is screwed to take the nut, and the bottom inside to receive the axial magazine. There are six fire-holes bored through the bottom of the stem for conveying the flash from the axial magazine to the quick-match priming at the commencement of the time ring.

Round the exterior of the body will be found two copper safety pins, an arrow denoting the position of a fire-hole leading from the upper surface of the body to the blowing charge, and by which the fuze is set, and a hole to take the projection on the circular arm of the key for screwing the fuze into the shell.

The composition ring fits over the upper surface of the body; a channel lined with asbestos paper runs nearly all round its under side, and contains fuze composition, burning at rest from 14·8 to 15·4 seconds. The beginning of the ring is indented and primed with quick-match to ensure ignition. Composition ring.

A hole on the upper surface of the ring allows of the gas escaping into the dome; this hole is stopped with fine white paper. Another hole is bored through the inner face and quick-match laid in it. This ensures the flame from the axial magazine reaching the beginning of the fuze composition.

Round the exterior of the ring will be found the divisions marked in even half seconds up to 30. These are further subdivided by unnumbered lines, so that the fuze can be set to read to eighths. Previous to the 25th thousand, the graduated lines read to quarters.

An arrow on the ring, nearly midway between the zero and extreme graduation, denotes the centre of the bridge or "safety point" of the fuze.

The dome is of gun-metal cast with four longitudinal strengthening ribs inside. It fits into a groove in the upper surface of the ring, which it covers, and forms a chamber for the gas to escape into. A small pin, projecting from the groove in the ring, fits into a corresponding slot in the dome. This retains the latter in the correct position. Dome.

The cap is hexagonal, screws on to the top of the stem and is used for clamping purposes. It has a small cylindrical projection at the top, through which four escape holes are bored. Cap.

The lighting arrangement consists of a needle plug having a steel needle fixed in its centre, screwed into the side of the body; a lighting Lighting arrangement

pellet and two retaining pellets, the three latter being free to move in slots radial to the circumference.

The lighting pellet contains in its end opposite to the needle a small cap. It is also bored out in the centre and filled with pistol powder, the other end being closed by a disc of paper.

The lighting pellet is kept from moving outwards against the needle by two retaining pellets, which project into a groove in it, and which are kept locked in that position by fine spiral springs. A safety pin of split copper wire also passes through each of the retaining pellets, and ensures the safety of the fuze in transport.

Safety pins.

Behind the detonator pellet, in a recess in the body, there is a pellet of pressed powder, pierced with a central hole.

Gun-metal screw plugs close the holes behind the retaining pellets. Screwed into the centre of these are brass pins, which fit inside the fine spiral springs to keep them in position.

Two small brass pins driven in from the under surface of the body project into grooves in the retaining pellets and prevent them turning round.

Axial magazine.

The axial magazine screws into the bottom of the stem. It is a small gun-metal cylinder filled with R.F.G.^{2} powder and primed with quick-match, the top is solid, and the bottom is closed by a screwed plug pierced with seven fire-holes. The axial magazine assists in conveying the flash from the lighting pellet to the time composition ring.

The bottom of the fuze is coated externally with waterproof cement. Weight of fuze 1 lb. 4 oz.

Preparation and action.

The fuze is prepared in a similar manner to the T. and P. fuzes, except that both safety pins are removed at the moment of loading. Nothing occurs on the shock of discharge, but immediately the shell begins to rotate the retaining bolts acted upon by centrifugal force fly outwards, compressing the spiral springs and releasing the lighting pellet, which, acted upon by the same force, also flies outwards against the needle, firing the detonating composition, the flash passing through the body of the pellet to the axial magazine; thence it passes out through the fire-holes in the bottom of the stem and ignites the fuze composition. The latter burns round until it reaches the channel behind which the arrow is set, the flame is then communicated to the blowing charge in the bottom, and so to the bursting charge of the shell.

§ 7305.

When fuzes of the above-mentioned descriptions are repaired and refitted with new time rings, they will be dealt with in batches, the original number of thousand being barred out, and each batch marked with a letter instead.

Armstrong "E" time.

Fuze, Time, Armstrong "E," No. 22, Mark III.—This fuze is used with 9, 12, and 20-pr. segment shells, and is shown in cut.

§§ 1472, 1790, 1791, 2178, 2496.

On firing the gun, the brass cup is crushed in, the pellet strikes the needle, which explodes the detonating composition, the ring of fuze composition is ignited by the flash and burns till it comes to the channel marked by the arrow head, leading to the groove in the neck primed with mealed powder; the flash is then instantaneously conveyed into the blowing chamber, and thence into the shell.

Use.

Action.

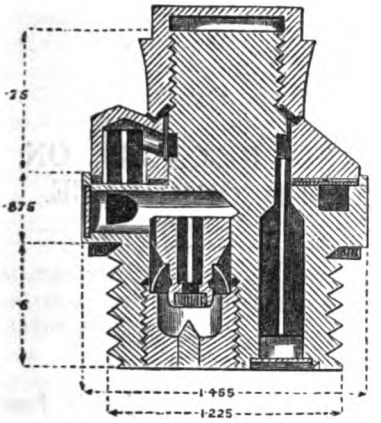
Issue.

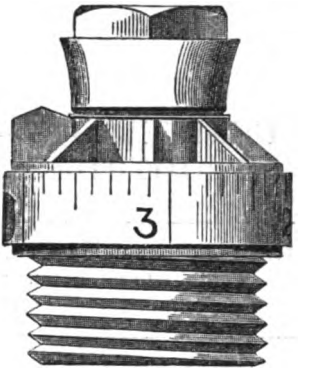
§ 2751.

One in a waterproof bag placed in a tin cylinder wrapped in brown paper, 72 boxes in a deal case, placed on the sides or heads, the bottom of each tin box is marked "top" to prevent it being placed downwards. Since June, 1875, the tin boxes containing "E." time fuzes, primed with cap composition, are stamped "cap," and the same word is stencilled on the waterproof bag. Since July, 1875, in

§ 2761.

the case of repaired fuzes the date of repair will be labelled on the boxes containing them.





Fuze, Time and Percussion, No. 61, *Mark I.*—This fuze is a conversion from No. 56, Mark IV. The escape hole in the body of the fuze is closed by a plug sweated in, the two escape holes in the time ring are also closed. A hole is bored in the time ring at the commencement of the composition, this is closed by a brass disc and Pettman cement, the disc being blown out when the composition is ignited forms an external gas escape. The composition is made slower burning by increasing the proportion of brown powder. For identification, the dome and cap are painted red, also the cylinder in which it is packed.

All time and combined fuzes for storage are placed in Group II, Division I. Storage.

For proof, *see* Regulations for Army Ordnance Services, 1900. Proof.

CHAPTER XII.—GENERAL REMARKS ON PROJECTILES FOR RIFLED ORDNANCE.

SYSTEMS OF RIFLING.—WINDAGE.—CLEARANCE.—LENGTH AND WEIGHT OF PROJECTILES.—GENERAL REMARKS.—ARMOUR-PIERCING PROJECTILES.—COMMON SHELL.—SHRAPNEL SHELL.—CASE SHOT AND STAR SHELL.

Systems of rifling with service examples.

THERE are four systems of giving rotation to a projectile fired from a rifled gun which are practically adopted:—

1. A breech-loading system in which a projectile, coated with soft metal, and with this coat slightly larger in diameter than the bore of the gun, is forced by the explosion of the charge into and through the rifling, which consists of a large number of shallow grooves cut spirally in the gun.

In this system, which is only adapted to guns rifled with an uniform twist, there is a shot chamber between the powder chamber and the rifling. *Service example*—The R.B.L. lead-coated system.

2. A system in which the projectile is furnished with studs to fit the grooves. This is a muzzle-loading system, sufficient play being left between the studs and grooves to admit of easy loading. *Service example*—R.M.L. guns firing studded projectiles.
3. A system in which the projectile is rotated by means of a copper gas-check attached automatically or otherwise to its base. Such projectiles may be fired from guns rifled on the Woolwich principle, but in ordnance expressly constructed for the purpose, the grooves are shallower and more numerous, the system being known as the "modern poly-groove." *Service example*—The R.M.L. guns and howitzers of modern construction.
4. A breech-loading system, in which the soft metal coat is replaced by a single ring of copper at or near the base. In this system the greater part of the projectile lies in the bore, the driving band being partly in the cone connecting the bore with the powder chamber, and the base of the projectile in the latter. It may be applied to guns rifled with an increasing or an uniform twist. *Service example*—B.L. guns.

Windage.

One of the disadvantages of the studded system is *windage*, which is theoretically the difference in area between a section of the bore of the gun taken at right angles to its axis and the corresponding section of the projectile, but practically it is estimated by the linear difference in diameter between the bore and the projectile, and it will differ with the part of the latter over which it is taken. Thus

the windage over the studs will be the difference between the diameter of the gun across the grooves, and that of the projectile outside the studs. Similarly, the windage over the body is the difference between the diameter of the gun across the lands, and that of the body of the projectile. In some projectiles it may also be measured in a third place, viz., across the bands.

The disadvantages of windage are that it occasions a waste of powder gas, leads to erosion of the gun, tends to injure the studs on which the projectile rests when home, as the first rush of gas over the projectile creates great downward pressure, and moreover tends for the same reason to prevent the perfect "centering" of the projectile, and hence to diminish range and accuracy.

Clearance.

When the projection of the stud from the body of the shell is greater than the depth of the groove of the gun, the difference is called "*clearance*." The result is that the projectile rests entirely upon the studs, and there is an interval between the body and the bore. This is the case in all the Service R.M.L. guns which fire studded projectiles, the clearance varying with the calibre. If, on the other hand, the depth of the groove was greater than the projection of the stud there would be no clearance, and the greater part of the friction in the bore would take place between the projectile and the lands, instead of between the comparatively soft studs and the grooves. Clearance also centres the projectile in the bore.

Gas-checks.

Gas-checks considerably modify, if they do not altogether prevent, windage; and in the case of the latest R.M.L. guns considerably improve the shooting.

In B.L. guns the driving band, and in R.B.L. guns the lead coat, act as a gas-check, and there is little windage, but nevertheless B.L. guns have not been so free from scoring as could be desired.

Loading and driving edges.

A studded projectile for a gun with uniform twist bears in loading on one side of the studs, which is called the "loading edge"; on firing it bears against the other side, which is called the "driving edge," and though the small stud of a projectile for a gun with increasing twist bears upon the driving edge in loading as well as in firing, the sides of the studs of all projectiles, whether for uniform or increasing twist, are distinguished by the above names. That on the left hand side, as seen when the projectile stands upon its base, is the driving edge, the other the loading edge.

French system.

In the Woolwich guns there is no tendency of the stud to override the groove; but in the old type field guns the driving edge of the groove is an inclined plane and that of the stud of corresponding shape, so that the latter runs up the side of the groove, and thus centres the shot, *i.e.*, brings its axis to coincide with that of the bore.

Length and weight of projectiles.

There are certain considerations which govern the length and weight of rifled projectiles.*

Assuming that the gun with its rifling, charge, and carriage are fixed, and neglecting the question of transport.

First as to weight. If two projectiles of different weight be fired under similar conditions from identical guns, they will at the muzzle have equal energies, as the work done by the powder on both is equal,† or approximately so, if the difference of weight be not

* Here and elsewhere the expression "rifled projectiles" is to be understood as an abbreviation for "projectiles fired from rifled guns."

† This is only approximately true, as the greater inertia of the heavier projectile will cause it to have a slower initial motion. Consequently the powder gas will be more closely confined and exercise to a certain extent a greater mean pressure in the bore.

excessive. The energy of both being the same, it follows that the lighter projectile must have the higher velocity, the velocities varying inversely as the square roots of the weights. But by the laws of resistance of the air the heavier projectile will part more slowly with its muzzle energy than the light one, and will thus at any given distance from the muzzle possess a larger amount of kinetic energy. Hence it would appear that the heavier the projectile is, the more powerful it is, but sundry considerations influence the matter of weight, and these are mostly in favour of a light projectile.

The weight is, to a certain extent, limited in both directions by the length, and by the strain admissible on the gun and carriage, which increase with the weight of the projectile and by the amount of interior cavity desirable in the case of a shell, which is itself limited by the necessary thickness of walls and base to stand the shock of discharge. Again, at moderate ranges light projectiles will have flatter trajectories than heavy ones; but at long ranges the reverse is the case.

Thus the best theoretical weight of a projectile for one range is by no means necessarily the best for another.

Practically, however, it is the length which limits the weight of projectiles.

On the one hand, although their length and consequently weight have increased with modern B.L. guns, projectiles do not exceed $4\frac{1}{2}$ calibres in length, the majority being from $3\frac{1}{2}$ to 4 calibres long, since the very long projectile necessitates a sharper twist of rifling and greater strain on the gun.

The question of the greatest length of projectile admissible for a gun with a given twist has been treated mathematically by Professor A. G. Greenhill, M.A., F.R.S.

A hollow projectile of the same weight as a solid one may be longer than the latter, as, owing to the weight being distributed further from its axis, it has a longer radius of gyration, and hence a greater power of keeping up its rotation.

On the other hand, the lowest admissible length for accurate shooting is stated to be two calibres ("Extracts," Vol. III, p. 128).

Since the weight of all projectiles for the same gun (case and special ones excepted), is the same, the lengths must vary. It follows therefore that the longest, which would usually be the common shell, must not exceed about $4\frac{1}{2}$ calibres, while the shortest must be over two calibres in length.

The numerical value of the expression, $\frac{w}{d^3}$, where w is the weight of the projectile in lbs., and d its diameter in inches, forms a convenient method of expressing the relation between weight and calibre. It will be seen from the table below that the value of this fraction has steadily increased since the first introduction of rifled ordnance, or in other words, that the projectiles have gradually increased in length.

Value of $\frac{w}{d^3}$ for R.M.L. Palliser Shot.

Gun.	$\frac{w}{d^3}$
7 -inch	·3470
8 ,, ...	·3623
9 ,, ...	·3523
10 ,, ...	·4098

Gun.	$\frac{w}{d^3}$
11 -inch	·4065
12 „ (25 tons)	·3543
12 „ (35 „)	·4128
12·5 „	·4171
16 „	·4197
17·72 „	·3594

Value of $\frac{w}{d^3}$ *for B.L. Projectiles.*

12-pr.	·463
15-pr.	·518
4 -inch	·39
5 „	·4
6 „ Gun	·463
6 „ Howitzer (4½ calibre shell) ..	·567
8 „	·41
9·2 „	·488
10 „	·5
12 „ (Marks I to VII guns)	·413
12 „ (Marks VIII and IX guns) ..	·492
13·5 „	·508
16·25 „	·42

When a new gun, of the same calibre as one of older design, is made, in some cases there is a difference in weight between the projectiles of the new and old guns. For instance, the 12-inch B.L. guns, Marks I to VII, fire a 714 lb. projectile, while the 12-inch B.L. Mark VIII fires one weighing 850 lb. It is necessary to distinguish these projectiles, and they are respectively known as "light" and "heavy." The "light" projectiles have the letter L stamped on the base, and the "heavy" the letter H.

Before proceeding to describe the various projectiles under their separate headings, a few general remarks will be made upon—

Armour-piercing projectiles.
Common shell.
Shrapnel shell.
Case shot.
Star shell.

Armour piercing projectiles.

The armour-piercing projectiles now in the Service are Palliser and armour-piercing shot and shell.

Although the importance of Palliser projectiles has been very much diminished by the introduction of modern armour, the following remarks are still of interest as showing the requirements of armour piercing projectiles, and their history.

In 1863, the late Sir William Palliser proposed a projectile of iron cast in a metal chill to render it hard for the penetration of armour, providing for the evil effects of brittleness by the form of head he gave to it, which was an "elongated point."

These projectiles, as fired in 1864, were chilled to a considerable depth, but not throughout; they proved so successful that their manufacture was afterwards carried on in the Royal Laboratory, until Mr. Davidson, late manager of that department, so worked out the selection and trial of various samples of iron, and the method of conducting the manufacture in concert with Major Palliser, as to bring the projectiles to the state of efficiency in which they now exist in the Service.

In an armour-piercing projectile, in addition to the general considerations of weight and length, the following points must be taken into account:—

1. The metal.
2. The manufacture.
3. The form.

Palliser projectiles.

Cast iron contains more or less carbon, and is non-malleable and fusible. It is distinguished from wrought iron in that it is fusible in an ordinary blast furnace or cupola and from both wrought iron and steel in that it cannot be rolled or forged. The different varieties of cast iron depend on the condition in which the carbon exists in the cooled product. If it is all, or very nearly all, chemically combined with the iron, the product is intensely hard, brittle, and of a silvery fracture, and comparatively hard to fuse; this variety is known as *white* cast iron. If, on the other hand, the carbon is chiefly mechanically mixed in a free state with the iron in the form of graphite we obtain a darker product, comparatively soft and easily fused, and known as *grey* cast iron. A mixture of these two varieties results in an iron known as "mottled" iron from its appearance. These three classes of cast iron shade into each other, and no distinct line can be drawn between them.

Metal.

It may be generally said, in spite of the fact that some samples of iron will be white and others grey, however they may be cooled, that any tendency of iron and carbon to separate is encouraged by slow cooling, and thus certain irons, or mixtures of irons, which would be mottled if slowly cooled, will be white if chilled or suddenly cooled. This is the kind of iron used in the manufacture of Palliser projectiles.

Manufacture.

The projectiles are cast with the head downwards in an iron "chill," the body which is uppermost being cast in a sand mould. The object of this arrangement is that the head of the projectile may be specially sound and dense, and that being rapidly cooled by contact with the metal chill, it may be made of the very hard and brittle white iron; while in the body, the metal being cooled more slowly, may assume the somewhat more tenacious form of mottled iron. The body of one of these projectiles broken longitudinally should show the silvery fracture of white iron from the point to the head of the interior cavity, the mottled appearance commencing just beyond the shoulder, and extending to the base.

The characteristics of projectiles thus cast are—

1. Intense hardness.
2. Crushing strength.
3. Brittleness or want of tenacity.
4. Increased density.

Hardness prevents the point from flattening in penetration.

Crushing strength may appear at first to be very much the same as hardness, but while the latter relates to the rigidity of actual particles, the former applies to the rigid connection or building up of particles so as to resist their being forced in upon each other.

To compare glass and iron, the former has greater hardness, and the latter crushing strength; thus the former will scratch the latter but the latter will crush the former.

Crushing strength is a very important element in armour-piercing projectiles, as in default of this quality they would set up and become distorted on impact with an armour plate, thus not being able to deliver their blow.

At the same time, even in the body of the projectile, it is necessary to have a hard, unyielding metal. If the body was of soft metal while the head was hard there would be considerable loss of power on impact, owing to the setting up of the soft metal. The reason of this is as follows:—A projectile from a gun has a certain amount of energy stored up in it; this energy may be converted into mechanical work, or into heat. Now, when a projectile strikes an iron plate, we wish as much of the energy as possible to be devoted to penetration. What is used up in the setting up or distortion of the projectile itself is so much dead loss; hence we try to produce a projectile that will change its form as little as possible.

Previously, however, to March, 1870, the whole of the projectiles were chilled. Besides the greater tenacity gained in the body by the present system of casting, there is another most important advantage. The projectile is rendered far less subject to the action of molecular forces, which in a chilled casting, where the particles are in an unnatural and constrained position, are liable to come into action on slight provocation, and may either split the shell or crack it imperceptibly so that it breaks up in the bore of the gun.

Form.

The form of the head of a Palliser projectile is suited to enable it to do the maximum of work in penetration when its surface is being pressed from front and sides towards one centre. Efforts have been made to get the principal mass of metal as far forward as possible, so that it may impress its momentum directly upon the plate without having to act through the medium of the walls of the shell, which are its weakest part.

The Service form of head is ogival, struck with 1½ diameters radius for the studded and two diameters for the studless R.M.L., and for B.L. projectiles.

Palliser shell.

Palliser shell have also been made, and after having once been declared obsolete, were reintroduced for Naval Service. They are now only fired from R.M.L. guns in the Navy. They are fitted to take a base fuze and are nearly as effective as Palliser shot, and on striking a light structure they act like common shell.

Armour-piercing projectiles.

The introduction of hard-faced armour against which Palliser projectiles break up, has led to the manufacture of armour-piercing shot and shell.

Armour-piercing shot.

Armour-piercing shot are made of steel, cast or forged, having ogival heads struck with a radius of two diameters. They have a small cavity and are carefully hardened by special processes, the point being made extremely hard while the body is softer so as to give greater tenacity and enable the shot to hold together when it strikes a hard-faced armour plate. These projectiles are proved by firing a percentage against armour plates and the behaviour of these governs the acceptance of the lot. The manufacturer is allowed great latitude, as is described in the chapter on B.L. projectiles, pages 211, *et seq.*

These shot hold together well on impact. They are made for B.L. or Q.F. guns only, for Naval Service.

Armour-piercing shell.

Armour-piercing shell were originally introduced for the smaller Q.F. guns, but their use has now been extended to the heaviest B.L. guns. They are pointed projectiles, externally resembling the A.P. shot, but as their name implies they carry a bursting charge of powder. They have a considerable thickness of metal in the head but the cavity is much larger than that of the shot. The base is prepared to take a base fuze. They are made of steel, cast or forged,

hardened in much the same manner as the shot, and the same latitude is allowed to the manufacturer. They have not the same penetrative power as the shot, but have considerably more power against modern armour than pointed common shell.

The effect of inclining the plate to the line of fire is to increase its resistance to penetration, and also to try the projectile more severely. For instance, a projectile which will perforate a 9-inch hard-faced plate, the line of fire making an angle of 30° with the normal, will probably perforate 12-inches if it strikes direct. (*See* recent range tables for 6-inch, 9·2-inch and 12-inch B.L. guns.)

It will be readily understood that a shell will have a greater destructive effect upon a ship than a shot, unless it strikes the most heavily-armoured position of the vessel. Since it is impossible to cover a ship entirely with heavy armour, there will always be a large portion open to shell fire. A.P. shot should therefore be reserved for the attack of an anchored or crippled vessel at short range. (*See* Garrison Artillery Drill, 1899, Vol. I, Part II, Section VII.) Manufacturers have now obtained highly satisfactory results with A.P. shell, which gives them an increased importance.

Caps. Certain makers have advocated the use of "caps" on A.P. projectiles. These are usually of wrought iron or mild steel and cover the point of the projectile. It is claimed that the use of these caps improves the penetrative power of the projectile, especially when the plate is struck at an angle to the normal. The most generally accepted theory is that the cap supports the point of the projectile at the moment of impact, and so enables it to pierce the extremely hard skin of modern armour.

Penetration. The standard upon which all the present formulæ and tables for calculating the effect of projectiles upon armour are based is the complete perforation of soft wrought-iron plates unbacked.

Wrought iron. One penetration formula is Fairbairn's:—

$$t^2 = \frac{Wv^2}{2g \times 2240} \times \frac{1}{\pi D} \times \frac{1}{K}.$$

Where W = the weight of the shot in lbs.
" v = the striking velocity in feet per second.
" D = diameter of shot in inches.
" t = thickness of perforated plate.
" K = a variable whose value is obtained from tables and depends on v.*

If the plate is in two layers, t may be multiplied by $\frac{25}{24}$; if in three layers, by $\frac{10}{9}$.

For modern guns and velocities over 1,600 f.s. Krupp's formula may be used:—

$$t^{\frac{4}{3}} = \frac{Wv^3 \times 1}{d^{\frac{5}{3}} \times \log^{-1} 5{\cdot}7776}$$

---

*. A table of the values of K is given at p. 35, Captain Orde Brown's "Armour, and its Attack by Artillery."

No tables or diagrams are available for calculating the effect of projectiles on hard armour. From the few data extant, it would appear that the effects of any one gun are proportional to the total striking energy of the shot; but, as the face of hard armour peels off under repeated blows, perhaps more total effect would be produced on this kind of target by a number of guns of medium calibre, than by a few of the largest. Hard armour

With high velocities and hard-faced armour the following formula may be used. It is Krupp's 1896 formula:—

$$t^2 = \frac{Wv^2}{d} \times \frac{1}{\log^{-1} 6{\cdot}3532}$$

Failing tables or diagrams, the late Captain Orde Brown's rule may be used. Take the calibre of the gun as a measure, and reckon that for every calibre of thickness of wrought iron to be perforated, at least 1,000 f.s. striking velocity will be required. In old type guns with light shot considerably more velocity may be required. Rule of thumb.

For hard-faced armour the rough rule is that for every calibre of thickness to be perforated at least 2,000 f.s. striking velocity will be required.

The proportional resistance to perforation of wrought iron, compound or mild steel, Harveyed and Krupp-cemented armour may be taken roughly as 1 : $1\frac{1}{3}$: 2 : $2\frac{1}{3}$.

When the gun is not sufficiently powerful to perforate the target, the penetration into wrought iron will be only nine-tenths of the perforation given by the above rules; but it must be remembered that very little damage is done to a wrought-iron target by this method of attack, and it might be better to husband one's resources for a more vulnerable target.

For more complete information on this subject, *see* "Armour, and its Attack by Artillery," by the late Captain Orde Brown, R.A.

A common shell is a locomotive mine destined, as a rule, for the destruction of material, or as a man-killing projectile when used against troops behind substantial cover. Large shells would be used against ships or earthworks, smaller ones against troops protected against the effects of shrapnel fire by natural or artificial means. As with other projectiles, certain limitations must be observed as to length and weight. Common shell, &c.

It is desirable that a common shell should contain as large a bursting charge as possible, but the size of the interior cavity must be regulated by the other conditions requisite to ensure the projectile being an effective one. The shell must be strong enough to resist the shock of discharge, and the shock of impact against targets offering considerable resistance. It should also, if possible, be capable of producing a large number of fragments, when burst, of fairly uniform weight, but this last condition is more important for field service shells than for those of large calibres.

The introduction of A.P. and lyddite shell has diminished the importance of common shell, and it seems not improbable that the latter may be superseded by them in the future.

Common shells have been made of cast iron, and cast and forged steel. It may be taken that the use of the first will be restricted to practice, except for those old guns for which no steel common have been designed.

Cast-steel common shell have now been introduced for all the heavier B.L. guns, 6-inch and upwards. The first experiments with Cast-steel shell.

cast-steel common shell took place in 1885, when the superiority of that metal over cast iron was clearly shown; its increased strength not only enables a larger bursting charge to be carried, but it ensures the efficiency of the shell when fired against earthworks. A cast-iron shell fired with such a high velocity as is obtained from our B.L. guns will generally break up on striking an earth parapet before the fuze has time to act or the shell to penetrate; the bursting charge is then either not ignited, or ignited after the shell is broken up; in either case the effect is lost.

The bursting charge of the 6-inch B.L. Mark VI cast-steel common shell is 9 lb. 13 oz. The Mark III cast-iron shell of the same calibre contains 7 lb. 6 oz.

Forged-steel shell.

If forged steel is used for common shell a still longer projectile with thinner walls and consequently a larger bursting charge can be obtained with the same total weight, but in addition to the greatly increased cost, a forged steel shell has the disadvantage of only breaking up into a very few large fragments if filled with powder. The extra length which could be obtained with a forged-steel common shell would be, except in a very few cases, of no advantage, because the length of a projectile necessary for accurate shooting is limited by the twist of rifling adopted in our B.L. guns, and this length can generally be obtained with cast steel.

The bursting charge of the 4-inch B.L. Mark V forged-steel common shell is 2 lb. 14½ oz. of powder, the bursting charge of the cast-iron Mark III shell of same calibre is 1 lb. 6 oz.

The manufacture of steel "gunpowder" common shell, fitted for nose fuze, has been discontinued.

Pointed, common.

Common shell of cast steel with pointed heads have been introduced. These shell resemble the A.P. shell in external appearance, but differ from them in the increased size of cavity and the comparatively slight thickness of metal in the head. They are fitted with a base fuze, and a recent order restricts their use to the Royal Navy.

Penetration.

The pointed steel common shell may be expected to perforate about two-thirds of its calibre of hard-faced armour, provided that the plate is struck direct, and that the striking velocity is at least 2,000 f.s.

Shell, double.

Double shell exist for the 7-inch and 7-pr. R.M.L. guns. They are longer, and contain a heavier bursting charge than the common shell for these guns. Owing to their length they are not available for extreme ranges.

Stars, incendiary.

The incendiary effect of common and ring shell may be increased by charging them with "stars" of incendiary material. Ordinary common shell, under favourable circumstances, will often give good incendiary effects.

Lyddite shell.

"Extracts," p. 52, 1895.

Lyddite shells are of the nose-fuzed common shell type, and are always made of forged steel with solid bases, as it is not at present considered that a base-fuzed shell can be made absolutely safe from all chance of premature explosion. The interior of the shell is filled with lyddite, leaving a cavity for the exploder, of picric powder (*see* page 28). The exploder is fired by the fuze and brings about the detonation of the lyddite.

The action of lyddite shell depends upon the complete detonation of the explosive and upon the extreme rapidity with which detonation takes place. The shell, though made of forged steel, is broken up into an enormous number of pieces ranging in size from a pea to fragments weighing a few pounds only, even with the largest shell. These fragments are projected in every direction, even backwards towards

the gun. These small pieces are capable of considerable damage to personnel. This is very different to the action of gunpowder which tears a forged-steel shell into a comparatively small number of pieces. In addition to this all the pieces are projected forwards, lying inside an angle of 40° to 50°, and there is no backward effect.

At Lydd, in 1892, it was found that a 6-inch lyddite shell was equal, if not superior, to an 8-inch powder shell. "Extracts," p. 57, 1892.

As common shell of the ordinary type often break into very few fragments of very variable size, ring shell have been introduced for certain guns. Its object is to form a projectile which will possess nearly as much penetrating power as a common shell, and yet shall be more available as a man-killing weapon. With this view it is constructed so as to break up into numerous fragments of a uniform and moderate size, and is chiefly destined for field or siege service. A description of 2·5-inch R.M.L. ring shell will be found at p. 272. Practically it is much the same in principle as the segment shell introduced with the R.B.L. guns. Ring shell.

Such shell should burst close up to the object at which they are fired, as the lateral dispersion of the fragments due to the spin of the shell and the position of the charge is very great; and the fragments, from their shape and small weight, rapidly lose their velocity; percussion fuzes should, therefore, be used with them.

There are two distinct classes of shrapnel shell; those with the bursting charge in the base, the usual service pattern, known as the Boxer system, and those with the bursting charge in the head, a principle advocated by the Elswick Ordnance Company, and of which there are only two calibres in the service, the 4-inch B.L. and the 2·5-inch R.M.L. Shrapnel shell.

These latter differ from the well-known service pattern in having the head firmly and the base very lightly attached to the body; so that, on the explosion of the bursting charge, the head and body remaining together, are drawn over the bullets as a glove is drawn off, and allow the bullets to scatter and proceed on their course.

This construction has the advantage of giving greater space for bullets, since there is no central tube or diaphragm, but the position of the bursting charge is unsatisfactory as its explosion and action of drawing off the body tend to check the velocity of the bullets at a most important time, and also the cone of dispersion of the bullets is greater. On the other hand, the bursting charge of the base-filled shrapnel is in the most advantageous position, and its explosion tends to accelerate the bullets. The loss of space due to the internal arrangements of the shell is also of less moment in the larger shells; so the value of the head-filled construction decreases as the calibre increases and the tendency now is to employ only base-filled shrapnel, and to gain greater effect by making the bodies of high-class steel which allows of very thin walls and so permits an increase in the number of bullets. The latest shrapnel for the 4-inch B.L. is of the base-burster type. It contains 169 bullets, while the earlier pattern contains 230 bullets of practically the same size.

The proportion of the weight of the bullets to that of the entire shell is called the "percentage of useful effect" and is usually higher in the small shells.

By using steel for the body of a shrapnel its capacity is increased, as is shown by the following example:—

9·2-inch cast-iron contains 420 2-oz. sand shot.
cast-steel „ 640 „ „
forged-steel „ 900 „ „

Bursting charge.

The bursting charge of shrapnel has hitherto been made as small so possible, consistent with sufficient power to open the shell. Some makers, however, advocate larger charges, and state that greater effect is obtained and no detrimental effect from the breaking up of the bodies.

Some howitzer shrapnel contain bursting charges sufficiently powerful to accelerate the velocity of the bullets in addition to releasing them.

Size of bullets.

The size of the bullets is an important point in the construction of shrapnel. The smaller they are, the closer they will pack, and the greater the number that can be put into a given shell. But the size must not be diminished beyond a certain point; for the smaller a bullet is, the sooner will it lose its velocity after being released from the shell, and the less will be its disabling power. The sizes actually used vary from 4-oz. iron balls in the heaviest shrapnel to mixed metal balls of 35 to the lb. in the shrapnel for field service. Recently, however, bullets as small as 48 to the lb. have been tried.

Mixed metal bullets of the latter size are generally considered to require a striking velocity of 400 f.s. to be effective.

Some shell, such as the 15-pr., contain a few much smaller bullets on top of the larger ones, more with the object of filling up the space and correcting the total weight than with the expectation that they would possess much disabling power.

Besides the pattern with the bursting charge in the head, the Boxer shrapnel may, independently of a few individual peculiarities, be divided into two classes; heavy, and field.

Details of all these patterns will be found in the chapters respectively devoted to B.L., heavy R.M.L., and field service R.M.L. projectiles.

Shrapnel is essentially a man-killing projectile, its effects against material being insignificant.

Use of shrapnel.

The larger natures of shrapnel would be used against troops or boat attacks, or gun crews in military tops or barbettes, at distances beyond the effective range of heavy case, and the small natures against troops. Shrapnel is the principal projectile for field guns, and has a great searching power. It has been abundantly proved that shrapnel are, under ordinary circumstances, much more effective when used with time fuzes than with percussion fuzes, though under certain special circumstances the latter fuzes give the best results. The best point of burst for shrapnel is too long a subject for discussion here. It is sufficient to say that with time fuzes the distance of the point of burst from the object fired at will vary with the extent of front of the object, the range, and the height of the point of burst. The object in all cases is to render as much as possible of the cone of dispersion formed by the bullets available against the target, by direct hits with the upper portion of the cone and ricochet hits with the lower.*

When shrapnel are burst in the air by a time fuze, the bullets have a descending angle, and their velocity is accelerated by gravity and retarded by the resistance of the air only. On the other hand, when shrapnel are burst by a percussion fuze on graze, the bullets have an ascending angle, and are retarded both by gravity and the resistance of the air. Moreover, their velocity as a whole has been checked by the retardation of the shell on graze. A considerable portion of the cone of dispersion is wasted, and in general terms the

* *See* "Preliminary Tactics," by Lieut.-Colonel Eden Baker, R.A.

shell is, under favourable circumstances, much less effective than time shrapnel; under at all unfavourable ones, as soft ground, &c., its effect is wholly lost. At the same time percussion fuzes are very useful when rapidly moving objects seen for a limited time form the target. They should be burst closer to the object than time fuzes.

Shrapnel shell have been recently discarded in the Land Service for B.L. guns above 6 inches in calibre.

Shrapnel has been used in cases of emergency in lieu of case shot in R.M.L. guns, the shell being placed head first in the bore, the fuze-hole plug being removed. This plan would only be resorted to when no case shot was available.

There are in the Service practically three classes of case shot, though, as in the case of other projectiles, individual natures have their own minor peculiarities. Case shot.

The first class is that used for the 9·2-inch B.L., 12·5-inch R.M.L. and upwards, and may be distinguished from the others by its central staybolt.

The second class is for R.M.L. guns from 8-inch to 12-inch calibre and 8-inch B.L. guns. It has no staybolt, and the base is a wrought-iron disc.

The third class is fired from all guns of lower natures, and the envelope is made of tin with the base strengthened by a wrought-iron ring round the exterior. For details of the several classes see Chapters XIII, XV, XVI, and XVII.

The making of case shot for rifled guns is not such a simple business as to make case for S.B. guns. In the case of S.B. guns all that is required is to make an envelope for the sand shot, &c., which is strong enough to resist the shock of discharge without smashing up altogether in the bore. It must, of course, in all cases be weak enough to burst and liberate its contents on leaving the gun.

Now, in the case of a rifled gun, we are met at the outset by an anomaly. We want to fire a projectile from a rifled gun, and yet not allow it to take the rifling. Did the case shot leave the bore with the spin of other projectiles, the dispersion of the balls laterally would be very great, and their range to the front very small. In fact, for firing case shot we want to use the rifled gun as a smooth bore. Then in the case of rifled guns, especially in the case of those having wrought-iron barrels, as some R.B.L. guns, we must, as much as possible, guard against injury to the bore, and yet ensure the case breaking up properly on leaving the gun. In fact the case shot must be strong enough in its construction:—

1. Not to set up on discharge, so as take the rifling.
2. Not to be easily injured by travelling, or the ordinary knocking about unavoidable on service;

while it must be weak enough, as above mentioned, to release its contents on leaving the gun.

These two considerations are obviously conflicting, and, as in so many similar cases, it is a question of hitting the proper mean between the two.

It must be recollected that the weight of the envelope and of the expedients used to strengthen it, as well as the weight of the packing in which the balls are placed, are necessary evils. The actually useful part of the projectile is the assemblage of balls within the case. The remaining constituent parts of the projectile are practically useless in a projectile sense. In the old S.B. case the envelope

averaged about one-ninth the weight of the projectile; in the case for rifled guns the envelope and accessories sometime amount to nearly as much as (in one or two instances even more than) the weight of the balls.

A change in the construction of case shot for B.L. field guns and howitzers has recently taken place, in order to ensure the breaking up of the shot. The base is strengthened and provided with a narrow copper band to give pressure, and a small hole is bored through it. The powder gas acts upon a loose diaphragm which covers this hole, and so causes the body to part from the base, thus ensuring the breaking up of the shot. The band takes the rifling but does not rotate the body; and its function is to offer resistance to the passage of the shot up the bore of the gun; this causes the cordite charge to be properly consumed and so develope its full power, thus aiding the breaking up of the shot.

Special case shot.

Case shot containing chilled iron balls, each weighing 3 lb. 9½ oz., have been introduced for certain heavy R.M.L. guns. These are known as *Special Case Shot* and are intended for the defence of narrow channels against torpedo boat attack. They are of the heavy type of case shot, all except the 9-inch, having the central stay bolt, and all have two rings for lifting purposes.

Use of case shot.

Case shot is essentially a close-quarter projectile. With heavy case shot, which would be fired to repel boat attacks, or to defend mine fields, the limit of effective range is about 1,000 yards. With field guns the range would, of course, be very much less. Field case under very favourable circumstances, is effective up to nearly 500 yards; up to 300 yards it is annihilating.

In firing case much depends on the ricochet of the balls. It will be more effective when firing over smooth water or hard level ground than over rough water or rough soft ground.

Case shot may be fired with full or reduced charges. When engaging an enemy, the former should invariably be employed as giving the best recoil. On emergency R.M.L. guns up to the 12-inch may be double shotted.

Star shell.

Star shell are fired from rifled howitzers and from the 2·5-inch and 7-pr. R.M.L. and 10-pr. B.L.

Those for the R.M.L. howitzers are spherical; for the B.L. howitzers and the guns mentioned above they are elongated. The stars which they contain are cylinders of paper, filled with brightly-burning composition.

They are used for the purpose of lighting up the ground in front of a position, discovering an enemy's working parties, &c.

They should be burst in the air from 100 to 200 feet above the ground and to windward and in rear of the area to be lit up. By this means they will burn partly in the air and partly on the ground. They are only illuminating agents, not offensive projectiles, except perhaps morally, as has been found to be the case in hill campaigns.

CHAPTER XIII.—PROJECTILES FOR B.L., Q.F., OR Q.F.C. GUNS.

DRIVING BANDS.—AUGMENTING STRIPS.—COMMON SHELL.—SHRAPNEL SHELL.—STAR SHELL.—ARMOUR-PIERCING PROJECTILES.—PALLISER PROJECTILES.—CASE SHOT.—DRILL SHELL.

In this chapter the projectiles for B.L. guns and for Q.F. or Q.F.C. guns (except the 2·95-inch 6-pr., 3-pr. and 1-pr. Q.F.), which are identical with those used with B.L. guns, will be considered.

The ammunition for breech-loading guns on the interrupted screw system is distinguished from that for those on the Armstrong lead-coated plan by the designation B.L., the latter being known as R.B.L.

In B.L., Q.F., or Q.F.C. guns rotation is imparted to the projectile by means of a somewhat narrow ring or band of copper attached to it not far from the base. This ring is larger in diameter than the bore of the gun, and consequently when the charge is fired the soft metal is compressed into the grooves and cut into by the lands, overflowing somewhat into cannelures or towards the base, at the same time receiving from the grooves a motion of rotation which it imparts to the projectile.

Position of driving band.

The driving band should be as near the base of the projectile as possible, it being generally found that the more rearward position of the band gives the most accurate shooting. In practice, however, this is limited by the thickness of metal behind the band which is necessary to support the great strain thrown upon the shell, when the band is forced through the grooves, tending to tear off the base.

Material.

This tendency to break off the base of the shell round the ring is intensified when any material harder than copper, such as brass or gun-metal, is employed for the band, and consequently copper has been universally adopted for the purpose. But the hardness of two samples of the same copper differently prepared will vary, and it is found in practice that the best condition of the metal for this purpose is that in which it is cut from drawn tubing in the shape of rings which are afterwards annealed and then forced into a groove round the circumference of the shell by a powerful hydraulic or other press. Electro-deposited copper is also used.

Centering.

In our service the projectile is centred by confining the limits at the shoulder within the narrowest compass, so that the projectile may fit as accurately as possible between the lands; and by giving a considerable bearing surface to the driving band.

Elswick ring.

The early projectiles for the B.L. 80-pr., now obsolete, were fitted with the Elswick ring. This consisted of a cylinder of copper, fitted to the projectile and flanged for ·5-inch over the base. It was attached by solder, the projectile being turned down to receive it. It had six shallow cannelures, filled with beeswax.

Modification.

The early projectiles for the 4-inch B.L. gun had a similar ring, but somewhat thicker, and attached by copper rivets and a ring of solder round the base. It had three cannelures only without beeswax.

These rings extending over the base of the projectile are peculiarly liable to be set up by rough usage, and require special care in store and transport.

Segmental. Next came a segmental ring, used with the early projectiles of the 5-inch and 6-inch B.L. guns. It was similar in width and appearance to the Vavasseur narrow driving band, but made of cast copper in six segments, pressed tightly into a groove near the base of the projectile.

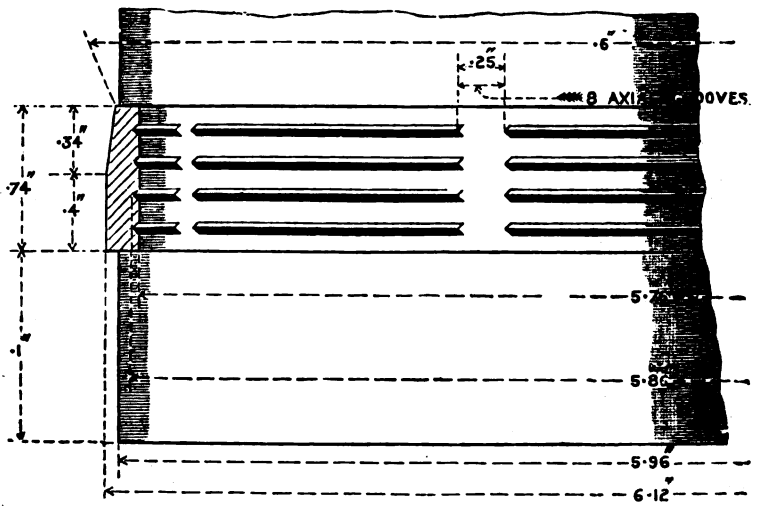
Vavasseur. The Vavasseur driving bands are now employed. There are three descriptions; the "narrow," the "broad," and the "broad with gas-check."

Narrow band. The narrow band is applied to 4-inch common and Shrapnel, Mark II; 5-inch common, Mark II; 6-inch common, Mark II, and Shrapnel, Mark I, made since May, 1883, and Palliser, Mark III; 8-inch projectiles, Mark I; 9·2-inch projectiles, Mark I, and Palliser, Mark II; and 12-inch projectiles, Mark I.

*Description. It consists of a ring of copper cut from a tube and pressed into a shallow groove round the circumference of the shell near its base. The width of the ring varies with the calibre. The distance of the rear of the ring from the base of the shell also depends upon the calibre, but it is always reduced to a minimum consistent with the strength of the projectile. The groove is cast in the Palliser and turned in the common and shrapnel shells. On the bottom are ribs parallel to the circumference, triangular in section, and ·04 inch high. These ribs are not continuous, being divided by grooves parallel to the axis of the shell in the Palliser, and by a number of similarly situated chisel cuts in the other natures. The object of dividing the ribs is to prevent the band slipping.

Into this groove the band is forced by a powerful press and afterwards turned to exterior dimensions, the front part being bevelled off

Narrow Driving Band.



* The latest marks of 6-inch projectiles have the bottom of the groove for driving band formed into triangular "*waved*" or zigzag ribs (*W.R.*), there are no parallel grooves. This method is likely to be introduced for all projectiles 10-pr. to the 16·25-inch.

at a slope of 7°, so as to fit into the cone between the bore of the gun and the powder chamber, and hold the projectile in its place.

Broad band.

One of the objections to a narrow band of large diameter is the "jamming out" of the metal; that is, the surplus copper is dragged back by the lands of the gun as the projectile passes down the bore and forms a sort of fringe behind the band. When the shell leaves the gun this fringe is no longer supported, and the pressure of the gas behind it turns it up at various angles to the axis of the projectile, thus forming variable resistances and causing irregularity of flight.

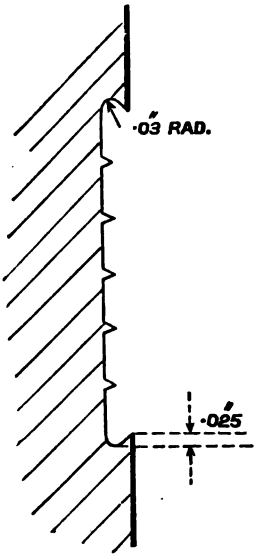
To meet this objection, the broad band has been introduced. In it the exterior diameter has been somewhat reduced and the width considerably increased, while cannelures have been cut in the copper to receive the excess of metal.

The band is of pure copper cut from a tube, and pressed into a groove near the base of the projectile.

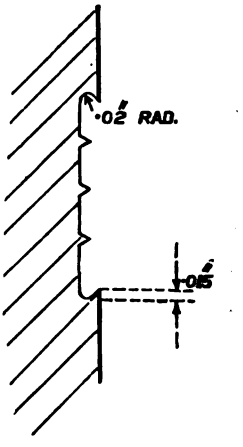
§§ 9957, 10157.

Previous to April, 1899, the sides of this groove were straight, but since that date the groove has been undercut for all projectiles, except Palliser, in order to make a firmer attachment with the driving band. (*See* wood-cut.)

Undercut grooves for driving bands, showing dimensions of undercut.



4-inch and upwards.



Below 4-inch.

§ 9998.

This change involves an advance in the numeral of the projectile, except in those cases where no issues have already been made. Projectiles (with the exception of Palliser, and Q.F. 4·7-inch Mark V common-pointed iron-shell), which have not been manufactured with the grooves for the driving band undercut, and which, on repair in Ordnance factories, are rebanded, will at the same time have their grooves undercut. This modification in the case of such projectiles will not involve an advance of numeral, but they will be distinguished by the date of rebanding, which will be stamped on the driving bands.

Description.

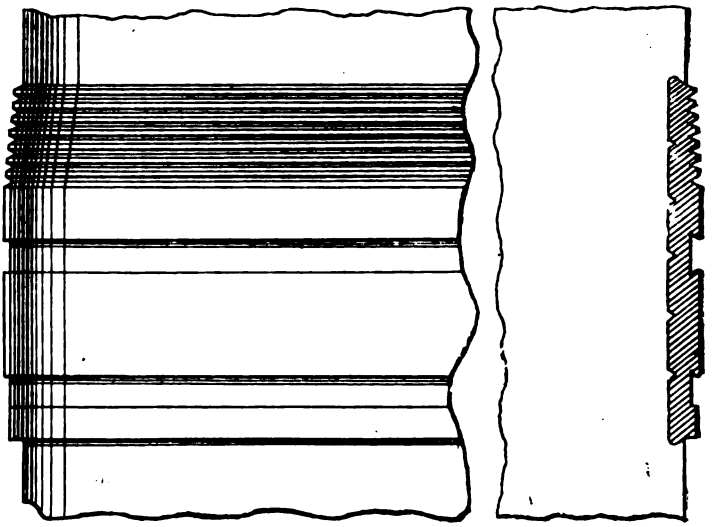
The total width of these rings, including half the front slope, is one-fourth the calibre, and the diameter of the cylindrical part is ·0023 of the calibre more than that of the gun across the grooves; but that portion of the ring which is in rear of the rear cannelure is slightly reduced, exceeding the diameter of the gun across the lands by ·05-inch only. The distance of the ring from the base of the projectile is determined by the minimum amount of material necessary for its support, the position being the same in all natures of projectiles of the same calibre. The front slope of the ring is 7° as before, and it is furnished with two cannelures for all natures up to and including the 6-inch, above which there will be one cannelure for every 3 inches or part of that length equal to 1½ inches of calibre.

The rear cannelure is ·15 inch from the rear of the ring, and the others equally divide the distance between the front of the rear cannelure and a point half-way up the front slope.

These cannelures are ·15 inch wide for the 4-inch and larger calibres, and ·1 inch for the smaller natures, the bottom of the cannelure being in line with the exterior of the shell.

Broad Vavasseur Driving Band.

Full size, 6-inch.



Part Elevation. Section.

§ 8919.

From 4-inch and upwards, except the 30-pr. 5-inch and 5·4-inch B.L. Howitzers, and the 4·7-inch Q.F., the bottom angles of the cannelures (except the rear bottom angle of the rear cannelure, *see* cut) are undercut to take the augmenting strips.

§ 9723.

The cannelures of 12-pr. Q.F. projectiles, other than shrapnel shell, are also undercut to take augmenting strips.

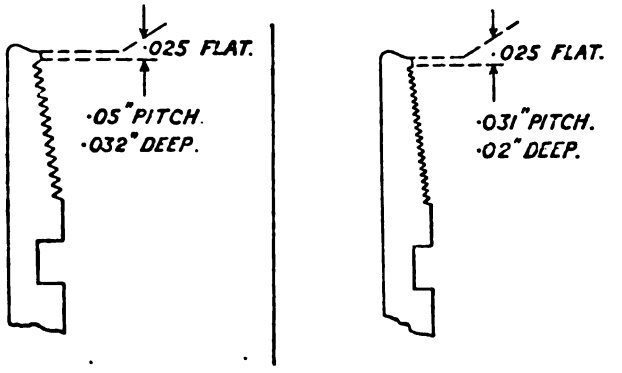
§§ 6119, 6225 7569, 8693, 10304.

The front slope of all broad driving bands is now grooved or serrated to ensure the projectile gripping in the chamber and to prevent slipping back when loading with the gun elevated. This alteration was approved first for 9·2-inch and upwards, then in June, 1894, it was extended to 6-inch and upwards, and finally extended to all calibres. The dimensions are shown in the cut.

Serrations on front slope of driving bands.

Typical.

Scale enlarged.



Above 3-inch. *3-inch and under.*

Existing stores of B.L. projectiles, 10-inch and upwards, which had their front slopes plain will be altered locally as follows. At those stations where the necessary lathes are available, empty shell will be altered in them, instructions and tools being supplied on demand. Projectiles which have been filled with powder before having the grooves cut and also empty projectiles at stations where no lathes are available will have the slope roughened by horizontal chisel cuts. Three rows of cuts will be made, the first row being parallel to and ·12 inch from the front edge of the driving band; the second row will commence opposite the centre of the first row and ·16 inch from it, and the third row be similarly situated as regards the second row. The cuts will be $\frac{3}{4}$ inch apart from end to end. The tools required are a $\frac{3}{4}$-inch steel chisel and a metal hammer. The operation will be regarded as a laboratory one and only one shell will be dealt with at a time. Fuzed shell will be first unfuzed and plugged. Care will be taken to remove the steel chisel from the building on completion of the operation. § 8693.

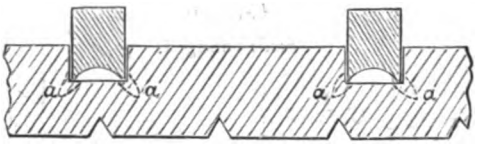
Strips, augmenting, B.L., Mark I, are issued for use with B.L., Q.F. or Q.F.C. projectiles, 4-inch and upwards, except for 5-inch and 5·4-inch B.L. howitzers, and 4·7-inch Q.F., and gas-check driving bands, in cases when the rifling of the gun has, owing to firing, become so worn that the gun ceases to properly rotate its projectiles. They are also issued for 12-pr. Q.F. projectiles, other than shrapnel shell, having the cannelured driving band. When the stock of these projectiles has been used up, the 12-pr. augmenting strip will become obsolete. Augmenting strips. §§ 5891, 6140, 6228, 9091, 9399, 9723, 10302.

A table showing the approximate number of rounds which may be fired before it will become necessary to use the augmenting strips, is given in "Treatise on Service Ordnance, 1900."

The strips consist of pure copper, of even section throughout, and grooved on one side (as shown in the sketch). The lengths of the strips vary with the calibre, and they are marked for the nature of the gun with which they are intended to be used. Description.

Projectiles with cannelures undercut will have the letter U stamped on the driving band between the first and second cannelures.

Scale, ½.



Mode of use. § 5687.

The augmenting strip is placed in the cannelure, grooved side downward, and hammered round the shell until the two ends meet.

When the gun is further worn and one strip is found to be insufficient, two may be used, the second being secured in the lower cannelure.

§ 9453.

With projectiles for the 13·5-inch B.L. gun, having 5 cannelures and the front slope grooved, the augmenting strip will be placed in the second cannelure, as it cannot be efficiently used in the first which comes at the junction of the front slopes with the cylindrical portion of the band. Future issues of these projectiles will have four cannelures only, and in that case the augmenting strip may be used in the front cannelure.

§ 5887.

For those projectiles which were issued before the undercutting of the cannelures, a special steel chisel is provided. By means of this chisel and a hammer V-shaped grooves are cut in the bottom angles of the upper cannelure, as shown by the dotted lines *a*, *a*, in the sketch.

§§ 8919, 9399.

Only *empty* existing 4-inch and 5-inch B.L. and 12-pr. Q.F. projectiles will have the cannelures thus prepared; projectiles of future manufacture will have them undercut.

§ 9723.

The 12-pr. Q.F. shrapnel will not have its cannelures undercut, and the preparation of existing 12-pr. Q.F. projectiles, other than shrapnel, will be restricted to N.S.

§ 6140.

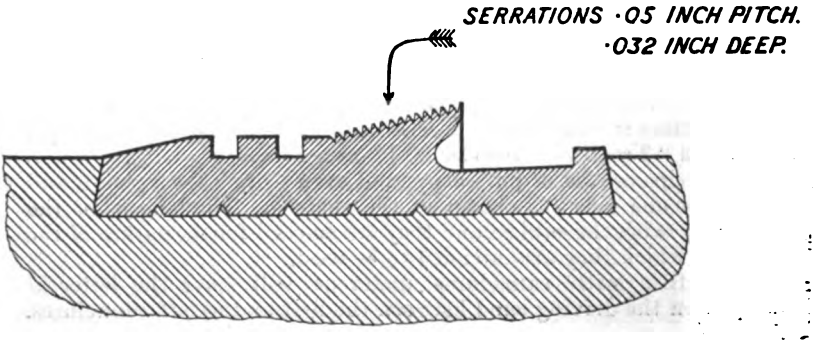
When using the chisel with projectiles of 12-inch calibre and upwards the undercut need not be continuous; eight 3-inch cuts made alternately on either side of the cannelure, at about equal distances around the shell, will be sufficient to secure the augmenting strip.

Varasseur Driving Band, with Gas-check.

Driving band with gas-check. §§ 8422, 9932.

A special driving band, with a gas-check, has recently been introduced for heavy guns, 6-inch B.L. and upwards, firing cordite charges.

Varasseur Driving Band, with Gas-check (Typical).

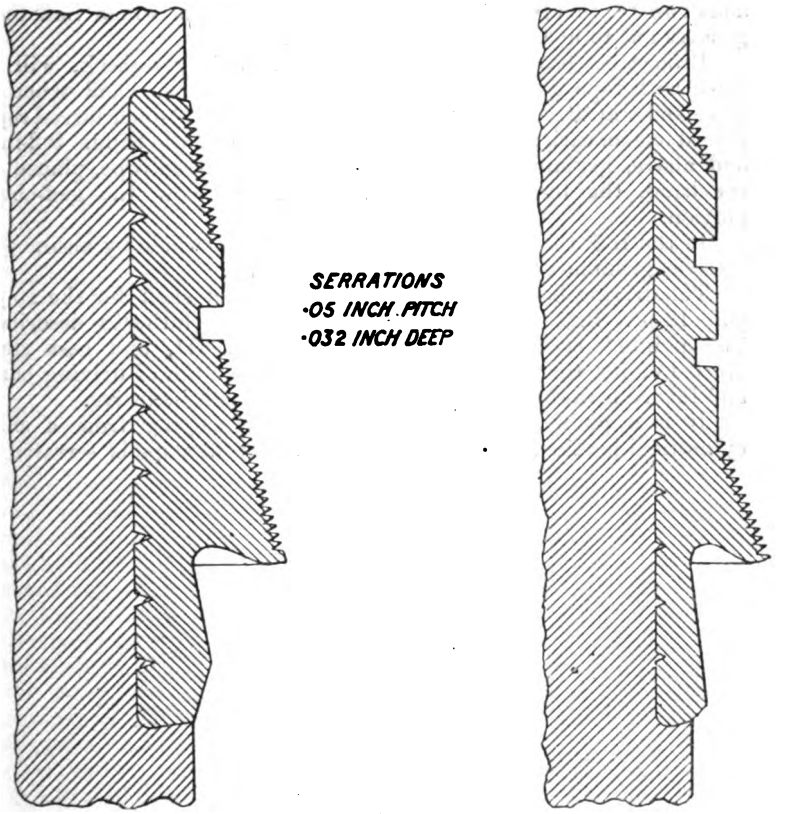


This band differs from the "broad" band in having a second slope formed near the centre of the band, and the metal cut away behind it thus forming a lip or gas-check. The apex of the lip is considerably higher than the remainder of the band, thus more efficiently sealing the bore. In addition the gas pressure on the under side of the lip tends to force it outwards against the bore of the gun. The band has cannelures of the ordinary type, in the cylindrical portion in front of the lip and the slope of the lip is serrated to hold the projectile in the chamber. The cannelures are not undercut, since augmenting strips are not required with this form of band (*see* cut).

Modifications have been made in this driving-band since it was first introduced, principally with regard to the extent and depth of

Vavasseur Driving Bands, with Gas-check, for 12*-inch B.L. guns.*

Full size.



Heavy.
(12-inch B.L., Marks VIII and IX guns.)

Light.
(12-inch B.L., Marks I to VII.)

the serrations on the gas-check lip. These are now made deep and sharply pointed in order to better ensure the projectile remaining fast in the chamber and not slipping back. The gas-check lip of these bands also tends to prevent over-ramming the projectile in worn guns.

§§ 10238, 10359.

An instrument for use, locally, in deepening the serrations on the earlier patterns of this band has been introduced. (*See* page 346.)

§§ 10177, 10187, 10252, 10508, 10720.

Bands of slightly different form have lately been introduced for the projectiles, both "Light" and "Heavy," of 12-inch B.L. guns, and also for B.L. 13·5-inch, 10-inch, 9·2-inch, and 8-inch. In these the front slope is also serrated, and the "grave" behind the gas-check lip differs in shape. (*See* cuts.)

The object of this is to prevent the metal of the lip "fringing" when it is jammed back by the passage of the driving band through the gun. This was found to occur and so affected the shooting of the gun. The size of the "grave" is so arranged that the metal of the lip just fills it and a tendency to fringe is eradicated.

§§ 8689, 10177, 10544, 10545, 10788, 10634.

Projectiles which are altered by being rebanded with the driving band with gas-check, will have the symbol * added to their numeral. Those rebanded with new gas-check driving band add **, the 12-inch H. adds one *, except the common pointed practice Mark I, which adds two **, this is to distinguish them from shells which had their grooves cut to fit the new bands, § 10341.

§ 8735. Rope grummets.

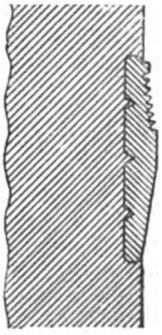
Projectiles having the driving band, with gas-check, will be fitted with rope grummets for the protection of the band when in store and transit. 6-inch to 8-inch grummets of 1½-inch tarred rope, placed one on each side of the gas-check portion of the band. 9·2-inch and above, grummets of 1½-inch and 2-inch tarred rope, placed on the band, the former above and the latter below the gas-check portion.

In the L.S. the grummets will be removed whole by means of a "driver-grummet," of hard wood, and a mallet.

§ 10301.

The driving bands of the Mark V shrapnel shell for the 15-pr. and 12-pr. B.L. or Q.F., differ from those hitherto described The pointed common, iron practice, Mark III, and cast steel, Mark IV, for the 12-pr. Q.F., also have this form of driving band, and future manufactured projectiles up to 4-inch inclusive.

It is a plain band, without cannelures, sloping from a short cylindrical portion, to front and rear. The front slope is serrated as



usual. The diameter of the cylindrical portion is slightly greater than that of the cannelured band, being 3·095 inches instead of 3·09 inches.

The projectiles fired from B.L. and Q.F. guns and howitzers are:—

Common	Shell.
Lyddite	
Armour-piercing	
Shrapnel	
Star	
Armour-piercing	Shot.
Palliser	
Case	

The projectiles for B.L. and Q F. guns have flat bases, and the heads of all except case shot are struck with a radius of two calibres.

Windage, &c.

The diameter of B.L. and Q.F. projectiles across the bands or the body of those which are cast without bands is ·05 inch less than that of the bore of the gun, except in the 6-inch and the 5-inch, which are ·04 inch less than the diameter of the bore across the lands.

Common shell.

Common shell of cast-iron, cast-steel, and forged steel will be found to exist in the equipments of the new B.L. guns. From 6-inch upwards the latest patterns fitted for nose fuzes are of cast-steel; for other calibres the latest patterns are of forged steel.

A general description of shells of each material is given in the following, and the differences in the various calibres pointed out.

The Roman numeral indicating the pattern refers to the mark of the projectile, and not to that of the gun. This applies to all natures of projectiles.

Cast steel.

Cast-steel common shell of the following calibres have been manufactured*:—16·25-inch Mark III, 13·5-inch I and II, 12-inch light IV and V, 10-inch I, 9·2-inch IV and V, 8-inch IV, 8-inch I, II and III, special for 8-inch Mark VII, 6-inch B.L. or Q.F., IV, V, and VI, and 30-pr. Mark I and II guns, and 6-inch 30-cwt. I, and 5·4-inch I and II howitzers.

§ 10412.

They have recently been declared obsolete for future manufacture.

Description.

These shells are cast head downwards, the mould being lined with a special preparation called "Steel Maker's Composition," instead of the ordinary sand used for moulding purposes. The interior cavity is formed by a core of the same material supported on a core spindle in the usual way. The use of this composition is necessitated by the higher temperature to which the molten steel is raised for casting. An unusually large dead head is formed at the base; this affords a certain amount of compression or feed to the metal underneath, and ensures sound material in the body, the lighter and inferior metal finding its way into the dead head, which is cut off in the subsequent operations of manufacture.

After casting, the shell are placed in an oven, where they undergo, during a period of about 24 hours, an annealing process.

They are about 3·5 calibres long, with ogival heads struck with a radius of two diameters, the walls being about one-seventh the diameter in thickness. A flanged gun-metal bush is screwed into the nose, and is threaded to the G.S. gauge, with the usual ·2-inch

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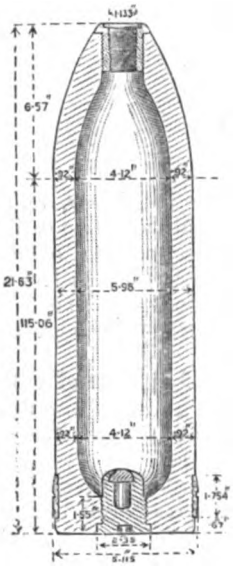
* Paragraphs of "List of Changes" introducing these shells will be found in Table 21.

Shells, B.L., Common, Cast Steel.

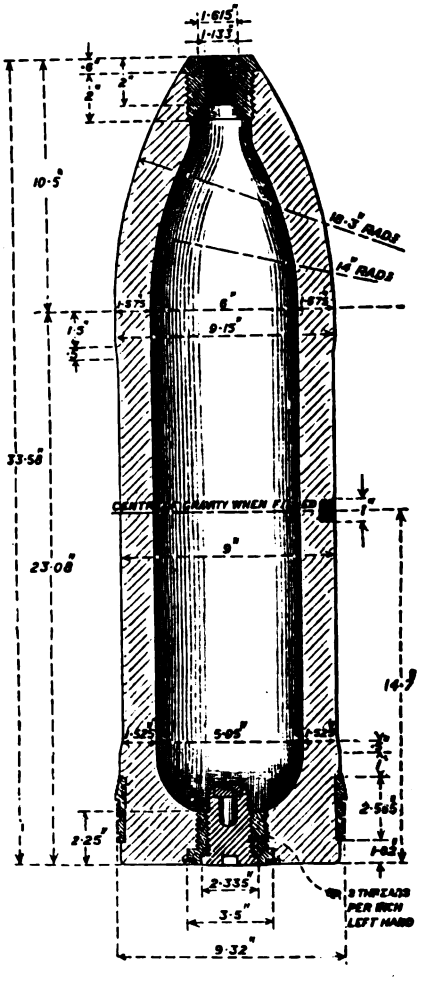
6-inch, Mark VI.

Scale, ½.



9·2-inch, Mark V.

Scale, ½.



countersink to receive the naval wad, except the 30-pr., which is not countersunk.

Bands. From the 8-inch and upwards they are cast with "bands"; that is, the diameter of the shell over the greater part of the body is slightly reduced, leaving a zone of metal at the base and another at the shoulder of the full diameter of the shell.

Lifting eye-bolt. From 8-inch and upwards, except the special shell for the 8-inch Mark VII and VIIa guns, they have a hole bored in the side, opposite the centre of gravity, and threaded to take an eye-bolt for lifting purposes. (*See* page 354.)

Testing. Each shell is tested for flaws in the R.L. with a water-pressure of 100-lb. on the square inch, and they are afterwards lacquered inside to contain the bursting charge.

They are all rotated by means of the broad Vavasseur driving band, or by the driving band, with gas-check.

In casting, the core spindle in the heavier natures passes entirely through the base, and to prevent its being melted by the highly heated metal, it has to be protected by a covering of asbestos, over which is placed a thicker layer of the composition referred to in the preceding. This necessarily causes a large hole to be left in the base of the shell. Closing bases.

This hole is threaded with a left-handed screw thread and in the earlier C.S. shell is closed by a solid gun-metal plug. There are two sizes of the plugs, the large in use with the 13·5-inch Mark I and 12-inch Mark IV, and the small with the 9·2-inch Mark IV shells. The joint between the plug and body of the shell is sealed by a lead ring, hammered into a recess round the plug.

For the 9·2-inch and upwards, these holes in the base are now closed by "adapters." The adapter is made of gun-metal, similar in size to the gun-metal plugs, mentioned above, but differing from them in being bored out and threaded with a left-handed screw thread to receive the large base plug. There are two sizes of these adapters, the large for use with the 16·25-inch Mark III, 13·5-inch Mark II and 12-inch Mark V and the small with the 10-inch Mark I and 9·2-inch Mark V shells.

The joint between the adapter and body of the shell is sealed by the lead ring hammered into a recess round the adapter and the joint between base plug and adapter by luting. (*See* page 377.) Formerly a lead washer was used, under the flange of the base plug, but when the plug is removed for any purpose, the lead washer, if present, is to be taken off and luting used when replacing the plug.

The 8-inch Mark IV and 6-inch Mark VI take the large base plug only, without adapter; while the 6-inch Marks IV and V take a base plug similar to those used with cast iron common shell, the joint in this case being sealed by a large lead disc, hammered into a recess over the plug. (*See* page 211). Some cast steel shells supplied by contract may not have the adapter, in which case they will be fitted with a large base plug similar to the 8-inch Mark IV or 6-inch Mark VI.

Black, with a white ring, ½-inch wide, at a distance of one inch from the fuze hole, denoting steel. The driving band is not painted. Paint.

For other marks on steel shell *see* page 296. Loose, except for field or siege, when they are boxed. Issue.

Rings, lead, base plug, large and small, are used with B.L. cast-steel common shell, 9·2-inch and upwards. They are made of lead, ·3-inch in thickness, and hollowed out on the under surface; they are intended to be hammered into the recess round the base plug or adapter to seal the joint. Rings, base, plug. § 5334.

The large ring is for 12-inch shell and upwards, and 16·25-inch forged steel Mark II, the small for 9·2-inch and 10-inch.

Shell, B.L, Common, Pointed, Cast steel, have been introduced for B.L. guns* 4-inch and upwards, and for Q.F. guns 12-pr., 4-inch, 4·7-inch, and 6-inch. Pointed, common.

They are for Naval Service, except the 12-pr. Q.F. § 10412.

They differ from the cast steel common shell mentioned above principally in having a pointed head and a fuze hole in the base, which is suitable for the fuzes, percussion, base, large and medium, the former with 6-inch and upwards, the latter below 6-inch. From

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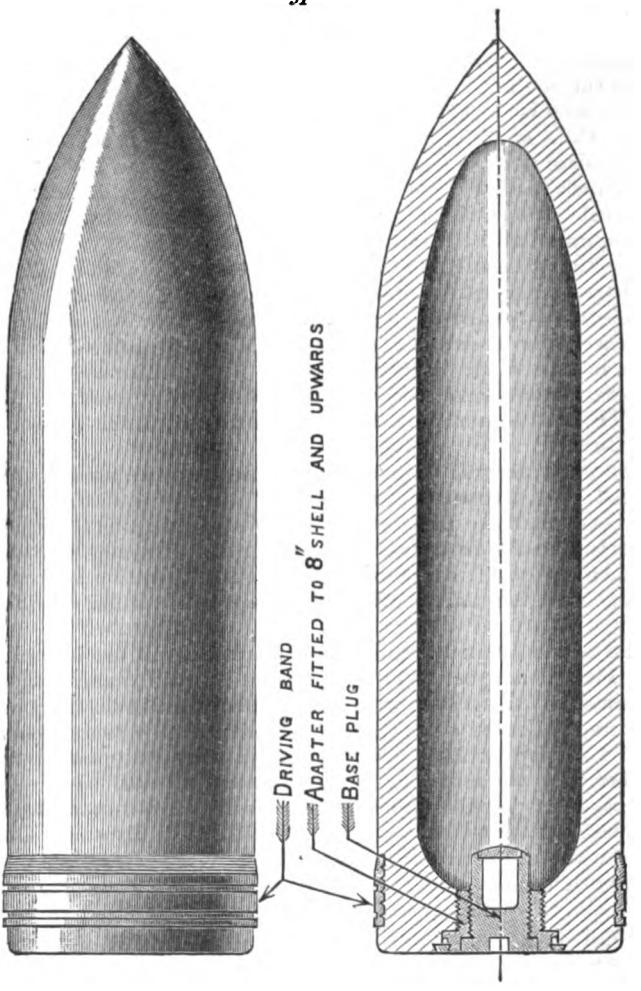
* Paragraphs of "List of Changes" introducing these shells will be found in Table 21.

B.L. Common Pointed Shell.
Typical.



8 inch and upwards they are cast with bands, have the hole for lifting eye-bolt, and the earlier patterns have adapters in the base; the small adapter for 8-inch and large for 9·2-inch and upwards.

§ 9363. The later patterns have a steel bush screwed into the base and the joint riveted up, instead of the adapter. This steel bush is screw-threaded inside to take the large base fuze or plug and is not removable. (*See* plate XVII.)*

The 6-inch has its base closed by the large base plug and below 6-inch by the medium.

Exceptions. The 4·7-inch Q.F., Mark III, took the Armstrong base fuze. This fuze is obsolete for L.S., but a few of them may still be met with in

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* The Mark V common, pointed for B.L. 9·2-inch differs from the Mark IV shown in the plate only in being fitted with the new pattern driving band. § 10508.

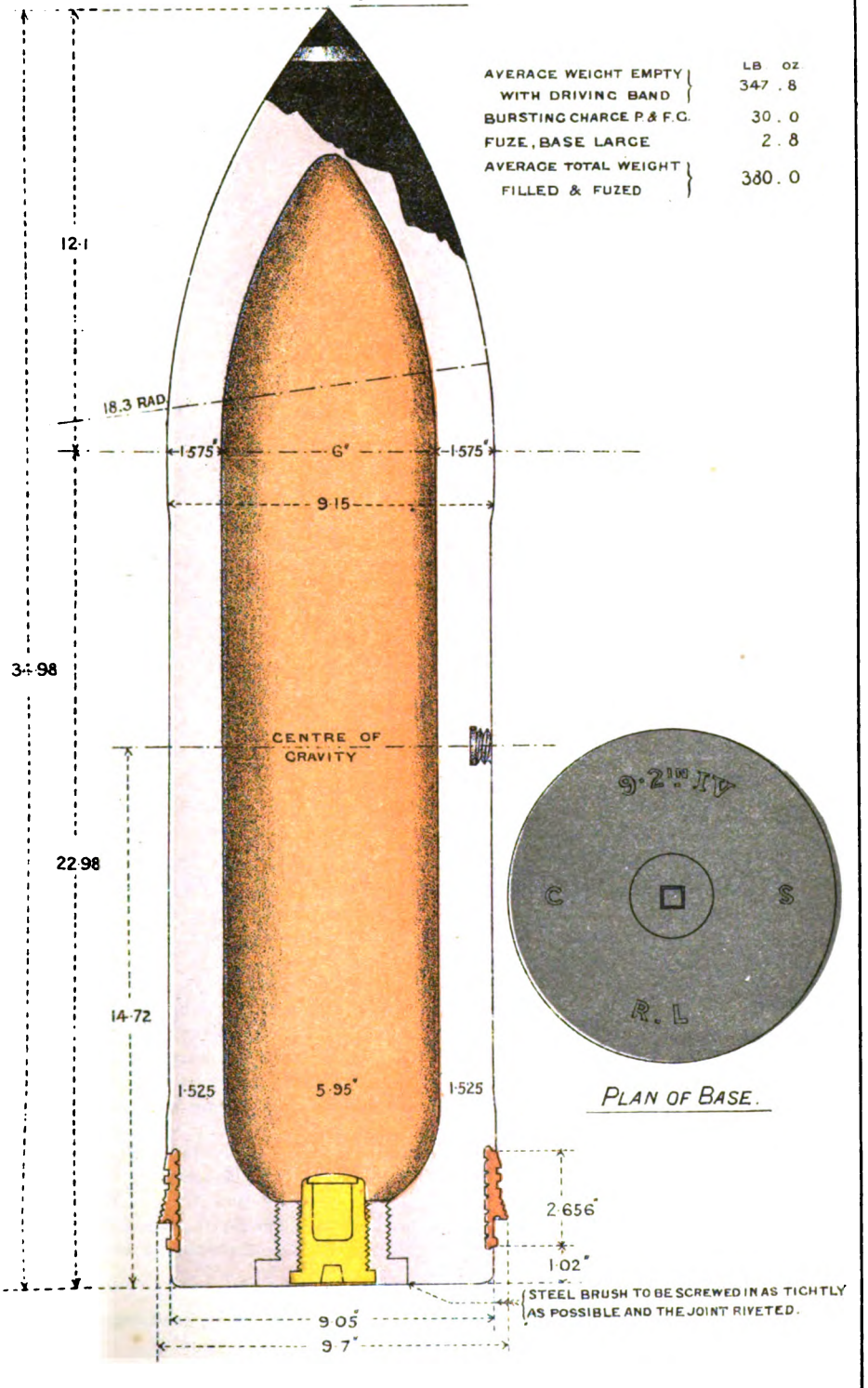
SHELL B.L. COMMON POINTED 9·2 IN CAST STEEL.

MARK IV N.

FOR LARGE BASE FUZE.

SCALE 1/5

§ 9963.

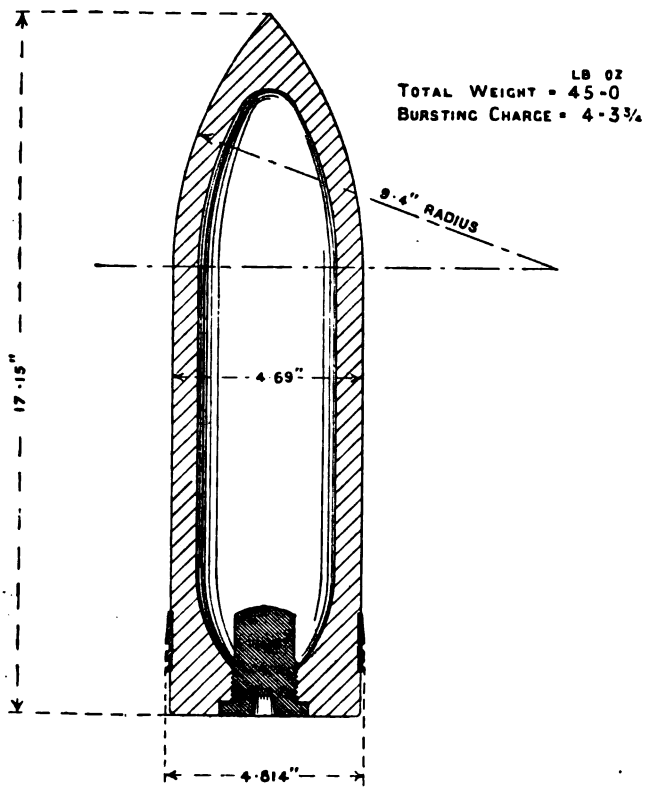


576 9. 1930.

E. Weller & Grahams, Ltd Litho. London.

Shell, Q.F., Common, 4·7-inch, Pointed, Cast Steel, Mark IV, N. for Base Fuze.

Scale ½.



the Navy. (*See* last edition of this Treatise.) The 12-pr. Q.F., Mark I, took the Hotchkiss base fuze. (*See* page 300.) Very few of these are likely to be met with.

Paint.

Black with a white ring, ½-inch wide, one inch from the tip, denoting steel. The driving band is not painted.

For other marks *see* page 296.

Issue.

Filled and plugged for Land Service.

Filled and fuzed for Naval Service.

5-inch and under, boxed.

6-inch and upwards loose, fitted with protectors. (*See* page 362.)

Forged steel.

Forged steel shells of the following calibres have been supplied to the service* :—

16·25-inch, Marks I and II, 12-inch, light, Mark III, 9·2-inch, Mark III, 8-inch, Mark III, 5-inch, Marks IV and V, and 4-inch, Marks IV, V, VI, and VII.

These shells, in external appearance, length, &c., closely resemble the cast-steel common, but being made of a stronger material, the

* Paragraphs of "List of Changes" introducing these shells will be found in Table 21.

walls are thinner, and their capacity for bursting charge increased in proportion. With one exception they are forged with solid bases, and consequently are filled through the nose. This exception is the 16·25-inch Mark II, which has the centre of the base bored out and screwed to receive the large adapter, as in the cast-steel. The 16·25-inch Mark I common shell has a solid base, and, for convenience of filling, the bush is removable. After filling, the bush is secured by means of red lead.

They are all fitted with flanged gun-metal bushes, and countersunk to take the Naval wad. The 8-inch and upwards have the hole in the side to take the "bolt, eye, lifting," and all have the broad Vavasseur driving band, or driving band with gas-check.

These shell are for use with powder charges, and are obsolete for future manufacture.

Paint. They are painted in the same way as cast-steel common shell.

Lyddite shell. *Shell, B.L., Common, Lyddite, Forged Steel* are made for the following calibres*:—

Land Service.—B.L. guns, 10-inch, 9·2-inch, 8-inch (special for Mark VII gun), 6-inch, B.L. or Q.F., 5-inch, 4·7-inch, Q.F., 30-pr., and 4-inch. B.L. Howitzers. 8-inch, 6-inch, 5·4-inch, and 5-inch.

Naval Service.—B.L., Q.F., or Q.F.C. 6-inch, and 4-inch. B.L. 5-inch and Q.F. 4·7-inch.

For the various marks of these shells *see* Table 23, pp. 512, 513.

The 5-inch Mark VII shell and 4-inch Mark II may also be used for powder if required and the 5-inch Mark VII gun shell is suitable also for the 5-inch howitzer.

These shell are all made of forged steel, with solid bases so as to prevent any chance of premature action from the penetration of gas through a base fuze, or between the plug and body of the shell. They are fitted with flanged gun-metal bushes, countersunk to take the flange of a special plug. From 8-inch and upwards they have the hole in the side for the lifting eye-bolt, and they are all rotated by the broad Vavasseur driving band or driving band with gas-check (for 6-inch and above). The latest mark of 4-inch has plain band. They are varnished inside with a hard brown varnish instead of being lacquered. (*See* plate XVIII.)

For exploders *see* tables and page 28.

Paint. Yellow all over.

Issue. Both Land and Naval services, filled and plugged, and loose except for Field or Siege service, when they are boxed. The shell for Naval service have also a "kit plaister," made of silk cloth dipped in kit composition and having two loops to facilitate removal, pressed on over the plug in order to make the shell damp-proof.

Some shell have been issued to the Royal Navy filled and fuzed, and in this case they will be boxed.

Cast-iron, common. *Shell, B.L., Common, cast iron*, have been made for the following calibres*:—

12-inch light Marks I, II and VII; 9·2-inch I, II and VII; 8-inch I, II and VI; 6-inch, I, II, III, VII, VII*, and IX; 5-inch, I, II, III and VI; and 4-inch I, II, III and VIII.

Howitzers for practice:—6-inch I, II and III; 5·4-inch I and II; 5-inch I and II.

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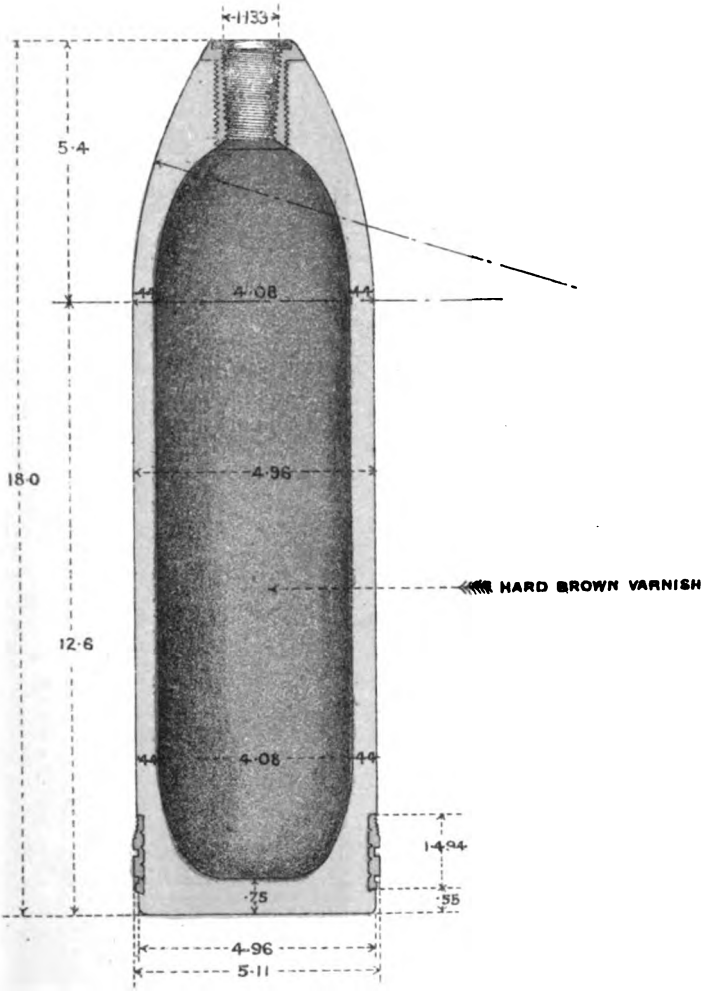
* Paragraphs of "List of Changes" introducing these shells will be found in Table 21.

SHELL B.L. LYDDITE COMMON 5 INCH HOWITZER MARK III. L.

FORGED STEEL.

SCALE ¼.

	LB.	OZ.
AVERAGE TOTAL WEIGHT	50	0
BURSTING CHARGE	9	15

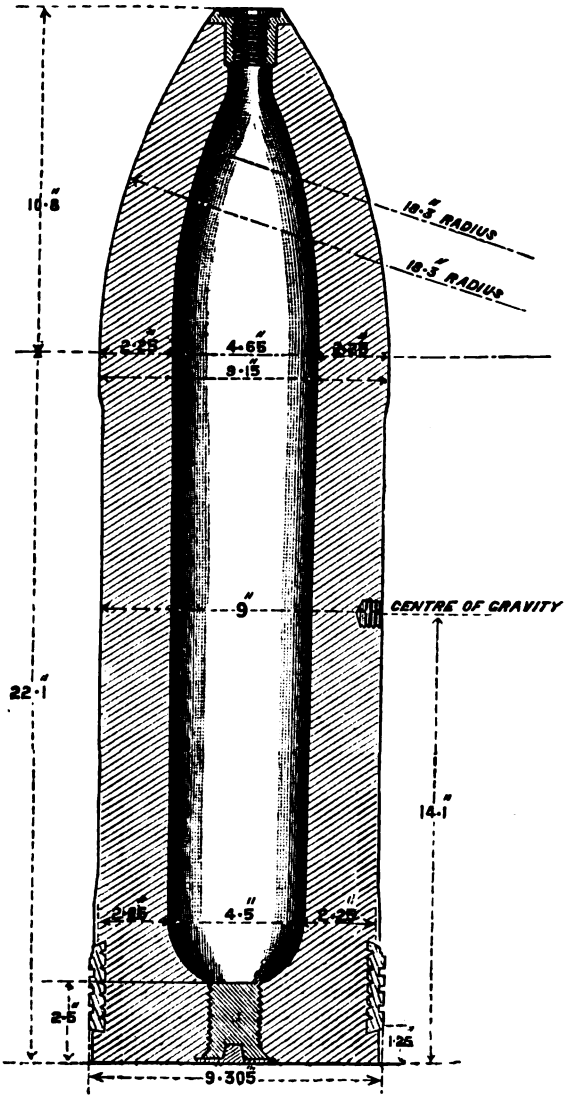


876. B. 1900.

E. Weller & Grahame Ltd. Litho London

Shell, B.L., Common, 9·2-inch, Cast Iron, Mark VII.

Scale, $\frac{1}{8}$.



These shells are cast base downwards in a sand mould; by this arrangement the heaviest and best of the metal remains at the base, which, being next the charge, requires to be strongest. The cavity in the interior is formed by a sand core, supported on a core spindle; on account of the greater length of B.L. shells, the core spindle, in the 6-inch and upwards, passes through the base in casting, to keep it more truly central; this leaves a hole in the base, which, besides supporting the core spindle, is convenient in the subsequent operations of turning the band, &c., and also in filling the shell. The

Descriptio

lighter and inferior metal rises into a small deadhead at the nose, and is afterwards cut off.

They are from 3 to 4 calibres in length, the walls and base being made of the necessary thickness to withstand the shock of discharge. Their heads are ogival, struck with a radius of two diameters, and the bases are nearly flat. From the 4-inch and upwards they are provided with a gun-metal bush, which has a flange extending over the nose and rounded on the exterior to the same shape as the head of the shell. This bush is threaded to the G.S. taper and pitch, and has a ·2-inch countersink to receive the Naval wad. From the 8-inch and upwards they are cast with bands, and a hole is bored into the side in line with the centre of gravity, and threaded to take an eyebolt for lifting purposes. Rotation is imparted to them by means of a copper driving band secured to the body near the base.

They are lacquered internally to take the bursting charge, which, from the 4-inch and upwards, is contained in a burster bag. The 6-inch and upwards have a hole in the base, through which they are filled; this hole is closed by a gun-metal screw plug, a recess left over the latter is sealed by a lead disc hammered in after filling.

Test. Cast-iron common shells are tested with a steam pressure of 40 lb. per square inch, to detect any flaws in the metal.

Paint. They are painted black all over, except the driving band, which is left unpainted.

5-inch, I and II. The 5-inch Marks I and II have gun-metal screw plugs in the base, but they are not to be utilised for filling. They are issued with the lead disc permanently hammered in.

§ 4375. The 5-inch Mark I is a weak shell, and is to be used up at practice with reduced charges only. The 4-inch Mark I has not any recess to receive the Naval wad.

Issue. As for cast steel common shell.

Bursting charges. For nature of powder used and method of filling all common shells, *see* chapter I, page 8, also *see* p. 370.

Practice shell. *Shell, B.L., Common, pointed, practice,* of cast iron are made for the following calibres*:—B.L. guns, 16·25-inch; 13·5-inch; 12-inch, heavy, light; 10-inch; 9·2-inch; 8-inch; 6-inch B.L., Q.F., or Q.F.C.; 5-inch; 4·7-inch Q.F.; 4-inch B.L., Q.F., or Q.F.C.; and 12-pr.

These shell are cast base downwards, and differ from the ordinary cast iron common shell only in being pointed, and in taking the large or medium base plug. The letter P is stamped on the base except for the 12-pr., stamped on the side, and they are not lacquered inside. They are not intended for use with a bursting charge but are filled with salt cake, common salt not to be used.

§ 10329. § 10668.

§§ 8481, 9957. †The 12-pr. Q.F. has pointed common shell, iron, Marks I and II. These shell are lacquered, may take a bursting charge and may be used for service on emergency. The 4·7-inch Q.F., Marks I and II are fitted for the Armstrong base fuze or plug, and the Mark V is lacquered inside.

§ 8715.

Paint. They are painted black all over, with a yellow band round the centre of the body (denoting practice). The 12-pr. Marks I and II have no yellow band, unless issued filled with salt.

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* Paragraphs of "List of Changes" introducing these shells will be found in Table 22.

† § 10973. N.S. 12-pr. practice shell will, in future, have a wood plug in the key hole of the base plug secured with shellac, to prevent the lid of the cartridge from taking a seating there on firing.

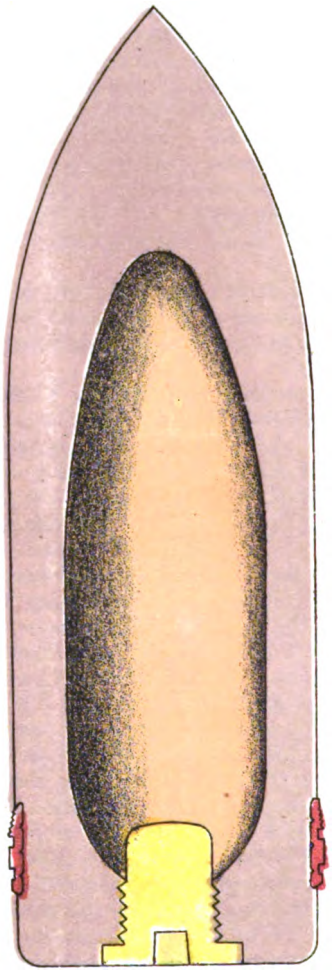
SHELL, Q.F. ARMOUR PIERCING, 4·7 INCH F.S.

MARK V.

SCALE 1/3.

§§ 460.

9957.



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Filled with salt and plugged.* Issue.

The fuzes employed with B.L. common shell in the L.S. are, 13·5-inch to 5-inch inclusive, the direct action; 4-inch and under, the small percussion. Fuzes.

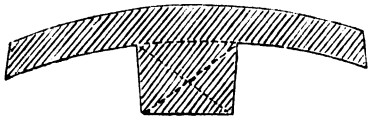
In the N.S. the direct action is, at present, the only fuze supplied for B.L. guns for use with common shell.

Pointed common shell take either the large or the medium base fuze.

Some of the early 4·7-inch Q.F. pointed common take the Armstrong base fuze.

Lyddite shell for N.S. take the direct action, impact fuze. For L.S. the direct action, impact for guns and the D.A. Mark II percussion fuze for howitzers and 5-inch gun. Fuzes for lyddite shell.

As mentioned above, *Discs, lead, base plug*, are employed with B.L. cast-iron common shells, 6-inch and upwards, and 6-inch cast-steel, Marks IV and V, to seal the joint when the base plug is screwed in. Lead discs. §§ 4137, 5083.



They are made of lead, slightly concave (*see* cut, which shows section of one), and have a square projection which fits into the hole in the base plug. When hammered flat they fit tightly into the slightly undercut recess in the base of the shell.

There are two sizes.

The small one is about 1·89 inches diameter, weighs $3\frac{3}{4}$ oz., and is used in the 6-inch (cast iron) and 8-inch.

The large is about 2·13 inches diameter, weighs 5 oz., and is used in 6-inch Marks IV and V (cast steel), 9·2-inch, and 12-inch.

Shell, B.L., Armour-piercing have been introduced for the following:—B.L. guns, 13·5-inch; 12-inch, heavy, and light; 10-inch; 9·2-inch; and 8-inch; and special for Marks VII and VIIA guns, B.L., Q.F., or Q.F.C. 6-inch; and 4-inch, Q.F. 4·7-inch. (*See* p. 513.) Armour-piercing shell. §§ 5966, 6226, 7379, 8460, 8480, 9529, 10027, 9957, 10307, 10508, 10509.

The 13·5-inch, 12-inch heavy, 8-inch and 4-inch are for Naval Service, the remainder being common to both services. The 8-inch special is for L.S.

These shell are made of steel, pointed and hardened for the penetration of armour. They differ from pointed common shells in the head, which has a much greater thickness of metal. (*See* Plate XIX.) They are lacquered inside for a bursting charge and from 6-inch and upwards are fitted for the large base fuze or plug; below 6-inch for the medium, except the 4·7-inch Q.F. I, II and III, which take the Armstrong base fuze.

For 6-inch and upwards armour-piercing shell may be of forged or cast steel, the choice being left with the manufacturer. The minimum capacity of the cavity and minimum thickness of walls are given, but the size, shape, and position of the cavity are left to the manufacturer's discretion, as also the exact length of the shell. He is given the weight of shell, the shape of the head, the diameter, and

* § 10329. Practice shells for L.S. were formerly issued empty and filled with water when required for use. In future, practice shells for both services are to be filled with salt.

the size and position of the driving band. The base may be screwed to take the large base fuze or a steel bush may be used. In the latter case the size of this bush is given. The Vavasseur driving band with gas-check is used. They have no hole for the lifting eye-bolt, as this would cause a point of weakness in the shell and it is important that the skin of the shell should be kept intact.

Below 6-inch the armour-piercing shell are usually made of forged steel,* turned to shape and carefully hardened. The base is screwed to receive the medium base fuze. They are rotated by the broad Vavasseur driving band 6-inch and up. Each shell is stamped with the letters A.P. on the base.

The 6-inch Mark II differs from Mark I in the dimensions of the cavity and in having the groove for the driving band undercut.

The 4·7-inch Mark V differs from Mark IV only in having the groove for the driving band undercut.

Marks I, I*, II and III differ from Mark IV in taking the Armstrong base fuze, and Marks I, I* and II from Mark III in having the base screwed in and from each other in the form of the driving band. These may be met with in the N.S. but the Armstrong base fuze becomes obsolete when expended. (*See* last edition.)

§§ 7725, 8106, 9630. The armour-piercing shell for the 12-pr. Q.F. are obsolete for future manufacture. Existing shell are withdrawn from the L.S. and are to be used up at practice in the N.S.

The hardening process is liable to set up a state of strain in the metal which may cause a shell to split spontaneously. In order to avoid this danger the shell, when possible, are kept for three months, or the whole of them or any part, may be tested by being immersed, head downwards, in hot water as far as the driving band until the shell is heated throughout, and then plunged into cold water. The difference in temperature between the hot and cold water is to be 130° F. After this they are carefully inspected before issue.

Tests.

A small percentage is also tested by firing against an armour plate, which must be perforated. The thickness of the plate and conditions of the test, of course, vary with the calibre of the shell, and are given in the previous chapter.

Paint. They are painted black with two white bands, $\frac{1}{3}$-inch wide, the first 1-inch from the point and the second $\frac{1}{2}$-inch below it.

Issue. Filled and fuzed for N.S., and empty, or filled, and plugged for L.S.

For both services, 5-inch and under are boxed, and 6-inch and upwards are issued loose, fitted with protectors. There are special orders for base fuzed shell issued loose. (*See* p. 379.)

Ring shell. † *Shell, B.L., Ring*, are made of the following calibre:—4-inch Mark I. This shell is made of cast iron, cast on a core of 12 iron rings, the rings being so arranged as not to break joint with one another. Each ring is so weakened as to break up into eight segments on the shell bursting. The head is ogival struck with a radius of two diameters, and is provided with a gun-metal bush to take the fuze, as in the case of common shell. The shell has the broad Vavasseur driving band, and is lacquered inside.

Paint. It is painted black over the body except the driving band, which is left unpainted. The tip is painted blue.

---

* The 4·7-inch Q.F. armour-piercing shell may now be made of cast or forged steel.

† None of these have been issued and the drawing has been cancelled.

The powder used for bursting charges of ring shell is exceptional (*see* p. 8). Bursting charge.

Shrapnel shells are manufactured at present for all calibres of B.L. guns, and, like the common, will be found made from cast iron, cast steel, and forged steel; but it may be said that for these guns steel, either cast or forged, has almost entirely superseded iron for this particular class of projectile. The latest patterns from the 6-inch upwards (except the 16·25-inch) are of cast steel—below 6-inch of forged steel. Shrapnel shell.

B.L. shrapnel are of two distinct constructions: those having the bursting charge in the base with the head very lightly attached, generally known as the Boxer system; and those in which the bursting charge is contained in the head with the base but lightly attached, and usually spoken of as the Armstrong system. The relative merits and defects of both are discussed in the introductory chapter to projectiles.

The construction proposed by General Boxer has been generally followed for the heavier natures, the Armstrong principle being confined to those of 4-inch calibre up to Mark VI.

The supply of shrapnel shells for B.L. guns above 6-inch has been discontinued, for Land Service. § 10282.

B.L. shrapnel shells are therefore issued as follows:—

N.S. 12-pr. and upwards, except 12-inch heavy.

L.S. 12-pr. to 6-inch inclusive.

Existing shrapnel above 6-inch in the L.S. will be used up as may be ordered.

Shell, B.L., Shrapnel, have been made for B.L. guns as under*:—

Cast iron, 12-inch light, 9·2-inch, 8-inch, 6-inch, 5-inch, 4-inch.

Cast Steel, 13·5-inch; 12-inch light; 10-inch; 9·2-inch; 8-inch; 8-inch (special for Mark VII gun); 6-inch (B.L., Q.F., or Q.F.C.); and 5·4-inch howitzer.

Forged Steel, 16·25-inch; 12-inch light; 9·2-inch; 8-inch; 6-inch; 5-inch; 4·7-inch, Q.F.; 30-pr.; 4-inch (B.L. Q.F., or Q.F.C.); 15-pr. and 12-pr. (B.L. or Q.F.); also 10-pr. B.L.

Of these the 4-inch IV, V and VI have the bursting charge in the head, the remainder are of Boxer or base burster pattern.

All Boxer shrapnel fired from B.L. guns may be broadly divided into two classes, viz., heavy and field. A description of each of these classes will be given in detail, and any individual peculiarities noted. Boxer shrapnel.

The *Shell, B.L., Shrapnel, 9·2-inch cast steel, Mark VI*, may be taken as a good representative of the heavy type. From 9·2-inch and upwards, the construction of B.L. shrapnel is identical, the principal point of difference being in the material from which the bodies are made, and consequent capacity, for sand shot. The cast iron have six longitudinal weakening grooves in the powder chamber to ensure their breaking up; the steel have no weakening grooves, as they are not intended to break up. 9·2-inch shrapnel, Mark VI.

It consists of a cast steel body, the walls of which are nearly as thick as those of the common shell of the same calibre, near the base the walls are thickened, so as to form a shoulder, on which rests a steel diaphragm, beneath which is the powder chamber. The Description.

* Paragraphs of "List of Changes" introducing these shells will be found in Table 25, and this will include later marks.

bursting charge is contained in a tin cup, which is coned at the top to facilitate unloading, and the neck of which fits on to the bottom of the wrought-iron pipe. The use of this cup is to guard against possible prematures from the roughness of the interior of the shell, and to prevent loss of powder. The bottom of the pipe has asbestos wrapped round it and is covered with Pettman cement in order to make a tight joint with the tin cup and so prevent rosin working in among the powder. The diaphragm, which rests upon the shoulder of the powder chamber, is of steel, and into it is screwed a piece of 1-inch gas-pipe, smoothed and lacquered inside. The interior of the shell is lined with brown paper, and contains (in this case) 640 2-oz. sand shot, the interstices between which are filled with melted rosin, and over the top of which is placed a felt washer. Round the exterior of the body, near the end, runs a groove, into which fits the Bessemer metal head. The latter is attached to the body by two rows of rivets, but as the lower row are only intended to prevent the head twisting off in flight, they are called "twisting pins," and to prevent them forming too strong an attachment, the metal of the head is slotted out to the edge, so as to oppose no resistance to a direct blow from the rear. A band of solder round the exterior of the shell at the junction of the head and body prevents these rivets and pins from falling out. At the point the head is flattened down to receive a gun-metal socket, the flange of which projects over the head and forms the extreme point of the shell. (See Plate XX.)

The upper part of this socket is tapped inside to the G.S. gauge, and the lower part to receive the "primer shrapnel shell." (*See* p. 361.) The socket is attached to the head by a ring of solder inside, and the head is lined with wood.

There is no attachment between the gun-metal socket and the wrought-iron tube; but the end of the latter is slightly recessed to receive the socket, which is carefully turned to fit it.

The shell is rotated by means of the broad Vavasseur driving band with gas-check, which is pressed into an undercut groove near the base.

In the plate will be noticed the hole for the lifting eyebolt, which is bored in the side of all B.L. shrapnel, 8-inch and upwards, and is in line with the centre of gravity.

The 9·2-inch Mark V differs from Mark VI only in not having the groove for driving band undercut, and the Mark IV differs from Mark V in having the broad Vavasseur driving band, without the gas-check, Mark VII has the latest gas-check driving band.

Action. The action of Boxer shrapnel is as follows:—The fuze fires the primer, which conveys the flash down the pipe to the bursting charge, the explosion of which blows off the head, and liberates the balls.

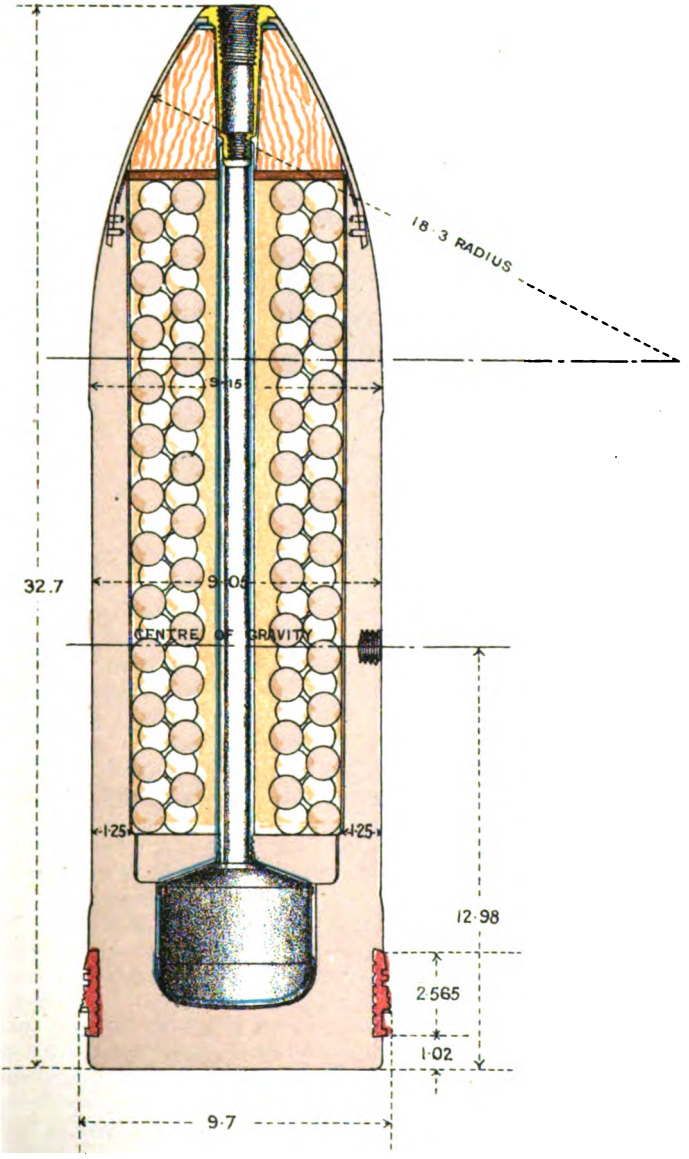
5-inch, Mark IV. The 5-inch Mark IV and 6-inch Marks VII and VIII B.L. shrapnel are alike in construction. The 5-inch is made of forged steel, and the 6-inch of cast steel. They are of the Boxer field service type, and the 5-inch is described in detail below.

Description. The body has parallel walls, shoulder and powder chamber, the bursting charge is contained in a tin cup, and the diaphragm is of steel, but the central tube is of brass, with comparatively narrow orifice, the bullets are of mixed metal (viz., four parts lead to one part antimony), and the socket is of different pattern from that for the heavier shell. The top of the brass tube is tapped to take the metal primer, and to the exterior is attached by solder a small tin socket which fits over a gun-metal socket attached to the interior of

SHELL B.L. SHRAPNEL 9·2 INCH CAST STEEL MARK VI |N|

SCALE 1/6.

	LB	OZS.
AVERAGE TOTAL WEIGHT	380	0
ABOUT 638 SAND SHOT (2 OZ)	79	12
BURSTING CHARGE	2	3



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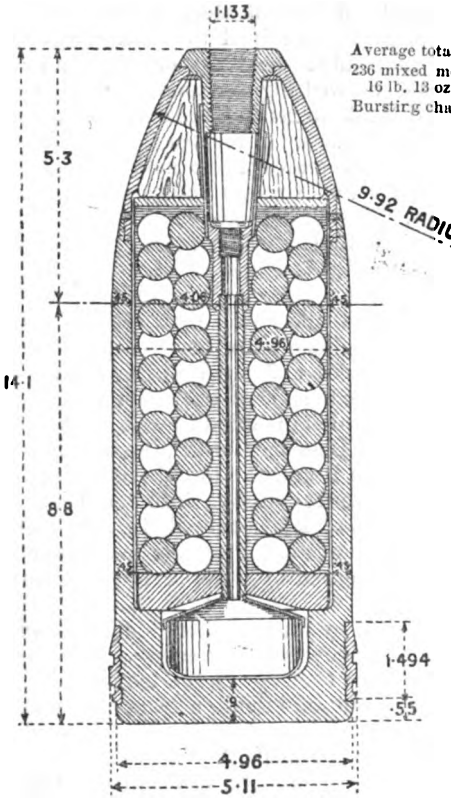
Shell, B.L., Shrapnel, 5-inch Gun, Forged Steel, Mark IV, | C | .

Scale, ½.



the head of the shell. The head has a wood and the body a paper lining, and a felt washer covers the bullets and prevents the rosin from working into the socket, where it might cause a blind, as well as allow the bullets to get loose. The shell contains 236 mixed metal balls, 14 per lb.

The bottom of the pipe has asbestos wrapped round it and Pettman cement in order to make a tight joint with the tin cup, as in the heavy type. This, in fact, applies to all shrapnel of the Boxer type.

Shrapnel were made for the 5-inch howitzer, but are declared obsolete as soon as the stock is expended. Existing shrapnel are to be used up at practice. §§ 8231, 8812, 9629.

The 8-inch B.L. shrapnel is of peculiar construction, having, like the Boxer field service type, the brass pipe and composite socket, but it is filled, like the heavy type, with iron sand shot. Exceptional shrapnel, 8-inch.

The Marks I and II 4·7-inch Q.F. shrapnel differ from others of the field type in having a fuze-hole socket like that of the heavy type and a wrought-iron central pipe, lacquered inside, and ·625-inch in diameter. It contains mixed metal balls. 4·7-inch.

The shrapnel for the 12-pr. B.L. or Q.F., 15-pr. B.L. or Q.F. and 30-pr. B.L. and 10-pr. B.L. are of the Boxer type, but differ in construction from those hitherto described.

§ 10301. The *Shell B.L. or Q.F. Shrapnel*, 12-*pr.*, 12, 8 *or* 6 *cwt. Mark V*, | *C* | , is for use with the 12-pr. B.L. or Q.F. guns, and differs in construction from the ordinary field service type. (*See* Plate XXI.)

Description. The body is made of forged steel, with shoulder and powder chamber. The charge is contained in a tin cup, above which is a steel diaphragm, into which the brass or metal pipe screws. This pipe is in two parts, screwed together, and the top part is enlarged and screw-threaded inside to receive the shrapnel primer. It is also screw-threaded on the exterior to receive a nut. The usual asbestos and Pettman cement are employed to make a tight joint between the bottom of the pipe and tin cup and so prevent rosin working in among the powder. The bullets are contained in a tin cage. This cage consists of a tin cylinder, which rests upon the steel diaphram and has perforations to let the bullets pass through. There is the usual brown paper lining between the walls of the shell and the cylinder. The cylinder is filled with about 156 mixed metal bullets, 35 per lb., and a few buck-shot are used to adjust the weight. On top of the bullets is placed a flanged tin ring and the top of the cylinder, which is fringed, is bent over and soldered to this ring. The space between the bullets is filled in with molten rosin.

The head is made of Bessemer metal, lined with wood, and a felt washer is placed between it and the top of the tin cylinder.

A short gun-metal socket screws into the head and is further secured by solder. This socket is threaded inside to the G.S. taper and pitch, and is bored out at the bottom to fit over the top of the central pipe, which is secured by a nut screwed on to it on the top inside the socket.

The head is attached by means of six steel screws and six steel twisting pins, which are covered with solder. The twisting pins are in the top row and fasten the cage to the head.

The driving band is plain, having a front and rear slope, but no cannelures. The front slope is serrated. It is pressed into an undercut groove near the base of the shell.

§ 9957. The Mark IV differs from Mark V only in the driving band, which is of the ordinary broad Vavasseur type, with two cannelures.

§ 8502. The Mark III differs from Mark IV in not having the groove for the driving band undercut.

§ 8233. The Mark II differs from Mark III in the construction of the cage, which is made of wires soldered together and is closed at the top by a wrought-iron disc. It is also attached to the head by separate steel pins. The diaphragm is slightly weaker than that

§ 8143. of the Mark III. In Mark I the fuze hole socket is fitted inside the top of the pipe instead of being secured by a nut.

§ 9058. Mark I has been altered to conform as far as possible with Mark III, and is then known as Mark I*.

§ 10301. The *Shell, B.L. or Q.F., Shrapnel*, 15-*pr.*, *Mark V*, is identical in construction with the 12-pr. Mark V, differing only in length and weight, and in the minor detail of having no wood lining in the head. It contains about 192 mixed metal balls, 35 per lb., and the bursting charge is the same in each case—$1\frac{1}{2}$ oz. R.F.G^2.

§ 9057. The Mark IV is similar to the 12-pr. Mark IV.

§ 8502. The Mark III differs from Mark IV in not having the groove for the driving band undercut. The early issues also had a small set screw in the head to secure the fuze or plug.

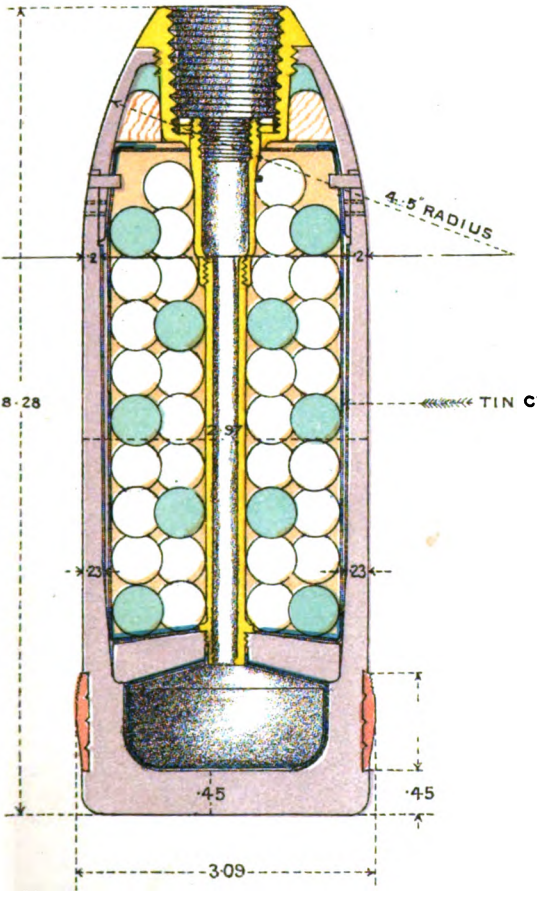
§ 8232. The Mark II resembles the 12-pr. Mark II and contains about 200 bullets. The Mark I resembles the 12-pr. Mark I in construction and differs from the Mark II in length and weight. It contains 210

SHELL B.L.OR Q.F.SHRAPNEL, 12 PR., 12, 8 OR 6 CWT, MARK V

FORGED STEEL.

SCALE 1/2.

AVERAGE TOTAL WEIGHT	12·8
ABOUT 156 MIXED METAL BALL	4·7¼
BURSTING CHARGE	1½



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bullets. It has been shortened and lightened and socket altered, and then becomes Mark I*. Mark I is to be used for practice. § 9058.

On emergency the 15-pr. shell (but not the cordite charge) may be fired from the 12-pr. B.L. gun.

The Shell, B.L., Shrapnel, 30-pr., Mark III, is similar in construction to the 12-pr. Mark IV. It contains 313 mixed metal balls, 27 per lb. and the bursting charge is 3-oz. R.F.G.[2]

The Mark II is similar to the 12-pr. Mark III and the Mark I to the 12-pr. Mark II.

The 30-pr. B.L. is only to be met with in India.

The 10-pr. B.L., Shrapnel, Mark I, is similar to 12-pr. Q.F., Mark V, in construction.

The *Shell, B.L., Shrapnel, 15-pr., Practice, Mark I, F.S.*, has a gun-metal head and fuze-hole socket in one piece, lined with wood, and attached by six steel screws, and six twisting pins to the body. The central pipe resembles that used with the 12-pr. Mark II, and is attached to the fuze-hole socket in the same manner as in that shell. The steel diaphragm is dome-shaped, and its circumference rests on a shoulder near the bottom of the shell. The chamber for the bursting charge is formed by a shallow tin cup soldered to the under side of the dome. § 8562.

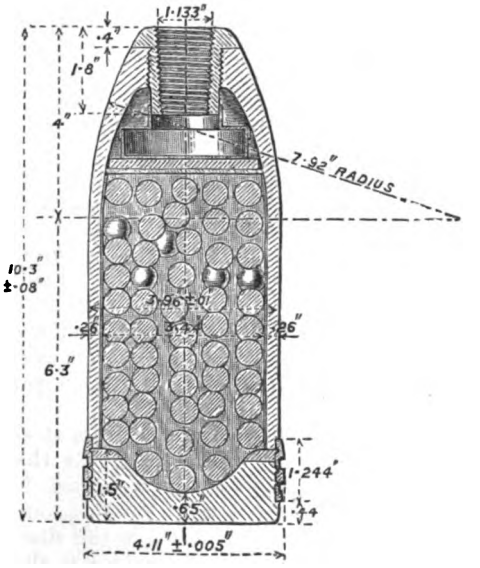
It is a conversion from the forged steel common shell for the 12-pr. B.L. of 7-cwt., which is now obsolete.

The shell, B.L., Shrapnel, 4-inch, Marks IV, V and VI are made of forged steel, and have the bursting charge contained in the head. 4-inch, Marks IV, V, and VI. §§ 5011, 5705, 5515, 9957.

Shell, B.L., Q.F., or Q.F.C., Shrapnel, Forged Steel.

Scale, ½.

4-inch Mark VI.



This shell has a body of forged steel tubing, head and body in one piece, and malleable cast-iron or mild steel base. A flanged gun-metal bush screws into the nose, and is tapped to the G.S. pitch and taper, being made long enough to take the short T. and P. fuze over the G.S. wad. A tin cup is placed inside the head to contain the bursting charge, the neck of the tin cup fitting over the lower portion § 9957. 4-inch, Mark VI. Description.

of the bush, and the space between the projecting portion of the latter and the tin cup is filled by a wood block. A felt disc is placed next the tin cup, then a wrought-iron one, which presses on top of the bullets and prevents the resin from working up. The body is lined with brown paper, and the bullets inserted from the base, molten resin being afterwards run in amongst them. The base is then lightly attached by six steel shearing pins and two steel keys, the latter fitting into undercut slots in the body and base. They prevent the base being twisted off, but do not oppose any resistance to a direct blow from the front. Rotation is imparted to it by means of the broad Vavasseur driving band, the groove for which is undercut. (*See* wood-cut.)

§ 5515. The Mark V differs from the above in having the groove for the driving band not undercut.

4-inch, Mark IV. §§ 5011, 5705. The 4-inch Mark IV shrapnel differs from the Mark V in having a cylindrical tin chamber in the head for the bursting charge; the latter is contained in a cylindrical red shalloon bag, which is first filled and then inserted in the shell choke downwards. There is only a wrought-iron disc over the bullets.

Action. The explosion of the bursting charge slightly checks the velocity of the bullets, and acting through them blows off the base of the shell. The body then slides over them like a glove, the bullets continuing their course with a velocity slightly reduced. It must be remembered that steel shrapnel are not intended to *burst*.

Paint. Shrapnel shell are painted black over the body, except the driving band, which is left unpainted. The tip for a depth of one inch is painted red. There is no distinguishing paint mark between steel and cast-iron shrapnel.

§ 8354. The 15-pr. B.L. shrapnel have lead-coloured bodies, and the fuze hole plugs are painted black, in order to readily distinguish them from the 12-pr. B.L. shrapnel, which they closely resemble in size. For other marks on shell *see* p. 295.

Issue. Filled or empty, loose, except 15-pr. and 12-pr., which are boxed. Those shrapnel having gas-check driving bands are fitted with rope grummets before issue.

Star shell. Star shell are at present used from the 5-inch, 5·4-inch and 6-inch B.L. howitzers. They are made on the same principle as shrapnel, that is, the head is lightly attached, and is blown off by the action of the bursting charge, the 10-pr. B.L. gun also fires a star shell.

5-inch B.L. howitzer. Star shell. §§ 9059, 9575, 9957. *Shell, B.L., Star, 5-inch Howitzer, Mark II.* The body is made of forged steel, with a small recess in the base for the bursting charge, which consists of 2 drams of R.F.G.^{2} powder, enclosed in a shalloon bag, through which two pieces of quick-match are threaded. The body is lacquered inside and lined with brown paper. (*See* Plate XXII.)

Above the burster is a wrought-iron, or mild steel, disc resting on a felt ring, which is placed on the shoulder at the bottom of the body. A wrought-iron pipe, with several holes, bored through it obliquely is screwed into the centre of the disc and is then soldered to it. There is a steel pin passing through the disc into the bottom of the body to prevent the disc turning inside the shell.

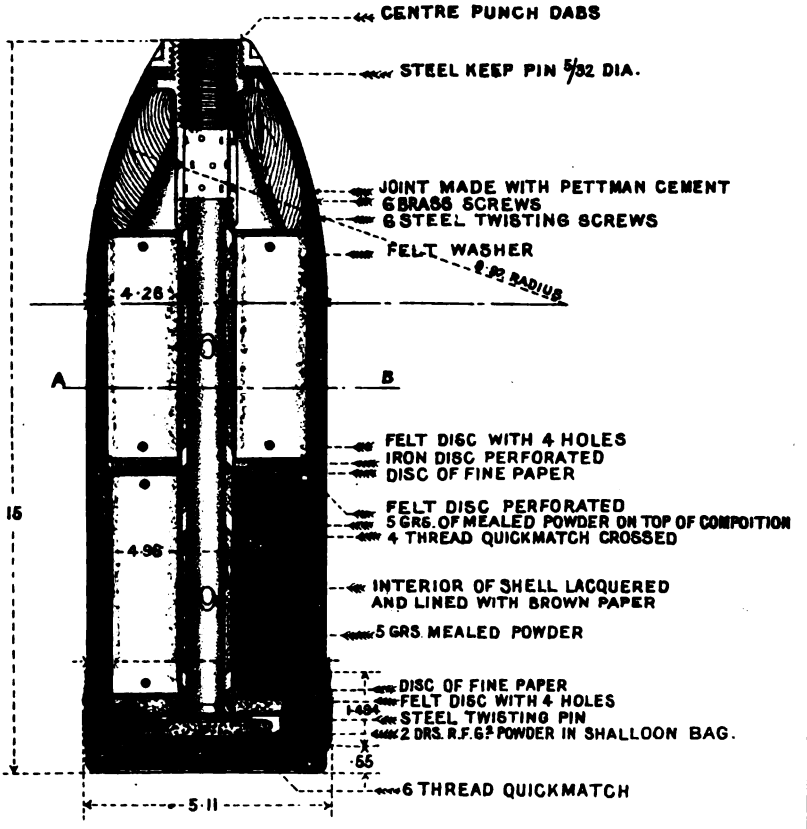
On the disc is placed a perforated felt disc, and on it four stars, forming the lower tier, rest. Between the stars are four wooden wedges which protect them from being crushed. Resting on these wedges is a wrought iron diaphragm, perforated and having a perforated felt disc on each side of it. On this is the second tier of four stars and wedges arranged like the lower tier, and above the

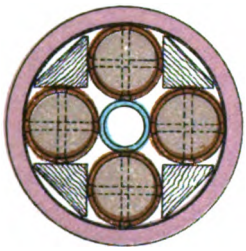
SHELL B.L. STAR 5 INCH HOWITZER MARK II |L|

FORGED STEEL

SCALE 1/4

LB. OZS.
MEAN TOTAL WEIGHT = 30 – 11





SECTION AT A.B.

E. Weller & Grahams. Ltd Litho. London.

stars is a felt washer. The head is made of wrought iron or mild steel and is lined with wood, recessed as shown in the plate. Into the head screws a gun-metal socket. This socket is flanged, and is screw-threaded on the outside above the flange, and on the inside at the top to the G.S. pitch and taper, and at the bottom to screw on to the top of the central wrought-iron pipe.

The socket is perforated with numerous holes to allow the flash from the fuze to reach the priming of the stars, and is screwed into the head from the inside, until the flange bears against the head. A steel keep pin prevents the socket unscrewing, and a gun-metal nut is then screwed on to it from the outside and forms the extreme nose of the shell. This nut is locked by four nicks or dabs in the metal of nut and socket.

The head is attached by six brass screws and six steel twisting pins, the ends of which are covered with solder. The joint between head and body is made secure by Pettman cement.

The shell is rotated by the broad Vavasseur driving band, pressed into an undercut groove near the base.

Stars.

The star consists of a rolled paper case, having four holes bored through it near each end. The star composition (*see* p. 552) is pressed into the case to within a short distance of the holes, which are then threaded with quick-match. Five grains of mealed powder are placed below the quick-match and more composition above it, nearly filling the case. Finally the ends are primed with a little mealed powder and closed by discs of fine paper.

Mark I differs from Mark II only in the groove for the driving band, which is not undercut.

5·4-inch.

The star shell for the B.L. 5·4-inch howitzer is similar, but contains ten stars instead of eight.

6-inch. § 10410.

Shell, B.L., Star, 6-inch Howitzer, Mark I, differs from the 5-inch star shell in the following particulars:—

The central tube is in two pieces, connected by a screwed gun-metal junction piece, which contains a primer of 70 grains R.F.G.^{2} powder.

The shell contains twelve stars in two tiers; six in a tier.

The charge to be used with this shell is the core only of the cartridge.

Paint.

Black all over except the driving band, which is not painted. The distinguishing mark is a white disc, upon which a red star is painted. Star shell will also have a red band, $1\frac{1}{2}$ inches from the point, and $\frac{1}{2}$ inch wide, denoting filled, since these shell are filled in manufacture.

Issue.

Filled as above and boxed.

Fuze.

These shell take the middle sensitive time fuze.

Shell, B.L., star, 10-pr. B.L. Mark I. (*See* p. 230.)

Armour-piercing shot. §§ 5663, 5993, 6289, 7186, 8287, 8437, 8424, 8771, 8973, 9271, 9279, 9631, 9957, 10412, 10508.

Shot, B.L., Armour-piercing, are fired from B.L. guns 6-inch and upwards and also from the 6-inch Q.F. or Q.F.C.; and 5-inch B.L. for testing plates. They are for N.S. only.

These shot are made of steel, cast or forged, and the same latitude is allowed to the manufacturer as in the case of A.P. shell.

The weight, form of head, maximum length, diameter over bands, and size and shape of driving band are laid down, but the material, shape, size and position of core, and closing of the base are left to the discretion of the manufacturer. The base, however, must be closed by some form of screw plug having two slots to take a service key.

In form the shot resemble A.P. shell, but are shorter and the internal cavity considerably smaller. They are carefully hardened

and undergo, much the same tests as already mentioned for A.P. shell, such as keeping, and the hot and cold water test. The firing test is also similar, but the plates used are naturally thicker.

Each shot is stamped with a distinctive number on the base and on the base plug. Later shot have the groove for the driving band undercut, and this causes an advance in the numeral of the shot.

There is no hole in the side of these projectiles for lifting purposes, as it is desirable to keep the surface intact, but the 12-inch light has a hole in the base plug to take the "bolt-eye lifting."

§§ 6402, 6972. These shot will be brought up to the mean Service weight by inserting the required quantity of dust shot and sawdust. Shot so weighted will have the letter "W" stencilled in white on the head, and stamped on the base plug. Those up to weight will be filled with sawdust, except in case of projectiles on board ship, and will be similarly marked.

Issue. They are issued loose, and have protectors fitted over the points to prevent injury in transit (*see* p. 362).

Paint. The body is painted black and the tip white (denoting shot), with a white band (denoting steel), ½ inch wide and 1 inch below the white tip.

Palliser shot. §§ 5738, 5837, 5992, 4968, 5032, 10508. *Shot, B.L., Palliser*, have been made for B.L. guns, 16·25-inch to 4-inch inclusive.

Construction. These projectiles have an interior cavity closed by a cast-iron plug permanently fastened in with lead (*see* cut), which is poured when molten into an annular recess round the base plug, whence four channels conduct it to a wide ring, cut partly in the metal of the shell and partly in that of the base plug, situated at about half the length of the latter from the base of the shot.

A soft iron bush is cast into the shot at the base of the core in order to form a sound seating for the plug. Some of the earlier supplies were manufactured without this bush.

This construction is considerably more economical than that of the shell. Shot of 8-inch calibre and upwards are cast with bands, and have the lifting-hole.

As the metal of the shot is so very hard, it is necessary to cast a soft iron bush into the side of the shot and the screw-thread is tapped in this.

Exceptional shot. The 16·25-inch B.L. Palliser shot has the interior cavity lacquered, the base being closed in a similar manner to the old pattern shell.

§§ 5838, 6919, 6273. For economy in manufacture, the 6-inch B.L. Palliser shot Mark V and VIII, the 5-inch Mark II, and 4-inch Mark II, are cast practically solid, a soft iron core being employed instead of the ordinary sand core used with other natures.

All B.L. Palliser shot have the broad Vavasseur driving band, or driving band with gas-check.

Paint. Palliser shot are painted black all over except the tip, which is white, and the driving band, which is left unpainted.

Bags, jute. §§ 5046, 5818. Jute bags for protecting the points of Palliser projectiles have been approved for B.L. 4-inch and upwards.

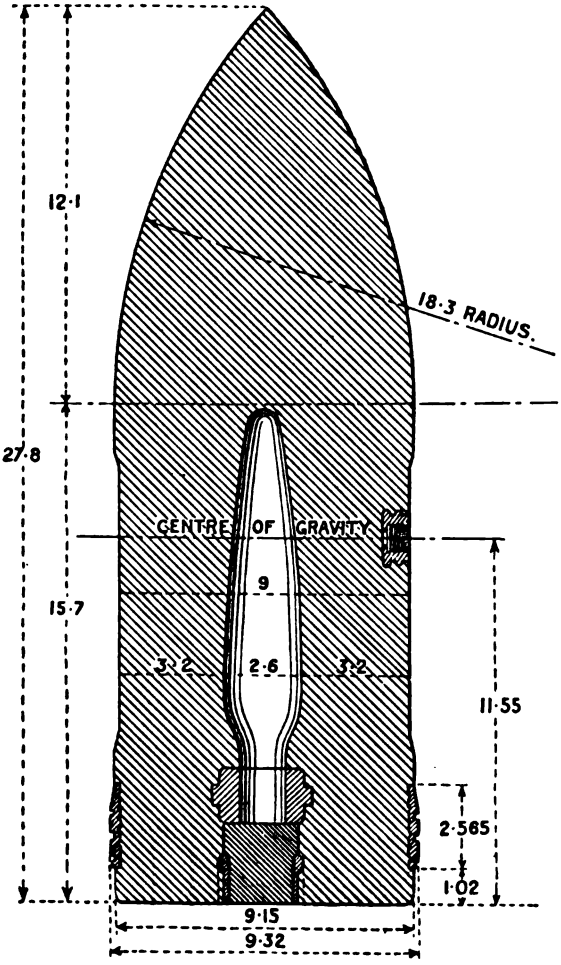
Issue. Loose, in jute bags.

Palliser shell altered to shot. §§ 4839, 4947, 4475, 4540, 4474, 4573, 4226, 5065, 4140. *Shell, B.L., Palliser, O.P.*, have been made for the 12-inch, 9·2-inch, 8-inch, and 6-inch, but the manufacture of these projectiles has been stopped, and those existing in store are to be emptied of the bursting charge and weighted up with sand, the designation altered from shell to shot, and the tip painted white. Shell so altered will be distinguished by having the letter "W" stencilled in white on the

Shot, B.L., Palliser, 9·2-inch, Mark IV, | C | .

Scale, $\frac{1}{8}$.

Average total weight = 380 lb.



(*Note.—Mark V Palliser Shot is fitted with new Driving Band.*)

head, and stamped on the base plug. Those shell in charge of R.A. or R.N. will retain the designation shell until emptied. The bases of these projectiles are closed by a gun-metal plug, with a left-handed screw working in a bush of soft cast iron, which is cast into the harder metal of the shell. The junction between this bush and the metal of the shell is sealed by a lead ring hammered into a recess formed in the casting.

In shell below the 8-inch this lead ring is not necessary, as the juncture of bush and body is covered by the lead disc.

They are issued loose in jute bags.

After this a new pattern of Palliser shell was reintroduced, for naval service, for B.L. or Q.F. guns, 4-inch to 16·25, differing from

Issue.
§§ 8438, 8439, 8714, 8694,

8695, 9280, 9281, 9316, 9398.

the old pattern in being fitted to take a base fuze. Owing, however, to the difficulty of sealing the shell perfectly against the ingress of powder gas, these shell have since been declared obsolete for future manufacture and are now ordered to be emptied and not to be fired as shell. They will be used up at practice.

Paint.

Black all over except the driving band, which is unpainted.

B.L. Case Shot.

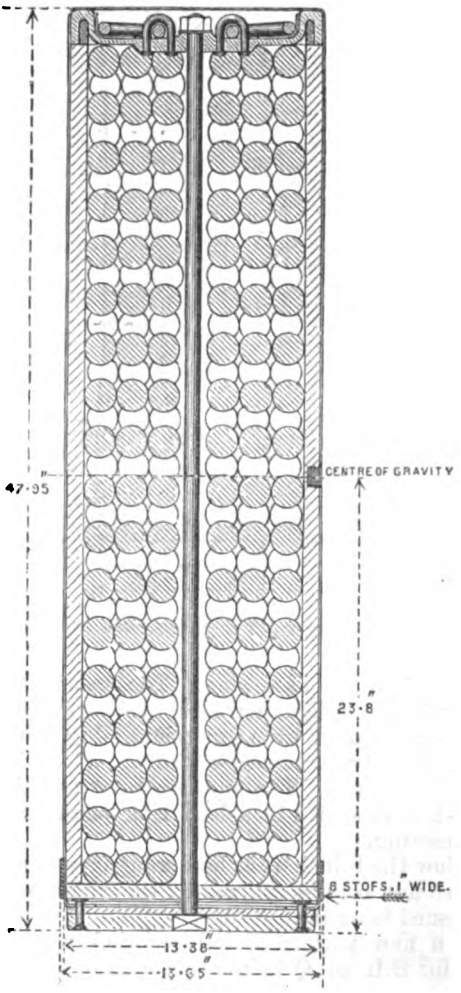
Case shot. §§ 4574, 4653, 4523, 4792, 4228, 4140, 4376, 4265, 5146, 6497, 8234.

Shot, B.L., Case, are made for all calibres of B.L. ordnance, except 16·25-inch. They are, however, only employed in the L.S., case shot of all calibres (except 12-pr. Q.F.) being obsolete for Naval purposes.

B.L. case shot may be divided into three principal classes, which run into one another, more or less. A specimen of each class will be first described, and individual peculiarities afterwards mentioned.

Shot, B.L., Case, 13·5-*inch*.

Scale, $\frac{1}{10}$.



13·5-inch. Description.

The case shot for the 13·5-inch is made of tinned sheet iron, ·072-inch thick, in three pieces, fastened by longitudinal rows of rivets. At the bottom it is fringed, and turned in and riveted to a disc of sheet iron of the same thickness.

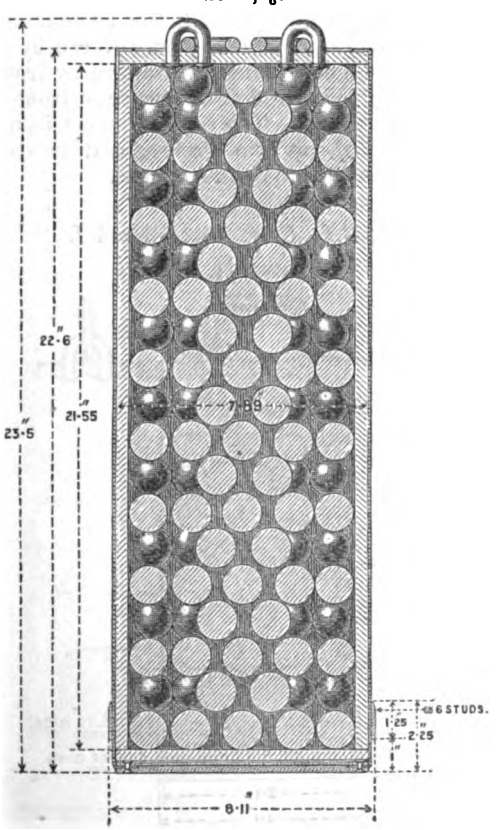
Through the centre of the case shot passes a wrought-iron stay-bolt, ·75-inch diameter, fastened by a nut and washer at the top, and prevented from turning round by a square head fitted into a similarly-shaped hole in a circular plate, ·75-inch thick, above this plate is another disc of W.I., ·34-inch thick, and both discs are riveted to the bottom. The top is of cast-iron lined with wood, and is recessed for two rings by which the shot is lifted, and which are retained in their recesses when not required for use by springs. The stay-bolt passes through the top, and is secured outside it.

On the exterior of the case, and close to the base, are eight stops of soft metal (lead and antimony) 3·5 inches long and 1 inch wide, bevelled off in front, to prevent the shot being rammed too far down the bore.

In common with all projectiles for the 8-inch B.L. and higher calibres, there is a lifting-hole for the eye-bolt in line with the centre of gravity, which in this case is bored and tapped through the exterior into one of the loose segments. Inside there is a loose base

Shot, B.L., Case, 8-inch, Mark I.

Scale, $\frac{1}{3}$.



disc; through a hole in the centre of which passes the stay-bolt, and eight loose segments of the same thickness (·75-inch) line the sides. The contents are 1,415 8-oz. sand shot packed in clay and sand. Case of this type are made for 9·2-inch and upwards, except 16·25-inch.

8-inch. §§ 4523, 4792.

The case shot for the 8-inch gun somewhat resembles in construction that for the R.M.L. gun of the same calibre, but it is longer and consequently contains more sand shot, and the bottom is made stronger.

The body is of tinned iron in one piece, fastened longitudinally by rivets, and is fringed and turned in at the top and bottom. At the latter end it is riveted to two discs of sheet iron, one on each side of the fringe. On the exterior are six soft metal studs to prevent the shot being rammed too far down the bore.

Inside is a loose wrought-iron base disc, ·375-inch thick, and six segmental linings of wrought-iron ·437-inch thick.

The top is a disc of tinned sheet iron, ·375-inch thick, fastened in by the fringing and soldering of the outer case. In it are fastened four staples bent round to form iron loops, riveted inside, into which fit the two handles, as shown in the cut. Mark I has no lifting-hole, Mark II has; and, as there is not sufficient thickness in the segment, an extra piece of metal is riveted on inside one of the segments.

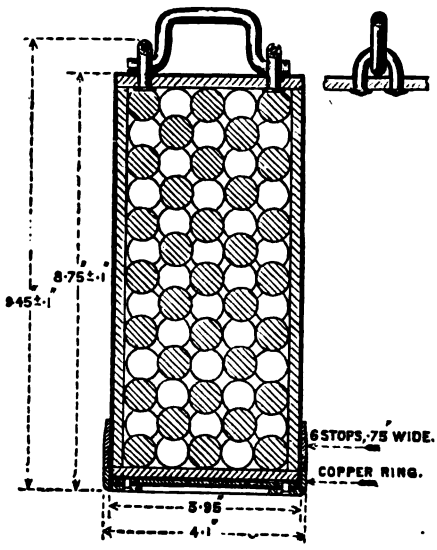
The contents are 468 4-oz. sand shot, packed in clay and sand.

4-inch. § 4265.

Shot, B.L., Case, 4-inch.—The body is of tin, in three longitudinal pieces, lap-jointed and soldered, the bottom is of the same tin, fastened in the same way, and is part covered by a copper ring of the form shown in the cut, which is attached by iron rivets. Six studs of soft metal are fixed round the exterior in front of the copper ring to act as stops in loading. The top is of sheet iron tinned, fitted with one handle attached by two staples, and is secured by the fringed end being bent over on it and soldered.

Shot, B.L., Case, 4-inch, Mark I.

Scale, ¼.



Inside the case there is a loose disc, and three segments ·22-inch thick, and 245 mixed metal balls, 16½ to the lb.

Shot, B.L., Case, 30-pr., Mark I, L., is identical with the above in construction, but it contains 300 mixed metal balls, 16½ to the lb.

A new construction for case shot, designed to ensure breaking up on leaving the gun, has been adopted for the 12 and 15-pr. guns, and 5-inch and 5·4-inch B.L. howitzers. The same shot is for use with the 12-pr. B.L. or Q.F. and 15-pr. B.L.; it is used with the 12-pr. Q.F. in the N.S. also.

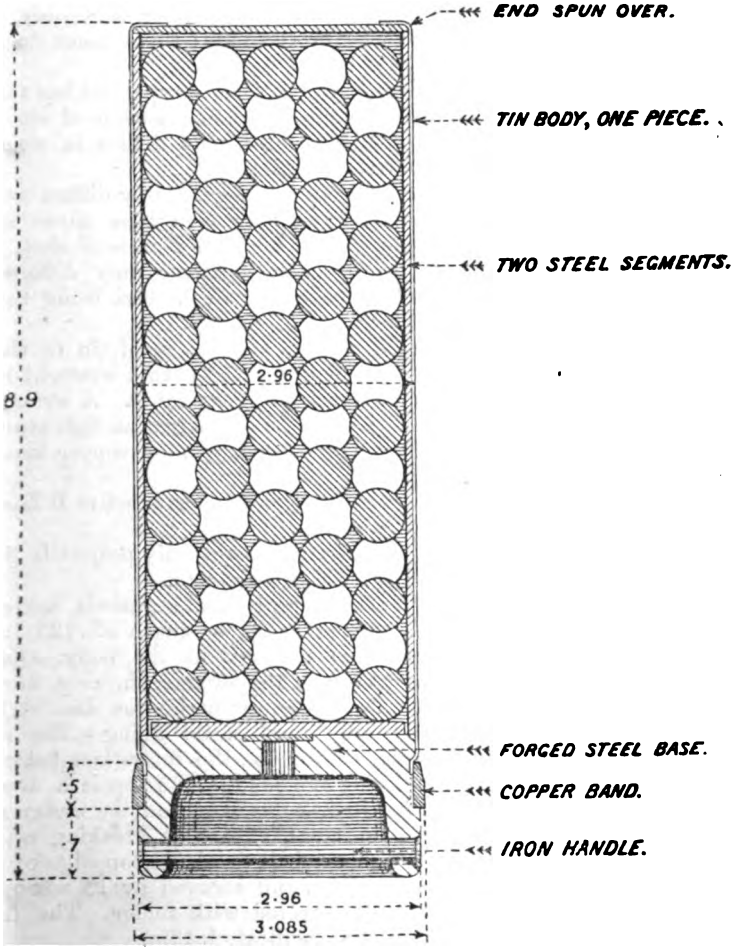
Shot, B.L. or Q.F., case, 15-pr. and 12-pr., Mark V, has a body of tin in one piece, lap-jointed and soldered. The base is of forged steel and is secured to the body by the bottom of the latter being pressed into a recess for, and being held by, a copper band. The bottom of the recess is milled. The base is recessed and is fitted with a straight wrought-iron handle. A small hole is bored through

Description. §§ 9456, 9815.

Shot, B.L. or Q.F., Case, 15-pr. and 12-pr., Mark V, | *C* | .

Scale, ¼.

Average total weight = 13 lb. 4 oz.
290 mixed metal balls, 34 per lb. = 8 lb. 9 oz.



the bottom of the recess and is closed on the inside by a thin wrought-iron disc soldered into a shallow recess. Inside the body are two steel segments, and between them, resting loosely upon the base, is a wrought-iron or mild steel disc. The body contains mixed metal balls (34 per lb.), the interstices being filled with clay and sand. The top is closed by a mild steel disc, over which the body is spun and lightly soldered. (*See* cut.)

Action.] On firing the band takes the rifling and seals the bore; the gas rushes through the hole in the base, forcing out the soldered disc, and acting upon the loose disc and the bullets, breaks the body away from the base, thus ensuring the release of the bullets before the shot leaves the bore of the gun.

§ 8736. The Mark IV differs from the above in the base being attached to the body by a coarse left-handed screw-thread and light soldering. There is no hole through the base, and the handle is not straight across but projects slightly to the rear. The base has a narrow copper band as in Mark V.

The base of this shot is intended to unscrew itself from the body as the shot passes up the bore of the gun, the rotation of the base effecting this.

§ 10283. Mark IV has been converted to Mark IV*, for N.S. only, by having two weakening holes bored in the base; these holes do not pass quite through.

§§ 8107, 8235. The Mark III is like the ordinary field service type, but has three corrugations round it, and the segmental linings are made of zinc.

Shot, B.L., case, 10-*pr. B.L. Mark I | L |* only differs in weight and dimensions from 12-pr. and 15-pr. Mark V.

§ 9515. The *Shot, B.L., Case,* 5-*inch howitzer, Mark II,* only differs from the Mark V 12-pr. and 15-pr. in having an iron base, three iron segmental linings, and in the contents, which are 2-oz. sand shot.

The Mark I case shot for 5·4-inch howitzer only differs in weight and dimensions from the above, and in the base being made of steel.

§ 8234. The *Shot, B.L., Case,* 5-*inch, howitzer, Mark I,* is of tin in three longitudinal pieces. The top is sheet iron fitted with a wrought-iron handle. It is lined with four wrought-iron segments. A wrought-iron disc is riveted on to form the base, and carries an iron stud in the centre, to which is attached a wooden block. A copper band is let into the wooden block.

Some 32-pr. smooth bore guns have been converted to B.L. and fire case shot for the defence of ditches.

Shot, S.B., B.L., Case, 32-*pr., Mark IV,* is the only projectile fired from these guns. Marks I, II and III are obsolete.

Mark IV. § 7258. The case is of sheet iron, in three longitudinal segments, soldered together. The bottom end is turned in for a length of ·125 inch. The bottom is a disc of the same material as the body, and is strengthened by a wrought-iron ring on the outside, the ring, flange, and disc being riveted together. A loose wrought-iron disc is laid resting on the bottom inside, but there is no lining. The case contains 730 mixed metal balls, 16 per lb., the interstices between which are filled with powdered clay and sand. The top is a disc of elm 2 inches thick, having 18 ·5-inch holes bored on the under side to a depth of 1·25 inch, to weaken it and ensure its breaking up; it is inserted in the case over the metal balls, and the top edge of the case, which is fringed, turned over it, and secured by 12 wrought-iron nails, the heads of which are covered with solder. The front end of the case is slightly tapered to facilitate loading.

There are three soft metal studs secured near the base to act as stops in ramming home.

The case shot for the 5-inch is of tin, and for the 6-inch of tinned sheet iron, in three pieces soldered together, and the bottom of sheet iron, protected by an exterior ring of the same material. §§ 4376, 4226. General remarks.

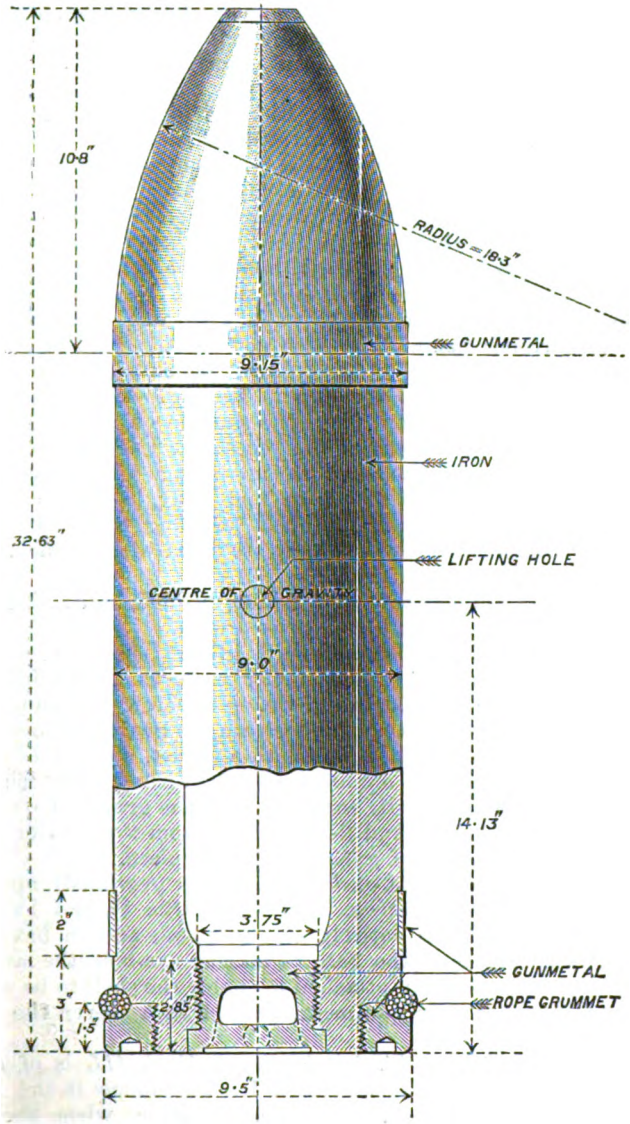
The 6-inch has six, and the 5-inch four loose segments.

Mixed metal bullets are employed up to the 5-inch, 4-oz. sand shot up to the 8-inch, above that 8-oz. sand shot.

With the 6-inch and under there is one handle; the 8-inch has two; the 9·2-inch and upwards two rings.

Shell, B.L., Drill, 9·2-inch, Mark I, Iron.

Scale, $\frac{1}{6}$. Total weight, 380 lb.



The central stay-bolt is used in the 9·2-inch, and all higher natures.

From the 5-inch to the 12-inch the top is of sheet iron, and not recessed; for the 13·5-inch it is of cast iron, with recesses for the rings to lie in.

From the 8-inch Mark II, and upwards, all have the hole for eye-bolt lifting.

Range. Case shot from the 9·2-inch B.L. gun is effective up to 1,100 yards; from field guns up to 300 yards.

Paint. Case shot are painted black, except the copper rings, which are unpainted.

Issue. Loose; except those for 5-inch B.L. howitzer and 15-pr. and 12-pr. B.L. guns.

Drill shell. §§ 6659, 9052, 9303. Drill shell are issued for B.L. guns and howitzers, and Q.F. guns up to and including the 13·5-inch, except for Horse or Field Artillery equipments, namely 12-pr. B.L. of 6 cwt. and 15-pr. B.L. guns and the 5-inch howitzer.

§§ 6659, 9052. *Shell, B.L. Drill*, 4-inch to 13·5-inch and 30-pr. guns, 5·4-inch and 6-inch howitzers have been approved.

They are all Mark I, except the 6-inch, of which there are Marks I II, III, and IV. These shells, except 6-inch Marks I and III, are made of cast iron of about the same dimensions and weight as the Service common shell, and are filled with sand and plugged. They are provided with two gun-metal bands, one near the base, the other at the shoulder. The bands are secured by being pressed into grooves prepared to receive them in the same manner as for the Service driving band. The base end of the shell is turned down and screwed to take a gun-metal ring, which projects over the side, and prevents injury to the gun in loading. The base is closed by a large gun-metal screw plug, the outside of which is recessed, a bridge being formed across the recess for the extractor to engage when withdrawing the shell in unloading. A groove is formed round the junction of the base and body to take a tarred rope grummet, which prevents the shell jamming when rammed home. From 9·2-inch and upwards they are fitted with a hole in the side to take the "bolt-eye, lifting."

In future manufacture of 9·2-inch, 10-inch, and 12-inch for L.S., the side lifting holes will be dispensed with.

§ 7491. When difficulty is experienced in the use of the 10-inch or 9·2-inch drill shell with the earlier patterns of loading tray, the following course will be taken, viz.:—Unscrew the gun-metal base ring of the shell one turn, well grease the grummet, and then carefully hammer it down all round with a mallet, until it is sufficiently reduced in diameter to admit of the shell being easily loaded. The base ring can be gradually screwed up as the grummet wears.

The 4-inch, 5-inch, and 6-inch differ from the heavier natures in having the base made of gun-metal in one piece.

6-inch, Marks I, II, and IV. §§ 6172, 6659, 7799. A *Shell, B.L., Drill, 6-inch, Mark I*, was previously approved for use in the L.S. It differs from the Marks II and IV described above, in being made entirely of gun-metal, and in having a hole bored in the centre of the base to take an eye-bolt, the latter having a lanyard of tarred rope attached to enable the shell to be withdrawn. Mark II had the rear gun-metal band 1 inch nearer the base than Mark IV.

§§ 7612, 8454. Mark III. The *Shell, B.L., Drill, 6-inch, Naval, Mark III*, is of gun-metal, and generally resembles the Mark I. The hollow in the base has a bayonet joint recess to receive the extractor, when the latter is

employed in withdrawing the projectile. It is weighted up to 100 lb. with lead ash, and is stamped with the letters B.L. on the body.

The drill shells for 4·7-inch Q.F., and 4-inch, 6-inch, Q.F. or Q.F.C. guns, differ from those in use with B.L. guns, in being made of wood, weighted with lead. The base has a gun-metal plate, and on the body are two bands, the front of copper, the rear of gun-metal; the latter, which is placed 1 inch from the base, is of sufficient diameter to prevent the shell being rammed too far. The base is fitted with a recess to take the T-extractor (see below).

In cases when the Mark II* shell for the 4·7-inch Q.F. has the rear band exceeding 1 inch in width, the front portion of the band will be reduced by being turned or filed until it is level with the body of the shell. § 8809.

The drill shell of these guns are:—4·7-inch Q.F. Marks II* and III; Q.F. or Q.F.C., 4-inch Marks I* and II; and 6-inch Marks I* and II. §§ 6509, 7834, 8154, 8459, 8809.

The drill shell for 12-pr. Q.F. are of gun-metal, tapped at the head with the G.S. fuze hole, and fitted with a recess at the base for the T-extractor. They are Marks I* and II. §§ 7931, 8459.

Extractors.

Extractor, Drill, Shell, No. 1, *Mark I*, consists of a wood stave, 5 feet long, grooved spirally at one end, and fitted at the other with a steel hook, which fits over the metal bar across the base plug of the drill shell. It is for use with B.L. 6-inch to 4-inch in the L.S. § 8453.

Extractor, Drill, Shell, No. 2, *Mark I*, is similar to the above, but the stave is 8 feet long, and the hook larger. For use with B.L. 8-inch to 13·5-inch (except 9·2-inch Mark IX on Mark III barbette carriage) in the L.S. § 8098.

Extractor, Drill, Shell, No. 3, *Mark I*, is similar to the above, but the stave is 13 feet 4 inches long. For use with B.L. 9·2-inch Mark IX on Mark III barbette carriage.

Extractor, Drill, Shell, No. 4, *Mark II*, consists of a steel bar, 3 feet 11·6 inches long, fitted with a T-shaped handle at one end and with a T-projection to fit the slot in the base of drill shells at the other. For use with Q.F. or Q.F.C. 6-inch to 4-inch and 6-inch B.L., all marks for N.S. and Mark VII for L.S. § 9503.

Mark I is shorter, being only 3 feet 7·6 inches long. It is not used with the B.L. 6-inch Mark VII. §§ 8454, 8628.

Extractor, Drill, Shell, No. 5, *Mark I*, is similar to the above, but only 2 feet long. For use with the Q.F. 12-pr. §§ 8454, 8628.

Shot, Paper, Empty, Marks I, II, III, IV, and V, have been sealed to govern manufacture. They are intended for use in land service, when specially ordered, in firing from guns from which, owing to their position, Service projectiles cannot be fired in time of peace. §§ 7542, 9341, 9452, 10330.

The shot are designed to cause the same amount of recoil as a Service projectile, and to break up in the bore of the gun.

The body is made of japanned papier-maché, Mark III and up, of wood pulp ·25 inch in thickness, and is filled with small shot and sawdust.

In the case of B.L. guns, 12-inch to 9·2-inch, the shot is made up as follows:—

				Weight, filled. lb.	oz.
12-inch front portion,	Mark V,	comprising six	$\frac{1}{7}$ charges,	127	8
12-inch rear ,,	,,	,,	one $\frac{1}{7}$ charge,	127	8
10-inch front ,,	Mark IV,	,,	three $\frac{1}{4}$ charges,	125	0
10-inch rear ,,	,,	,,	one $\frac{1}{4}$ charge,	125	0
9·2-inch front ,,	Mark V,	,,	three $\frac{1}{4}$ charges,	107	0

	Weight, filled. lb.	oz.
9·2-inch rear portion, Mark V, comprising one ¼ charge,	107	0
6-inch B.L. or Q.F., Marks I to IV	120	0
5-inch B.L., Mark I	60	0
4·7-inch Q.F., Marks I to III	45	0
4-inch B.L., Mark I	25	0

The "rear" shot has the body enlarged near the base, in order to prevent its being rammed too far in the gun, and to facilitate identification is marked "Rear": the Q.F. 4·7-inch and B.L. 6-inch shot also have the enlargement; the "front" B.L. shot being made cylindrical throughout.

The shot are issued empty: when required for use they are filled with a sufficient quantity of small shot (Nos. 1–5 waste) and sawdust, through a hole in the top, until they are of the required weight; the filling hole is then closed with a cork bung.

Shot of earlier patterns for the 9·2-inch to 12-inch were made in halves and quarters. They will be used up, but the number of portions per round will be in the proportions shown above, and each portion will be adjusted to the new weight by employing a larger quantity of sawdust to waste shot in filling.

Small supplies have been made of the Mark I pattern, which were made of brown paper, pasted and rolled to a thickness of from ·4 inch to ·45 inch (according to calibre), and were choked to an elm top and bottom, and filled through a hole in the top, closed by a wooden plug. In cases where the shot was made up of ½ and ¼ charges, the latter were fastened together in loading, by means of a loop on one being placed over the toggle of that in rear.

§ 9961. Paper shot are only to be fired with powder charges and the words "*not to be fired with cordite*" will be stencilled on them in white paint, in letters 1-inch high. Existing paper shot will be so marked locally.

Shell, B.L., star, 10-pr., Mark I (*see* p. 219).—The body is of F.S., with a small recess in the base for a bursting charge of one dram R.F.G.$_2$ in a shalloon bag primed with quickmatch. The interior is lacquered and lined with brown paper. On a shoulder above the burster is placed a felt washer with a W. I. disc above, to prevent the disc turning there is a steel pin in the body which fits a hole in the disc. A perforated brass pipe screws into the disc, and on the inside of the pipe a perforated bridge is formed which supports a shalloon primer of about 15 drams R.F.G.$_2$. The primer is kept in position by copper wire passing over the top through holes in the pipe. The shell is filled with ten stars in two tiers separated by a perforated disc. Felt washers are placed at each end of the stars, and ten wood wedges slightly longer than the stars are put in parallel to them, five in each tier. Each star consists of a body of paper and thin sheet brass, and primed as in the 5-inch howitzer (*see* p. 219). The head is similar to the 5-inch howitzer star shell, and is secured in the same way, but the socket is not screwed to the head.

CHAPTER XIV.—GAS-CHECKS.

WHY INTRODUCED FOR R.M.L. GUNS.—MATERIAL.—ATTACHED GAS-CHECKS.—AUTOMATIC GAS-CHECKS.—SPECIAL GAS-CHECKS.

Soon after R.M.L. guns were introduced, it became apparent that a great evil had to be combated. This was, that the heavy charges used, and the consequent rush of gas along the bore, especially at that portion of it immediately over the seat of the shot, seriously eroded the steel tubes of the guns. Obviously this erosion shortened the lives of the guns, and though they could be rendered serviceable again, for a time, by turning them upside down, then re-venting them, and plugging up the old vent, this entailed much labour and expense, could only be done at Woolwich, and was at best only a palliative, not a cure.

A committee was appointed to investigate the question of adopting means for the prevention of scoring in the bores of heavy rifled M.L. guns. They examined into various proposals put forward, and made practical trials of those which appeared to be most promising. The question was somewhat complicated by the strong desire expressed by the Navy for an automatic gas-check, that is to say, a gas-check which could be rammed home unattached to the projectile, and which, by the pressure of the powder gas on firing, became attached.

The problem to be solved was to obtain a gas-check, suitable to existing projectiles, which should have a simple means of attachment to the projectile (automatic, if possible), should thoroughly answer the requirements expressed by its name, and should remain firmly attached to the projectile during flight, without breaking up or stripping.

At this time, though some automatic gas-checks gave good results, yet no thoroughly satisfactory gas-check of this type was found, and attached gas-checks were introduced into the Service for heavy R.M.L. guns. There was a gas-check previously introduced for the 6·3-inch howitzer common shell which was of a different type; but this was, and is, the only one of its kind. It will be described below.

Numerous experiments had shown that copper, to which about 3 per cent. of zinc had been added for convenience of casting, was by far the best material for gas-checks, being the least liable to break up. Freedom from this fault is obviously most important, as guns may often have to fire over their own troops, and hence no gas-check which is liable to throw off fragments, or to become bodily detached in flight, is admissible for Service purposes.

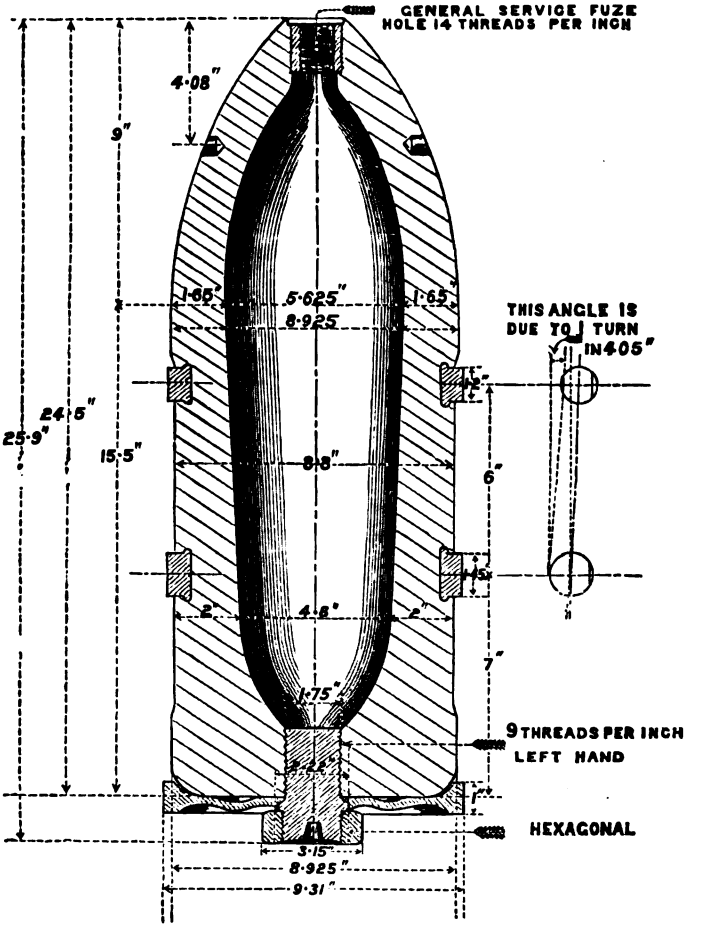
Gas-checks were found not only to answer the purpose of stopping to a great extent, if not wholly, the erosion in the bore of guns, but also to increase both the range and accuracy of the guns.

Gas-checks for Studded Projectiles.

All studded common shell and Palliser projectiles, 9-inch and up, are issued with gas-checks.

The only heavy studded shrapnel that takes a gas-check is the 12·5-inch. In the other natures the base of the shell is rounded off at a different radius from that of the common and Palliser projectiles, and consequently it will not take the same gas-check; and it has not been considered necessary to introduce special ones for shrapnel only.

It was found that the attached gas-checks, Mark I (now obsolete), which had no projections, gave good shooting, and imparted rotation to studless projectiles, but experiments in this direction were not continued, as the question of the introduction of gas-checks having projections to fit the grooves of the gun was under discussion. The addition of ribs to gas-checks was necessitated by the introduction into the Service of slower burning powders than R.L.G., with which the early experiments with gas-checks were carried out. The rapid action of R.L.G. powder expanded the smooth gas-check into the grooves of the gun almost instantaneously. With slower burning



powders, such as P. and P.², the expansion of the gas-check is more gradual, and its action not so regular. A certain quantity of gas passes the gas-check, and scoring is thus not prevented.

It is to be remembered that an attached gas-check, with projections to fit the grooves of a gun with increasing twist of rifling, must be capable of revolving independently to a certain extent, or the projections will jam when the projectile is rammed home.

Mark II. §§ 3799, 3813, 3863.

The Service gas-check now manufactured for studded projectiles for guns of 9-inch calibre and upwards is the Mark II.

It consists of a flanged copper disc of the same diameter as the shell, and has projections on the rim. It is slightly convex to the rear, so that the pressure of the powder gas flattens it on firing, and so helps to expand the metal of the flange into the grooves and against the lands of the gun, thus sealing the windage (*see* cut).

Plug.

The *Plug Gas-check, Mark II*, is shown in the cut above, where it will be seen that the Mark II has a shoulder. This shoulder prevents the nut from binding the gas-check on to the shell, and allows independent rotation for the reasons mentioned previously.

Nut.

The *Mark II Nut* is not required to screw down home on the shell, but only on to the shoulder, to protect the plug when the shell is stored without the gas-check.

The gas-checks, plugs, and nuts, respectively of Mark II can be used only with the other articles named bearing the same numeral.

§ 4689.

There is a special wrought-iron plug for gas-checks used in lieu of the metal plug for 9-inch Palliser shot, Marks III and IV. This is on account of the small size of the original bush in the base. The head is of the same dimension as that of the metal plug, and it takes the same nut.

Palliser projectiles.

All Palliser shot and shell existing on the date of the introduction of Mark I gas-checks (September, 1878) were ordered to be altered to take gas-checks. The alteration consists in enlarging the plug hole in the base, and tapping it with a left-handed thread, to take the gun-metal gas-check plug in lieu of the old base plug with a right-handed thread of the same pitch, nine threads to the inch. The 9-inch Palliser shot, Marks III and IV, are tapped to take the special wrought-iron plug mentioned above.

All projectiles so altered are marked with a * in addition to the original numeral.

Certain Palliser projectiles cannot be so altered, and are ordered to be broken up. They are as follows:—

Shell, Palliser ..	9-inch, Marks I and II..	Because they have flat bases.
Shot, Palliser	9-inch, Marks I and II 10 „ Mark I 12 „ „ I	Because they have no screw plug in the base, and are chilled all over.

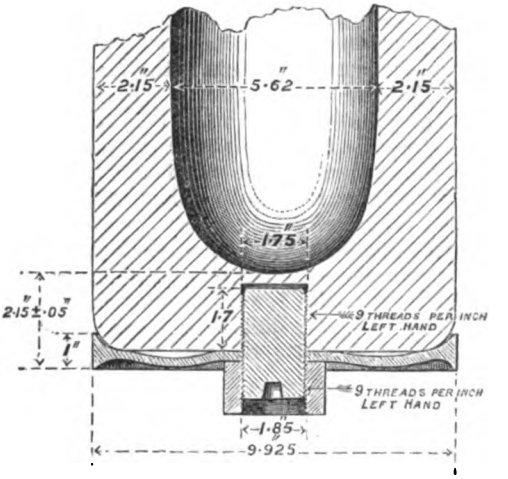
All Palliser projectiles, 9-inch and up, made since the introduction of gas-checks, have been cast so as to take the gas-check fittings, and differ from the projectiles of previous patterns in having a larger bush cast in the base.

At the same time the existing stock of 10-inch, 11-inch, and 12-inch (25 tons and 35 tons) common shell were ordered to be altered to take gas-checks.

Shells so altered are not to be fired with full charges.

The alteration (*see* cut, which represents a 10-inch Mark II* common shell) consists in boring and tapping a hole in the base to take the "plug, metal, for gas-checks," the hole is not bored com-

pletely through. The cut shows Mark I gas-check, plug, and nut. A shell so altered would, however, equally well take a Mark II gas-check and fittings, but all altered shell which are distinguished by a * after the numeral require shorter plugs than those of the latest pattern.



§ 4759. It is therefore ordered that in all demands for such plugs, the distinguishing mark of the shell for which they are required (I, I*, II, II*, or as the case may be) should be specified after the proper vocabulary designation of the shells.

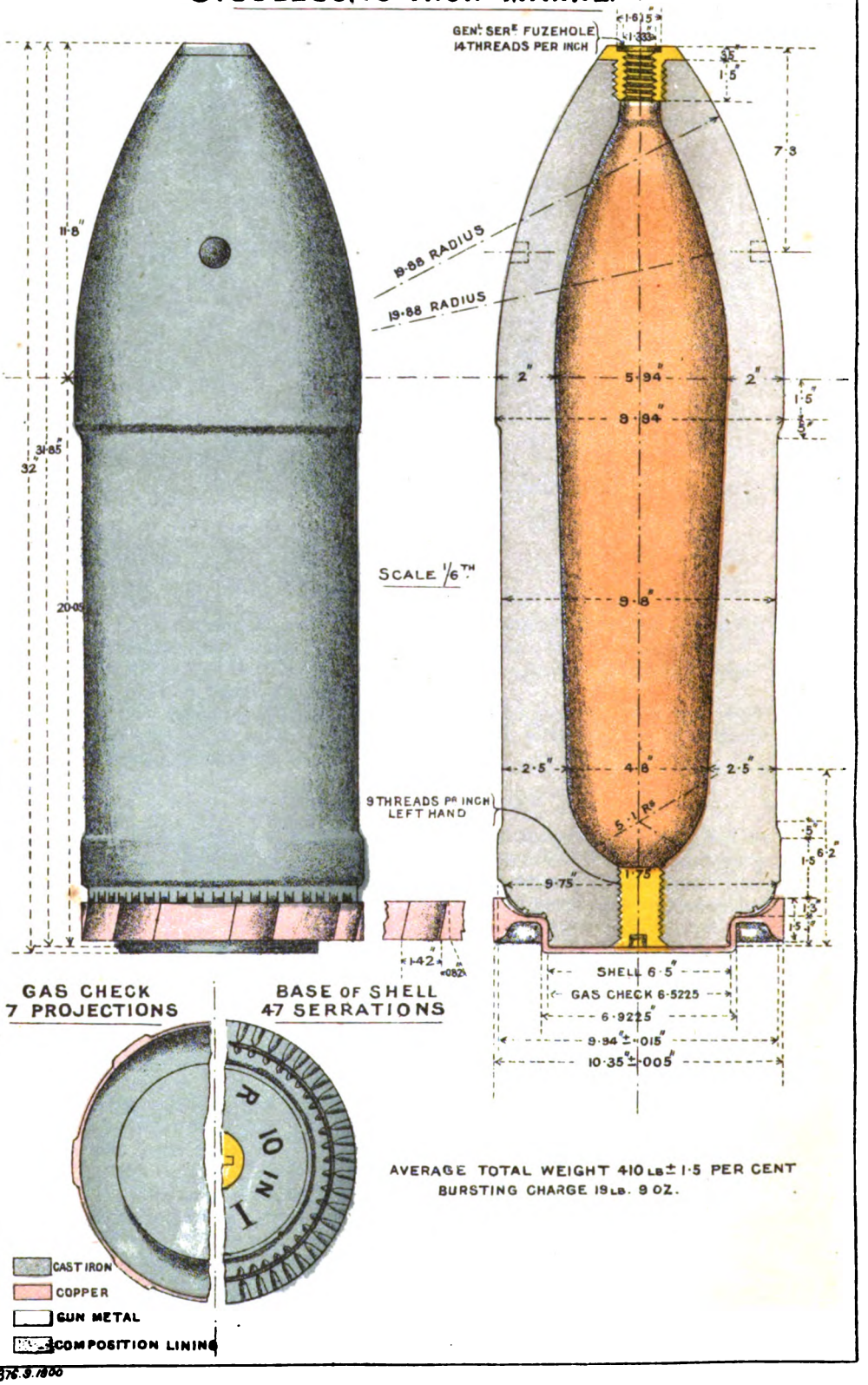
All common studded shell, 9-inch and upwards, made new since the introduction of gas-checks, are cast with a hole completely through the base.

Automatic Gas-checks.

During the competitive trials of various gas-checks applied to studded projectiles, some shell designed by Sir William Armstrong and Co. were fired. These projectiles differed from those then supplied to the Service in having no studs, rotation being imparted to the projectile by means of a gas-check, which received its own rotation from projections on its edge fitting into the grooves of a Woolwich gun, and communicated it to the projectile by biting into undercut flutings on the rounded edge of the base of the shell. For this cause it was at first called a "rotating" gas-check. But it is also a truly automatic one, that is, it can be loaded separately from the projectile, and will firmly attach itself to the latter on discharge. Hence, as it would unnecessarily complicate the nomenclature to have two descriptive names, and the term automatic in some degree describes the action of the gas-check in transferring rotation from the grooves to the projectile, it has been decided to call them "Automatic" Gas-checks.

Advantages. It has been found that projectiles fitted with automatic gas-checks have considerably greater range and accuracy than studded projectiles not fitted with gas-checks, and that they compare favourably with them even when so fitted; then again, in the case of an armour-piercing projectile it is of great advantage to have no stud holes, which form lines of weakness in the shell, and tend to break it up.

SHELL RIFLED MUZZLE LOADING GUN COMMON. STUBLESS. 10 INCH MARK I.



AVERAGE TOTAL WEIGHT 410 LB ± 1·5 PER CENT
BURSTING CHARGE 19 LB. 9 OZ.

876.3.1800

For these reasons studless projectiles have been adopted for many of our R.M.L. guns. These comprise common and shrapnel shell and Palliser projectiles, all of which for the same gun are fired with the same automatic gas-checks, and which are now made of the following calibres :— §§ 4115, 4116, 4117, 9063.

R.M.L. Heavy, 9-inch to 17·72-inch, and 8-inch pointed common.
„ Medium, 80-pr. and 6·6-inch.
„ Howitzers, 6·6-inch, and 8-inch of 46 and 70 cwt.
„ Field and Mountain, 2·5-inch, and 13-pr.

Description. The gas-checks for the heavier natures (*see* Plate XXIII) extend completely over the base of the shell, and somewhat resemble soup plates, with rims or flanges about 1·5 inches deep, on which are projections to fit the grooves of the gun. For guns having the Woolwich rifling, these projections are cast and planed; for those rifled on the polygrooved system, the spaces for the lands are simply planed out of the continuous edge.

The base of the shell is prepared to receive this gas-check by having a projection on the base, round the edge of which there is an undercut groove. The edge of the base also is rounded, with a radius which varies with the calibre, but it is the same for all projectiles for the same gun, and on this rounded base are cast certain fluted projections with sharp edges somewhat resembling raised willow leaves. The heavier calibres have two grooves running round this part of the shell—one in the middle of the flutings, the other between them and the projection on the base. On the shock of discharge the soft copper of the gas-check is driven into these grooves and the spaces between the flutings, &c., and thus securely attaches itself to the shell, to which at the same time it communicates its own rotation.

16-inch and 17·72-inch. §§ 4115, 4374. The gas-checks for the 16-inch and 17·72-inch guns are similar to the above, but the rim is strengthened by projections opposite the spaces for the lands of the gun, which partially occupy the painted side between the rim and the crown.

Mark II. §§ 5062, 5862. It has been found that, if the inside of the projection which fills the grooves be hollowed out at the back, there is not only a slight easing of metal, but the rim expands more readily, and seals the windage more securely. Automatic gas-checks of this pattern will be known as Mark II, for the following ordnance :—12·5-inch to 9-inch R.M.L. guns, 8-inch howitzer of 70 cwt., and 6·6-inch gun and howitzer.

§§ 5862, 8691, 8733. The automatic gas-checks for the 8-inch howitzer of 46 cwt., 8-inch gun, for pointed common and 9-inch and 10-inch polygrooved guns (on high angle mountings) although constructed similar to the Mark II described above, are Mark I, no gas-checks of the original pattern having been made for these pieces.

§ 8733. The Mark II gas-check, for the 9-inch high angle gun, has a hole 1¼ inches in diameter bored through the centre in order to ensure that the base fuze is set in action.

(NOTE.—The 9-inch high angle gun fires a "heavy" projectile which is pointed and takes the large base fuze.)

Mark I gas-checks can be altered locally by having the hole bored through them, and will then be known as Mark I*.

§§ 5948, 6060. The gas-checks for the 8-inch R.M.L. howitzer of 70 cwt. have been altered by having eight fire holes ·15-inch diameter drilled through the rim, to facilitate the ignition of the wood time fuze.

80-pr. § 4723. The studless projectiles for the 80-pr. R.M.L. take an automatic

gas-check with projections to fill the three grooves of the gun which are connected with the crown of the gas-check on the painted side by strengthening ribs which form part of the casting.

Attachment.

All automatic gas-checks may be loaded independently of the projectile, the painted side being next the charge, and may be depended on not to come off during the flight of the shell, though they almost invariably become detached on graze; but should it be required to draw the charge without firing the gun, it will be found very difficult to extract the gas-check. For this reason they are usually lightly attached, by "nicking" the copper in the edge of the crown into the groove round the projection on the shell with a cold chisel, sharp-pointed hammer, or similar tool.

The gas-checks of the 9-inch and 10-inch gun on high angle mountings are always attached.

§§ 7048, 9345, 9980.

Instruments, Fixing Gas-checks, R.M.L., have been introduced for the 12·5-inch and 16-inch in the Naval Service, and 9-inch and 10-inch (on high angle mountings) in the Land Service.

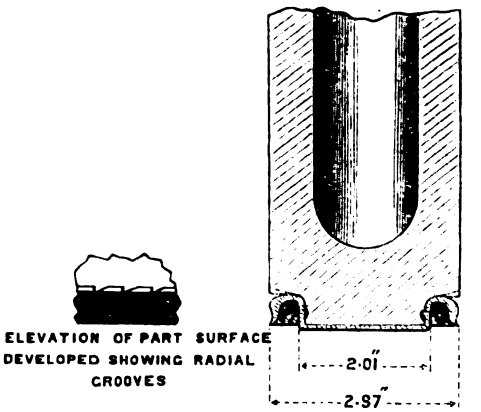
The instrument consists of a cylindrical steel plate, through the centre of which is a screw bolt, with a cross handle at the top and three claws or arms at the bottom. The instrument is placed on the gas-check and by turning the cross-handle the claws grip the gas-check and force it in below the locking rim on the projectile.

Automatic gas-checks for studded shell. §§ 4117, 4602.

It was at one time contemplated to use automatic gas-checks with studded shell, fitting the latter for their reception by attaching a wrought-iron disc, having a groove round its edge, to the shell by means of a gun-metal plug. But the expense of the alteration would have been great, and it was found on trying it that the attached disc and gas-check altered the position of the centre of gravity of the projectile sufficiently to spoil the shooting; so the idea was abandoned, and all studded shell continue to use the Mark II attached gas-check.

13-pr. and 2·5-inch. §§ 3800, 4060.

The gas-check for the 13-pr. and that of Mark I numeral for the 2·5-inch are also automatic, but differ from those above described in



having no projections to fit the grooves, and in the shape of the rim, which is not parallel to the bore of the gun, but formed with a lip, as shown in the cut. This assists the expansion of the rim, and at the same time facilitates its engaging the stop at the end of the rifling. The method by which rotation is imparted to the shell is somewhat different from that described for the heavier natures.

The base of the shell beyond the central projection is not rounded, but forms a nearly flat ring round which in the 13-pr. (shown in the cut) are 20 saw-shaped radial grooves into which the gas-check bites. In the 2·5-inch these grooves are replaced by 12 radial projections which perform the same office.

Issue.

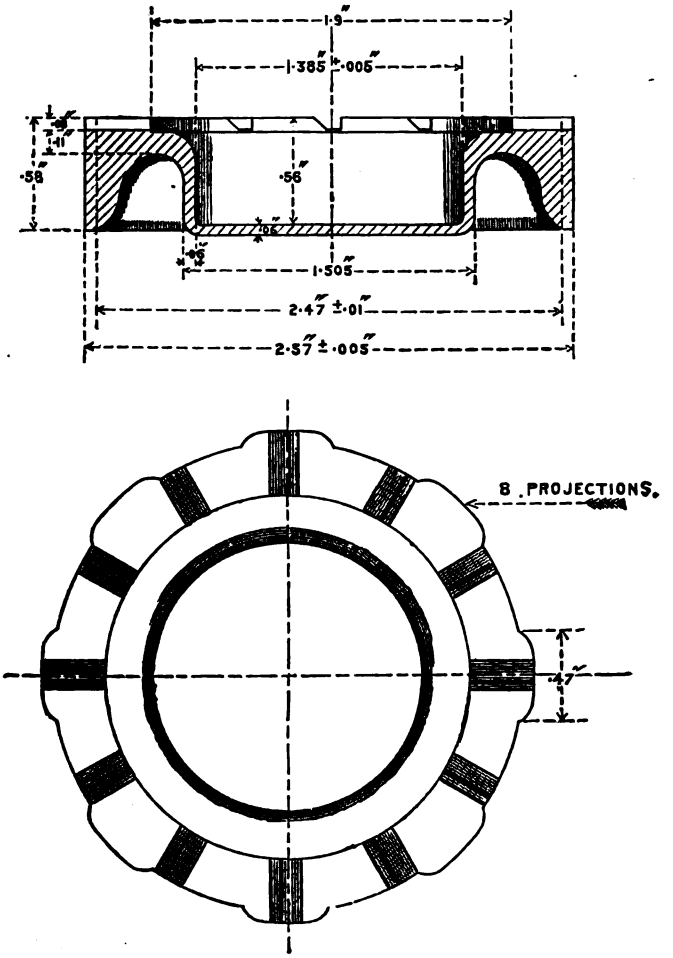
These gas-checks are issued permanently attached to the shell by being spun on; the gas-check is placed on the projection of the shell, and the two being made to revolve rapidly in a lathe a blunt wheel is brought up against the side of the crown so that the copper is pressed into the groove all round the projection on the base of the shell, and the two are firmly fixed together.

2·5-inch. Mark II. § 4807.

The gas-checks above described for the 2·5-inch gun answered very well when the charge of the gun was of R.L.G.^{2} powder for which they were introduced; but with the milder burning R.L.G.^{3} used in India they occasionally failed to take the rifling, and erratic shooting resulted. To remedy this an advanced numeral, Mark II (*see* cut),

Gas-Check, R.M.L., 2·5-inch, Mark II, Copper, Automatic.

Full size.



has been introduced which resembles the automatic gas-checks for larger calibres in having the rim parallel to the sides of the projectile, and in being provided with projections to fit the grooves. On the face of the gas-check, where it touches the ring round the base of the shell, are filed 12 grooves which fit over the corresponding radial projections on the shell. The rim is wider, and the gas-check generally stronger.

Issue. Like Mark I, this is issued with the shell to which it is permanently attached.

Grummets. Rope grummets are fixed to all Palliser studless projectiles (except the Mark II studless shell), and to the common and shrapnel shell, 12·5-inch and upwards, which take automatic gas-checks; they are to protect the rim of the base from being chipped during transit, and must be removed previous to loading.

Special Gas-checks.

8-inch howitzer of 46 cwt. § 3380. § 4014. The studded common shell of the 8-inch howitzer of 46 cwt. takes a fixed gas-check, marked 8-inch howitzer, 46 cwt.

It has four projections to fit the grooves of the piece, and has eight fire-holes bored through it close to the rim to allow of a passage of sufficient flash to ignite the R.M.L. time fuze, should one be used.

It is secured to the shell by a gun-metal plug, with hexagonal head. The same plug, except as regards length, serves for 8-inch and 6·3-inch howitzers.

Mark I, Common Shell, can be altered to take the gas-check, and when so altered (similarly to common shell for the heavy guns) is to be marked with a * in addition to original numeral.

Mark II, Common Shell, differs only in being cast with a hole through the base, which is fitted to take the plug.

40-pr. R.M.L. gun. § 3382. The gas-check for the 40-pr. R.M.L. gun is similar to the last described, having three projections to fit the grooves, and six fire-holes. It is attached to the shell by a hexagonal-headed plug, which was scaled for the 40-pr. and smaller natures, but no smaller attached gas-check has been introduced. As both the 40-pr. R.M.L. gun and the 8-inch howitzer, 46 cwt., have the uniform twist of rifling, there is no necessity to provide for the rotation of the gas-check on its plug; but before tightening the plug it is necessary to align the projections with the studs on the projectile.

Shrapnel taking gas-checks. The 40-pr. and the 12·5-inch are the only studded shrapnel that are fired with gas-checks.

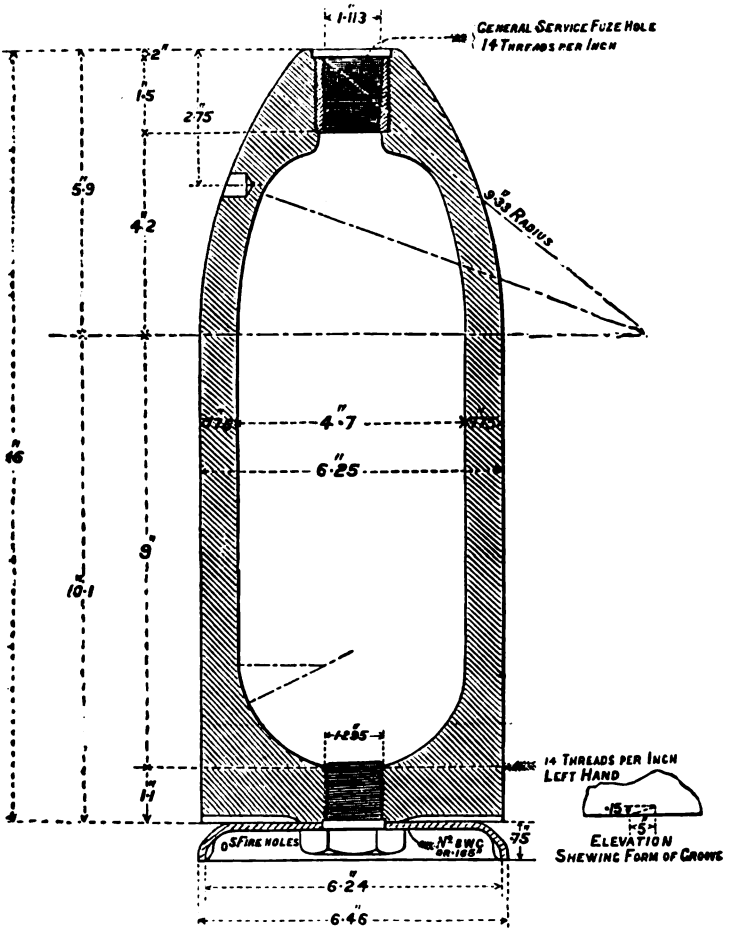
6·3-inch howitzer. § 3285. The 6·3-inch howitzer common and shrapnel shells take a saucer-shaped gas-check, with projections to fit the grooves of the piece.

The gas-check is stamped from sheet copper, and has projections on its convex side to fit into the radial grooves (eight in number) cast in base of shell. It has five fire-holes. The plug is of the same pattern as that for the 8-inch howitzer gas-check, differing in length only.

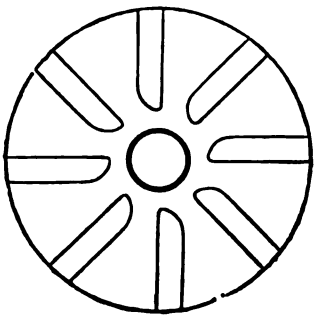
Action. On discharge the gas opens out the check and expands the edges well against the grooves and lands of the bore. The radial projections jam into the radial grooves on the base of the shell, which are slightly undercut, and thereby rotation is given to the shell, which is studless.

Paint. Gas-checks for the 6·3-inch howitzer, the 13-pr., and the 2·5-inch guns are issued unpainted. There can be no doubt as to the way in which the first should be attached; and the four

Shell, R.M.L., 6·3-inch Howitzer, Mark 1.



Plan of Base of Shell.



latter are issued fixed to the shell. All other gas-checks are painted black on one side and unpainted on the other. The painted side should always go next the charge.

Issue. All gas-checks, except those issued spun on to the base of the projectile, are issued separately packed in deal boxes, containing different numbers according to the nature.

The plugs and nuts are issued with the projectiles.

CHAPTER XV.—PROJECTILES FOR R.M.L. HEAVY GUNS (7-INCH AND UPWARDS).

COMMON SHELL.—DOUBLE SHELL.—SHRAPNEL SHELL.—PALLISER PROJECTILES.—CASE SHOT.

THE R.M.L. guns of 7-inch calibre and upwards consist of two classes as far as their rifling is concerned. The 17·72-inch, 16-inch, 10-inch, Mark III, and 9-inch, Mark VI, have the form of rifling known as the "modern polygroove," and fire only studless projectiles rotated by automatic gas-checks.

The other existing heavy guns, viz.:—12·5-inch, 12-inch of 35 tons, 12-inch of 25 tons, 11-inch, 10-inch, Marks I and II, 9-inch, Marks I to V, 8-inch, and 7-inch have the form of rifling known as the "Woolwich groove."

Of these the 7-inch fires studded projectiles only, and does not at present use any gas-checks; the remainder, from the 8-inch to 12·5-inch, inclusive, fire both studded and studless projectiles; the 8-inch studless are pointed common only; the remaining projectiles being studded. The studless are rotated by automatic gas-checks, the studded use the attached gas-check, Mark II, with their common and Palliser projectiles.

The 12·5-inch studded shrapnel takes the same gas-check as the common and Palliser.

The 12·5-inch, 12-inch, and 11-inch have nine, the 10-inch seven, the 9-inch six, the 8-inch four, and the 7-inch three grooves.

The number of studs in each ring on the projectile corresponds with the number of grooves, and it is generally possible to identify the nature of a projectile at once by this means.

The bottom of the groove is circular, but in no case is the bottom concentric with the bore of gun. Hence the studs of studded projectiles or the projections of gas-checks for use with these guns have to be planed after rough turning instead of being finished in the lathe.

All these guns, with the exception of the 7-inch gun, have increasing twist, the 7-inch gun has a uniform twist.

In all Woolwich guns, when firing studded projectiles, twist is given by the bearing of the studs on the grooves. Action of studs.

The studs are of an alloy almost identical with gun-metal. They are secured to the projectiles by being pressed into undercut holes, which are cast into the Palliser and cut in other projectiles. Material of studs. § 1980.

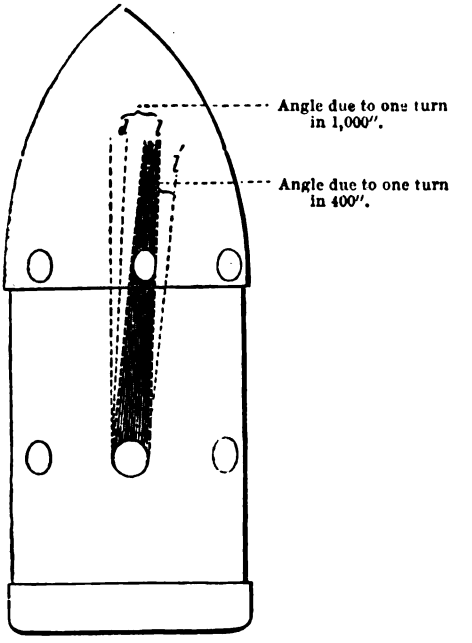
Those made before December, 1870, were of a harder alloy, while previous to April, 1867, they were screwed into the shells. The edges are circular, and are planed to fit the grooves. "Extracts," Vol. V, p. 153.

The front studs in all the Service projectiles project the same amount as the rear ones, so as to keep the axis of the projectile parallel to, although not mathematically coincident with, that of the bore. As to rotation, with a uniform twist the front studs exactly Front studs with

increasing twist.

resemble the rear ones, and both together drive the shot throughout its passage up the bore, but with the increasing spiral this is impossible, for the groove runs nearly longitudinally along the projectile at the bottom of the bore, while it crosses it at almost the angle due to the full rate of rotation before the front studs clear the grooves at the muzzle, hence it follows that there is only a very much narrower strip of the projectile that comes opposite to the groove in both its extreme positions, which are roughly shown in the annexed figure. The rear stud being of the dimensions given above, it will be seen that the front stud must be reduced to remain opposite to the groove in all positions, and it is therefore necessarily limited in its breadth to enable the shot to pass down the bore; for to enter the grooves d' l' at the muzzle the front stud must not extend to the left of the edge d', while to admit of being rammed home it must not extend to the right of the edge l. The exact breadth will, of course, vary with the circumstances of each case, and cannot therefore be laid down here.

Thus the front stud touches the driving edge d' on entering the bore, and the loading edge l, when well home; and the reverse action occurring in firing, the share it takes in the work of rotation is very small, for until the driving edge meets it, the whole pressure is on the rear stud; indeed it is only owing to the wear of the latter that the former comes in contact with the driving edge of the groove



before it reaches the muzzle, and it has even been doubted whether it actually does so, but an inspection of the front stud of recovered shot bears out the statement that a certain part of the work of rotation falls on it, although the chief use appears to be to steady the projectile.

§ 2490. Two rings of studs have not been found sufficient for the Palliser projectiles of the 12-inch (35-ton) gun, in some cases the front ring of studs was shorn off; this has been remedied by inserting a second

ring midway between the front and rear ring. It has also been found advisable to add a third ring of studs to the common shell for these guns, as two were found insufficient when full charges were used. The projectiles for the 12·5-inch gun also have three rings of studs. § 2557.

The longitudinal position of the studs is fixed as follows:—The centre of the rear stud is to be not less than 4 inches from the base of all projectiles. Longitudinal position of studs.

The front and rear studs are to be put at equal distances in front and rear of the centre of gravity of the projectile, except in the case of Palliser projectiles, and are to be the same distance apart on all projectiles for the same gun.

The bases of studded Palliser projectiles and common shells for all heavy guns are rounded off to a curve of 1 inch radius. Form of base § 1599. § 1765.

This was done before the introduction of gas-checks, in order to facilitate loading. The bases of shrapnel have different curves, as will be seen in details hereafter given.

The various projectiles for each calibre of gun are generally brought to the same weight (except case shot and double shell). It has not, however, been found practicable to do this in all cases. The 12-inch (25-ton) gun has an exceptionally slow twist, therefore a long projectile cannot be fired from it, hence the weights of the studded common and shrapnel shell are much less than those of the Palliser projectile.

The 12-inch (35-ton) gun has a twist as rapid as the majority of Woolwich guns, but even with this twist it would be impossible to lengthen the common shell or shrapnel, so as to bring them up to the weight of the Palliser projectiles, which are exceptionally heavy for a gun of that calibre. By reference to the table, p. 520, it will be seen that the common shell is nearly three calibres in length.

All projectiles cast since 1873 have the calibre of the gun marked on the base, being cast on studded, and cut on studless ones. In the case of those for the 12-inch, the weight of the gun is also given. Distinguishing marks.

Shell cast prior to 1873 are not thus marked, but they may be known by the number of studs in each ring, except in the 11-inch, 12-inch, and 12·5-inch, which have the same number of studs in each ring, but the 12·5-inch has three rings for all its shell, and the 12-inch (35 tons) three rings of studs for the common and Palliser, and only two for the shrapnel.

The 9-inch R.M.L. gun on high angle mounting fires a "heavy" pointed common shell, weighing 360 lb. In order to distinguish this projectile from those intended for 9-inch on ordinary mountings, which weigh only 256 lb., the former has the letter H stamped on the base, and all the latter have the letter L similarly stamped. § 9911.

It having been found that studs formed lines of weakness, and that studless projectiles gave better shooting, since 31st January, 1882, studless projectiles only have been made for R.M.L. guns of 9-inch calibre and upwards, the manufacture of studded projectiles for these natures having been discontinued. Studless projectiles.

In all heavy studless projectiles the head is struck with a radius of two diameters, and the shell is cast "with bands," that is, the diameter of the projectile over the greater part of the body is reduced ·14 inch, leaving a zone of metal 1·5 inches wide at the base, and another at the shoulder of the full diameter of the shell. Construction.

The base of these shell is of peculiar form, *see* Plate XXIII. Base.

Behind the rear band the diameter of the shell is reduced to that of the body, and then rounded off.

On this rounded part are raised flutings with sharp edges, into

which the soft metal of the gas-check is squeezed on the explosion of the charge, rotation being thus imparted to the shell. Two annular grooves intersect the raised flutings and assist the attachment of the gas-check, which is further secured by a flat projecting disc about 1 inch thick, which forms the base on which the projectile stands when point uppermost.

The extreme edge of this disc forms a "locking rim" projecting over the circular side, and thus forming a groove into which the side of the automatic gas-check is firmly wedged on the explosion of the charge.

The weights of all the Service projectiles are given in the tables, p. 520, *et seq.*

Service projectiles.

The Service projectiles for heavy R.M.L. guns are common, double, and shrapnel shell, and Palliser and case-shot.*

Common Shell.

Calibres.
§§ 1765, 2378, 3378, 3497.

Shell, R.M.L., Common, Studded, of cast iron, have been made for the following heavy guns, viz., 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, 9-inch, 8-inch, and 7-inch.

§§ 4115, 4116, 4141, 4374, 4962.

Shell, R.M.L., Common, Studless, of cast iron, are made for the 17·72-inch, 16-inch, 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, and 9-inch.

§§ 5537, 7287, 7520, 8563.

Shell, R.M.L., Common, Studless, cast steel, are made for 9-inch, 10-inch, 11-inch, 12-inch (25 tons), 12·5-inch, 16-inch, and 17·72-inch R.M.L. guns.

§§ 7287, 7426, 7979.

§ 8576.

Shell, R.M.L., Common, Studless, pointed, cast steel, are made for 16-inch, 9-inch heavy, 8-inch, 9-inch, 10-inch, 11-inch, 12-inch (25 tons), and 12·5-inch.

§§ 8465, 8770, 9393.

Shell, R.M.L., Lyddite, Common, Studless, 10-inch Mark I, is of forged steel.

It is similar in construction to the B.L. lyddite shell, but has the base prepared to take the automatic gas-check.

§ 9726.

Shell, R.M.L., Common, 10-inch high angle, iron, is for practice, and takes a bursting charge. This shell is of cast iron and differs from other studless common in having the base closed by a steel plug, screwed in and riveted.

Construction.

The studded shell are about 3 calibres long, except that for the 12-inch (25-ton) gun, which is 2½ calibres long, for the reason given above, and are mostly without "bands." Their heads are ogival, struck with a radius of 1½ calibres, with flattened points for the insertion of the fuze. There are two extractor holes in the head of all these shell.

They are provided with a gun-metal bush, which is a short section of pipe without flange, screwed into the shell and itself tapped to the G.S. gauge to receive the fuze; and there is a countersink ·2 inch deep at the top of the fuze hole to receive the Naval wad. A few shell of early manufacture have this countersink only ·1 inch deep, and though perfectly good for L.S. must not be issued to the N.S.

All these shell made between March, 1869, and February, 1873, have unloading holes in the head closed with gun-metal screw plugs and papier-maché wads. These holes were for use in unloading the shell when it was found difficult to extract the plug, but experience showed that they were very rarely used, and they have been discontinued.

* The 7-inch gun of 90 cwt. (N.S.) is not to fire Palliser projectiles or double shell except when mounted on carriages with hydraulic buffers.

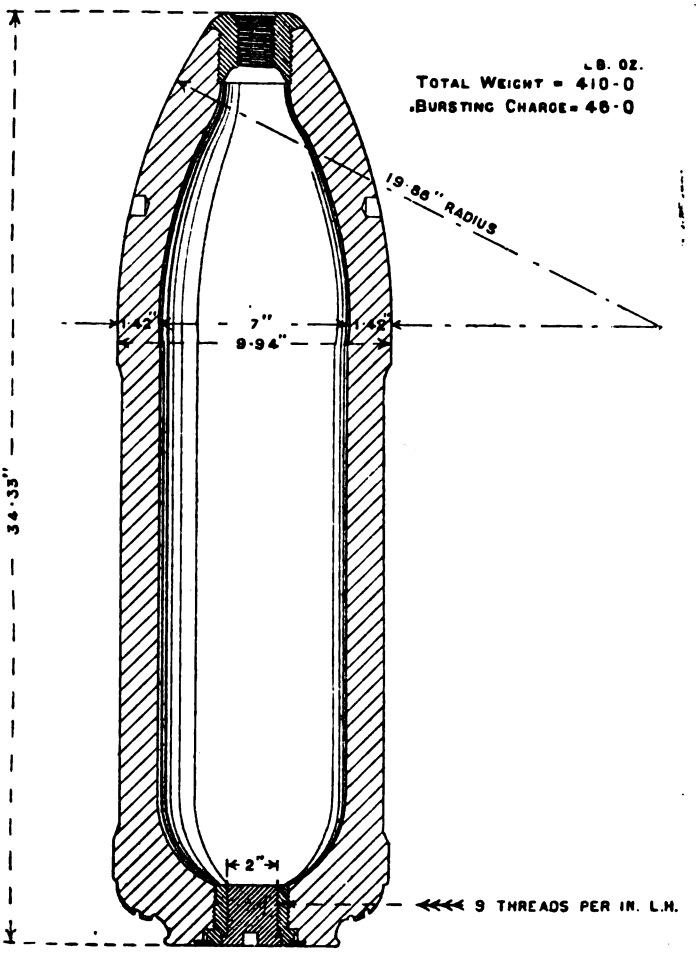
The iron are from 2·75 to 3 calibres long, and are cast "with bands," the heads being struck with radii of 2 diameters. The gun-metal bush in this case has a flange extending over the top of the shell, the exterior being rounded off to the same shape as the head of the projectile, and having the recess for the Naval wad in the material of the bush. There is also a hole cast in the base, intended primarily to support the core spindle and keep it truly in the centre during the operation of casting. This hole is afterwards bored out, screwed left-handed, and closed with a gun-metal plug. It is made use of for filling the shell. All have extractor holes. (See Plate XXIII.) Studless shell.

The studless common shell of 12·5-inch calibre and upwards have a hole in the side for the lifting eye-bolt.

With the iron common shell for the 17·72-inch R.M.L. gun, the threads of the lifting hole are sometimes broken away and will not allow of the insertion of the lifting eyebolt. When this occurs, the § 9304.

Shell, R.M.L., Common, 10-inch, Studless, Cast Steel, Mark III, C.

Scale, ½.



hole is to be bored out, and a steel bush screwed in, being retained by a keep pin. This bush is to be made and fitted locally.

The 12·5-inch and 16-inch have a pawl hole in the side to steady them on the trolly when being brought up to the gun. The 16-inch common shell, Mark II, has a hole bored in the centre of the base plug and screwed to receive an eye-bolt.

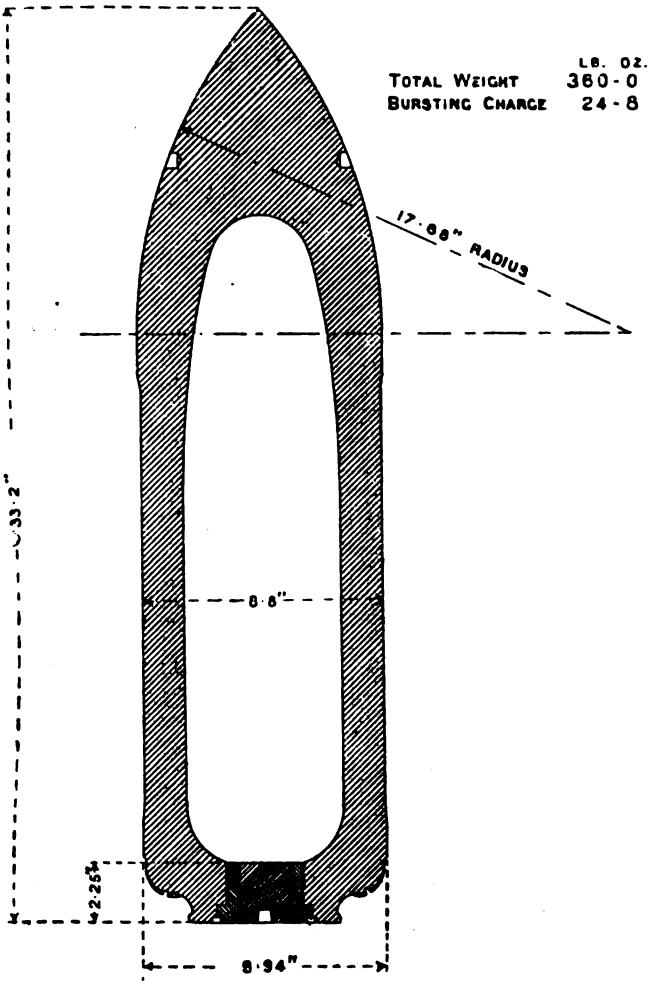
Cast steel.

The studless cast-steel common shell in general construction resembles the iron, but being made of the stronger material the walls are thinner and longer, the capacity for bursting charge being increased in proportion (*see* woodcut above). The base of the 9-inch common shell is closed by a gun-metal screw plug similar to that used with the 6-inch and 8-inch B.L.

Other R.M.L. cast-steel common shell have the bases closed by the plug and adapter, the 10-inch has the small and 11-inch and upwards the large, as described at p. 205.

Shell, R.M.L., Common, Pointed, 9-inch, Heavy, Mark I, L. Cast Steel for Base Fuze, 360 lb., for Guns on High-Angle Fire Mountings.

Scale, $\frac{1}{8}$.



The pointed common shells for the 8-inch and up are Mark I, except for the 12·5-inch, which are Mark II, and have their bases closed by a steel bush, riveted in. The bush is fitted to take the large base fuze or plug. The 12·5-inch Mark I pointed common has its base closed by the large adapter.

The 9-inch heavy has the small adapter in the base.

All these shell are lacquered inside, and their bursting charges are invariably to be contained in bags. They are to be filled by capacity, and it is important that they should be completely filled. The studded shell are filled through the fuze hole; the studless ones through the base, except the 10-inch lyddite and iron practice shells.

Direct action percussion Mark III for N.S. and Marks II or III for L.S., and Pettman G.S. Fuzes.

Pointed shell take the large base fuze, and the 10-inch lyddite the direct action impact fuze.

The Pettman G.S. fuze can only be relied upon to act when fired with a full charge, but unfortunately some common shell are not sufficiently strong to withstand the shock of this charge without breaking up in the gun. The following is a list of R.M.L. projectiles that must be fired with reduced charges:—

All studded common shell, except 12·5-inch, 9-inch, Mark VI, 8-inch, and 7-inch, which may be fired with full.

All studded shrapnel, except 12·5-inch, which may be fired with full.

The effect produced by the pressure on the sides of a studded R.M.L. common shell from the gas rushing past when gas-checks are not used, is found to be most remarkable, the shell having a faint tendency to assume a form approaching that of a dumb-bell. The base being solid transversely, is not appreciably compressed, but the end of the body close to the commencement of the head, although receiving considerable support from the latter, is acted on somewhat, while the body about the middle, where it is weakest, is forced inwards, and decreased in diameter to a considerable extent. The lower side of the shell in the gun appears to be convex, and the upper concave. When gas-checks are used the tendency is for the shell to set up instead of being compressed.

Common shell are painted black, except the studs, which are left unpainted. Steel shell have a white ring, ½-inch wide, painted round the head to distinguish them. When filled a red band is painted round the head. Paint.

All R.M.L. common shell are issued loose. For N.S.— Issue.

1. Filled and fuzed, and having the wad Naval with loop cemented in.
2. Filled with G.S. plug and wad Naval, with loop cemented in.
3. Empty with G.S. plug.

For L.S., empty with G.S. plug.

The 10-inch lyddite shell is of forged steel and varnished inside. It is painted yellow all over. It is for guns on H.A. mountings. Lyddite shell. § 8465.

Double Shell.

There is only one calibre of double shell for these guns in the Service, viz., the 7-inch, a studded shell.

The fuzes used with this shell, its paint, and the manner of its issue, are the same as the common shell, from which it differs only in being longer and in having three longitudinal strengthening ribs §§ 1339, 1518, 1765, 5370.

inside. The interior is lacquered, and, as the bursting charge is contained in a bag, these ribs make the shell somewhat difficult to fill, and it is necessary to see that the bag fits well into the spaces between them during the operation.

All made between March, 1869, and February, 1873, have the unloading hole.

Use. The double shell is chiefly intended for use against unarmoured ships. Owing to its great length it is inaccurate at long ranges.

Shrapnel Shell.

§§ 2491, 2522, 2523, 2780, 3377. *Shell, R.M.L, Shrapnel, Studded, of cast iron*, are made for the following heavy guns, viz., 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, 9-inch, 8-inch, and 7-inch.

§§ 4115, 4116, 4267, 4338, 4962. *Shell, R.M.L., Shrapnel, Studless, cast iron*, are made for the 16-inch, 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, and 9-inch.

§§ 5537, 7287. *Shell, R.M.L., Shrapnel, Studless, cast steel*, are made for 9-inch, 10-inch, 11-inch, 12-inch (25-ton), 12·5-inch and 16-inch R.M.L. guns.

§ 7730. Shrapnel for 17·72-inch have been made, but will become obsolete as soon as existing store is used up; they are to be fired plugged with ¾-charge at practice. Land Service 16-inch shrapnel will be disposed of in a like manner with full charges.

Cast-iron construction. The construction of the studless shrapnel shell is very similar to that of the heavy B.L. shrapnel described on p. 213. (*See* woodcut.)

The shell is of iron cast with bands. It has the tin cup, wrought-iron diaphragm, and gas-pipe, and gun-metal socket flanged over the Bessemer-metal head. There are two extractor holes, which in the plate are shown bored into the cast iron, but in some natures fall in the Bessemer-metal head, and are bored through that into the wood lining. In these, the extractor holes are lined with tin sockets to exclude damp from the interior of the shell.

The contents are sand shot (2-oz. up to the 9-inch, and 4-oz. for higher natures), packed, as usual, in melted rosin, contact with the sides of the shell being prevented by a brown paper lining, while the rosin is prevented from working out by a felt washer covering the bullets at the top.

The interior of the shell is slightly larger at the mouth than at the base, with the object of facilitating the dispersion of the bullets; and to assist in breaking up the shell there are six longitudinal weakening grooves in the body, and in the powder chamber of those made of iron.

The 12·5-inch studless and upwards have the hole for the "bolt eye lifting projectiles" in the side.

The 12·5-inch and 16-inch have the pawl hole.

§ 5082. The Mark II 16-inch shell has a hole bored in the base plug to receive an eye bolt.

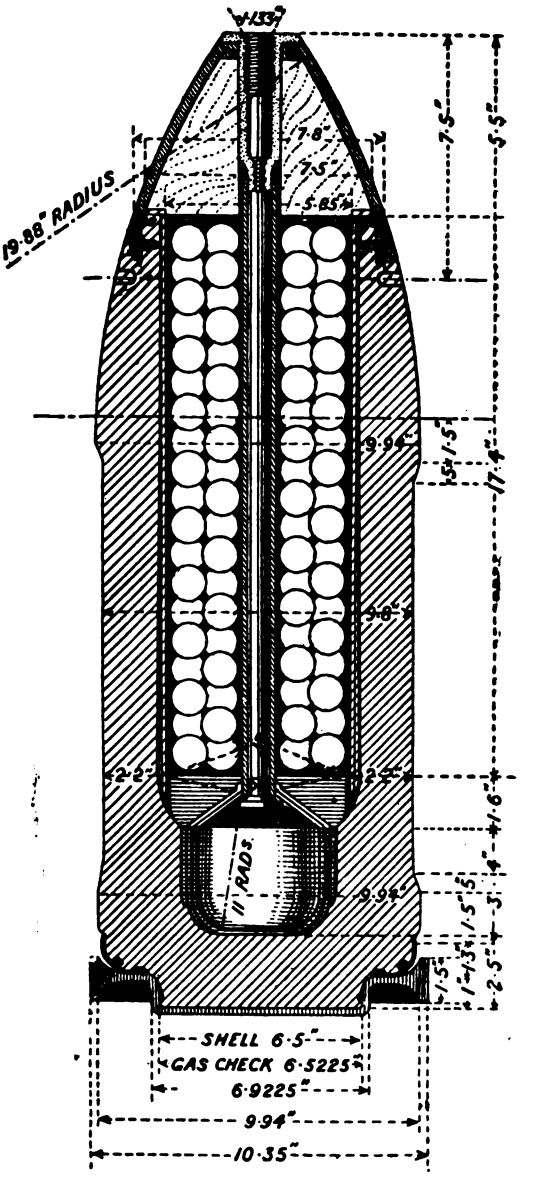
12·5-inch studded. The studded shrapnel for the 12·5-inch generally resembles the studless 10-inch above described, but has its head struck with a radius of one and a half diameters instead of two, has three rings of gun-metal studs, and is the only heavy-studded shrapnel fitted for a gas-check.

Studded shrapnel for Studded shrapnel of natures below the 12·5-inch have no gas-checks, as their bases are rounded off with curves differing from

Shell, R.M.L., Shrapnel, 10-inch, Studless, Mark 1.

Scale, $\frac{1}{4}$.

Average total weight = 410 lb.
Bursting charge = 1 lb. 10 oz.



those used for common and Palliser shells for the same guns. They are cast without bands, and have flatter heads than any of those yet described. The studs are disposed in two rings, and the extractor holes always fall in the Bessemer-metal head, and are consequently invariably lined. The gun-metal socket has no flange, the metal of head being bent down to receive it.

smaller natures.

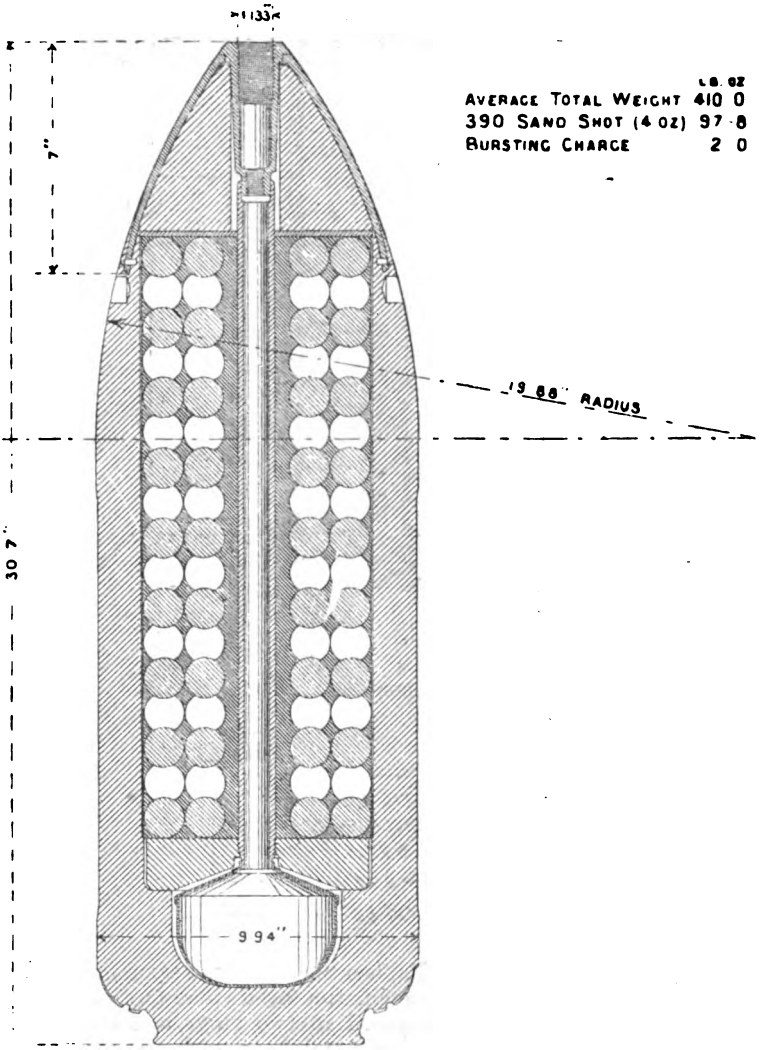
In studded shrapnel the upper row of rivets are called twisting pins, and the holes for them are bored close to the edge of the cast iron; in studless, the lower row is so called, and the holes for them are bored close to the edge of the Bessemer metal, which is slotted out beneath them.

Cast steel.

The studless cast-steel shrapnel for the R.M.L. guns differs principally from the iron in the walls being thinner, consequently a greater number of sand shot can be got inside it. The diaphragm is of steel instead of wrought iron, and there are no weakening grooves cast inside the body or powder chamber. (*See* cut of 10-inch.)

Shell, R.M.L., Shrapnel, 10-inch, Studless, Cast Steel, Mark II, C.

Scale, $\frac{1}{8}$.



Fuzes.

Until the supply is used up, the 15 seconds M.L. wood time fuze is to be used with these shrapnel, except for 10-inch or lower natures

when fired with gas-checks. In this case the flash of the charge will not ignite the fuze, and the 15 seconds with detonator, Mark III, is to be used. Both these fuzes will be superseded by the middle time and percussion fuze.

The body of the shell is painted black, except the studs, which are left unpainted. The tips of all shrapnel are painted red for a distance of 1 inch from the point. Paint.

Filled or empty and loose, except studded shrapnel, which are issued boxed for N.S. Issue.

Palliser Shot.

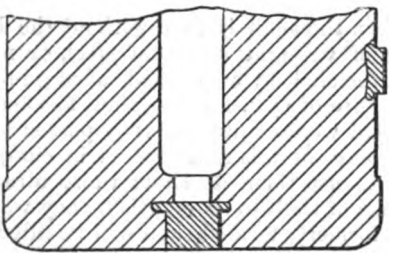
There have been two patterns of Palliser shot in the Service for R.M.L. guns, the old and the new.

The O.P. shot were studded and were made for the 12-inch (25-ton), 10-inch, 9-inch, 8-inch and 7-inch guns.

They had an interior cavity closed at the base by a wrought-iron plug hammered in (*see* cut).

Palliser Shot, 12-*inch*, *Mark I.*

(Base closed by a plug hammered in.)



These shot were liable to break up owing to the wedge-like action of the plug, when driven in by the action of the powder, and their manufacture was discontinued long ago. In consequence, all these shot were altered by having the plugs bored out and tapped, to receive a mushroom-headed plug which covered the junction of bush and body.

N.P. Palliser shot were then introduced for the 12·5-inch, 12-inch (25 tons), 11-inch, 10-inch and 9-inch guns.

They are studless, taking the automatic gas-check, and in construction are similar to the new pattern Palliser shot described in the chapter on B L. projectiles (p. 220).

16-inch Palliser shot, Mark II have a hole in the base plug to receive a lifting eye-bolt. § 5032.

Palliser shot manufactured since 1873, inclusive, are marked on the base with the word "shot" and with the calibre of the gun, the weight of the gun being added when there are two guns of the same calibre.

For dimensions, &c, *vide* Table, p. 527, *et seq.*

Black all over, except the tip which is painted white, and the studs of studded shot, which are unpainted. Paint.

Loose in jute bags. Issue.

Palliser Shells.

Palliser shells are also described as old and new pattern.

The O.P. shells have been made as follows:—

Calibres. §§ 3376, 3560. §§ 4115, 4116, 4141, 4374. § 4266.

Studded shell, 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, 9-inch, 8-inch, 7-inch.

Studless shell, Mark I, 16-inch, 12·5-inch, 12-inch (35 tons), 12-inch (25 tons), 11-inch, 10-inch, 9-inch.

Studless shell, Mark II, of different construction from Mark I, see below; 12·5-inch, 12-inch (35 and 25 tons), 11-inch, 10-inch, 9-inch.

These shell have their bases closed by a gun-metal base or gas-check plug, in a similar manner to the O.P. Palliser shells for B L. guns already described.

The studless shells require no lead ring round the base bush, since the whole of the base is covered by the gas-check.

Studless shell cast in one piece are known as Mark I and have been made for all natures from 9-inch to 17·72-inch.

Studless Palliser, Mark II. § 4266.

But for smaller natures it was found difficult to cast this elaborate base, and in all it is found that when the base is cast in the hard, brittle metal used for Palliser shell, the locking rim is very liable to be broken away in transport, &c., so Mark II studless Palliser was introduced for all natures from 9-inch to 12·5-inch (*see* cut).

In this pattern the shell is cast without the base disc, which is made separately of wrought iron, cast steel, or malleable cast iron, and attached to the shell by a conical-headed gun-metal plug.

§ 4839. § 4947.

The manufacture of O.P. Palliser shell has long since ceased, and those already filled were emptied as they passed through the R.L. or at any station where there is a laboratory in charge of an I.O.O., as it was decided to use them as shot; those already in the Service retained the name of shell until emptied, they were then called shot.

Palliser shot formerly termed shell will be filled with sand, equivalent in weight to the authorised bursting charge.

§ 5033.

The shot so filled will have a W stencilled in white on their head, and also stamped on the base plug.

They are also painted with a white tip, denoting shot.

§ 8438.

Palliser shells for R.M.L. guns have been re-introduced for Naval Service, and are made of the following calibres:—

Shell, R.M.L., Palliser, Studless, 16-inch Mark III, 12·5-inch Mark IV, 12-inch (25 tons) Mark IV, 11-inch Mark IV, 10-inch Mark IV, 9-inch Mark IV.

They are lacquered internally, and are prepared to take the large base percussion fuze.

Paint.

Black all over, except studs, which are not painted.

Issue.

Filled or empty, fitted with point protectors.

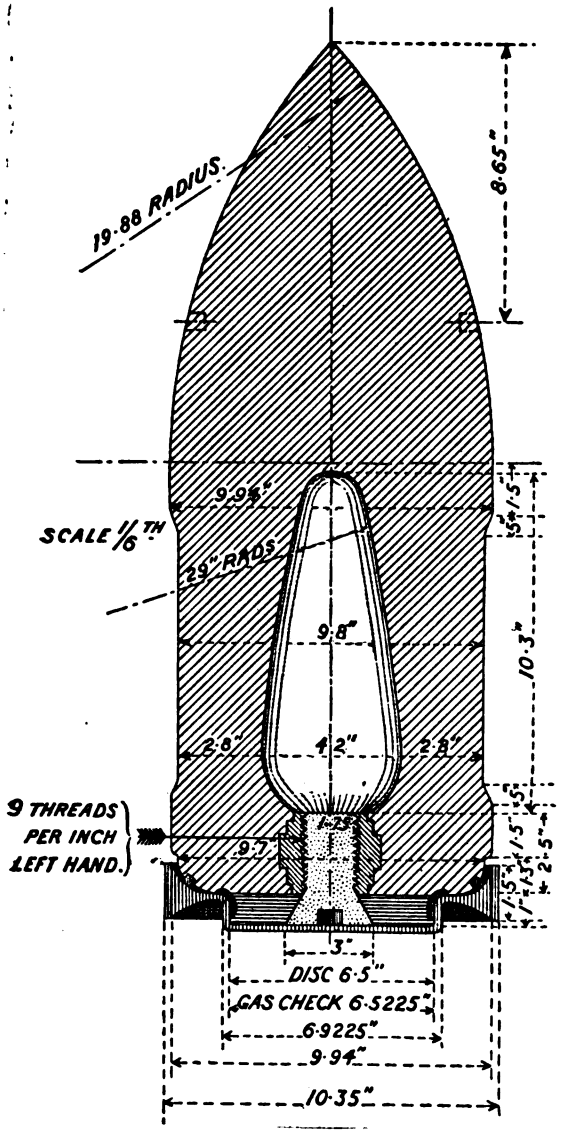
Palliser projectiles are now individually tested by hammering the base all over with a pointed hammer, to detect weak or porous portions.

The tip or point of a chilled projectile is occasionally broken off by the impact of a shell or shot rolled or struck obliquely against it; for, strange as it may appear, the point which may penetrate directly through many inches of armour without injury may be fractured by a very slight transverse blow.

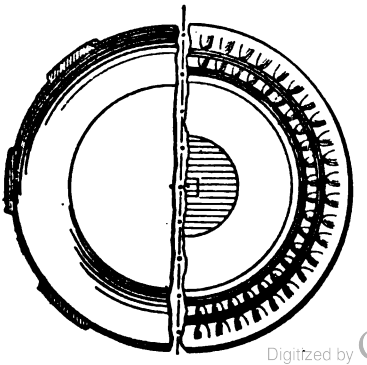
A.C., Cl. 73, 1887.

Plaster of Paris models, labelled respectively "A" and "B," are issued to Inspecting Ordnance Officers, to guide them in the examination of Palliser projectiles.

Shot, formerly shell, R.M.L. Palliser
Studless, 10-inch Mark II.



Gas Check, 7 projections. *Base of Shell, 47 serrations.*



Any Palliser projectiles that may be found with their points broken to a greater extent than what is shown in model "B" will only be used for practice, and will be retained at stations for that purpose if so required; if not required, they will be sent to the Royal Arsenal, Woolwich.

"A" may be considered obsolete.

Case Shot.

Calibres.

Shot, R.M.L., case iron, 17·72-inch, 12·5-inch, 12-inch, 11-inch, 10-inch, 9-inch, 8-inch, and 7-inch.

Shot, R.M.L., special, 12·5-inch, 11-inch, 10-inch, and 9-inch.

Iron case shot. Construction.

Case shot for the heavy R.M.L. guns may be divided into two classes, viz., that for the 12·5-inch and that for guns from 8-inch to 12-inch.

§§ 4049, 4962.

The first class generally resembles the case for the heaviest B.L. guns, described at p. 223. It has the central stay bolt, bottom protecting disc, cast-iron top recessed for the two rings, which are retained in position by springs, loose disc at bottom, and wrought-iron lining in eight segments. The 12·5-inch is provided with eye-bolt holes and pawl holes. The soft metal studs of the B.L. case are replaced in the 12·5-inch by three gun-metal studs attached to the bottom of the shot, which enter the grooves and prevent the shot being rammed home too far.

The contents are 8-oz. sand shot packed in clay and sand.

§ 4877.

The 17·72-inch is exceptional, being made of steel plate ·095-inch thick, fringed at both ends, and soldered at the bottom to a plate of the same thickness (*see* cut).

The top of the case is of cast steel recessed for two rings, lined with wood, and secured by the ends of the case being turned over and soldered, and to the stay bolt by a hexagon nut.

The base is a disc of cast steel, 3 inches thick, riveted to the bottom, through the centre of which passes a wrought-iron stay-bolt. The interior of the case is fitted with a loose wrought-iron disc at the bottom and four segmental steel linings. It is provided with a lifting hole, but no pawl hole; and contains 1,915 8-oz. and 195 4-oz. sand shot.

§§ 1611, 1705, 1777, 2115, 2188, 2264, 2265, 2382, 2742, 2924, 4083.

Case shot, from 8-inch to 12-inch, are made of tinned iron in one piece, riveted longitudinally, and fringed at both ends. The bottom fringe is bent down and riveted to the sheet-iron bottom, and when the case is filled the upper end is bent over and soldered to the tinned iron top. The 9-inch and upwards have two handles attached to iron staples, which are bent round to form a loop and riveted to the inside of the head. The 8-inch has one handle.

In the interior of the cylinder is a wrought-iron disc lying loosely on the bottom, and on this stand three wrought-iron segments forming a lining to the case; and the contents are 8-oz. sand shot packed in powdered clay and sand.

There is but one case for the 12-inch of 35 tons, and the 12-inch of 25 tons.

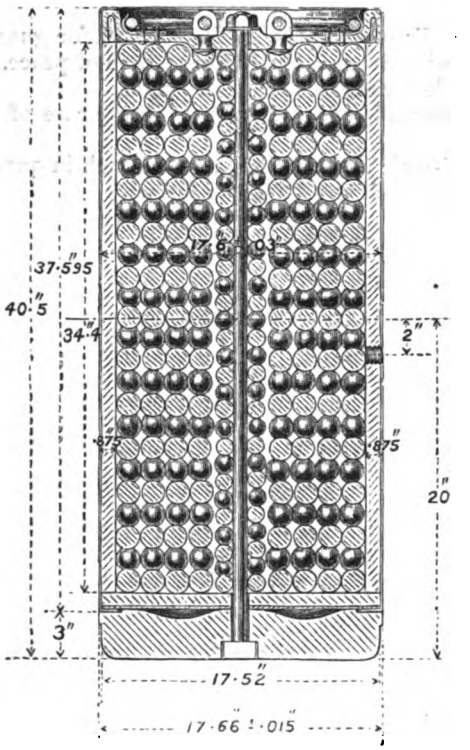
§ 5952.

In the 11-inch case shot, Mark III, the loose wrought-iron base disc fits inside the segmental linings to facilitate its breaking up. For the same reason, the bottom is weakened by having the iron disc replaced by an iron ring.

7-inch.

The shot for the 7-inch more nearly resembles the F.S. type, and is fired from both R.M.L. and R.B.L. guns of this calibre.

Scale, $\frac{1}{12}$.



The body is of tin, in three pieces, secured longitudinally by lap joint and solder, and the top and bottom ends are fringed. The bottom is a disc of the same material secured by the fringe being bent over on it and soldered, and strengthened outside by a wrought-iron ring riveted on. A loose wrought-iron base disc is laid resting on the bottom inside, and a loose wrought-iron lining in three segments stands upon this disc. Description.

It is filled with 8-oz. sand shot packed in powdered clay and sand.

The top is of sheet iron tinned, and is secured by the fringe being bent over on it and soldered. There is one handle attached to the top by two staples, which are riveted inside. There are three soft metal studs near the base to act as stops in loading, when fired from the 7-inch R.B.L. It is marked on the top 7-inch M.L. or B.L., with the Roman numeral denoting the pattern.

All these case shot have the words "Filled iron shot" stamped on the top.

Special case shot, filled with chilled iron shot, weighing 3 lb. 9½ oz. each, have been introduced for the 9-inch, 10-inch, 11-inch and 12·5-inch guns. They are intended for the defence of narrow channels, cordite charges having been designed for use with them. Special case shot. §§ 8452, 9060.

They are similar to iron case shot except in dimensions and contents, and in having rings, instead of handles, fitted to their tops. They have the words *Filled Chilled-iron Shot* stamped on the top. They are all fitted with stay bolts, except the 9-inch.

In all case shot for rifled guns the handles are to be away from the charge. Rule for loading.

Paint. All case shot bl... Special case shot have a white band.

Issue. Loose.

§§ 7012, 9452, 10330. *Shot, Paper, Empty, Marks I, II, and III*, for guns that in L.S. cannot be fired with Service projectiles in time of peace.

They are made for the 7-inch to 12·5-inch.

These shot are made of wood pulp, as in the case of the B.L. (*see* p. 229).

For the 12·5-inch they are in sixths, 11-inch in quarters, 10-inch in thirds, 9-inch, 8-inch and 7-inch in halves.

CHAPTER XVI.—PROJECTILES FOR MEDIUM AND SIEGE R.M.L. GUNS AND HOWITZERS.

COMMON SHELL.—INCENDIARY SHELL.—SHRAPNEL SHELL.—STAR SHELL.—PALLISER SHOT, AND CASE SHOT.

For convenience, there will be described in this chapter the projectiles fired from 6·6-inch, 80-pr., 64-pr., 40-pr., and 25-pr. guns, 8-inch of 70 cwt., 8-inch of 46 cwt., 6·6-inch and 6·3-inch howitzers.

The 8-inch howitzer, 70 cwt., and the 6·6-inch gun and howitzer and 6·3-inch howitzer, are rifled on the modern polygroove system, and fire only studless shells; all the other pieces fire studded projectiles, except the 80-pr. and 8-inch howitzer of 46 cwt., future supplies of which will be studless, as will be seen below.

The Service projectiles for the above-named ordnance are common, shrapnel, and star shell, Palliser and case shot. Service projectiles.

A lyddite shell has just been introduced for the 6·3-inch howitzer.

Common Shell.

Shell, R.M.L., Common, Studded, of cast iron, are made for 80-pr., 64-pr., 40-pr., and 25-pr. guns, and 8-inch howitzer of 46 cwt. Common shell.

Shell, R.M.L., Common, Studless, of cast iron, are made for the 6·6-inch and 80-pr. guns, and 6·3-inch, 6·6-inch, and 8-inch howitzers of 46 and 70 cwt. §§ 5370, 3366, 3380. §§ 4030, 5644, 5370, 4031.

Shell, R.M.L., Common, Studless, cast steel, for the 8-inch howitzers of 46 and 70 cwt. § 5465.

For the 80-pr., the common shell has two rings of copper studs, three studs in each ring. The studs in the front ring are much smaller than those in the rear ring. This, as well as the adoption of copper for the material, is done in order to minimise the strain on the iron when pressing them in; for in order to obtain a large capacity the thickness of the walls has been reduced as much as possible, especially towards the front of the shell; and in order to give the necessary strength to the walls, the metal is thickened underneath the front studs, forming a strengthening band in the interior of the shell. It has the recess for naval wad, two extractor holes, and is not fitted for a gas-check. §§ 2278, 5370. Description of studded shell.

The common shell for the 64-pr. has three rings of copper studs, three in each ring, and three extractor holes in line with the studs, by which peculiarities it may be distinguished at once from any other projectile of approximate calibre. The use of copper for the studs is necessary to allow them to be compressed when firing from the shunt gun; and to prevent the soft studs from shearing, a larger bearing surface is necessary, which is attained by having three rings of studs. §§ 1768, 3172, 5379, 9318

Some early and quite serviceable patterns had the studs disposed in five rings.

It has no gas-check.

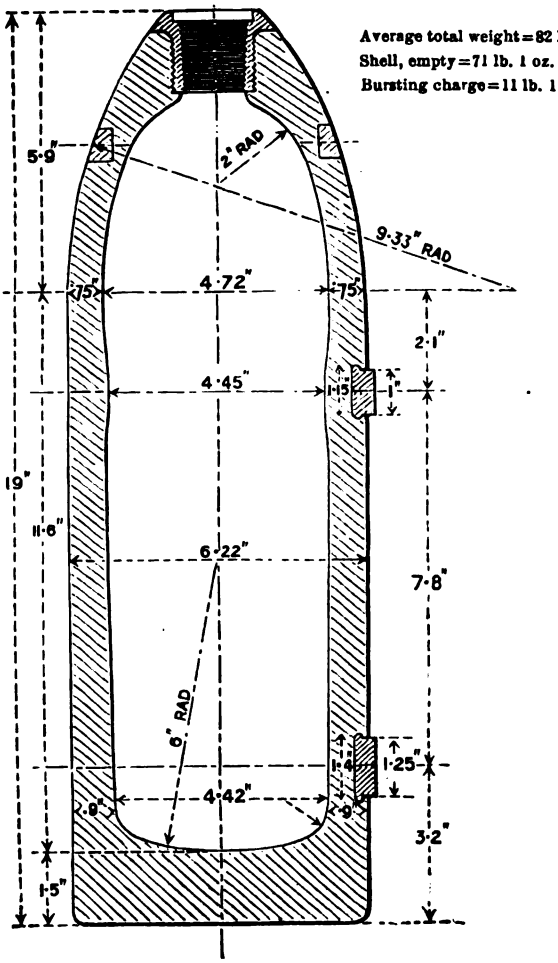
§ 3382, 5370. The common shell for the 40-pr. R.M.L. gun has six gun-metal studs of uniform size arranged in two rings. The fuze hole is countersunk, and it has a flanged gun-metal bush in the nose. Earlier patterns of 40-pr. common shell have plain gun-metal bushes, and their fuze holes are not countersunk for the naval wad.

The present pattern shell is fitted to take the gas-check. As the gas-check is gripped by the plug and is not free to revolve when fastened on, it is necessary to align the projections on it with the studs of the projectile before tightening up the plug.

§ 3366. The rifling of the 25-pr. is also uniform, and its common shell has six gun-metal studs arranged in two rings. It has no bush, and does not take a gas-check.

Shell, R.M.L., Common, 80-pr., Studded, Mark III.

Scale, ½.



The common shell for the 8-inch howitzer, 46 cwt., is the same as the shell for the 8-inch gun, except the studs, which are made to suit the quick uniform twist of the howitzer (the twist is one turn in 16 calibres). As the twist is uniform, the front and rear studs are of the same size, so that the shell can easily be distinguished from that for the gun. §§ 25, 3380 4414.

The Mark I shell can be altered to take a gas-check by boring a hole into, but not through, the base, and tapping it. The shell is then distinguished as Mark I*. Mark II is cast and fitted for one with a hole completely through the base. As the length of plug required is different in the two cases, it is essential to quote the correct numeral of shell in demanding gas-check plugs.

When fitting the gas-checks the projections on it must be aligned with the studs before screwing up the plug.

The studless common shells for the 6·6-inch and 80-pr. guns, and 6·6-inch and 8-inch howitzers are rotated by automatic gas-checks. They are about 3 calibres long, and have ogival heads, struck with radii of 1½ diameters, and the usual pattern of base for studless projectiles, but without the grooves which intersect the flutings on the rounded part. They are cast with bands, except the 80 pr., which is plain. All have flanged gun-metal bushes, and the usual ·2 inch countersink to receive the naval wad. Studless common.

Like the heavier studless common shell, they have a hole in the base closed by a gun-metal plug with a left-handed thread, and which is utilised for convenience of filling. The bursting charges of all are contained in bags.

The same common shell is fired by the 6·6-inch gun and howitzer, the 8-inch howitzers of 46 and 70 cwt. also fire the same studless common shell, but with a different gas-check.

There is only one cast-steel common shell at present in use with medium R.M.L. ordnance, that for the 8-inch howitzers. It differs from the iron only in length and in the thickness of the walls. Its capacity for bursting charge is greater than the iron, and, like the heavier studless common shell, it is filled through the base, the latter being closed by a gunmetal plug. This shell and the iron studless of 8-inch calibre are only to be fired from the howitzers, and recently the letters "HOW." have been added after the calibre on the base to indicate this. It takes the ordinary automatic gas-checks in use with the 8-inch howitzers. The automatic gas-checks used with the 46-cwt. and 70-cwt. howitzers necessarily differ. Cast steel, 8-inch. §§ 5465, 6453.

The common shell for the 6·3-inch howitzer differs from other studless projectiles in being cast plain, and having eight radial saw-shaped grooves in the base, into which fit corresponding radial projections on its saucer-shaped gas-check, which is fastened on by a gun-metal plug with hexagon head of the same size and thread, though not of the same length as that used with the 8-inch howitzer, 46-cwt. (*See* cut, p. 239.) This shell is filled through the nose, and takes the same burster bag as the 64-pr. R.M.L. § 3285.

Common shell may be used as incendiary shells by employing stars of an incendiary nature. Incendiary shells.

The *Star, Incendiary, Mark I,* is to be used up in common and double shells, but is not suitable for R.M.L. 2·5″ ring shell. It consists of a cylinder of brown paper, about 2 inches in length and ·7 inch in diameter. This cylinder is dipped in melted paraffin wax, driven with incendiary composition (*see* p. 553), and primed at both ends with two 1-inch lengths of quickmatch. They should burn about 8 seconds. They form part of the equipment of the siege §§ 5645, 9862.

train. They are not carried in the shell, which are charged as required.

Star, incendiary, Mark II, is suitable for use in common and double shell and R.M.L. 2·5-inch ring shell. It differs from Mark I, in being 1·7 inch long and ·55 inch in diameter. The length of quickmatch strands is also reduced to ·8 inch. It should burn (when lighted at both ends) not less than 4·5 seconds.

§ 3779. Box, star, incendiary, Mark I, having a tin lining like a S.A.A. box, holds 200 of the Mark I, and 460 of the Mark II, incendiary stars.

To charge a Shell.—Remove the original bursting charge, if necessary, put in a few stars at a time, and shake them well down. Powder is introduced from time to time to fill up the spaces between the stars, and when well shaken down another layer of stars is put in, and so on till the shell is filled tightly. Before using a shell see that there is powder close up to the fuze hole. These shell are fired with percussion fuzes.

Fuzes. The fuzes employed with these common shell are the D.A. percussion for R.M.L. guns 40-pr. and upwards and for R·M.L. howitzers 6·3-inch and upwards, and the D.A. delay with the latter for high angle fire. The R.L. fuze will be used up with R.M.L. guns up to the 40-pr. and will be superseded by the small percussion for the R.M.L. 25-pr. only.

Paint. All common shell are painted black, the studs, when there are any, being left unpainted. Steel shell have the usual white ring painted round the head to distinguish them. The markings on the shell denoting that it is filled, &c., are in red.

Issue. Filled shells if for siege train, transported and stored boxed.

Remainder loose.

Lyddite shell, 6·3-in. How. The Lyddite shell for the 6·3-inch howitzer differs from the common shell in being made of forged steel, and in the hole for the gas-check plug which does not pass through the base. It is varnished inside.

It is painted yellow.

Shrapnel Shell.

Calibres. *Shell, R.M.L., Shrapnel, Studded, of cast iron*, are made for the 80-pr., 64-pr., 40-pr., and 25-pr. guns.

Shell, R.M.L., Shrapnel, Studless, of cast iron, for the 6·6-inch and 80-pr. guns.

Shell, R.M.L., Shrapnel, Studless, cast steel, for the 6·3-inch, 6·6-inch, and 8-inch howitzers.

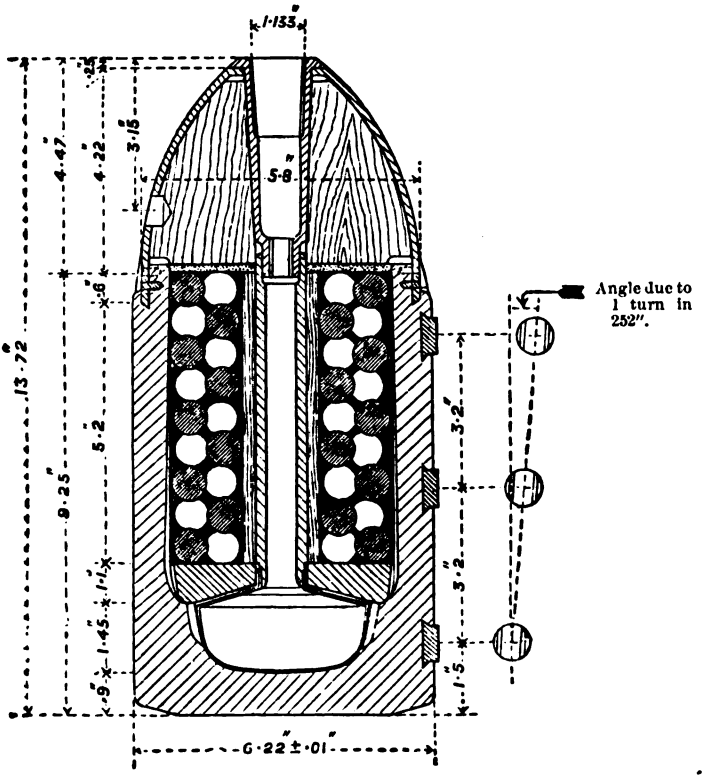
Construction. § 9348. The *Studded* shrapnel for the 80-pr. and 64-pr. guns are peculiar in construction, forming an intermediate stage between the heavy and light types.

The principal difference between the 80-pr. and 64-pr., which are of the same calibre, is that the former has only two rings of copper studs and two extractor holes, while the latter has three rings of studs of the same material, and three extractor holes in line with the studs. The front stud of the 80-pr. is slightly smaller than the rear one, and the shell is somewhat longer than the 64-pr. They have six weakening grooves in the powder chamber only.

Both resemble the heavy type in having the wrought-iron pipe and gun-metal socket with extractor holes lined with tin; but the balls are of mixed metal, and round the central iron tube is a thin

wooden tube, which is introduced to fill up space and bring the shell to the proper length without unduly increasing the weight. Two longitudinal slots are cut at each end, so as to allow the rosin to flow in and bind the tubes together. The slots at the bottom are cut at right angles to those at the top, so as to enable them all to extend half the length of the tube without actually dividing the latter. (*See* cut.)

The shrapnel for the 40-pr. and 25-pr. are of the field service type, with gun-metal pipe, composite socket, and no extractor holes; the former has six gun-metal studs disposed in two rings; in the latter, the studs, which are similarly disposed, are of copper, so as to have as little pressure as possible on the thin metal of the shrapnel shell. They have no internal weakening grooves.



The 40-pr. is the only studded shrapnel of field or medium calibre which takes a gas-check.

Studless shrapnel shell of cast iron are made for the 6·6-inch and 80-pr. R.M.L. guns. In construction they resemble the heavy studless shrapnel described in the previous R.M.L. chapter, but they contain mixed metal bullets instead of sand shot, and have weakening grooves in the base only. The 6·6-inch is cast with bands, the 80-pr. has a plain body. Both are rotated by automatic gas-checks, and have the usual form of base for studless shell. (*See* cut on page 262.) Studless iron.

The 6·6-inch gun shrapnel is not to be fired from the 6·6-inch howitzer. § 90.1.

Howitzer, shrapnel, cast steel.

Shrapnel shell, which might be described as "shooting shrapnel," of cast steel, are made for use with the 6·3-inch, 6·6-inch, and 8-inch R.M.L. howitzers.

They have a larger capacity for bursting charge than the ordinary type of shrapnel with burster in the base, so that the striking effect of the bullets is made independent of the remaining velocity of the shell at burst.

This is necessary with howitzers on account of the very light charges from these pieces, and consequent low velocities. They are intended for high angle fire, for keeping open an already formed breach, and for searching out the enemy's gun portions and works.

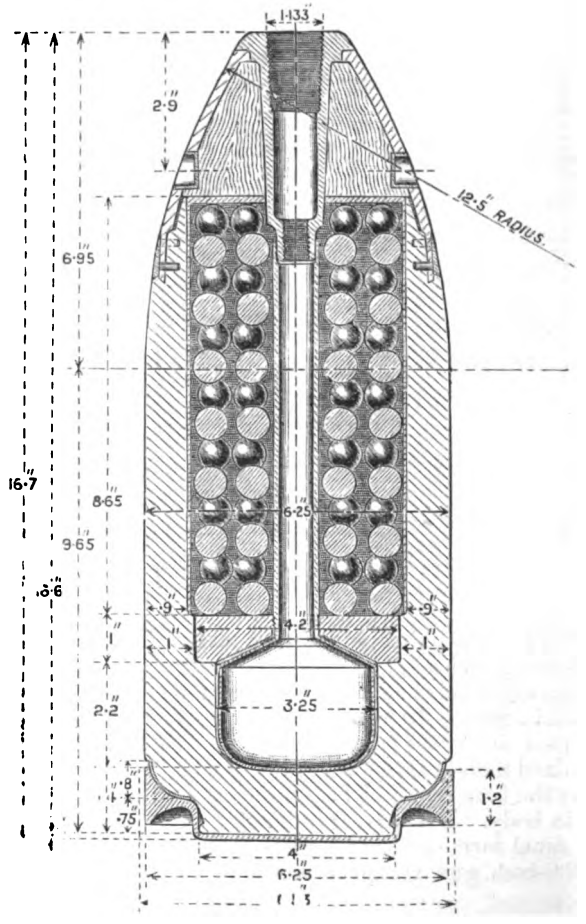
These shells are described in detail below :—

8-inch. § 5389.

Shell, R.M.L., Shrapnel, 8-inch Howitzer, Cast Steel, Mark I.—The body of this shell is of cast steel, the walls and base being made strong enough to resist breaking up on the explosion of the bursting charge. The body from the base to near the centre is thickened, forming a shoulder in the interior, and below which is the powder

Shell, R.M.L., Shrapnel, Studless, 80-pr., Mark I.

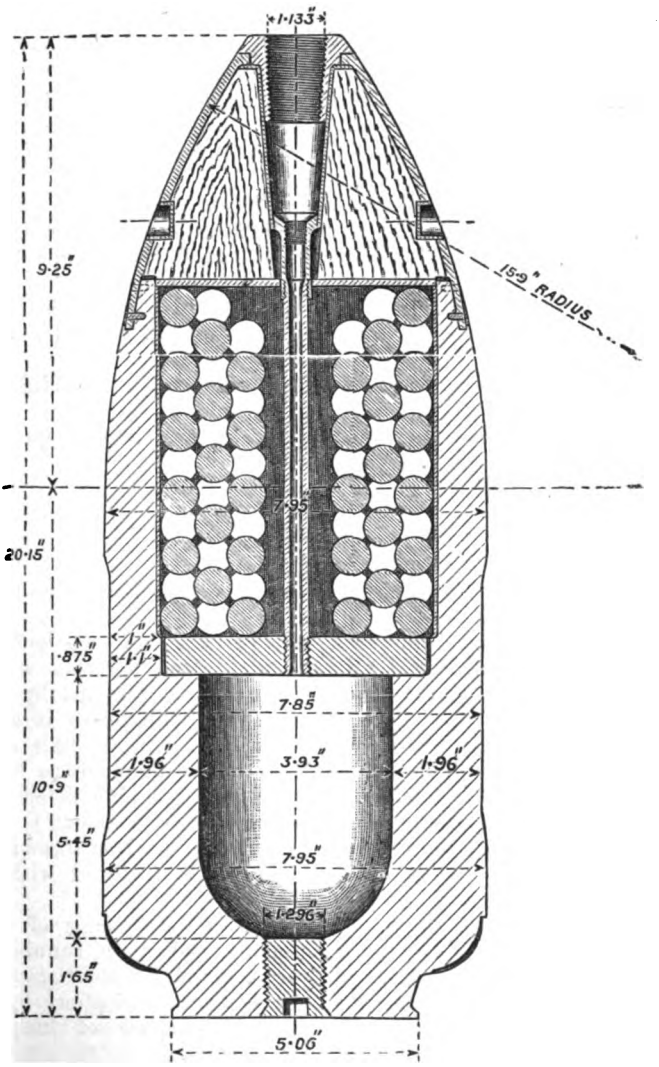
Scale, ½.



chamber; the latter is of larger dimensions than in ordinary shrapnel shell, and is lacquered to take the bursting charge. A cast-steel disc rests on the shoulder, and covers the powder chamber; a brass pipe of small internal diameter screws into the centre of the disc, and its upper portion is threaded to take the shrapnel primer. The body in front of the disc is lined with brown paper, and filled with mixed metal bullets, molten rosin being poured in amongst them to keep them from knocking about, and a felt washer is placed over them. The head is of Bessemer metal, lined with wood, and lightly attached by rivets and twisting pins, the joint being afterwards soldered over. A composite socket fits into the head, the gun-metal portion of it being secured by solder, and screwed to the G.S. gauge ;

Shell, R.M.L., Shrapnel, 8-inch Howitzer, Mark I.

Scale, ¼.



the tin portion is soldered outside the upper end of the central pipe. There are two extractor holes which fall in the Bessemer metal head and are lined with tin sockets. The shell is filled with loose powder through the base, the hole in the latter being closed by a gun-metal base-plug. It is cast with bands, and is rotated by means of an automatic gas-check in the usual way.

§ 5413. 6·6-inch. The 6·6-inch howitzer shrapnel differs only from the above in dimensions and weight.

6·3-inch. The 6·3-inch, in general construction, resembles the others, but the base is flat, and has eight radial grooves to take the projections on the saucer-shaped gas-check by which it is rotated. It is cast without bands. The gun-metal plug, with hexagon head for attaching the gas-check, also closes the base of the shell. Like the 6·6-inch and 8-inch, for convenience, the bursting charge is inserted through the base.

Action. The fuze fires the primer, which in turn ignites the bursting charge, and the head is blown off. The walls hold together, the large bursting charge driving the bullets forward with increased velocity, thus the body of the shell acts as a kind of "flying gun."

Fuzes. The fuzes employed with these shrapnel shell are the sensitive middle for R.M.L. guns 25-pr. and upwards, and for R.M.L. howitzers 6·3-inch and upwards. This fuze when expended will be superseded by the T. and P. middle.

The 15-seconds M.L. fuze may also be used for R.M.L. guns 25-pr. and upwards, except the 6·6-inch and also the 40-pr. when fitted with a gas-check, with which shells the 15-seconds with detonator will be used.

Paint. All shrapnel are painted red at the head, to distinguish them from common shell, and black over the body, except the studs, which are unpainted.

Issue. Studded shrapnel, 64-pr. and upwards, when for N.S. will be transported boxed.

Filled shrapnel, if for the siege train, will be transported and stored boxed.

Remainder loose.

Star Shells.

8-inch, 6·6-inch, and 6·3-inch, Mark IV. § 6090. *Shells, R.M.L., Star*, are made for the 8-inch, 6·6-inch, and 6·3-inch howitzers.

They are spherical in form, and are made of two hemispheres of Bessemer metal, tinned all over and fitted together with a lap joint. The inside of each hemisphere is strengthened by a ring of wrought-iron. In the centre of the top hemisphere is a hole to receive a gun-metal socket tapped to G.S. gauge. This socket is perforated with small holes, and fixed to the hemisphere by solder. In the bottom of the shell is a wood block and ring fitted so as to form a bed on which the stars are packed. (*See* woodcut.)

The hemispheres are fastened together by six iron screws and six twisting pins, and the exterior of the joint is coated with shellac cement.

Round the lower part of the exterior is a ring of wood in two thicknesses, made in four segments, the grain running cross-wise in the two thicknesses, which are secured together by eight iron screws. The ring is fastened to the bottom hemisphere by marine glue and drops of solder, and serves the purpose of keeping the fuze-hole in the proper position when loading.

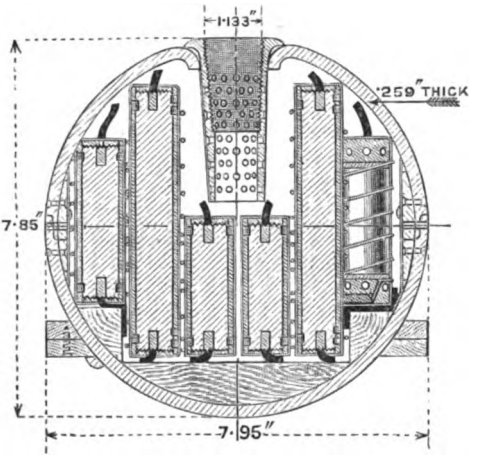
Each star consists of a rolled paper case driven with composition (*see* p. 552) and primed at both ends with mealed powder and quick-match. At each end of the star, six holes are bored through the case into the composition, and driven with mealed powder. The quick-match, and ends of the stars for about half an inch, are coated with sulphur. They are strengthened by a woolding of fine, soft copper wire. **Stars.**

The fuze employed with these shell is the 15-seconds M.L. with special priming (*see* p. 170). **Fuze.**

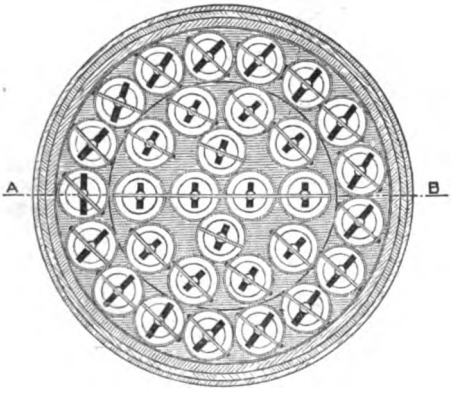
The charges are 2½ lb. for the 8-inch, 2 lb. for the 6·6-inch, and 2 lb. for the 6·3-inch. **Charges.**

Shell, R.M.L., Filled Star, 8-inch, Mark IV.—Spherical.

Scale, ¼.



SECTION AT A B.



PLAN WITH TOP HEMISPHERE REMOVED.

The flash from the fuze ignites the quick-match, sulphur, and mealed powder priming on the ends of the stars. The gas evolved bursts the shell, and blows the stars well away from both hemispheres. There is no bursting charge required. **Action.**

Earlier patterns. §§ 3915, 3916, 4199, 4337.

Earlier patterns differ principally from the above in the number, construction, and composition of the stars. They contained a small blowing charge which was always issued in the shell.

Palliser Shot.

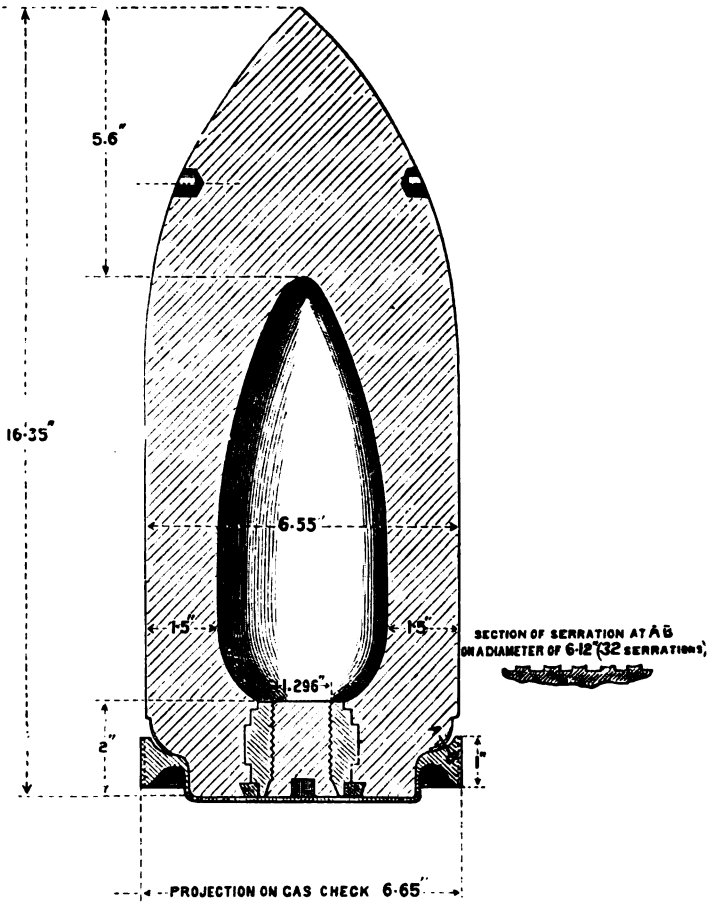
Shot, R.M.L., Palliser, Studless, are at present fired only from the 6·6-inch gun.

§ 4284. §§ 4030, 4285.

The Palliser shot for the 6·6-inch gun is cast without bands, and has a pointed head struck with a radius of $1\frac{1}{2}$ diameters, the interior is lacquered, and there are two extractor holes. A soft iron bush is cast into the metal of the shot and closed with a gun-metal screw

Shot, R.M.L., Palliser, 6·6-inch Gun, Mark I.

Scale, 3 inches = 1 foot.



plug. The junction of the bush and shot is sealed by a lead ring (*see* cut). In the cut, however, the groove round the projecting base disc is omitted.

Case Shot.

The calibres of the case shot for these guns are 8-inch, 80-pr., 64-pr., or 6·3-inch howitzer, 6·6-inch gun or howitzer, 40-pr. and 25-pr. Calibres.

Both 8-inch howitzers fire the same case shot as the 8-inch R.M.L. gun. It has been already described at p. 254. § 4286.

The same case shot is fired from the 80-pr. and 64-pr. guns, and from the 6·3-inch howitzer. The 6·6-inch gun and howitzer also fire the same case shot, which in construction is similar to the 64-pr. hereafter described, except that it contains 4 oz. sand shot. §§ 2925, 3243.

The body is of tin, in three segments, secured longitudinally by lap joint and solder, and the top and bottom ends are fringed. The bottom, which is a disc of the same material, is secured by the fringed end being bent over on it and soldered, and is strengthened by a wrought-iron ring riveted on the outside. A loose wrought-iron disc is laid inside resting on the bottom, and the body is lined with wrought iron, in six segments, fitting loosely inside. It is filled with 8-oz. sand shot packed in powdered clay and sand. The top is of sheet iron tinned, and is secured by the fringe being bent over on it and soldered. There is one handle attached to the top by two staples, which are riveted inside. 80-pr., 64-pr., or 6·3-inch howitzer.

It is marked on the top with the Roman numeral indicating the pattern, and with the calibres of the pieces for which it is intended.

The case shot for the 40-pr. and 25-pr. are of the field service type. 40-pr. and 25-pr.

The body is of tin, in three pieces, soldered together longitudinally, to ensure uniformity and ease of breaking up. The bottom is of tin, soldered in; and riveted to it on the outside is a ring of wrought iron. The top is a tinned iron disc, secured by the fringed end of the case being bent over and soldered down, and there is one handle. In the interior is a loose disc on the bottom of the case and a loose lining in three segments. The contents are 1 oz. mixed metal balls, packed in clay and sand. Construction.

Black. Paint.

Loose. Issue.

Paper Shot.

Shot, paper, empty, Marks I, II and III, are issued for R.M.L. 6·6-inch gun or howitzer and 64-pr. and 6·3-inch howitzer, in the L.S. They are brought up to weight, when required, in the usual way. §§ 7542, 9452, 10330.

CHAPTER XVII.—PROJECTILES FOR R.M.L. FIELD AND MOUNTAIN GUNS.

STUDDED SHELL—STUDLESS SHELL—STAR SHELL AND CASE SHOT.

THE R.M.L. field and mountain guns in the Service are the 16-pr., 13-pr., 9-pr., 7-pr., and 2·5-inch guns.

The 2·5-inch R.M.L. is the jointed gun formerly called the 7-pr.* (400 lb.); but, as this designation was found to lead to confusion, it was re-named as above.

In the 16-pr., 9-pr., and 7-pr. guns the twist of rifling is uniform, and the grooves are of the "modified French" form in the 16-pr. and 9-pr., and of the "French" in the 7-pr.

There are several 7-prs. in the Service, for which various charges are issued. (*See* p. 469.)

The 7-pr. 6-oz. charge sometimes fails to ensure the percussion fuze acting, the shock being too slight for the guard to always shear the feathers. This small charge also causes a difficulty with case shot, which frequently does not break up.

In the 13-pr. and 2·5-inch guns, the system of rifling is the "modern polygroove" with increasing twist.

The 16-pr., 9-pr., and 7-pr. guns fire studded projectiles only, and do not take gas-checks; the 13-pr. and 2·5-inch fire studless projectiles only, rotated by automatic gas-checks, except in the case of star shell. The projectiles of these two classes will be described separately.

The projectiles fired from these guns are common, double, ring, and shrapnel shell, star shell, and case shot.

STUDDED PROJECTILES.

Calibres 16-pr., 9-pr., and 7-pr.

The shell for all the guns have the G.S. gauge of fuze hole; those for the 7-pr. had originally the common gauge.

Common shell.

The studs for the 16-pr. projectiles are made of gun-metal for common shell; those of the 9-pr. and 7-pr. were formerly made of zinc, in order not to injure the bronze guns first introduced for these calibres; the manufacture of 9-pr. bronze guns has been discontinued, and the studs are now made of copper. Zinc does not corrode rapidly when not in contact with another metal, but when iron and zinc together are exposed to the action of the weather a galvanic action is set up which hastens corrosion, and projectiles may be seen in which the zinc studs are reduced to a mere white patch of oxide of zinc from this cause.

* Any 2·5-inch shells marked "7-pr. 400 lb." will be re-marked "2·5-inch," § 6660.

Hence projectiles with zinc studs should always be stored under cover when practicable.

The construction of the common shell will be seen from the cut, which shows that for the 16-pr. gun. All these shell are lacquered inside, the bursting charge is put in loose in the 7-pr. and 9-pr., the fuze hole being made sufficiently long to take a G.S. wad as well as the plug. In the 16-pr. the bursting charge is contained in a bag. Construction.

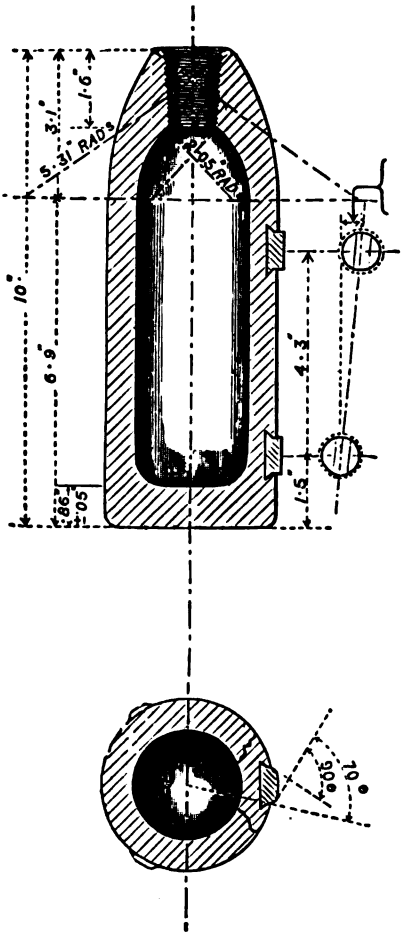
R.L. Percussion, Mark IV.—Mark I, if any existing, may be used for the 7-pr. and 9-pr. only. The Small Percussion will eventually supersede the R.L. fuze for these shells. Fuzes.

Black, studs unpainted. Paint.

Filled or empty, transported boxed. Issue.

There is only one calibre of double shell, viz., that for the 7-pr. Double shell.

Common Shell, 16-pr.



It is intended for high-angle fire with low charge (4 oz.), and as it carries a comparatively large bursting charge (15 oz.) it would be effective against houses. Use.

The construction is similar to that of the 7-pr. common shell.

Fuzes. The direct-action, percussion and small percussion fuzes, and 15-seconds M.L. with special priming, may be employed with this shell.

Paint and issue. Paint and issue as for common shell.

Calibres 16-pr., 9-pr., and 7-pr.

Shrapnel shell. *Shell, R.M.L., Shrapnel*, are the most important projectiles, two-thirds of all those in the equipment of field and mountain guns being of this nature.

Construction. The construction of these shell generally resembles that of the B.L., but they have cast-iron bodies and copper studs for all natures. (*See* cut, which shows the section of a 16-pr.) They have the composite socket, gun-metal tube, and mixed-metal balls, packed as usual in melted rosin, brown paper lining, and felt washer, which for these shell is soaked in beeswax.

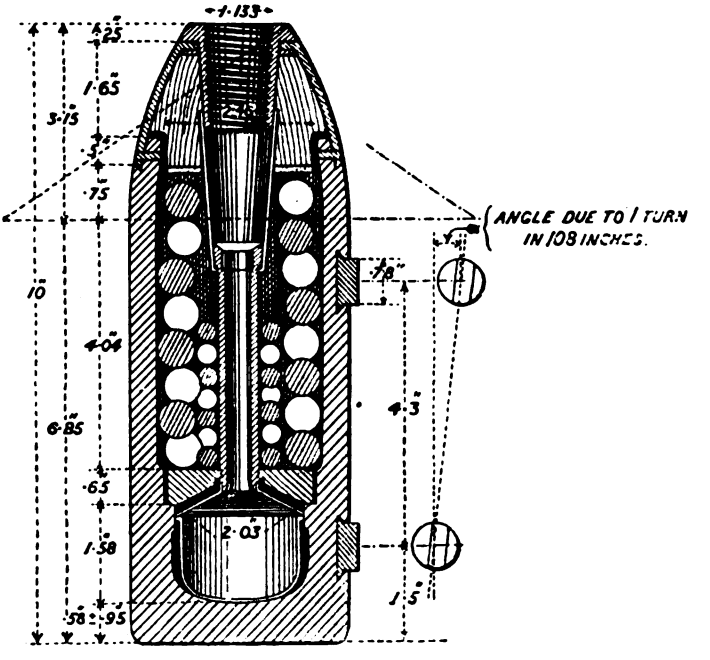
In the 9-pr. and 7-pr. the diaphragm is not coned, and in the 16-pr. the interior diameter is slightly reduced towards the top, with a view to increasing the number of fragments into which the shell breaks up.

The 7-pr. has six weakening grooves in body and base, the 9-pr. has them in the powder chamber only, and the 16-pr. has none, but the thickness of metal all round the tin cup is slightly reduced, as shown in the cut.

Fuzes. For the 16-pr, 9-pr., and 7-pr., the 15-seconds M.L. fuze; it will be superseded by the T and P, No. 56, Mark IV.

Issue. Filled or empty, transported boxed.

Shrapnel Shell, 16-*pr.*



Studless Shell.

The common and shrapnel shell for the 13-pr., and the shrapnel and ring shell for the 2·5-inch guns are studless; the star shell for the 2·5-inch has studs, although this gun is rifled on the modern polygrooved system.

Shell, R.M.L., Common, of cast iron, are made for the 13-pr. Common shell.

As there are no studded common or shrapnel shell for these guns, the word "studless" does not form part of the nomenclature. In all these pieces the shell receive their rotation from an automatic gas-check, which for convenience of transport and loading is always permanently secured to the projectile.

The 13-pr., Mark II, common shell, are of cast iron, with parallel walls, having the G.S. fuze hole, and lacquered inside. The base is formed by a projecting disc similar to that of the heavier studless shell, and having a groove round its edge, to which the gas-check is attached by being spun on before the shell is issued. Construction, 13-pr. and 4-inch howitzer, Mark II.

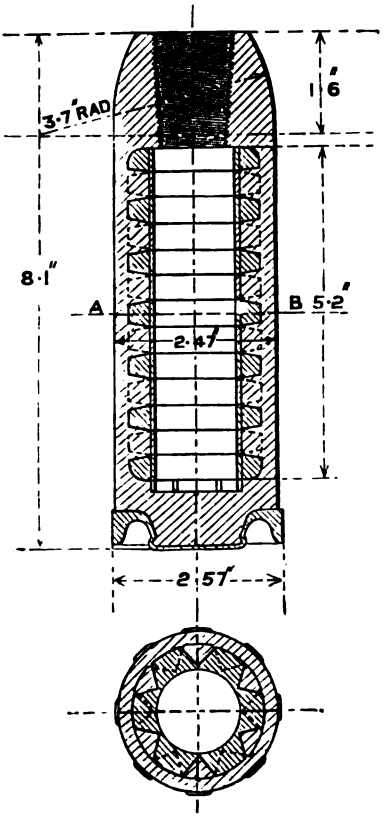
The edge of the base in front of the disc is not, however, rounded off as in the heavier natures, but forms a flat ring. To ensure the gas-check imparting its rotation to the shell, the surface of this ring is in the 13-pr. formed into 20 saw-shaped serrations, which fit into corresponding grooves in the front of the gas-check.

An iron common shell was formerly made for the 2·5-inch, and is described in previous editions of this Treatise; it has been superseded by a ring shell, and is to become obsolete. § 6748.

All these shell are lacquered inside, and the bursting charge is put

Shell, R.M.L., Ring, 2·5-inch, Mark I.

Scale, ½.



in loose the fuze hole being made sufficiently long to take a G.S. wad as well as the plug.

Fuzes. For the 13-pr. the R.L. Percussion; to be superseded by the Small Percussion.

Filled or empty, transported boxed.

Issue. *Shell, R.M.L., Ring, 2·5-inch, Mark I,* is of iron cast on a core of
§ 6748. 13 iron rings, each ring so weakened that it should break up into six segments on bursting. The inside is lacquered, and no bag is used with it. The base has 12 radial ribs. It is issued with the Mark II gas-check spun on. Its weight when filled and fuzed is the same as the shrapnel when filled and fuzed.

Filling. The powder used is a mixture of R.L.G.^{2} and R.F.G. (*see* p. 8).

For method of filling with stars, incendiary Mark II *see* p. 260.

Fuzes. Small percussion fuze.

Paint. Body black. The head is painted blue down to the shoulder.

Issue. Filled or empty, transported boxed.

Shrapnel shell. *Shell, R.M.L., Shrapnel,* of forged steel, are made for the 13-pr., and 2·5-inch guns.

Shell, R.M.L., Shrapnel, Mark I, of cast iron, for the 13-pr. guns only.

The shrapnel shells for the 13-pr. have the bursting charge in the base, and those for the 2·5-inch have the bursting charge in the head.

13-pr., Mark II. § 5050. The *Shell, R.M.L., Shrapnel, 13-pr., Mark II,* is of forged steel, with solid base. Near the base the walls are thickened, forming a shoulder, on which rests the wrought-iron diaphragm, and beneath which fits a pear-shaped tin cup to contain the bursting charge. The powder chamber is made of this peculiar shape in order to thicken a portion of the base, and thus prevent any tendency towards breaking up at that point. A gun-metal pipe of small internal diameter screws into the centre of the diaphragm, and its upper portion is enlarged and threaded to take the shrapnel primer. The walls are lined with glazeboard and filled with 133 mixed metal bullets of 34 per lb., molten rosin being run amongst them to bind them together. A felt washer is placed over the bullets and keeps the rosin from working up. A tin socket is soldered over the upper end of the central pipe. The head is of Bessemer metal, lined with wood, and is lightly attached to the body by twisting pins and rivets, solder being run round the exterior of the junction to further secure it. A gun-metal socket is soldered to the head; it is screwed to the G.S. gauge, and its lower end fits inside the tin socket, but they are not permanently fastened together. The base is prepared to take the automatic gas-check, having the locking rim and serrations as in the common shell.

Some 13-pr. shrapnel Mark II have been made rather shorter than the above; these are to be used up for practice, and are marked with a yellow band.

Mark I. § 4060. A Mark I shrapnel of cast iron has been made and issued for the 13-pr. R.M.L. The construction differs very slightly from that above described; the body is thicker, consequently there is less capacity for bullets, and the walls are lined with brown paper. The tin cup is of the ordinary coned description. Its contents are 116 bullets of 34 per lb.

In the 13-pr. shrapnel, both steel and iron, the central gun-metal pipe is of smaller internal diameter than usual, in order to economise space, and for this reason special care has to be taken in filling these shell.

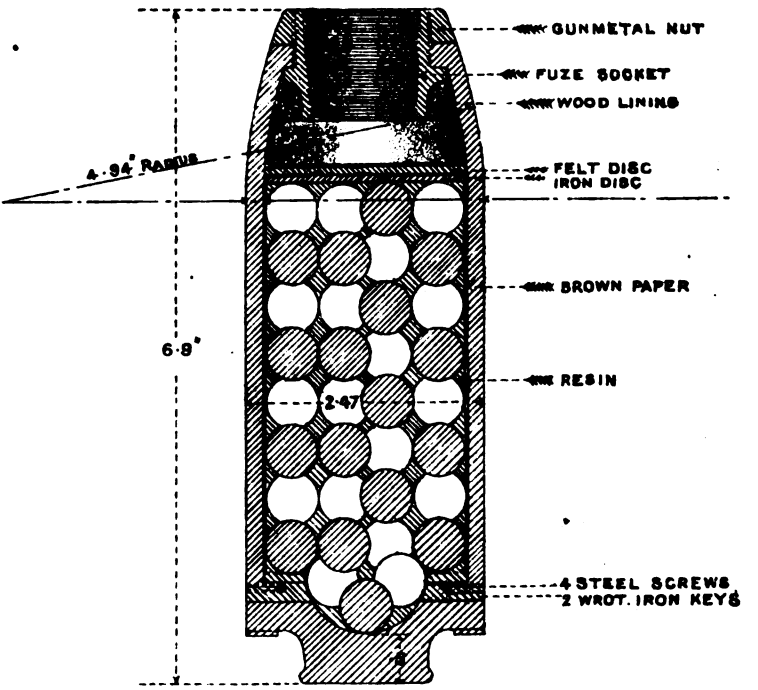
Primers. These shell are carried on their sides in the limbers and ammuni-

SHELL R. M. L. SHRAPNEL 2·5 INCH MARK IV. L

FORGED STEEL.

SCALE 1/2

AVERAGE TOTAL WEIGHT	7 – 10
IN MIXED METAL BALLS (18 PER LB)	2 – 14½
BURSTING CHARGE	½



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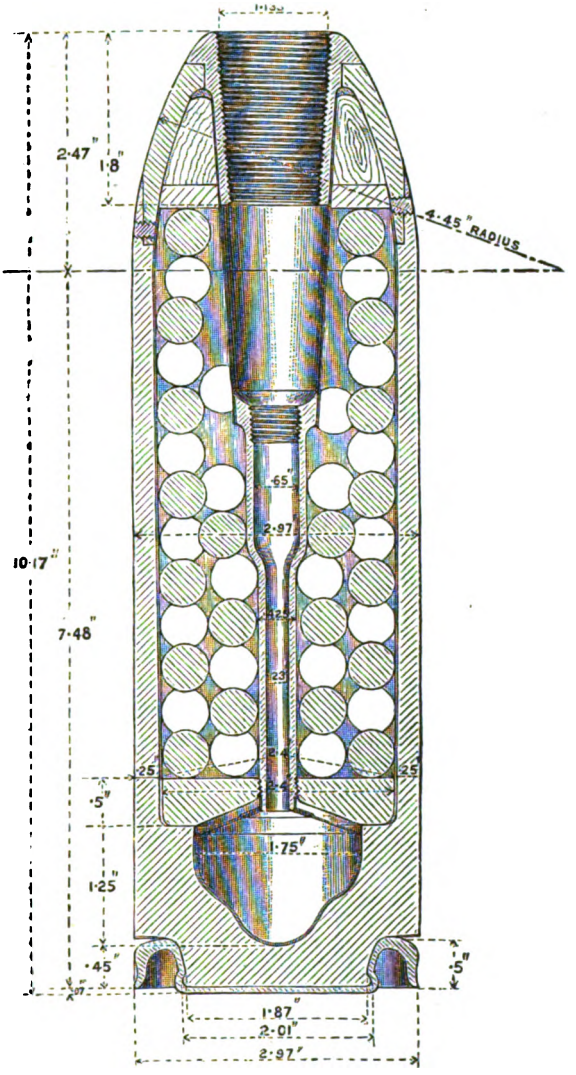
Shell, R.M.L., Shrapnel, 13-pr., Mark II.
Scale, 1.



tion wagons, and in several instances the bursting charge has been found to work its way either through or round the brass primer into the socket. To remedy this defect, Mark III primer (*see* p. 361) was introduced.

In any case in which part of the bursting charge is found in the socket, the primer should be removed, and the powder returned to the tin cup, as the charge of these shell is small, and the loss of even a few grains might impair its efficiency.

Shell, R.M.L., shrapnel, 2·5-inch, Mark IV, has the bursting charge contained in the head. (*See* Plate XXIV.) §§ 8972, 9727.

This shell has a body of forged steel tubing, head and body in one piece, and the base is of malleable cast iron or mild steel. The fuze

socket is of gunmetal with a flange on the exterior so that when screwed into the head from inside, the socket flange fits against the interior. Above the head, a gun-metal nut screws on to the end of the fuze socket and down on to the truncated top of the head. The fuze socket is tapped to the G.S. pitch and taper and is long enough to take a T. and P. fuze over a wad.

The head is lined with wood and a tin cup is placed inside to contain the bursting charge which is put in loose the neck of the tin cup fitting round the socket. Under the tin cup is placed a felt disc and a wrought-iron one.

The body is lined with brown paper and filled with mixed metal balls, 35 per lb. packed in melted rosin.

The base is then lightly attached by four steel screws, formerly pins, and two wrought-iron keys, the latter fitting into undercut slots in the body and base. The latter is prepared to take the automatic gas-check which is issued permanently attached to the base by being spun on.

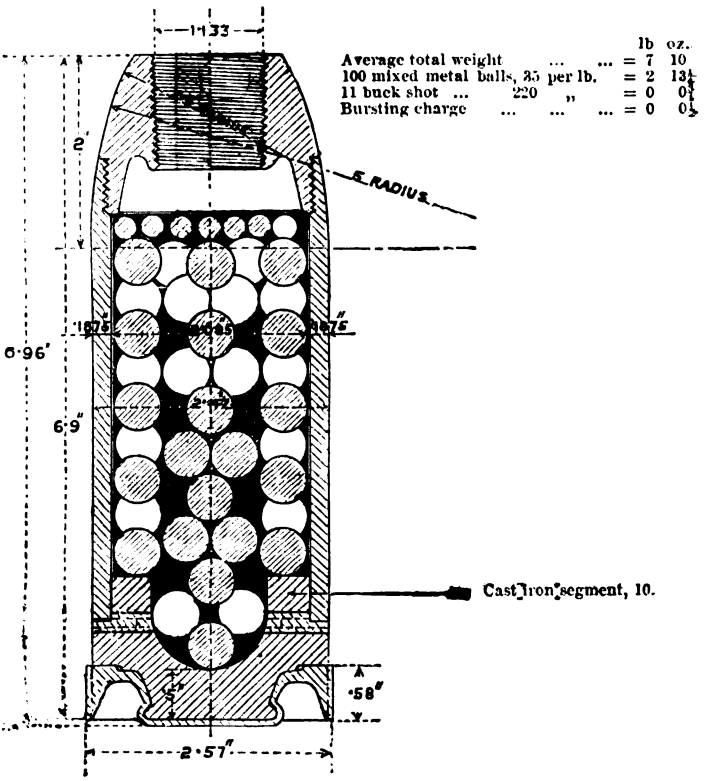
Action. The action is the same as for the B.L., Q.F., or Q.F.C. 4-inch shrapnel Mark VI, p. 218.

§ 5031. Shell, R.M.L., shrapnel, 2·5-inch, Mark III differs from Mark IV as follows:—

I. A malleable cast-iron head, tapped to G.S. pitch and taper, lacquered internally and with tin disc soldered to its under-surface,

Shell, R.M.L., Shrapnel, 2·5-inch, Mark III, Forged Steel.

Scale, ½.



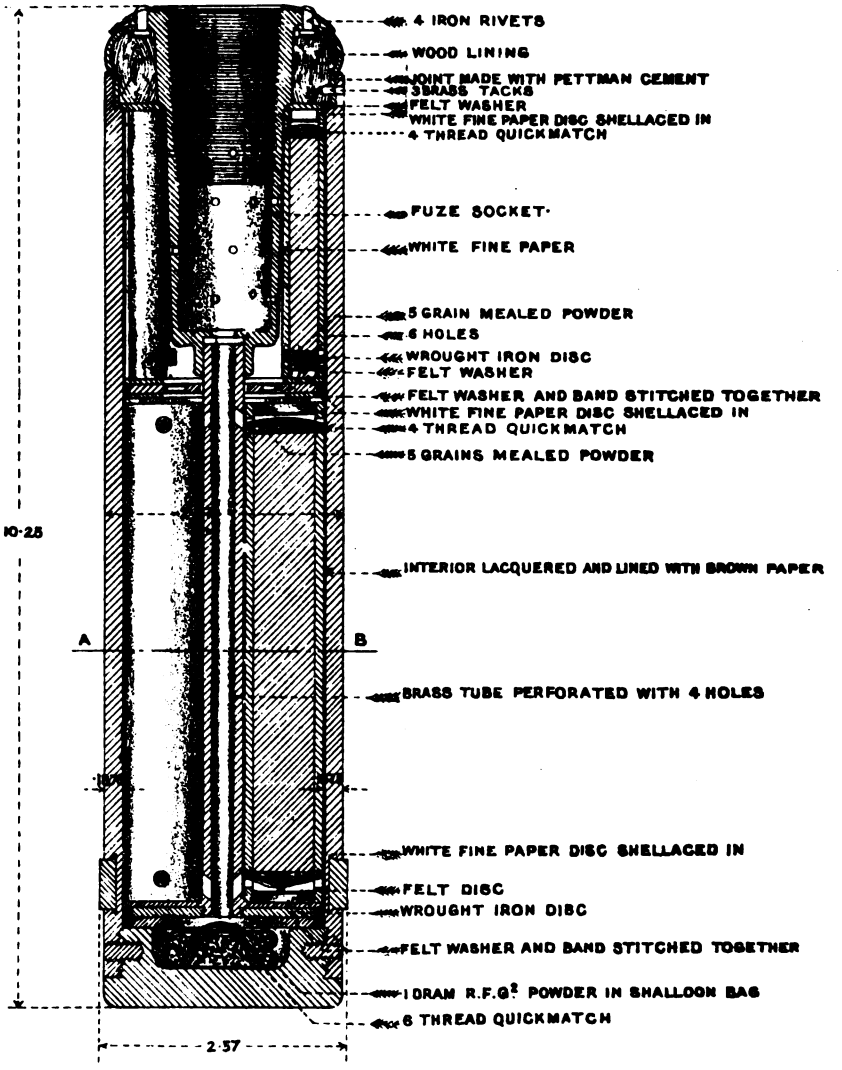
	lb	oz.
Average total weight	= 7	10
100 mixed metal balls, 35 per lb.	= 2	13½
11 buck shot ... 220 "	= 0	0½
Bursting charge	= 0	0½

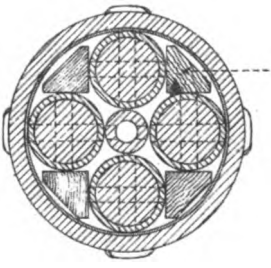
SHELL, R. M. L. STAR, 2·5 INCH, MARK IV. L

ELONGATED

SCALE ½

MEAN TOTAL WEIGHT = LB. 6 OZS. 0





SECTION AT A. B.

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screws into the front of the body and is kept from working loose by a keep screw.

II. It has no tin cup felt or wrought-iron disc.

III. Ten cast-iron segments rest on the the shoulder of the base inside the shell, and the base is lightly attached by shearing pins instead of shearing screws.

The disadvantage of Mark III shrapnel is that on the ignition of the bursting charge there is a great tendency of the head to be blown off instead of the base.

Mark II.—The cavity in the head is larger than in Mark III, and a shalloon bag is used to contain the bursting charge. The contents are the same except that 70 buckshot are inserted instead of 11 as in the Mark III. §§ 4142, 9864.

Mark I, not published in List of Changes, differed only from Mark II in its contents, which were 98 lead bullets. § 9864.

Mark I* has a cylindrical chamber in the head, and the bursting charge is contained in a cylindrical shalloon bag. § 9864.

The existing stock of R.M.L. 2·5-inch shrapnel, Marks I, I*, II and III, are to be used up at practice as authorized. § 9864.

The 13-pr., the T. and P., No. 56, Mark IV. Fuzes.

The 2·5-inch, the T. and P. short which will be superseded, when used up, by the T. and P., No. 56, Mark IV.

Black, tips painted red for 1-inch in depth, except the 2·5-inch Mark I* which is painted red all over. The gas-checks are unpainted. Paint.

Filled or empty, transported boxed. Issue.

Star Shell.

Shell, R.M.L., star, elongated are made for the 2·5-inch and 7-pr. guns. Star shell.

Shell, R.M.L., star, 2·5-inch, Mark IV, has a body of forged steel tubing with a base screwed in. The base, which may be of malleable cast iron or mild steel, is prevented from unscrewing by keep pins. The interior of the shell is lacquered and lined with brown paper. A recess in the base contains a shalloon bag, filled with a bursting charge of one dram R.F.G.[2] gunpowder primed with quick-match. A wrought-iron disc, which rests on a felt washer and band, covers the recess, and contains the lower end of the perforated brass tube which is screwed into it. On top of the wrought-iron disc is placed a felt disc on which rest four large stars, kept in position by four wood wedges placed between. The wedges are slightly longer than the stars so that they support the disc with the upper tier of stars and prevent the lower tier from being crushed. A perforated wrought-iron disc with felt washer above, and felt washer and band below, fits on top of the wedges and supports eleven smaller stars. The smaller stars are covered by a felt washer. (*See* Plate XXV.) § 9521.

The stars consist of rolled paper cases, driven with star composition (*see* p. 552), and near each end are four holes threaded with quick-match. Mealed powder is placed on the inside of the latter and star composition outside it. Mealed powder priming is placed over the star composition, this being covered with a paper disc.

The head is of sheet iron, lined with wood, having a perforated gun-metal fuze socket, screwed to G.S. taper and pitch, riveted on. The lower part of the perforated socket is covered on the outside with white fine paper, and the lower end fits round the top of the central pipe, the later being perforated near each end to allow the

flash from the fuze to reach the quick-match priming in the long stars. The head is secured to the body by brass tacks, or rivets, and Pettman cement.

The shell is rotated by four copper studs near the base.

§ 6069. Shell, R.M.L., star, 2·5-inch, Mark III differs from Mark IV as follows :—

The central pipe is screwed to the fuze socket. The base is of malleable cast-iron and the disc over the bursting charge is perforated and made of tinned iron. The interior of the shell is neither lacquered, nor lined with brown paper, and Pettman cement is not used at the junction of head and body. There are no felt washers. The central disc or diaphram is not used and there are no wood wedges.

The shell contains 20 stars, 10 large and 10 small, built up in three layers.

Stars. Each star consists of a rolled paper case driven with composition (*see* p. 552), and primed at both ends with two short lengths of quick-match. The face of the composition in each end is roughened and coated with mealed powder and sulphur, and the ends of the body for about ·25 inch are also coated with sulphur.

They are woolded with fine copper wire round the body and over the ends to strengthen them.

Mark II. Mark II differs from the above as follows :—

§ 4693. 1. There is no sulphur priming on the ends of the stars, but the quick-match is rather longer.

2. The central pipe fits inside the bottom of the socket, but is not screwed to the latter.

3. The blowing charge consists of a disc of paper with quick-match sewn on the upper side of it.

Mark I. A few Mark I shell have been issued. They differ from Mark II in having (1) the base made of gun-metal and rounded, (2) four projections on the base instead of four studs on the body, and (3) a larger chamber for the blowing charge.

§ 9455. Shell, R.M.L., star, 7-pr., Mark VI, has a body of forged steel, lacquered internally and lined with brown paper. A recess is formed in the base into which a felt disc is placed for the reception of a shalloon bag, containing a bursting charge of 1 dram R.F.G. gunpowder, primed with quickmatch. Over the felt is placed an iron disc (having a central hole), with a thin felt disc on top. On this is placed a tier of four large stars kept in position by four wood wedges placed between. The wedges are slightly longer than the stars and prevent the latter from being crushed, as the perforated iron disc, or diaphragm, with felt on either side of it, rests on them. This disc supports the upper tier of nine smaller stars which are covered by a felt disc. (*See* Plate XXVI.)

The stars in construction are similar to those for the 2·5-inch, Mark IV, star shell (*see* p. 275).

The head is similar to the 2·5-inch, but the perforated gun-metal fuze socket differs slightly at the bottom as there is no central pipe, in the 7-pr., for it to fit over. The head is secured to the body by brass tacks, or rivets, and Pettman cement, and the upper tier of stars is steadied by the fuze socket fitting between the stars.

The shell is rotated by three copper studs near the base.

§ 6068. Shell, R.M.L., star, 7-pr., Mark V, differs from Mark VI, as follows :—

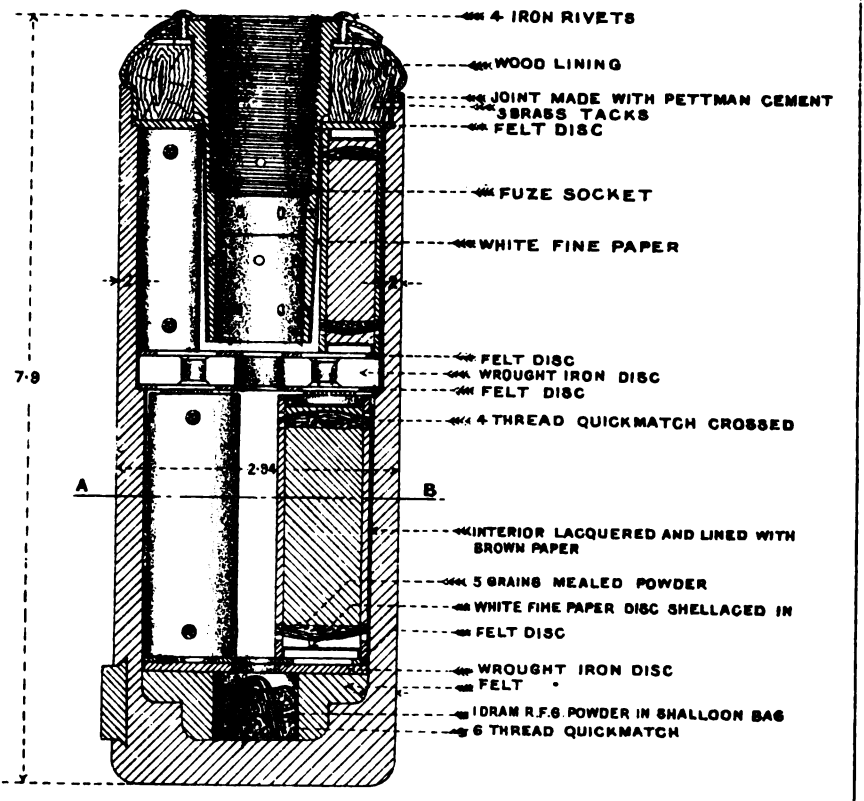
The body of the shell is of cast iron, it has a central perforated metal pipe, screwed at the top to the fuze socket, and at the bottom

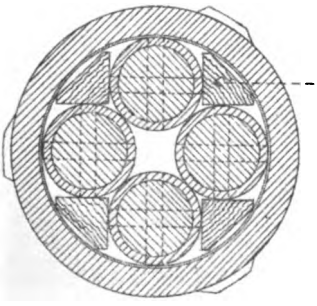
SHELL R.M.L. STAR 7 Pr MARK VI L

FORGED STEEL.

SCALE 1/2

MEAN TOTAL WEIGHT = LB. 6 — OZS. 12





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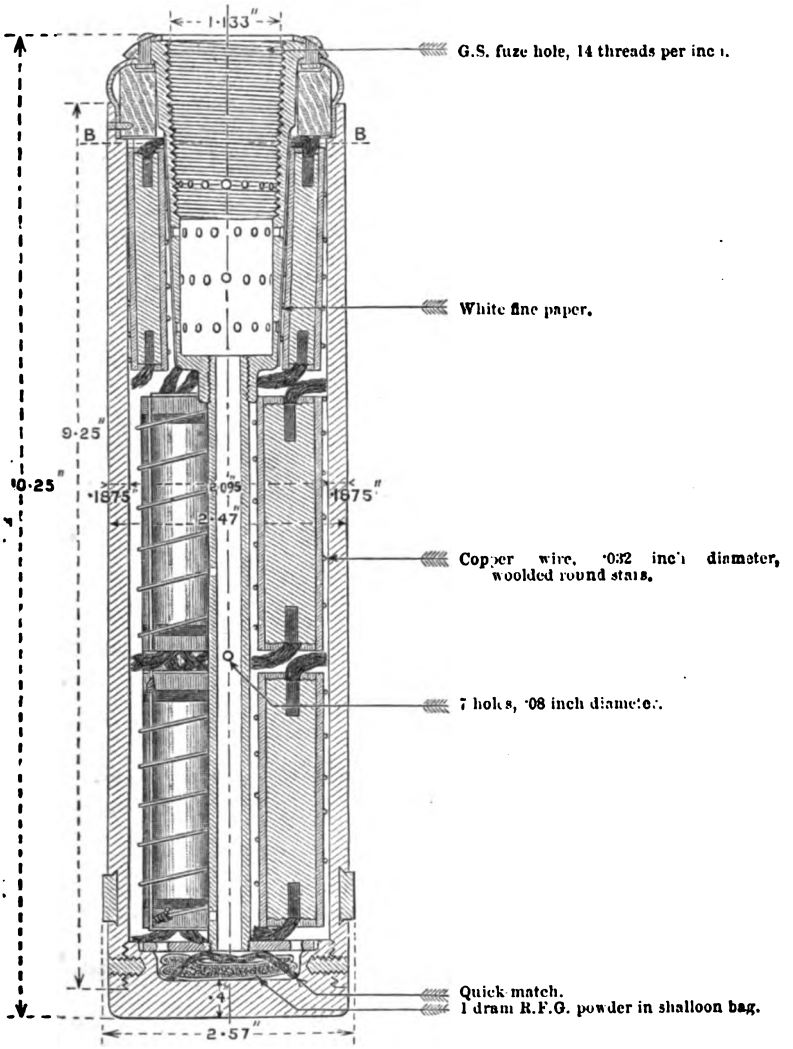
Shell, R.M.L., Filled Star, 2·5-inch, Mark III, Elongated.

Scale, ½.



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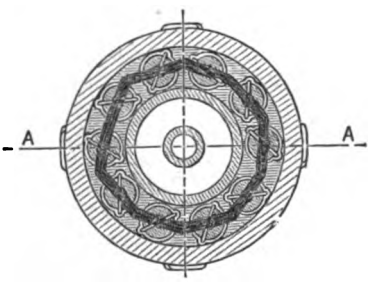


SECTION AT BB.

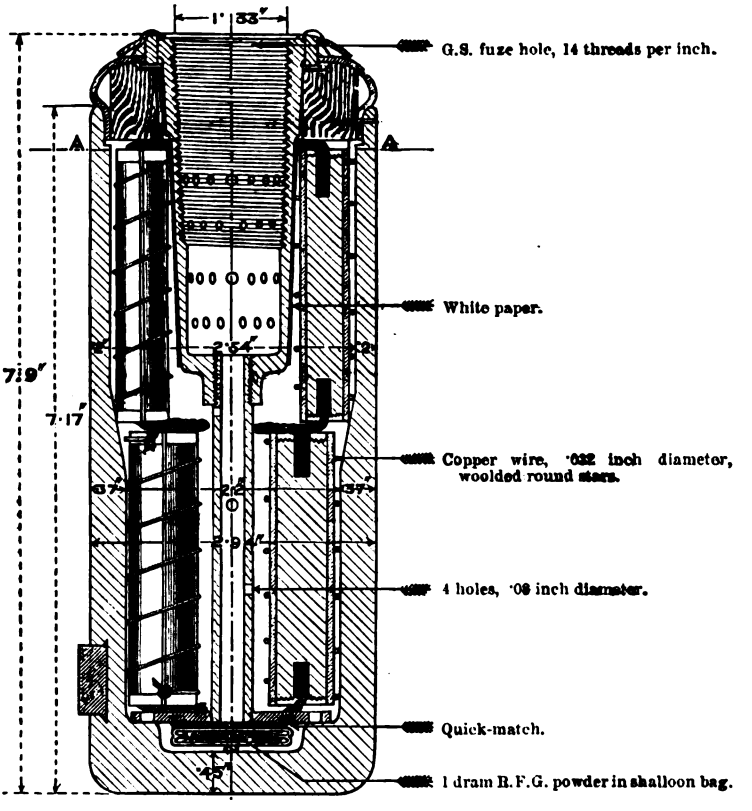
to a perforated tinned iron disc. The interior of the shell is neither lacquered, nor lined with brown paper, and Pettman cement is not used at the junction of head and body. There are no felt washers nor wood wedges, and no central disc, or diaphragm is used.

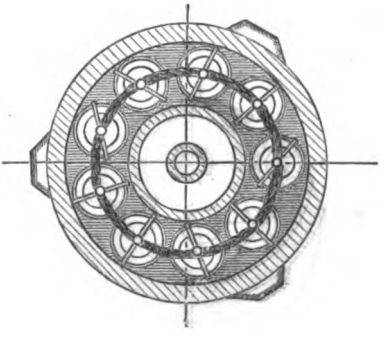
The shell contains 15 stars, 6 large and 9 small, in two layers.

The stars in construction are similar to those for the 2·5-inch, Mark III, star shell (*see* p. 276), except that the ends are not primed with sulphur.

Shell, R.M.L., Star, 7-pr., Mark V.

Scale, ½.





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The Mark IV Star shell, for the 7-pr., differs from the above in having the central pipe fitting mechanically inside the lower end of the socket, and the blowing charge is of quick-match, sewn on a disc of paper. The quick-match priming on the stars is also slightly longer. Mark IV. § 4828.

Previous patterns were an inch shorter, and contained only thirteen stars. Marks I, II, and III.

They had a bursting charge of ½ dram R.F.G. powder contained in a shalloon bag, but no central pipe. The stars had considerably more quick-match priming, and were not bound with copper wire.

Mark III had the socket perforated with several holes to allow the gas to escape and ignite the front row of stars. § 3788.

Marks I and II had a plain socket, and the head of tin instead of tinned iron. Mark I had zinc studs. This shell can be fired from the 9-pr. R.M.L. gun, but is not included in the equipment for the latter. §§ 2492, 2526, 2756.

Fuze, time, 15 seconds, M L., special priming, Mark I, for 2·5-inch and 7-pr. Fuzes.

Black, except the studs which are unpainted, a red band ½-inch wide, 1½-inches from the point, denoting filled, and on the shoulder, as a distinguishing mark, a white disc upon which a red star is painted. Paint.

R.M.L. 2·5-inch and 7-pr. filled as above and transported boxed. Issue

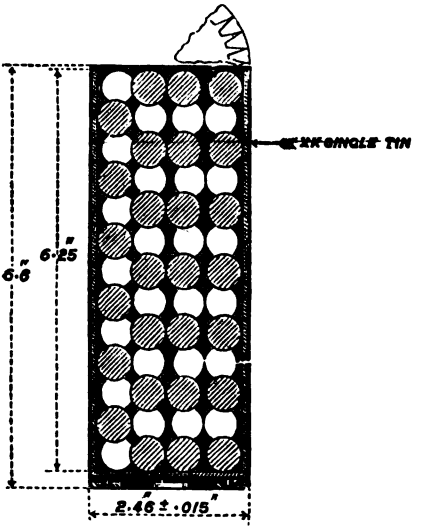
Case Shot.

Shot, R.M.L., Case, are made for the 16-pr., 13-pr., 9-pr., 7-pr., and 2·5-inch guns. Calibres.

All are of the F.S. construction, viz., tin body in three pieces soldered together longitudinally, with tin bottom attached by the same means and strengthened with a ring of sheet iron riveted on. Construction. §§ 2279. 5888, 4060, 2802, 5990, 4649, 5683, 7570, 8108.

The top is of tinned iron secured by the fringed body being bent over and soldered. There is a loose sheet-iron disc inside the base,

Shot, R.M.L., Case, 2·5-inch, Mark I.



and a loose wrought-iron lining of three segments. The contents are mixed metal balls packed in clay and sand. (*See* cut.)

The loose disc and segmental linings in earlier patterns of the 9-pr. were made of zinc to avoid injuring the bore of the bronze guns.

§ 8108. When 16-pr. I, 13-pr. I, 9-pr. IV, 7-pr. IV and V, and 2·5-inch I are fitted with handles, an asterisk will be added to the numeral.

For the 9-pr. the shot has a wood disc under the top, to bring it up to the length required by the fittings of the axletree boxes.

The 7-pr. has a tin top, soldered on like the lid of a tin cannister.

This will frequently fail to break up when fired with the 6-oz. charge from the light 7-pr. gun.

In order to ensure the 7-pr. case shot breaking up, the latest pattern for that gun has the loose iron base disc fitting inside the segmental linings.

Paint. Black all over.

Issue. All are issued in boxes.

Drill shell. § 5126. A *Shell, R.M.L., Drill, 13-pr., Mark II*, is supplied for use at drill with that gun. It resembles the common shell, but has a flat base. To prevent injury to the bore of the gun, it is provided with two copper bands, one at the base, the other at the shoulder; these are attached in the same way as the Vavasseur driving bands. When used it will be filled with sand and sawdust, and plugged.

§ 4068. Mark I differs from the above only in having the band secured by copper rivets.

CHAPTER XVIII.—PROJECTILES FOR R.B.L. GUNS ON THE LEAD-COATED SYSTEM.

SHORT NOTES ON PROJECTILES FOR RIFLED GUNS. DISTINGUISHING MARKS FOR PROJECTILES.

INTRODUCTION. — SEGMENT, COMMON, AND SHRAPNEL SHELL. — CASE, AND SOLID, SHOT.—SUMMARY OF RIFLED PROJECTILES.—DISTINGUISHING MARKS.

Lead-coated system.

THE Armstrong R.B.L. system adopted for the Service in 1858, comprises the following guns, viz., 7-inch, 40-pr., 20-pr., 12-pr., and 9-pr. Some 40-pr. guns have been altered by giving the trunnions a quarter-turn to the left, so that the vent piece works in a slot on the right side of the gun. They are known as "side closing" guns. The tin cup is the only store which differs from those supplied to other 40-pr. guns.

Principle.

In the R.B.L. system a soft-coated projectile is forced through a polygroove bore of such diameter that it can only pass through by the lands cutting their way into the soft coat.

Calibres.

The calibres of Armstrong guns are the diameters taken at the smallest part of the bore immediately in front of the seat of the shot; this part is called the "grip," it extends a short distance up the bore.

The twist is in all cases uniform.

There is no windage in this system, and, consequently, the fuze cannot be lit by the flash from the charge.

Projectiles.

The projectiles in use with this system are common, segment, and shrapnel shell; case, and solid shot.

The 7-inch and 40-pr. are obsolete for Naval Service. § 10366.

COMMON SHELL.

Calibres.

Shell, R.B.L., common are made of the following calibres, viz., 7-inch, 40-pr., 20-pr., 12-pr. and 9-pr.

Construction.

These shell are of cast iron, about $2\frac{1}{2}$ calibres long, with ogival heads struck with a radius of $1\frac{1}{2}$ diameters and are lacquered internally.

A thin coat of an alloy of 19 parts lead to 1 part antimony extends from base to shoulder. This alloy is considered more economical than the first that was employed, which consisted of soft and antimonial lead, and tin.

Attachment.

The lead coat has been attached in three ways:—

1st. By tin solder and square cut grooves in the shell. This stripped very much.

§ 271. 2nd. By mechanical means, viz., undercut grooves. This was better.

§ 330. 3rd. By zinc-solder, no grooves.

This method, which was first introduced for the heavier natures, has been extended to all, whether new or repaired. It depends on the principle that zinc is capable of forming an alloy both with iron and with lead, and is thus carried out :—

The shell, having been cleaned, is warmed in a bath of equal parts of tin and lead, then dipped in a bath of liquid sal-ammoniac to remove any scale, and then into one of melted zinc, which attaches itself to the clean surface of the iron. The shell is again dipped into the lead and tin bath, this time to reduce the temperature, after which it is placed in a mould, and the melted lead and antimony run round it. The coat so formed is afterwards turned down to the proper dimensions, and a cannelure is formed near the base of the coat to take any lead stripping off the front part.

The diameter of the lead coat behind the cannelure is slightly increased, to enable the projectile to be gripped at the shoulder and base on ramming home, also to prevent windage, and to retain the grip until the base of the shell leaves the muzzle.

Stripping. Complaints were made of lead-coated projectiles stripping in such a manner as to render it dangerous to fire over the heads of troops; this objection, however, was made against shells with tin attachment, and can hardly apply to undercut or zinc attached shells. With the zinc, although it is the best method, the coat has occasionally become detached in places where the lead has risen up into blisters from the formation of gas underneath it.

Such blisters are generally small, and may be pricked and then hammered down, when they will in no way affect the fitness of the shell for service. If left to develop themselves they have been known to attain a large size.

A place on a shell where the coat is detached is detected by the flat, dull sound heard on tapping it, instead of the ring that comes from a sound spot.

Classes. Common shell are of two classes :—

1. Garrison.
2. Field.

Army Equipment, 1881, p. 164. 1. *Garrison.*—Calibres 7-inch and 40-pr., G.S. Gauge.

A light common shell was introduced at one time for N.S., the recoil from the heavy shell having proved inconveniently great on board ship. This shell may be met with in the L.S.; it is unsuitable for use with the 7-inch gun of 72 cwt., charge 10 lbs., as the charge is not sufficient to ensure the lubricators breaking up properly when the light shell is used; on an emergency, however, the shell might be used.

Fuzes. The percussion fuzes are the direct action for the 7-inch, and the R.L. and small for the 40-pr. The primer, fuze, percussion, R.L. is used in conjunction with the R.L. fuze for the 40-pr.

Issue. Filled or empty, loose.

Field. 2. *Field.*—Calibres, 20, 12, and 9-prs.; gauge, Armstrong field service, except the 20-pr. N.S., which has the G.S. gauge.

§ 2061. They have a flanged gun-metal socket to take the fuze; the socket contracts at the bottom to prevent the fuze being put in with the rim down.

§ 1708. These shell take the R.B.L. field service plug with left handed thread.

As this gauge is tapped with a coarse, quick screw, the plugs are apt to unscrew from the jolting of the limber. Care must be taken to examine the plugs frequently, and to screw up any that have become unscrewed.

The 20-pr. N.S. shell takes the R.L. or D.A. percussion fuze. All the others take the B.L. plain. Fuzes.

The 12 and 9-pr., empty or filled, are issued boxed. Issue.

Segment Shell.

Shell, R.B.L. Segment have been made of the following calibres, viz., 7-inch, 40-pr., 20-pr., 12-pr. and 9-pr., but no more will be made. The existing stock will be used up and then these shell will become obsolete. Existing L.S. segment shells are to be used up for practice. Calibres. § 4954.

The shell consists of a cast-iron body, about 2 calibres long, lined with cast-iron segments built up in layers, having a powder chamber in the centre and the base is closed with a cast-iron disc. Externally the shell closely resembles the common shell (excepting paint marks) but the lead coat extends somewhat more over the base to retain the cast-iron disc, under the segments, in position. Construction.

Segment shells were divided into two classes :— Classes.

1. Garrison.
2. Field or Boat.

Garrison 7-inch and 40-pr. G.S. Gauge, formerly Moorsom gauge. They are lacquered inside and take a bursting charge of loose powder.

The 7-inch takes the direct action percussion, and the 40-pr. the R.L. percussion. The time fuze for use with both guns is the 15-seconds with detonator Mark III. Fuzes.

Filled or empty, loose. Issue.

Field or Boat—20-pr., 12-pr., and 9-pr., Gauge, Armstrong Field Service.

In these shell the powder "shell F.G." is contained in wrought-iron gas-pipe bursters, the pipe is dropped into the powder chamber, which is of the same diameter as the fuze-hole, the brown paper cover in which the burster is issued is retained, the top end being torn off to allow ignition, the ends of the burster are closed by serge and paper discs fastened to metal rings. § 754. Bursters. § 1954.

Bursters are occasionally found to leak; this may be remedied as a temporary measure by inserting the burster in the shell, or, if already in the shell, by reversing it.

Field service shells are carried filled, over the burster is placed a wooden plug covered with serge to keep it from shaking about, the R.B.L. field service gun-metal plug with leather collar is then screwed in.

To prepare the shell for firing, the gun-metal plug is unscrewed, the serge-covered plug taken out, and the fuze dropped in rim uppermost; the safety pin being withdrawn (in most segment shells it is impossible to put the fuze in wrong, as the rim comes in the way), the gun-metal plug is again screwed in. It was found necessary to insert a lead disc at the bottom of the shell to keep the percussion fuze from having play in the shell, owing to the screw thread in the gun-metal plugs being shorter than the time fuze. Shells which have these discs permanently fastened in are marked with the letter D on the lead coat. This does not apply to shells for N.S. § 2028. § 2050.

Fuzes. The B.L. plain percussion and the E time fuze.

Issue. The 12-pr. and 9-pr., empty or filled, are issed boxed.

Paint. The tips of all segment shells are painted blue, and the uncoated portion of the base is painted black, the paint in both cases extending over the edge of the lead to prevent corrosion.

Shrapnel Shell.

Calibres. Shell, R.B.L., shrapnel are issued for the 7-inch, 40-pr., 12-pr. and 9-pr. guns. The general construction is much the same as for R.M.L. guns.

These shell are of cast iron, about $2\frac{1}{2}$ calibres long, with ogival heads struck with a radius of $1\frac{1}{2}$ diameters. They have internal weakening grooves both in the body and in the base. The 7-inch and 40-pr. have wrought-iron central pipes, the 12-pr. and 9-pr. metal pipes, and each have the composite fuze socket. They are filled with mixed metal balls.

Fuzes. These shell have the G.S. gauge, and the fuze to be employed with them is the 15-seconds with detonator, Mark III. The 5-seconds and 9-seconds B.L. time fuzes may also be used up with these shell.

For the 7-inch and 40-pr. shrapnel the middle sensitive fuze is also used, but when this fuze is used up it will be superseded by the middle T and P fuze.

Paint. The tips are painted red for 1 inch deep, the remainder of the shell, except the lead coat, being painted black, the paint extending over the edge of the lead to prevent corrosion.

Issue. The 12-pr. and 9-pr., filled or empty, boxed. The 7-inch and 40-pr. loose.

Case Shot.

Shot, R.B.L., case are made for all natures.

§ 1611. The R.L. pattern of case is now adopted. The general construction of R.B.L. and R.M.L. case is similar, but the former have solder studs to prevent their being rammed too far into the bore. Some early patterns of field service case have segmental rings of solder instead of studs.

The balls of the earlier patterns of case shot were packed in coal dust, but equal parts of clay and sand are now used.

The 7-inch case shot is made to suit both R.M.L. and R.B.L. 7-inch guns by having three large solder studs at one end, which cause it to stop in the shot chamber when ramming home in a R.B.L. gun, but find room in the three large grooves of the Woolwich gun.

In other respects it generally resembles the F.S. pattern. For details, *see* p. 549.

The 7-inch is the only one provided with a handle.

The 7-inch and 40-pr. case shot contain 8-oz. sand shot, the 20-pr., 12-pr. and 9-pr. contain mixed metal balls.

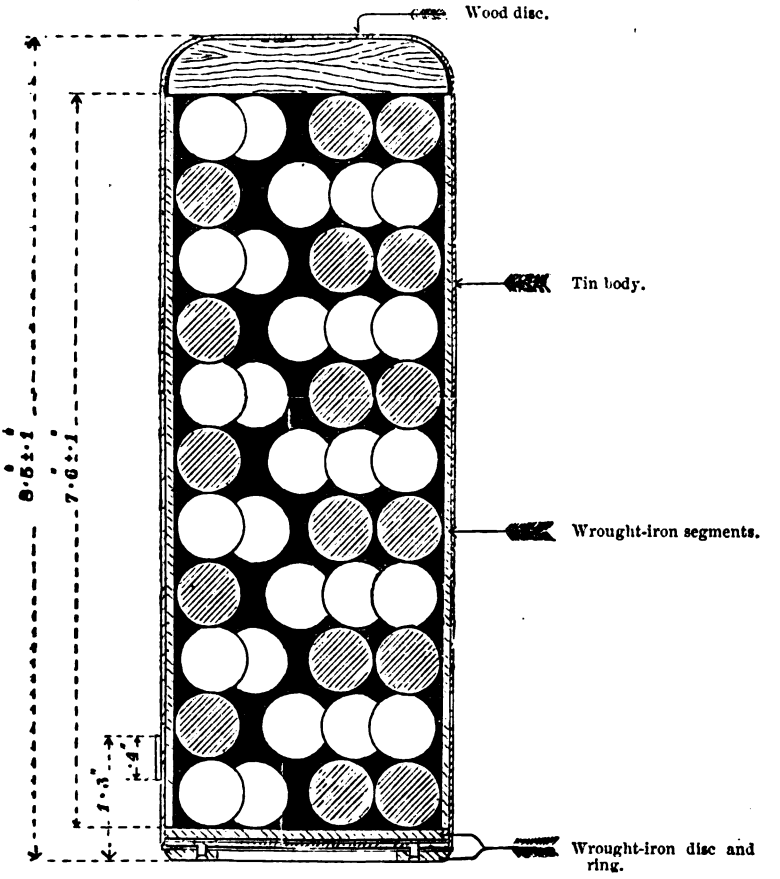
§ 5219. The 20-pr. R.B.L. case shot, Mark IV, differs from previous patterns in having the loose iron base disc made smaller, so as to fit inside the longitudinal segments in order to make the shot break up more easily on discharge.

In the 20-pr., 12-pr., and 9-pr., case the top is of rounded tin, a wooden disc fitting underneath it. (*See* cut.)

Paint. Case shot are painted black all over.

Issue. The 12-pr. and 9-pr. boxed, the remainder loose.

12-*pr. Case Shot. Mark IV.*



In loading R.B.L. case the studs go towards the rear. The case shot should be pressed home gently, if much force is used it may be rammed past the shot chamber, the soft studs being shorn off. Loading.

Solid Shot.

Shot, R.B.L., Solid, are made of the following calibres, viz., 40-pr., 20-pr., 12-pr., and 9-pr., and they are only used for practice. Calibres.

They have much the same form and length as segment shells.

They are issued loose, but might be packed in boxes if convenient for transit or for India. Issue.

Tip white. Paint.

Drill Shot.

Shot, R.B.L., Drill.—For the larger guns down to the 20-pr. inclusive, recovered shells, with their coating turned down, are used. For the 9 and 12-prs. special shot are used with the lead coating extending over the head, to avoid injury to the copper bush. The shell or shot used for drill purposes may be known by the absence of cannelures. §§ 942, 1088, 742.

Paper Shot.

§ 10330. Shot, paper, empty, Marks I, II and III are issued for the 7-inch, 40-pr. and 20-pr. guns in the L.S. They are brought up to weight in the usual way, and the rear of the shot is enlarged to prevent its being rammed too far into the gun.

Short Notes on Projectiles for Rifled Guns.

The following remarks will in great part be found scattered through the various chapters treating on rifled projectiles. They are here given in a brief collected form, and as generally as possible. Details of the various projectiles will be found in the places allotted to them, and, as a rule, only the latest patterns will be dealt with here. The few notes here given are simply intended to aid the memories of those who already have a general knowledge of the subject.

Projectiles in use. The projectiles fired from rifled guns, including Q.F. 12-pr. and up, are:—

Common shell (iron and steel).
" pointed shell (steel and practice).
" lyddite shell.
Double shell.
Armour-piercing shell.
Ring shell.
Shrapnel shell.
Segment shell.
Star shell.
Palliser shell.
" shot.
Armour-piercing shot.
Case shot.
Solid shot.

Common shell. Common shell are fired from all natures of rifled guns and howitzers, except the B.L. 12-pr. 6 cwt., and B.L. or Q.F. 15-pr., and R.M.L. 2·5-inch guns.

Length. For B.L., Q.F. or Q.F.C. guns they are from 3 to 4 calibres long, for R.M.L. about 3 calibres long, and for R.B.L. about $2\frac{1}{2}$ calibres long.

They are all now lacquered internally with red lacquer.

Gun-metal bushes. The B.L., Q.F. or Q.F.C. guns 4-inch and up; B.L. howitzers 5-inch, 5·4-inch and 6-inch; R.M.L. 40-pr. and upwards have flanged gun-metal bushes in the nose; the R.B.L. 7-inch, 40-pr. and 20-pr. N.S. have plain gun-metal bushes.

Flanged sockets. The R.B.L., 20-pr., L.S., 12-pr. and 9-pr. common shell have flanged gun-metal sockets to support the B.L. plain percussion fuze.

Recess for Naval wad. The following common shells have a ·2-inch recess in the nose to take the Naval wad:—

B.L., Q.F. or Q.F.C. 4-inch and upwards (guns and howitzers) except the 30-pr. gun.
R.M.L., 40-pr. and upwards.
R.B.L., 7-inch, 40-pr.; and 20-pr. N.S.

Burster bags. Burster bags are used in filling common shells as under:—

B.L., Q.F., or Q.F.C., 4-inch and upwards (guns and howitzers).
R.M.L., 16-pr. and upwards.

R.M.L. howitzers, 6·3-inch, 6·6-inch, and 8-inch.
R.B.L., 7-inch and 40-pr.

Loose powder.

The common shells which are filled with loose powder are:—
R.M.L. 13-pr., 9-pr. and 7-pr. guns.
R.B.L. 20-pr., 12-pr. and 9-pr. guns.

Filled through base.

The following common shells are filled through the base:—
B.L., Q.F. or Q.F.C., 6-inch and upwards (except 6-inch howitzer practice Marks II and III).
R.M.L., studless, 80-pr. and upwards.
R.M.L., howitzers, 6·6-inch and 8-inch, studless.

Filled through nose.

The common shells which are filled through the nose are:—
B.L. 6-inch howitzer practice Marks II and III, B.L. 5-inch and under.
R.M.L., all studded.
R.M.L., common, 10-inch H.A. iron and studless below the 80-pr.
All R.B.L.

Discs, base plug.

These are used to seal the base after filling in common shell:—
B.L., cast-iron, 6-inch to 12-inch.
B.L., cast-steel, 6-inch Marks IV and V.

Rings, base plug.

Lead rings are used to seal the base of cast-steel common shell, B.L. 9·2-inch and upwards, and 16·25 forged steel common shell, Mark II, R.M.L. 10-inch and upwards, and common-pointed B.L. 8-inch and upwards, when these shell have adapters screwed in the base, or else are fitted with large solid plugs.

Closing bases.

The bases of cast-steel common shell are closed as follows:—
B.L. 6-inch Marks IV and V, by a metal plug.
B.L., 6-inch VI, and 8-inch IV, by the large base plug.
B.L., 9·2-inch and 10-inch by the small adapter.
B.L., 12-inch and upwards, by the large adapter.
R.M.L., 9-inch large base plug, 10-inch small adapter.
R.M.L., 11-inch and up, large adapter.
B.L., 13·5 Mark I and 12-inch Mark IV have large solid plug, 9·2 Mark V the small.

The R.M.L. 10-inch H.A. iron and 6-inch howitzer practice Marks II and III have their bases closed by steel plugs riveted in.

Peculiar common shell.

The common shell for the 8-inch B.L. Mark VII and VIIA gun weighs only 180 lb.

The 80-pr., R.M.L., studded common shell has a strengthening band cast in the interior underneath the front ring of studs.

Unloading holes.

All R.M.L. common shell, 64-pr. and upwards, made between March, 1869, and February, 1873, have unloading holes in the head.

Pointed common shells.

Common pointed shells of cast steel are fired from:—
Q.F. 12-pr. and 4·7-inch.
B.L., Q.F. or Q.F.C. 4-inch and 6-inch and B.L. 5-inch and up.
R.M.L. 9-inch heavy, 8-inch, 9-inch, 10-inch, 11-inch, 12-inch, 25-tons, 12·5-inch, and 16-inch.

Closing bases of pointed common shells.

The bases of pointed common shell are closed as follows:—
B.L. and Q.F. 12-pr. to 5-inch, medium base No. 2 plug.
B.L., Q.F. or Q.F.C. 6-inch, large No. 1 base plug.
B.L. 8-inch and upwards steel bush, which takes the large No. 1 base plug, riveted in during manufacture.
The 12-pr. Q.F. pointed common Mark I was closed by the

Hotchkiss No. 3 base plug and the Q.F. 4·7-inch Mark III by the Armstrong base plug.

Earlier marks of B.L. pointed common shells had gun-metal adapters in the base, the 8-inch the small, the 9·2-inch and upwards the large.

R.M.L. 9-inch heavy, small adapter; 12·5-inch Mark I, large adapter.

R.M.L. 8-inch and upwards except 9-inch heavy, steel bush riveted in during manufacture.

All the above have their bursting charges contained in burster bags except the Q.F. 12-pr. which is filled with loose powder.

Common pointed practice shells.

Common pointed practice shells of cast iron are fired from:—

B.L. 16·25-inch, 13·5-inch, 12-inch heavy, 12-inch light, 10-inch, 9·2-inch, 8-inch and 5-inch.

B.L., Q.F. or Q.F.C. 6-inch and 4-inch.

Q.F. 12-pr. and 4·7-inch.

Closing bases.

The latest marks have their bases closed as follows:—

12-pr. to 5-inch medium No. 5 base plug, 6-inch and upwards large No. 4 base plug.

The Q.F. 4·7-inch Marks I and II were closed by the Armstrong base plug.

The latest marks of the practice shells are unlacquered and issued filled with salt.

The letter P is stamped on the body of the Q.F. 12-pr. and on the base of all the others, a yellow band, denoting practice, is painted round the centre of the body.

Lyddite shell.

Common lyddite shells are made for the following calibres:—

B.L. guns, 10-inch, 9·2-inch, 8-inch, special for Marks VII and VII$_A$ guns, 5-inch and 30-pr.

B.L., Q.F. or Q.F.C. guns 6-inch and 4-inch.

B.L. howitzers, 5-inch, 5·4-inch, 6-inch, and 8-inch.

Q.F. 4·7-inch.

R.M.L. 10-inch on H.A. mounting; and 6·3-inch howitzer.

They are made of forged steel, have solid bases, and are varnished inside instead of being lacquered.

They take nose fuzes.

Double shell.

Double shell are made for the R.M.L. 7-inch and 7-pr. only, and 2·95-inch Q.F.

They resemble common shell, but are longer and have larger capacity for bursting charge. The 7-inch, on account of its great length, has three strengthening ribs cast inside.

The 7-inch is filled through the nose and takes a burster bag. The 7-pr. is filled with loose powder.

Armour-piercing shells.

Armour-piercing shells are made for the following calibres:—

B.L. guns, 13·5-inch, 12-inch heavy, 12-inch light, 10-inch, 9·2-inch and 8-inch.

B.L., Q.F. or Q.F.C. 6-inch and Q.F. or Q.F.C. 4-inch.

Q.F. 4·7-inch.

The 4-inch armour-piercing shell is made of forged steel, the 4·7-inch and upwards may be of cast or forged steel. They are lacquered internally and take bursting charges which are contained in burster bags.

The 4-inch and 4·7-inch Marks IV and V have the hole in the base threaded to take the medium No. 2 base plug or fuze.

The 4·7-inch armour-piercing shell Marks I, I*, II and III, take the Armstrong base fuze.

The 6-inch and upwards may have the base screwed to take the large No. 1 base plug or fuze or a steel bush may be used, which, as in the common pointed shells, is riveted in during manufacture.

Ring shell are only made for the R.M.L. 2·5-inch gun. — Ring shell.

The 2·5-inch has no metal bush but the metal of the shell is threaded to take the nose fuze.

It is lacquered internally, and the bursting charge is put in loose.

Shrapnel shell are made for the following calibres:— — Shrapnel shell.

B.L. guns 12-pr. and upwards, except the 12-inch heavy.

B.L. howitzer, 5·4-inch.

Q.F. 12-pr. and upwards.

B.L. shrapnel above the 6-inch are not used now in the L.S.

R.M.L. guns 7-pr. and upwards, except R.M.L. 9-inch and 10-inch on H.A. mountings.

They are of two distinct constructions, those having the bursting charge in the head, and those having the bursting charge in the base. — Construction.

Shrapnel shell, having the bursting charge in the head, have been made for the following calibres:—

B.L., Q.F. or Q.F.C. 4-inch, Marks IV, V and VI, and R.M.L. 2·5-inch, Marks I, I*, II, III, and IV. — Bursting charge in head.

Of these the 4-inch Marks V and VI, and R.M.L. 2·5-inch Marks III and IV have the bursting charge put in loose. — Bursting charge loose in head.

All the others have the bursting charges contained in red shalloon bags. — Bursting charge in bags.

Boxer shrapnel shell, or those having the bursting charge in the base, may, for the sake of classification, be divided into the following types:— — Bursting charge in base.

Heavy.
Field.
Shooting.

The calibres of the heavy type are:— — Heavy type.

B.L., 9·2-inch and upwards.
R.M.L., 7-inch and upwards.

The characteristics of the heavy type are, the wrought-iron pipe up the centre, heavy gun-metal socket, and iron sand shot.

The calibres of the field type are:— — Field.

B.L. and Q.F., 6-inch and under.
R.M.L., 40-pr. and under.
R.B.L., 12 and 9-prs.

The characteristics of the field type are, gun-metal or brass central pipe, composite socket of gunmetal and tin, and mixed metal bullets.

The B.L. or Q.F. 12-pr. and 15-pr. and 30-pr. have their bullets in a cage, and a short socket, also the 10-pr. B.L. — Special shrapnel.

The 5·4-inch howitzer shrapnel Mark II although of the ordinary field type has a short socket like the 12-pr., 15-pr. or 30-pr.

The 5·4-inch howitzer shrapnel Mark I and the 15-pr. practice shrapnel have a gun-metal head screwed to the body.

Shooting shrapnel.

Shooting shrapnel have been made for R.M.L. howitzers, 6·3-inch, 6·6-inch and 8-inch. They differ principally from the field type in having a larger chamber for powder in the base, and have this chamber lacquered similar to a common shell, and are filled through the base with loose powder.

Primers, shrapnel shell.

All shrapnel shell having the bursting charge in the base require a primer; in the heavy shrapnel it screws into the bottom of the socket; in the field shrapnel the top of the pipe is threaded to take it.

Steel shrapnel have no weakening grooves, as they are not intended to break up.

Weakening grooves.

B.L. cast-iron have six longitudinal weakening grooves in the powder chamber only.

R.M.L. studded and studless 7-inch and upwards, 7-pr. R.M.L., and 40-pr., 12-pr., and 9-pr. R.B.L. have six longitudinal weakening grooves in both body and powder chamber.

The R.M.L. 6·6-inch gun, 80-pr., 64-pr., and 9-pr. have them in the base only.

Contents.

The 16-pr., 25-pr., and 40-pr. R M.L. have no weakening grooves.

The contents of shrapnel shell are:—

B.L., 10-inch and upwards	4-oz. sand shot.
R.M.L., 10-inch and upwards	
B.L., 8-inch and 9·2-inch	2-oz. sand shot.
R.M.L., 7-inch, 8-inch, and 9-inch ..	
B.L., and Q.F., 6-inch and under ..	Mixed metal bullets.
R.M.L., 6·6-inch and under, and all R.M.L. howitzers..	
R.B.L., 7-inch, 40-pr., 12 and 9-prs. ..	

Peculiar shrapnel.

The 8-inch B.L. shrapnel is fitted with a brass central pipe and composite socket similar to the F.S. type, but its contents are 2-oz. sand shot. That for the 8-inch Mark VII gun weighs only 180 lbs.

The Q.F. 4·7-inch shrapnel Marks I and II were fitted with a fuze-hole socket like the heavy type and a wrought-iron central pipe, but the contents were mixed metal balls.

Wooden tubes.

The R.M.L. 64-pr., and 80-pr. studded shrapnel, have a thin wooden tube round the central pipe to bring them up to length without unduly increasing the weight.

The sockets of shrapnel shell are not countersunk.

Mark III shrapnel primer.

The Mark III shrapnel primer only must be used with the Field Service shrapnel shell.

Segment shell.

Segment shell are fired from R.B.L. guns only, and are made for all calibres from the 9-pr. to the 7-inch inclusive.

The 7-inch and 40-pr. segment shells have plain gun-metal bushes, with the usual ·2 inch countersink, and are lacquered inside similar to common shell.

Bursting charges, 7-inch and 40-pr.

The 7-inch and 40-pr. take the bursting charge loose, a G.S. wad being driven into the bottom of the bush, as in common shell filled with loose powder.

20-pr. and under.

The 20, 12, and 9-prs. have the bursting charge contained in wrought-iron gas-pipe bursters.

Star shell.

Elongated star shells are made for B.L. howitzers, 6-inch, 5-inch, and 5·4-inch, 10-pr. B.L. and 2·95-inch Q.F., and for R.M.L. guns, 7-pr. and 2·5-inch; spherical star shell for R.M.L. howitzers, 6·3-inch, 6·6-inch, and 8-inch.

Material.

The 6-inch, 5-inch and 5·4-inch, 10-pr., 2·95-inch Q.F., 7-pr., Mark VI, and 2·5-inch star shells have bodies of forged steel.

The 2·5-inch has a base of malleable iron or steel screwed in. All the others have solid bases. Bases.

The heads of the 6-inch, 5-inch, and 5·4-inch and 10-pr. are of iron or mild steel of the shrapnel form. Heads.

The R.M.L. 7 pr. and 2·5-inch heads are of tinned iron, rather flat at the top.

The B.L. 6-inch howitzer star shell contains 12 stars, the 5·4-inch 10 stars, the 5-inch howitzer 8 stars, the R.M.L. 7 pr. 13 stars, and the 2·5-inch 15 stars. In each shell the stars are arranged in two tiers. They are issued filled.

Palliser shells may be divided into two patterns, the old and the new. The former were lacquered inside, filled with powder and *plugged*. They were, however, ordered to be emptied of their bursting charges, and an equivalent weight of sand substituted. They are then designated shot. Palliser shells (O.P.) were at one time made for the following calibres :— Palliser shell.

B.L. guns, 6-inch, 8-inch, 9·2-inch, and 12-inch.

R.M.L. { Studded, 7-inch to 12·5-inch.
Studless, 9-inch to 17·72-inch.

Of the R.M.L. studless there were two marks for R.M.L. guns 9-inch to 12·5-inch, but Mark II only differs in having a detached base disc, or locking rim.

Palliser shell (N.P.) were lacquered inside, filled with powder, and *fuzed*. They were made for the following calibres :—

B.L. guns, 4-inch and upwards.

R.M.L. guns, 9-inch to 16-inch, except 12-inch of 35 tons.

These Palliser shells are still fired from R.M.L. guns in the N.S., but, owing to a liability of prematures in B.L. guns, they are not fired from the latter. B.L. Palliser shells are now emptied of their bursting charges.

Palliser shot may also be divided into two patterns, the old and the new. Palliser shot.

The old pattern Palliser shot were made of the following calibres :—

R.M.L. studded, 7-inch, 8-inch, 9-inch, 10-inch, and 12-inch (25 tons).

They were rather shorter than the shells, most of them being lacquered inside. Access to the interior was obtained by means of a gun-metal screw plug working in a soft iron bush cast into the base, as in the shells.

New pattern Palliser shot have superseded, for future manufacture, both the shells and the old pattern shot referred to above. New pattern shot.

Up to the present they have been made for the following guns :—

B.L., 4-inch and upwards.

R.M.L., 9-inch, 10-inch, 11-inch, 12-inch (25 tons), and 12·5-inch.

They are not lacquered inside, and their bases are permanently closed by a cast-iron plug secured with molten lead. They have a soft iron bush cast into the bottom of the core to form a seating for the plug.

The 16·25-inch Palliser shot is lacquered inside similar to the early Palliser shells. Exceptional shot, B.L. 16·25-inch.

The Palliser shot for the 8-inch B.L. Mark VII guns weighs only 180 lb. 8-inch B.L.

The B.L. 6-inch Marks V and VIII, 5-inch and 4-inch Mark II, B.L., 6-inch,

Marks V and VIII. Palliser shot, are cast solid, a soft iron core being used instead of the ordinary sand core employed in casting.

Palliser shot for the R.M.L. 6·6-inch gun differs only in having the interior lacquered and the base being closed by a gun-metal screw plug.

A studless Palliser shot has been made for the R.M.L. 80-pr. gun of coiled iron for the Government of Victoria, it is lacquered inside and has a detached base disc.

Armour-piercing shot. Armour-piercing shot are made of the following calibres:—

B.L. guns 16·25-inch to the 8-inch, B.L., Q.F. or Q.F.C. 6-inch also for B.L. 5-inch. For the latter the armour-piercing shot is used for testing armour plates only. They are for N.S. only.

They are made either of forged or cast steel and are brought up to mean service weight by inserting the required quantity of dust shot and sawdust, or when up to weight sawdust only.

The bases are closed by screw plugs, the sizes of which may vary, but each must have two slots to take a service key.

Case shot. Case shot are fired from all rifled ordnance in the Service (except the 4-inch, 4·7-inch, and 6-inch Q.F.). They may, with a few exceptions be divided into three principal classes, viz.:—

Heavy.
Medium.
Field.

Heavy. The calibres of heavy case shot are:—

B.L., 9·2-inch and upwards.
R.M.L., 12·5-inch, and 17·72-inch. And when filled with chilled-iron shot 10-inch, 11-inch, and 12·5-inch.

The heavy class has the body of tinned iron in three pieces riveted together, bottom consisting of two or three pieces of wrought iron riveted together; and case further strengthened by a wrought-iron stay bolt running up the centre.

The lining is in eight segments, and there is a loose wrought-iron disc at the bottom.

Special case shot. Special case shot containing chilled-iron balls are made from 9-inch to 12·5-inch, except the 12-inch.

Medium. The medium case shot are made for:—

B.L., 8-inch.
R.M.L., 8-inch, 9-inch, 10-inch, 11-inch, and 12-inch.

The body of the medium is of tinned iron in one piece, riveted, the bottom being a disc of wrought iron; there is no stay bolt, and the lining is in three segments.

Field. The calibres of the Field Service case shot are:—

B.L., 5-inch, 30-pr., and 4-inch.
R.M.L., 40-pr. and under.
R.B.L., 40-pr. and under.

These have tin body in three pieces soldered together; wrought-iron ring riveted to base on the outside; loose wrought-iron disc inside, and lining in three segments.

B.L. or Q.F. case 10-pr., 12-pr. and 15-pr., Marks IV, IV*, and V, 5-inch howitzer Mark II, and 5·4-inch howitzer Mark I, have bodies of tin soldered together with a base piece, provided with a handle; there is a loose disc fitting inside and the lining is in three segments for the howitzers and two segments for the 10-pr., 12-pr. and 15-pr.,

Tops. In the 10-pr., 12-pr., and 15-pr. case shot Mark IV, IV*, and V, 5-inch howitzer Mark II, and the 5·4-inch howitzer Mark I the tops are discs of iron or mild steel, B.L. 4-inch to 12-inch the tops are of tinned sheet iron and in the B.L. 13·5-inch of cast iron recessed. The R.M.L. case shot have tinned sheet iron tops from 2·5-inch to 12-inch inclusive, the 12·5-inch a cast-iron top recessed and the 17·72-inch a cast-steel top recessed.

7-pr. R.M.L. The 7-pr. R.M.L. has a plain tin top, and the wrought-iron disc fits inside segmental linings.

R.B.L. The R.B.L. 7-inch and 40-pr. have tinned-iron tops; 20-pr. and lower natures have tin tops, with a rounded piece of wood fitting underneath them. In the 20-pr. the wrought-iron disc fits inside the segmental lining.

R.M.L. 9-pr. The R.M.L. 9-pr. has a disc of wood under the top to lengthen it.

Contents. The contents of rifled case shot are:—

- B.L., 13·5-inch to 9·2-inch .. .. } R.M.L., 17·72-inch to 7-inch and 64-pr. } 8-oz. sand shot.
  R.B.L., 7-inch and 40-pr. .. ..
- B.L., 8-inch and 6-inch } 4-oz. sand shot.
  R.M.L., 6·6-inch .. }
- B.L., 5-inch and 5·4-inch howitzers, 2-oz. sand shot.
- B.L., 5-inch and under } R.M.L., 40-pr. and under } mixed metal bullets.
  R.B.L., 20-pr. and under }

Case shot are fitted with handles on top for lifting as in the following:—

- B.L., 9·2-inch and upwards .. .. } R.M.L., 12·5-inch and 17·72-inch .. .. .. } 2 rings.
  R.M.L., 9-inch to 12·5-inch, with chilled iron balls }
- B.L., 8-inch .. .. } R.M.L., 9-inch to 12-inch } 2 handles.
- B.L., 12-pr. to 6-inch .. } R.M.L., 2·5-inch to 8-inch } 1 handle.
  R.B.L., 7-inch .. .. }
- R.B.L., 40-pr. and under are without handles

In loading rifled case shot the handles are always placed away from the charge, except the B.L. or Q.F. 12-pr. and 15-pr. case shot, Marks IV, IV*, and V, B.L. 5-inch howitzer Mark II and 5·4-inch howitzer Mark I.

The 17·72-inch R.M.L. case shot is almost entirely of steel, and the lining is in four segments.

11-inch R.M.L., Mark III. The 11-inch R.M.L. case shot, Mark III, has an iron ring instead of disc on bottom, and the loose base disc fits inside the segmental lining to ensure breaking up.

B.L. 6-inch, R.M.L. 6·6 inch, and 64-pr. These are of peculiar construction, having tinned-iron body in three pieces soldered; wrought-iron ring on bottom, and lining in six segments.

The 5-inch B.L. has the lining in four segments.

B.L. 5-inch, 4-inch, and 30-pr. A copper ring or gas-check takes the place of the wrought-iron ring on the base in the B.L. 30-pr. and 4-inch.

Studs. B.L. and R.B.L. case shot have soft metal studs near the base to act as stops in loading, except 12-pr. and 15-pr., Marks IV, IV*, and V, and B.L. howitzers, 5-inch Mark II, and 5·4-inch Mark I, and 10-pr.

12-pr. B.L. or Q.F. case, Mark III. The 12-pr. B.L. or Q.F. case, Mark III, had three corrugations round its body, and no copper ring or soft metal studs.

B.L. or Q.F. 10-pr., 12-pr., The 10-pr., 12-pr. and 15-pr. B.L. or Q.F. case, Marks IV, IV*, and V, and B.L. howitzer case, 5-inch Mark II and 5·4-inch have a

and 15-pr., B.L. 5-inch and 5·4-inch howitzers.

copper driving band near the base which takes the rifling and acts as a stop in loading.

R.M.L. 12·5-inch.

The 12·5-inch R.M.L. case shot has three gun-metal studs, near the base.

Solid shot.

Solid shot of cast iron for practice purposes only are fired from R.B.L. guns, 40-pr. and under.

Drill shell and shot.

Drill shell will be found at present in use with :—

B.L. guns, 4-inch to 13·5-inch.
B.L. howitzers, 5·4-inch and 6-inch.
R.M.L. guns, 13-pr.

Drill shot, R.B.L. guns, 12 and 9-prs.

Recovered projectiles with lead coating, filed down, are used with 7-inch, 40-pr. and 20-pr. R.B.L. guns.

Miscellaneous Eye-bolt hole.

The following projectiles are fitted with holes in the side to take the "Bolt, eye, lifting" :—

B.L. 8-inch and upwards (except armour piercing projectiles; the 8-inch, Mark I, projectiles, and the 8-inch cast-steel common shell, Mark IV).

R.M.L. studless, 12·5-inch and upwards.

Holes in base.

The B.L. 12-inch armour-piercing shot and the R.M.L. 16-inch, Mark II projectiles have a lifting hole in the base.

Pawl holes.

The R.M.L. 16-inch and 12·5-inch studless projectiles have pawl holes in the side for securing them on the trolly by which they are brought up to the gun.

Extractor holes.

All R.M.L. projectiles (except case shot), 64-pr. and upwards, have extractor holes in the head. The 64-pr. has three, all the others have only two.

Shape of heads.

Studded common shrapnel and Palliser projectiles have ogival heads, struck with a radius of $1\frac{1}{2}$ diameters; B.L. and studless R.M.L. have two diameter heads.

Bands.

The following calibres of common, shrapnel, and Palliser projectiles are cast with bands :—

B.L., 8-inch and upwards.

R.M.L. studless, 6·6-inch and upwards, except 6·6-inch Palliser shot.

Some R.M.L. studded Palliser projectiles will also be found with bands.

Studs.

Studded projectiles are fired from R.M.L. guns only. Their calibres are :—12·5-inch, 12-inch of 25 and 35 tons, 11-inch, 10-inch, I and II, 9-inch I to V, 8-inch, 7-inch, 80-pr., 64-pr., 40-pr., 25-pr., 16-pr., 9-pr., 7-pr., and 8-inch howitzer of 46 cwt.

Material.

The studs are made of a gun-metal alloy, except the calibres and natures mentioned in the following, which have copper studs :—

80-pr. common and shrapnel.
64-pr. „ „
25-pr. shrapnel.
16-pr. „
9-pr. common and shrapnel.
7-pr. „ „

Number of rings.

Generally speaking, studded projectiles have only two rings of studs, the number in each ring corresponding with the number of grooves in the gun. Some projectiles, however, will be found with three rings. Their calibres are :—

12·5-inch common, shrapnel, and Palliser.
12-inch (35 tons) common, and Palliser.
64-pr. common, and shrapnel.

Studless projectiles are made for the following R.M.L. guns:— 17·72-inch to 9-inch inclusive, 6·6-inch, 80-pr., 13-pr., and 2·5-inch, and for all R.M.L. howitzers. Studless projectiles.

It will be seen from the above that R.M.L. guns, 9-inch to 12·5-inch, fire both studded and studless projectiles, but it must be understood that for these pieces no studded projectiles have been manufactured since the introduction of studless ones in 1881.

Gas-checks are only used in connection with R.M.L. projectiles. They are of two kinds, attached and automatic. The projectiles with which they are respectively used are given below. Gas-checks.

Attached gas-checks are used for studded projectiles:—9-inch to 12·5-inch common and Palliser, and the 12·5-inch shrapnel, in addition. Attached.

The use of automatic gas-checks is confined exclusively to studless projectiles, viz.:—17·72-inch to 9-inch, 6·6-inch, 80-pr., 13-pr., and 2·5-inch guns, and all howitzers (except the 6·3-inch). Automatic.

Special gas-checks are made for the 8-inch howitzer of 46 cwt. studded common shell, 6·3-inch howitzer common and shrapnel, and 40-pr. common and shrapnel. Special gas-checks.

The R.M.L. 12-inch case shot is interchangeable with the 12-inch (25 ton) and 12-inch (35 ton) guns. Projectiles, interchangeable.

The 8-inch R.M.L. case shot can be fired from the 8-inch R.M.L. gun, and the 8-inch R.M.L. howitzers of 70 and 46 cwt.

The 8-inch R.M.L. studless common shells, iron and steel, are interchangeable with the 8-inch howitzers, but each piece requires its own gas-check.

The 8-inch R.M.L. spherical star shell and shooting shrapnel are also interchangeable with the two howitzers.

The same common shell and case shot are fired from the 6·6-inch gun and howitzer. These pieces also take the same gas-check.

The 7-inch case shot are fired from R.M.L. and R.B.L. guns of that calibre.

There are three R.M.L. pieces of 6·3-inch calibre, but as they are rifled on different systems, the case shot is the only projectile interchangeable with them; they are the 80-pr., 64-pr., and 6·3-inch howitzer.

The 7-pr. R.M.L. star shell might be fired from the 9-pr. R.M.L. gun, but it is not included in the equipment of the latter.

Shot paper empty are made for the following calibres:—

B.L. guns 9·2-inch to 12-inch.

B.L. and Q.F. 6-inch, and 5-inch.

Q.F. 12-pr. and 4·7-inch, and 4-inch.

R.B.L. 7-inch, 40-pr. and 20-pr.

R.M.L. 7-inch to 12·5-inch except the 12-inch also 64-pr. or 6·3-inch howitzer and 6·6-inch.

They are to be fired with powder charges only in the L.S., when specially ordered, from guns which, owing to their positions, service projectiles cannot be fired in time of peace.

Distinguishing Marks.

All projectiles, except those which are issued with the gas-check spun on, will have the calibre, numeral, and munufacturer's initials, or recognised trade mark, cast or stamped on the base, except the Q.F. 12-pr. common pointed shells which have this information on the body owing to there not being sufficient room on the base.

Such projectiles as are not suitable for either B.L., Q.F. or Q.F.C. guns of the same calibre will have the letters denoting the gun or guns for which they are suitable stamped or cast on them, in addition to the calibre and mark.

In the case of projectiles for guns and howitzers of the same calibre which take special shells, the word "gun" or "howitzer" will be added after the calibre.

In the case of B.L. 12-inch and R.M.L. 9-inch projectiles the letter "L" or "H" indicating "light" or "heavy" projectiles will be stamped on the base under the calibre.

Armour-piercing shells have the letters A.P. stamped on the base.

Armour-piercing shot have a distinctive number stamped on the base of the shot and on the base plug.

The letters C.S. are stamped on the base of cast-steel and F.S. on the base of forged-steel projectiles.

Common and common pointed shells of cast steel have the date of daily casting stamped on the head. Other projectiles will have the date of manufacture stamped on the head or side.

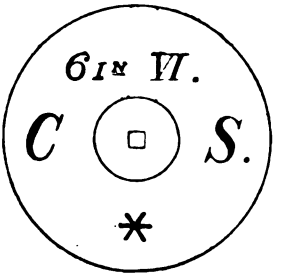
Shells issued with the gas-check spun on will have the marking, that should be on the base, a little above the gas-check on the side of the shell.

After projectiles are approved by the Inspection Branch they will be stamped with the ⅄ on the side.

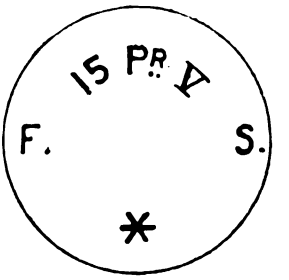
Examples of marking :—

Bases of

Shell, B.L., Q.F. or Q.F.C., Common, 6-inch.

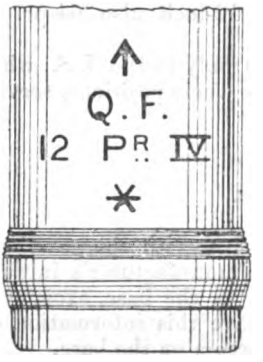


Shell, B.L., Shrapnel, 15-pr.

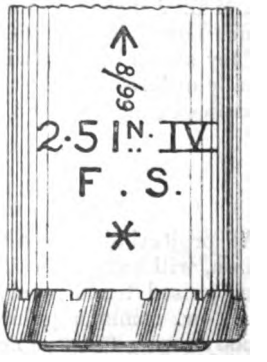


Sides of

Shell, Q.F. Common Pointed, 12-pr.



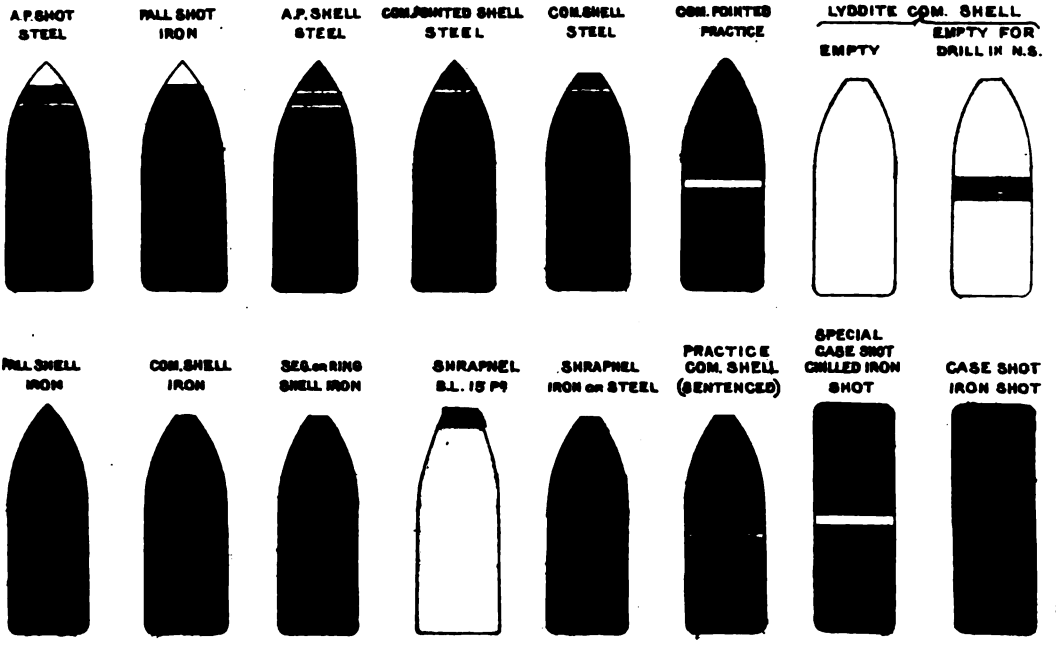
Shell, R.M.L., Shrapnel, 2·5-inch.



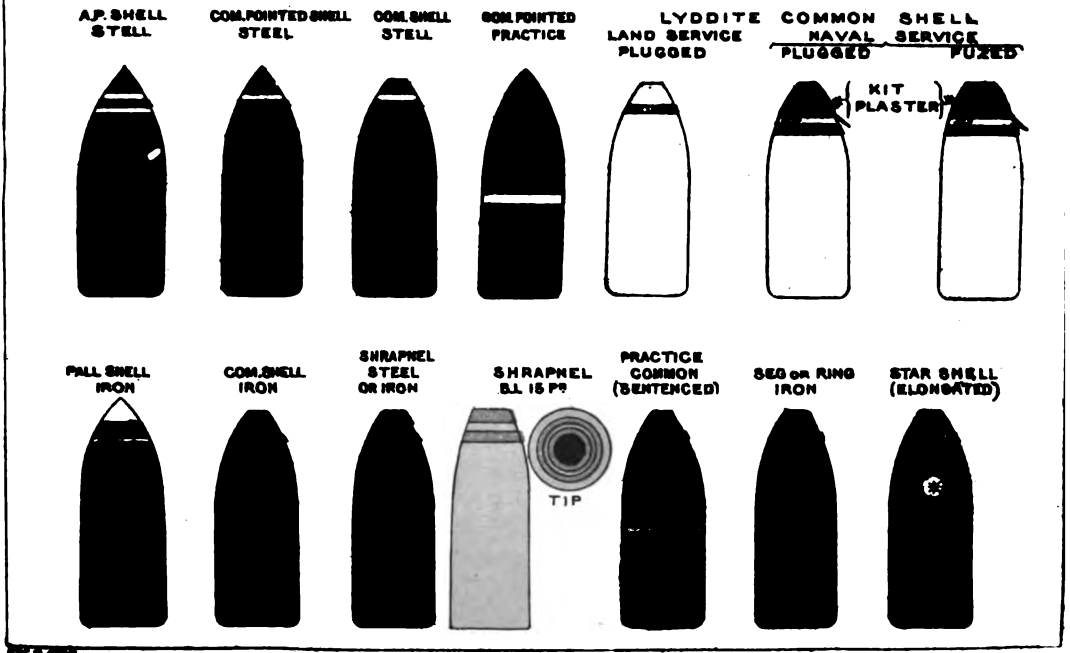
Manufacturer's initials or recognised trade mark stamped at*.

DISTINGUISHING MARKS FOR PROJECTILES FOR ORDNANCES, §§ 7836, 9198, 9340, 9574, 9771, 9829, 9859.

EMPTY.



FILLED

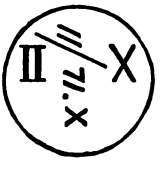


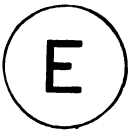
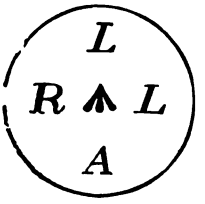
E. Weller & Grahams. Ltd Litho. London

Other marks on projectiles with their signification are:— §§ 7836, 8534, 9574, 9198, 9771, 9829, 9859.

Sign or Mark.	Signification.
Black tip.	Common (except lyddite common), Palliser, and armour-piercing shell.
Blue „	Segment and ring shell.
Red „	All shrapnel shell.
White „	Solid, and Palliser shot.
White tip and white band, 1-inch below.	Armour-piercing shot.
Red band.	Filled shell.
White „	Steel projectiles (except lyddite, shrapnel, and star shell). Special case shot have a white band.
Two white bands.	Armour-piercing shell.
Yellow band round the body.	Practice projectiles, empty or filled, that are sentenced as such; also unlacquered common pointed shells that are issued for practice purposes only.
Black band round the body.	Lyddite shells when used empty for drill purposes in the N.S.
Yellow body.	Lyddite common shell.
E. in red on head and monogram of station.	Shell emptied of its bursting charge.
W. in white on the head. **W. stamped on base plug.**	Palliser shot formerly shell weighted with sand, and armour-piercing shot weighted with dust shot and sawdust.
The word "salt," monogram of station and date stencilled in white on the body of a shell.	Common and armour-piercing shells, when filled with salt for practice.
Red star on white ground.	Elongated star shell.
Lead-coloured body and black plug.	15-pr. B.L. or Q.F. shrapnel.
U. on driving band.	Cannelures undercut during manufacture to take augmenting strips.

R.M.L. Studded only.

On studs.	
	II, mark or pattern. X Studs planed. 11/71, date of manufacture. X In all but 7-inch projectiles previous to 8.3.72, this mark indicates that the studs are of hard alloy.
This refers to all heavy studded projectiles.	

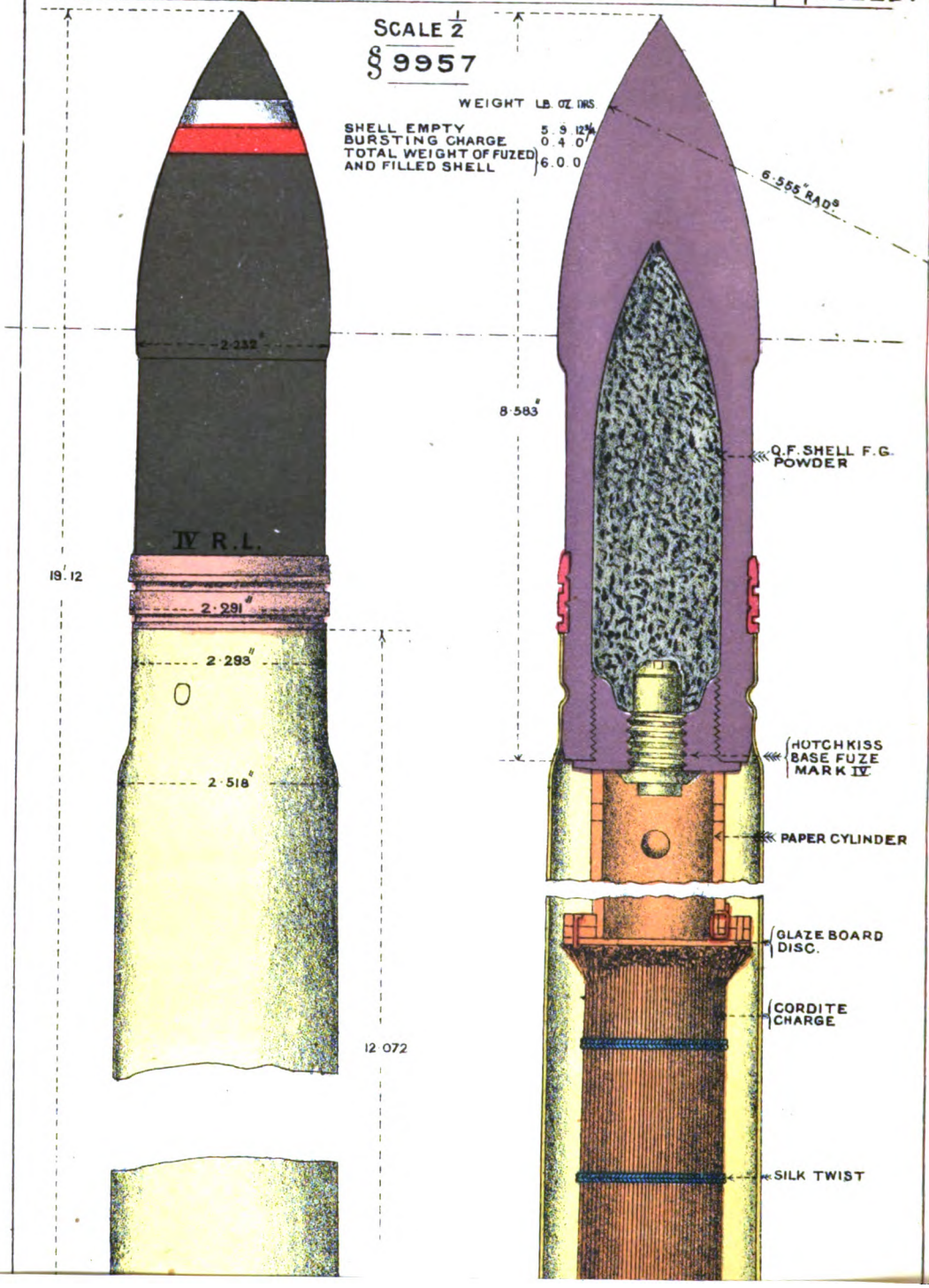
Sign or Mark.	Signification.
On rear stud.	
	Examined at base with pointed hammer to detect weak and porous places. These shells would be made between 1870 and August, 1872. All shells so examined have the hammer mark on base.
Palliser only.	
	12-inch 35-ton projectiles have this marking on the stud to distinguish them from 12-inch 25-ton projectiles. Asterisk in addition to Roman numeral denotes that the shell has been altered to take a gas-check. It has the same meaning with all studded projectiles.
U. C.	Near studs; undercut stud holes.
	R.B.L. Projectiles.
E. O. C.	Elswick Ordnance Company.
I. ⅄ I A.	Passed into the Service by an Inspecting Officer, R.A.
Z.	Zinc attachment.
U.	Undercut method of attachment.
D.	Disc of lead permanently fastened in segment shells; L.S. only.
In cannelure.	
	Shell with lead and antimony coating made in Royal Laboratory. This marking may sometimes be found on shells also having E.O.C. on the apex; it would then denote that the shell had been re-leaded in the Royal Laboratory; and would be found in the cannelure.

CARTRIDGE, QUICK FIRING 6 Pr CORDITE, STEEL SHELL MARK VII | C | FUZED.

SCALE $\frac{1}{2}$

§ 9957

WEIGHT	LB.	OZ.	DRS.
SHELL EMPTY	5	9	12¾
BURSTING CHARGE	0	4	0
TOTAL WEIGHT OF FUZED AND FILLED SHELL	6	0	0



CHAPTER XIX.—AMMUNITION FOR QUICK-FIRING GUNS.

SERVICE.—PRACTICE.—DRILL AND SALUTING CARTRIDGES.—BOXES.—CASES.—EXAMINATION.—RECTIFYING.—FILLING.—PACKING.

A *quick-firing* gun, as regards its ammunition, differs from an ordinary gun in having its charge and the means of ignition contained in a metal case.

The quick-firing guns at present in the Service are the 1-pr, 3-pr., 6-pr., 2·95-inch, 12-pr. of 8 cwt., 12-pr. of 12 cwt., 4-inch, 4·7-inch and 6-inch.

The projectiles for the 1-pr., 3-pr., 6-pr. and 2·95-inch are attached to the case, such ammunition is termed "fixed."

6-pr. ammunition. §§ 9957, 10498.

Cartridge, Q.F. 6-pr. Cordite, Steel Sheel, Mark VII, consists of a brass case, cap chamber with cap, igniter, charge, paper cylinder, and fuzed projectile. (*See* plate XXVIII.)

The case is made of solid-drawn brass of the dimensions shown in the plate, and has a projecting rim on the base to allow of extraction. A hole is bored through the centre of the base, the rear portion of which is enlarged to contain the cap chamber. The case is lacquered inside and out with the usual transparent lacquer.* The cap chamber is of brass, and has a raised anvil and three fire-holes in the bottom. It contains a copper cap filled with 1·2 grains of a special cap composition, containing no fulminate of mercury, pressed in, varnished, and covered with a tinfoil disc. It is secured in the cap chamber by the metal of the latter being spun over it. The cap chamber is pressed into the hole in the centre of the base.

The charge consists of 7¾-oz. of cordite, size 5. The sticks, about 12-inches long, are folded double so that one end is longer than the other, and bound together in three places with silk twist. The igniter (Mark III) consists of 4 drams of R.F.G.^{2} or new blank F.G. powder enclosed in a circular flat shalloon bag, which is tied to the fold of the cordite as shown in the plate.

The charge is inserted in the case, igniter downwards, so as to come next the cap. A paper cylinder, placed over the cordite, keeps the charge in position at the bottom of the case. This consists of a hollow cylinder of brown paper, pierced with holes, to the end of which two discs of millboard, also pierced with holes, are glued and and secured by copper wire. To the outside of these discs a glaze-board disc is attached by rivets, so that the glaze-board is next the cordite when the cylinder is in position.

The shell, Mark IV, is made of forged steel, pointed, the head being

* Cases which have been used to contain gunpowder charges are lacquered or varnished with a hard brown varnish. Should one of these cases be used for a cordite charge, a paper lining must be inserted to prevent the cordite from coming in contact with this varnish.

struck with a radius of nearly three calibres. It is rotated by means of a broad Vavasseur driving band, which is pressed into an undercut groove, some distance from the base, so as to allow the shell to be held in the case. Near the base is a cannelure for the purpose of securing it to the case, and below this the diameter is slightly reduced to facilitate insertion into the mouth of the case.

The interior of the shell is bored out to take a bursting charge, leaving a considerable thickness of metal in the head. The interior is lacquered.

The base may either be solid, or closed by a steel bush screwed in. It has a central hole, threaded with a left-handed screw thread to take the Hotchkiss base percussion fuze.

The shell is hardened and submitted to much the same tests as for armour-piercing shell, *see* page 212. When filled with salt and plugged, it should be strong enough to pass entirely through 3 inches of steel, the striking velocity being 1770 f.s.

The shell is filled with 4 oz. of Q.F. shell F.G. powder and the Mark IV Hotchkiss base fuze (see below) is screwed in, the threads and flange being lubricated with Mark III luting in a similar manner to the large base fuze.

The body of the shell below the driving band is painted with varnish and the shell is pressed into the mouth of the case, until the edge of the case bears against the driving band. It is then secured by three indents which force the brass into the cannelure round the base of the shell.

Paint. The shell is painted black, except the driving band which is left unpainted. A white ring, denoting steel, is painted round the head and below it a red ring showing that the shell is filled.

On the base of the cartridge are stencilled in red the word "Cordite" and the lot number of the cordite.

Mark VI. § 9450. The 6-pr. *Mark VI* cordite cartridge, with steel shell only differs from Mark VII in having the Mark III shell, the groove for the driving band of which is not undercut.

The fuze used with the Marks VI and VII cartridges, described above, is the Mark IV Hotchkiss base fuze of which a description follows.

Hotchkiss base fuze, Mark IV. §§ 9451, 9814. The *Fuze, Percussion, Base, Hotchkiss, Mark IV*, consists of a body, percussion pellet, spiral spring, screwed cap, screw plug, and detonator.

The body is of manganese bronze or other suitable alloy, screwed externally with a left-handed screw (12 threads to the inch) and the base is formed with a flange and a projection to take the key by which it is screwed into the shell. (*See* plate XXIX.)

The body is bored out from the front to take the percussion pellet, tapped at the top to receive the screwed cap, and has an undercut recess, the top edge of which is slightly rounded, formed at the bottom.

The percussion pellet consists of a brass casing, filled with lead (12 parts lead, 1 part tin), into which a roughened needle holder of hard brass wire, carrying a steel needle at its front end, is embedded.

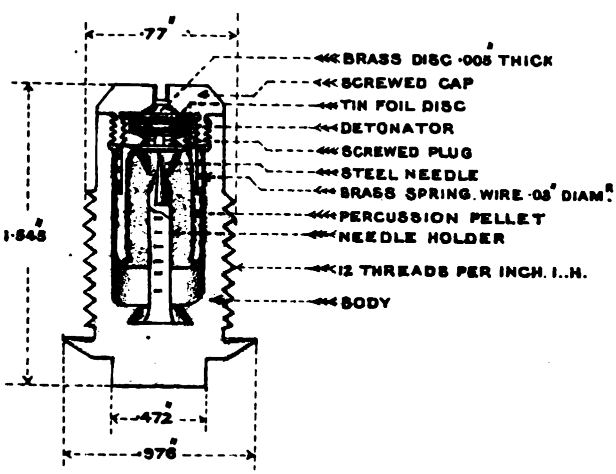
The brass casing is reduced in diameter on the exterior at the front end.

The needle holder has an enlarged base and rests in the undercut recess and supports the pellet; the latter projects beyond the point of the needle and prevents it reaching the detonator.

The brass spiral spring fits round the smaller part of the brass casing and prevents rebound of the pellet.

FUZE PERCUSSION BASE HOTCHKISS. MARK IV|C|

FULL SIZE.



SECTION

The screwed cap is threaded left-handed and closes the front end of the fuze, the rear portion is bored out to take the screw-plug, and through the centre of the front end a fire-hole is bored to allow the flash from the detonator to pass out.

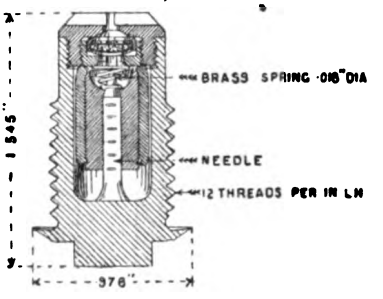
The screw-plug contains the detonator, which is similar, except in dimensions and amount of composition, to the R.L. cap, described on p. 160. It screws into the rear of the screwed cap. The fuze is lacquered externally.

Action. On the shock of discharge, the pellet sets back over the needle holder, thus allowing the steel needle to project beyond it. The lead at the bottom of the pellet cushions against the bottom of the fuze, and a small portion of it dovetails into the undercut recess, round the base of the needle. This forms a weak connection between the pellet and fuze body, and assists the spring in checking rebound action. On graze or impact the pellet and needle set forward, the needle pierces the detonator, and the flash passes through to the bursting charge of the shell.

Mark III. §§ 7490, 8229. The Mark III fuze differs from Mark IV in the following particulars :—There is no undercut recess for the lead of the pellet to dovetail into; the needle is shorter and is formed entirely of roughened brass wire, having no steel needle let into it; the spiral spring is weaker and is placed round the needle instead of round the pellet, and the front end of the brass casing of the pellet is consequently not decreased in diameter (*see* cut).

Fuze, Percussion, Base, Hotchkiss, Mark III, C., Metal.

Scale, full size.



Action. On the shock of discharge, the pellet sets back over the needle, allowing the point of the latter to project beyond it. On graze the needle and pellet set forward and the needle fires the cap.

§§ 5944, 7009. The Mark II fuze had no spring, and the base of needle is smaller in diameter than that of Mark III, and it had a smaller detonator.

§ 5006. The Mark I fuze had 14 threads to the inch.

Mark II fuzes are being converted to the same as Mark III, and then will be known as Mark II*.

§ 8141. The plug, base, shell, No. 3, Mark I, is used with such shells as take the Hotchkiss base fuze when fired plugged. It is of gun-metal, and resembles the fuze in shape and dimensions. It is stamped with the letter "P," and numbered.

6-pr. cartridge, Mark V. § 9?99. The *Cartridge, Q.F., 6 pr., Cordite, Steel Shell, Mark V* differs from Mark VI only in the shell being fitted with the Mark III Hotchkiss base fuze instead of Mark IV.

Mark IV. A few Mark IV cordite cartridges were issued. They differ from Mark V in having a wood wad and millboard disc over the charge instead of the paper cylinder. These were found to break up easily,

and Mark IV cartridges were declared obsolete for future manufacture.

Mark III.
§§ 7302, 7606, 7489.

Mark III cartridges are very similar to Mark V, and only differ from them in having a paper cylinder without the glaze-board disc. Some of the earlier Mark III cartridges had igniters of slightly different pattern (Marks I and II). There are no Mark I and II cartridges with steel shell having cordite charges.

§ 5944. Mark III

The Cartridge, Q.F., 6-pr., Steel Shell, Mark III, is similar to the cordite cartridge already described; the charge, however, is 1 lb. 15 oz. Q.F.[1] powder, nearly filling the case, and covered by a felt wad instead of a paper cylinder.

The inside of the case is varnished; should such a case be used for cordite a paper lining is inserted.

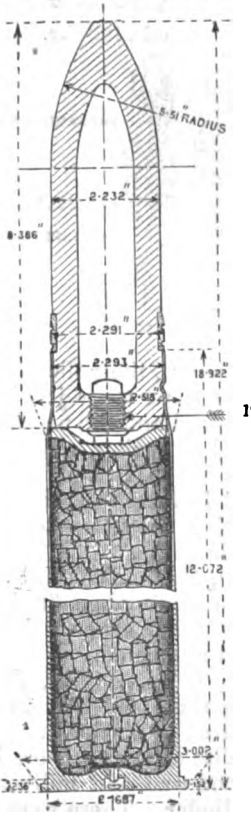
§ 5944. The shell with Mark II cartridge had a Mark I Hotchkiss fuze.

§ 5943. The Mark I cartridge had a brass primer tube, 3 inches long, containing F.G. powder; the driving band is of brass.

§ 10325. The *Cartridge, Q.F., 6-pr., Cordite, Common Shell, Mark V, L.* is similar to the Mark VII steel shell cordite cartridge. The shell, however, differs; it is made of cast iron with a truncated point, and contains a 3-oz. bursting charge. The groove for the driving band is undercut, and the Mark IV Hotchkiss base fuze is used. The shell is painted black all over, with the usual red ring.

Cartridge, Q.F., 6-pr., Common Shell, Mark II.

Scale, ½.



The Mark IV differs from the above in the groove for the driving band not being undercut. § 10325.

The Mark III differs from Mark IV in having the Mark III Hotchkiss base fuze. § 10325.

The Mark II differs from Mark III only in the paper cylinder which has no glaze-board disc attached. § 7302.

The *Cartridge, Q.F., 6 pr., Common Shell, Mark II, L*, is similar to the last described cartridge, but has a powder charge instead of cordite. § 6316.

Mark I had a primer tube in case, the shell had a brass driving band, the hole in base was screwed right-handed, 17 threads to the inch. § 5493.

Cartridges the shells of which are fitted with Mark I Hotchkiss base fuze or have brass driving bands are to be returned to Woolwich. Those with brass driving bands are declared obsolete: while those with copper driving bands will be plugged and utilized for practice purposes. § 9512.

Cartridge, Q.F., 6-pr., Practice, are generally similar to the service cartridges, but the shell is filled with salt and plugged instead of being fuzed. Plugs or fuze bodies used as plugs are stamped with the letter P to prevent fuzed shell on recovery being mistaken for plugged shell. The shell is painted black, with a yellow band round the centre and the word "Salt" stencilled on it in white. §§ 5944, 10503.

There are the following practice cartridges :—

Cartridges, Q.F., 6-pr., Practice—

Powder	Mark I	C	}	Steel or common shell.
	,, II	C		
	,, III	C		Steel shell.
Cordite	,, II	C		Common shell.
	,, III	C		Steel or common shell.
	,, V	C	}	Steel shell.
	,, VI	C		

Case Shot.—Case shot have been made, but are broken up on return to Woolwich.

In addition to the above cartridges Q.F. (Nordenfelt), 6-pr., may still be met with in the Service. They are described in former editions of this Treatise. The projectiles are common, and steel shell and case shot. The shell are electro-plated with copper all over, the steel shell is marked with an S above the case, the common with the letter C. § 5006.

Hotchkiss 6-pr. (and 3-pr.) ammunition have been declared obsolete. §§ 5006, 5127, 7607.

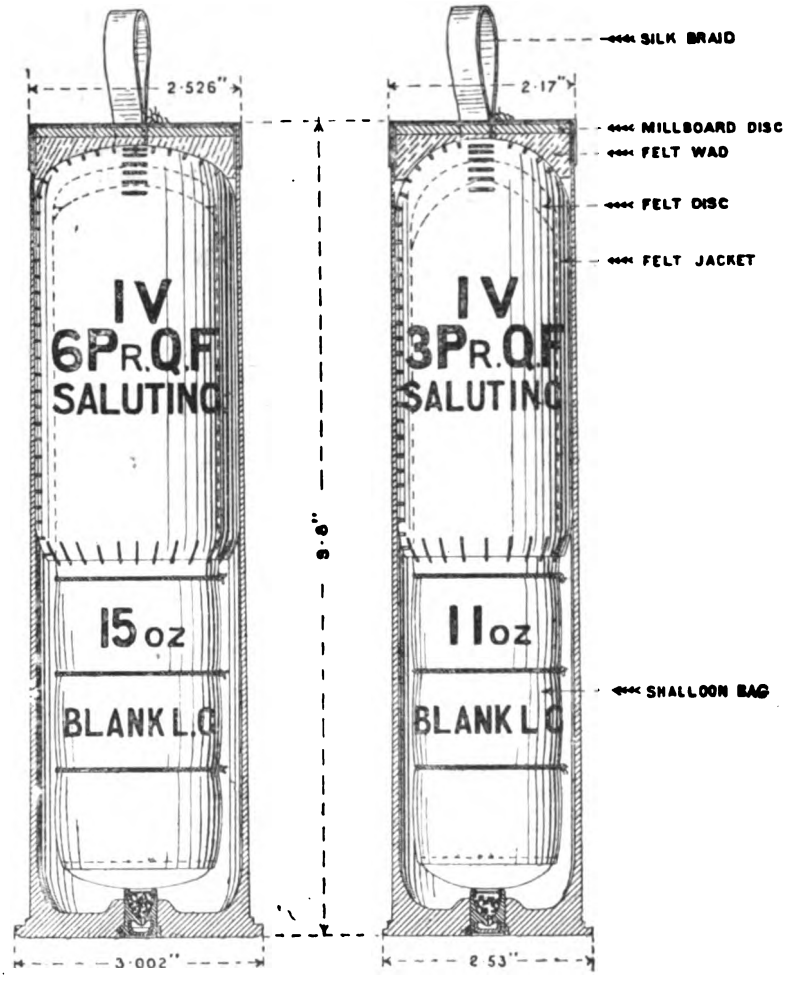
The caps in the cases of 3-pr. and 6-pr. cartridges are protected by a *Clip, Cartridge, Q.F.* Those of present pattern (Mark III) are of brass, with three arms and a central dome. The arms at the end are bent and clip on to projecting base of cartridge, the dome protects the cap from an accidental blow. Mark II had a felt cushion bearing against the cap, and Mark I had an india-rubber one. §§ 5006, 5127, 5655, 6824, 7151.

For storage, 6-pr. Q.F. Service cartridges are classed as Group I, Division IV. Eleven are packed in a box, base up. For a description of box, *see* p. 320 *et seq.* Storage.

Cartridge, Q.F., Saluting, 6-pr., *Mark IV*, | *C* | ., consists of a case, primer, charge, felt jacket and wads. The case (Mark IV) is of solid-drawn brass, varnished inside. A hole is bored through the centre of the base. The hole is recessed, and a spiral groove is cut in the recess to take a removable primer, two slots are made in the case near the mouth. The primer is of brass, with a cap chamber and §§ 8299, 8440, 9235.

Cartridge, Q.F., Saluting, 6-pr., Filled, Mark IV, C.: brass, 15-oz., Blank, L.G.

Cartridge, Q.F., Saluting, 3-pr., Filled, Mark IV, C.: brass, 11-oz., Blank, L.G.

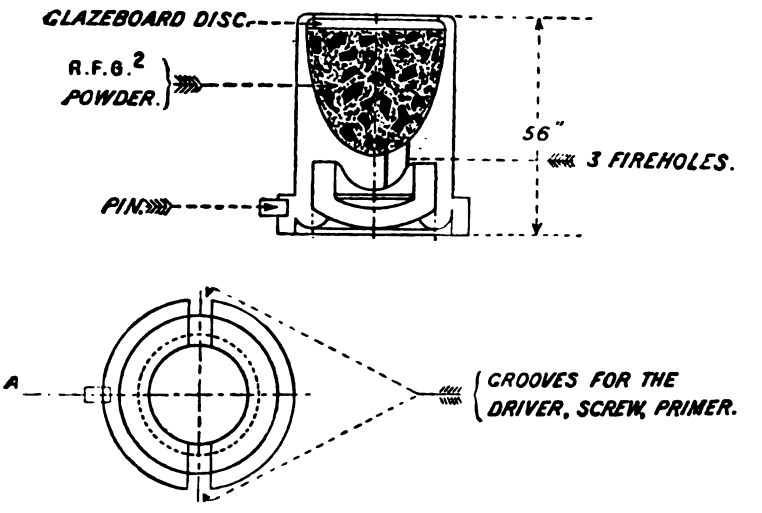


anvil formed in its rear end; three fire-holes communicate the flash from the copper percussion cap to about 5½ grains of R.F.G.[2] powder, with which the body of the primer is filled. The front is closed with a glazed-board disc, spun over and coated with shellac. A small brass pin projects from the head of the primer, by which it is secured to the case. There are also two slots in the head to take the "driver, screw, primer," for inserting or removing it.

§ 6542. The charge Mark IV is 15 oz. blank L.G. powder, contained in a red shalloon bag, hooped with silk twist. The red shalloon bag is sewn into a felt jacket, having a loop on the top. Over the charge is placed a felt and a millboard wad, the loop on jacket being passed through holes in them; the whole is secured in the case by a piece of narrow silk braid, which is passed through the loop, then through the slots in the case, and finally tied to the loop.

Primer, 6-pr. or 3-pr. With Cap; for Mark IV Case

Scale, ½.



The primers are issued packed in hermetically sealed cylinders.

The cases are issued in boxes of 20 (*see* p. 327).

The charges are issued filled, with the felt jacket sewn on, complete with wads, in half metal-lined cases. These cases contain 37 6-pr. charges or 50 3-pr. and for N.S. are painted red. § 8440.

In order to utilize the existing stock of Mark III 6-pr. and 3-pr. saluting cases, they will have two slots, for the silk braid, cut diametrically opposite each other half an inch from the mouth of the case, and the numeral IV stamped on the base. § 9626.

For descriptions of previous patterns see former editions of this Treatise.

A special 6-pr. saluting cartridge, containing a reduced charge, has been issued for use on H.M.S. "Tamar." § 10116.

For storage the charges are classed in Group I, Division I; completed cartridges in Group I, Division IV. Storage.

Cartridges issued for instruction will have two holes, ½-inch in diameter, drilled through the case at right angles so that it may be seen that the cartridge is not a service one. § 10094.

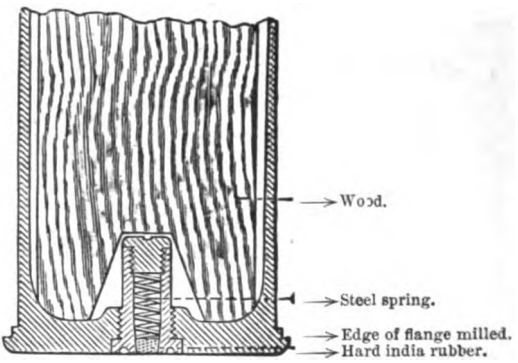
Cartridge, Dummy Drill, Q.F., 6-pr., Mark II, consists of an ordinary Service case into the base of which a receiver screws. The receiver is of gun-metal, and contains in its outer end a coned india-rubber plug, backed up by a spring. The front end is closed by a gun-metal screw plug. The case is completely filled with a teak block, a portion of which projects outside the case, and is shaped like the common shell. The block is secured by three brass screws, and is varnished. § 9197.

The edge of the flange of the case is milled.

The Mark I drill cartridge only differs from the above in the flange not being milled. They are converted locally to Mark I* by milling the flange. §§ 5836, 9197.

In Mark I boxes, which have the word "Dummy" painted on front and top. Issue.

Scale, ½.



3-pr. Ammunition.

The 3-pr. Q.F. gun fires the following :—

§ 9957. *Cartridge, Q.F., 3-pr., Cordite, Steel Shell, Mark VI, C.*
§ 9450. „ „ „ „ „ „ *Mark V, „*
§ 9299. „ „ „ „ „ „ *Marks III and IV, C.*
§§ 7000, 7348, 7489, 7606. „ „ „ „ „ „ *Mark II, C.*

§ 5944. *Cartridge, Q.F., 3-pr., Steel Shell, Mark II, C.*
§ 10325. *Cartridge, Q.F, 3-pr., Cordite, Common Shell, Marks, II to V, L.*
§ 6316. *Cartridge, Q.F., 3-pr., Common Shell, Mark II.*
§§ 5943, 7766, 10503. *Cartridges, Q.F., 3-pr., Practice :—*

Powder	Mark I	C	Steel or common shell.
	„ II	C	
Cordite	Mark II	C	Steel or common shell.
	„ IV	C	Steel shell.
	„ V	C	
	„ VI	C	Common shell.

§§ 8299, 8440, 9235. *Cartridge, Q.F., 3-pr., Saluting, Mark IV.*
§ 9197. „ „ „ *Dummy Drill, Mark II.*

Each of the above is similar to the corresponding 6-pr. cartridge except that 3-pr. cartridges with steel shells correspond to the 6-pr. cartridge of the mark next above them; for instance the 3-pr. cordite cartridge, with steel shell, Mark VI is similar to the 6-pr. Mark VII.

The cordite charge is 6⅜ oz. cordite, size 5. The powder charge is 1 lb. 8 oz. of Q.F.[1] and the bursting charges of the steel and common shells are 1 oz. 12 drams, and 1 oz. 6 drams respectively.

Storage. As for 6-pr. cartridges, but the box contains 16. For description *see* page 321.

1-pr. ammunition. § 10963. The 1-pr. ammunition is that used with the 1-pr. Maxim Q.F. gun. There are two cartridges, one having a pointed steel shell and another with a common shell of cast iron. The latter is the more important for L.S. since it breaks up better.

The *Cartridge, Q.F., 1-pr., Common Shell, Mark I* consists of brass case, cap chamber with cap, igniter, charge and fuzed projectile.

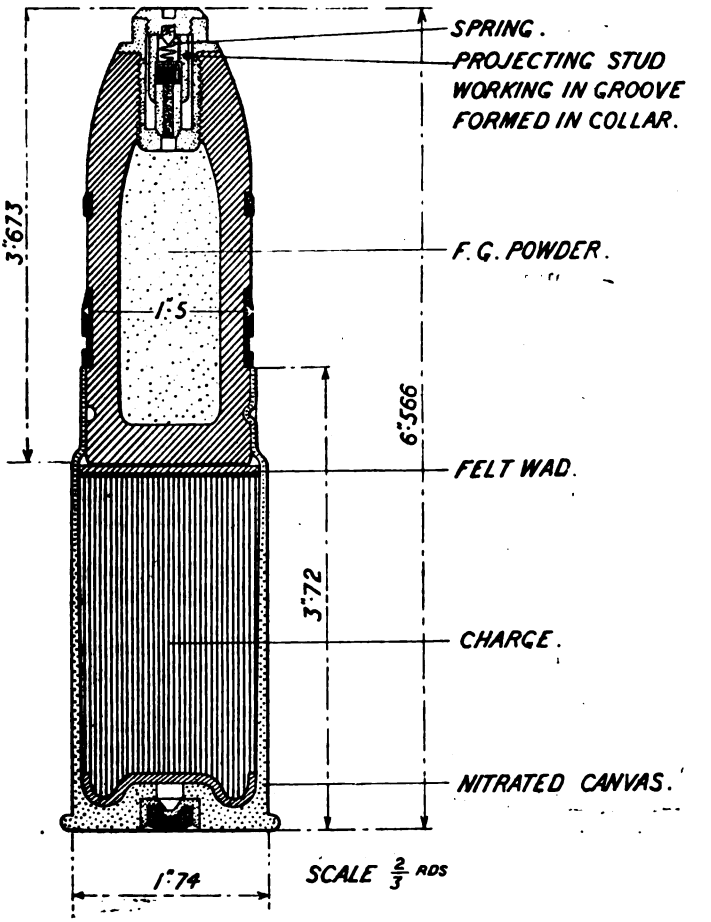
The case is of solid drawn brass as shown in the wood-cut, with a projecting rim at the base for extraction. The cap chamber and cap are similar to those already described for the 6-pr. Q.F. and fit into the base of the case in the same way. The case is lacquered with transparent lacquer inside only.

The igniter consists of nitrated canvas, which is shellaced to the bottom of the case. Above it is the charge consisting of about 1 oz. 90 grains of cordite, size $3\frac{3}{4}$.

The common shell is made of cast iron, and is fitted for a nose fuze, as shown in the cut. It has a cannelure near the base by which it is secured in the case and above it a Vavasseur driving band is pressed into a groove. There is also a narrow copper steadying band pressed into a groove near the shoulder. Common shell.

The shell is lacquered inside and contains a bursting charge of about 270 grains of F.G. powder. The weight of the shell is 1 lb. It is pressed into the mouth of the case and secured by the metal of the case being indented into the cannelure.

1-*pr. Common Shell.*



The percussion fuze consists of a metal body, screw-threaded on the outside to fit into the nose of the shell. The head has a flange and is cut away to take a fuze key. The body is bored out from the front and the bottom pierced by a fire-hole. In it is placed a detonator pellet, carrying the detonator and having a channel driven with powder. The composition in the detonator contains no Fuze.

fulminate of mercury, and is the same as in the cap of the cartridge.

Encircling the front end of the pellet is a split collar of brass, which prevents the pellet moving forward against the needle.

The top of the fuze is closed by a screw plug, carrying a steel needle on its underside, the plug is secured by a set screw.

Action. On shock of discharge, the split collar sets back over the pellet, thus unmasking the detonator; on impact the pellet and collar are thrown violently forward and the needle pierces the detonator, thus firing it. The flash from detonator and powder in the pellet passes through the fire-hole and ignites the bursting charge in the shell.

Paint. The shell is painted black all over, except the bands which are left unpainted.

Steel shell. The cartridge with steel shell is similar to the above, but the shell is made of steel, is pointed, and carries a base fuze. This fuze is similar to the nose fuze, but there are two fire-holes through the top plug, which are driven with powder. The action is identical. The bursting charge is about 270 grains of F.G. powder.

Paint. The shell is painted black, except the bands which are left unpainted, and it has the usual white ring denoting steel near the point.

Clips. The cartridges are provided with brass clips, which cover the cap in the base and are similar to those issued for 6-pr. or 3-pr. Q.F. cartridges.

Issue. The cartridges are packed in deal boxes, holding 80. The ends of the box are furnished with cleats and rope handles and the lid is attached by screws. The box is lined with tin, with a top soldered on which has to be torn off, similar to small-arm ammunition boxes. Inside the tin lining there are two wood-packing pieces, running the length of the box and having grooves to take the noses of the shells. The cartridges are packed heads and tails, each cartridge being placed in a cover of corrugated paper or else of straw similar to those used for wine bottles. These boxes are used for storage and transport only; not for use in the field. The approximate weight of a package in 157 lbs.

§ 10898. The projectiles fired from the 2·95-inch Q.F. mountain gun are shrapnel shell, common (double) shell, case shot, and a star shell.

The *Cartridge, Q.F., 2·95-inch, Shrapnel, Mark I*, consists of a brass case, cap-chamber with cap, charge, paper cylinder, shell and fuze (*see* woodcut).

Case. The case is of solid-drawn brass with a projecting rim for extraction, and a hole in the centre of the base to take the cap-chamber.

The cap-chamber and cap are similar to those used with the 6-pr. and 3-pr. Q.F. cartridges and fit into the case in the same way.

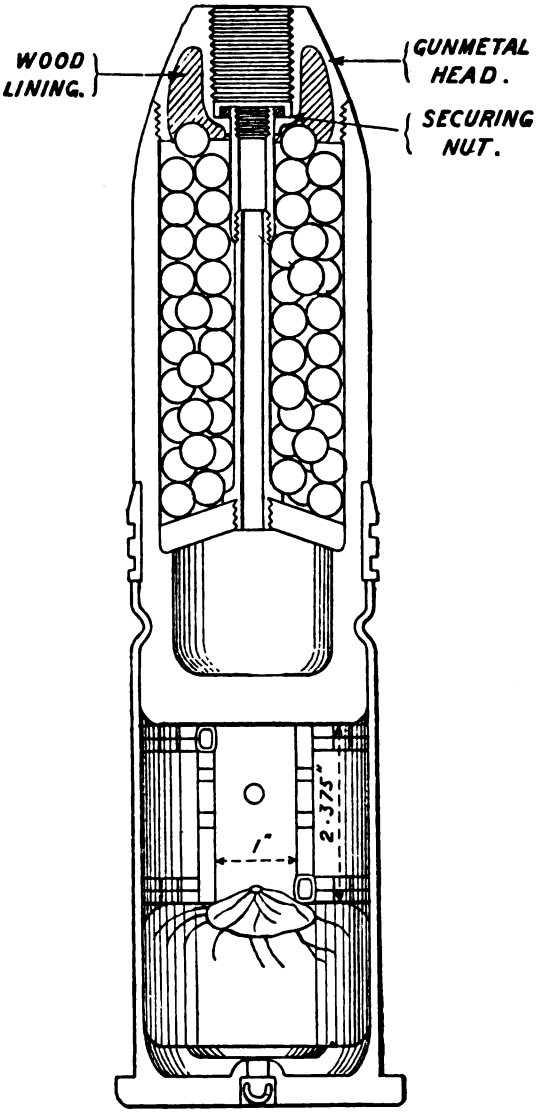
Charge. The charge consists of 5½-oz. ballistite, contained in a shalloon bag, with an igniter of F.G. powder at the bottom. It is retained in position by the paper cylinder, which consists of a tube of brown paper, pierced with holes, to both ends of which perforated millboard discs are secured by glue and copper wire.

Shell. The shrapnel shell has a body of forged steel, the walls of which are thickened near the bottom to form a shoulder for the steel diaphragm, and screw-threaded at the top to take the head.

The diaphragm rests on the shoulder, and the space below it forms the cavity for the bursting charge; there is no tin cup.

A brass pipe screws into the centre of the diaphragm, and the

Cartridge, Q.F., 2·95-inch, Shrapnel Shell, Mark I | L | .



body is lined with brown paper and filled with about 175 mixed-metal balls, 42 per lb.; the interstices between the bullets are filled with molten resin.

The head is made of gun-metal, lined with wood, and it screws on to the body. The interior of the head is screw-threaded to the G.S. pitch and taper to receive the fuze.

The central pipe projects through the bottom of the head, and is secured by a screw collar as in the 12-pr. B.L. or Q.F. shrapnel. It is screw-threaded internally at the top to take a shrapnel primer. The shell is rotated by a broad Vavasseur driving-band pressed into an undercut groove near the base, and a cannelure is formed below the band. The shell is secured in the mouth of the case by the

metal of the case being indented into this cannelure as in the 6-pr. Q.F. cartridge.

The bursting charge consists of 2½ ozs. of F.G. powder.

The shell weighs 12½ lb. filled and fuzed, and is painted black, except the driving-band, with a red tip and red band ½ inch below the tip.

Fuze. The fuze used is the T. and P. No. 56 Mark IV.

The *Cartridge, Q.F., 2·95-inch, Double Shell, Mark I* differs from the above in the charge being 5 oz. ballistite, and in the shell.

Double shell. The shell, Mark II, is made of cast-iron with truncated point and is tapped at the base to receive the medium base fuze, No. 12. (Some of the shells, Mark I, take the Armstrong base fuze.) The shell is lacquered inside and takes a bursting charge of 12½ oz. of P mixture. It is rotated by a driving-band like that of the shrapnel and is secured in the case in the same way.

Paint. The shell weighs 18 lb. when filled and fuzed; it is painted black all over, except the driving-band, with the usual red band to denote filled.

The *Cartridge, Q.F., 2·95-inch, Case Shot, Mark I* has a 5¼-oz. charge. The case shot has a brass body, lined inside with iron segments, and it contains 355 hardened lead bullets, 28 to 36 per lb. Two projecting rims are formed round the body near the base, and below them a cannelure by which the shot is secured in the case in the ordinary way.

The shot weighs 15 lb. (For star shell and saluting charge *see* p. 338.)

Ammunition for Q.F. Guns, 12-pr. and above.

The projectiles for these guns are not attached to the brass case, but are stored, transported and loaded separately. These projectiles, having been already described in Chapter XIII, reference only will be made to them here.

The cartridges for these guns are all made up on the same model, and only differ from each other in slight details which will be noted under the different calibres. A description of the 4·7-inch Q.F. cartridges follows and these may be taken as typical.

4·7-inch Q.F. projectiles. The projectiles fired by the 4·7-inch Q.F. gun are:—Armour-piercing shell; pointed common shell, cast-steel and practice, cast-iron; Lyddite shell; and shrapnel shell. Paper shot are also used in the L.S.

Cartridge, Mark V. § 9511. The *Cartridge, Q.F., 4·7-inch, Marks I to IV guns, filled, 5 lb. 7 oz. Cordite, Size 20, Mark V* consists of a case, electric primer, igniter, cordite cylinder, shalloon bag, felt and glaze-board wad, and lid. (*See* plate XXX.)

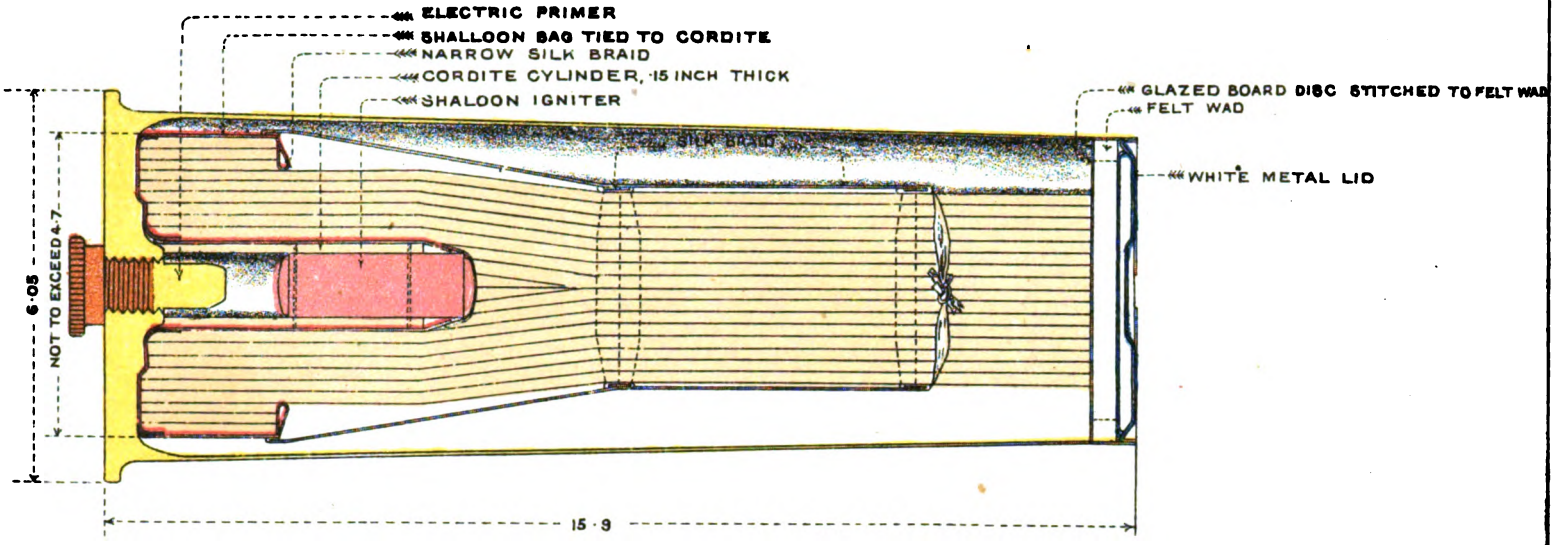
§ 9396. The case is made of brass which is usually solid drawn but may be built up. It has a projecting rim round the base to allow of extraction and a central hole through the base is screw-threaded to receive the electric primer. Round the mouth three tongues are formed by which to secure the lid. The case is lacquered inside and out with the usual transparent lacquer.* On the base are stamped the initials or trademark of the manufacturer, the date and the numeral or mark. This numeral refers only to the empty case, not to the filled cartridge. The charge, consisting of 5 lb. 7 oz. cordite, size 20, is weighed and divided into two portions. The larger portion consists of sticks nearly the full length of the case, which are secured together by two pieces of silk braid. Round the bottom of these sticks a short shalloon bag, with a pocket for the igniter, is

* Cases, which have been lacquered inside with brown lacquer or varnish, must have a paper lining if used for cordite charges.

CARTRIDGE, Q.F., 4·7 INCH, 5 LB. 7 OZ. CORDITE, SIZE 20, MARK V. |C|

BRASS, WITH LID AND ELECTRIC PRIMER

SCALE $\frac{1}{3}$

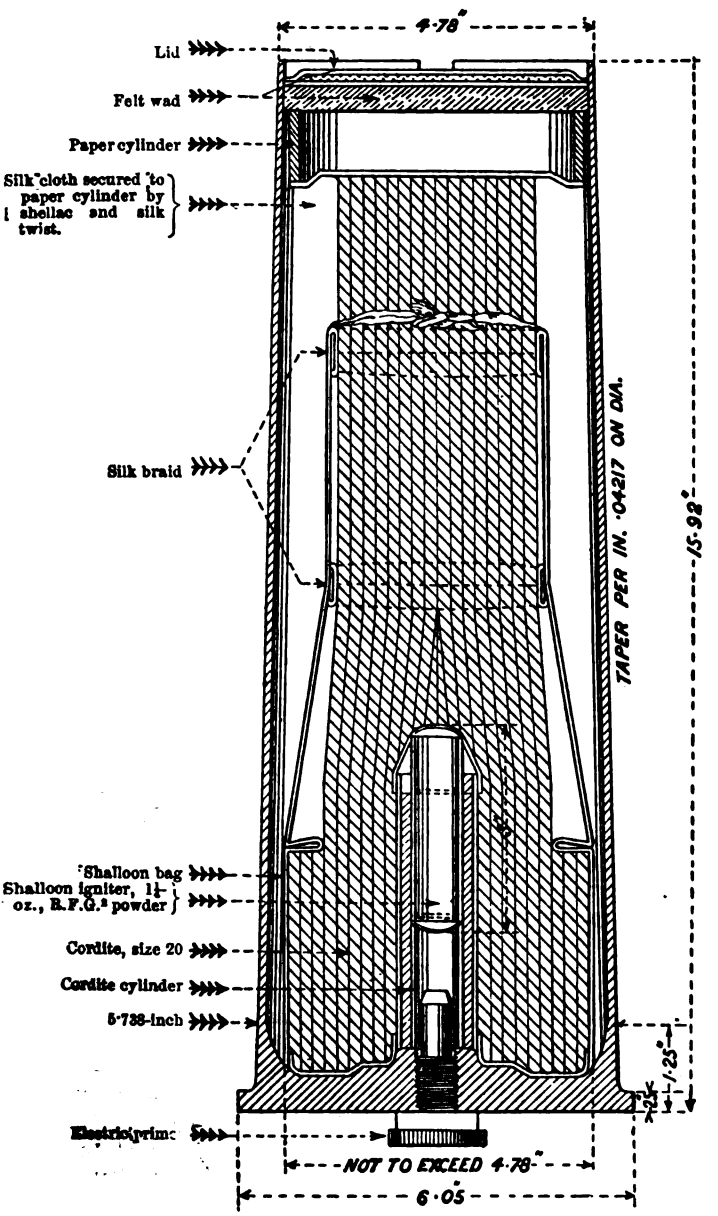


E. Waller & Grahame, Ltd Litho. London.

placed and the short sticks, which form the second portion of the charge, are packed in this bag, thus enlarging the diameter of the charge at the bottom. The bag is provided with a draw-string of silk braid which is pulled in and tied tightly above the short sticks. Two pieces of silk braid, attached to the bag, are passed up round the securing braid on the long sticks and fastened in the centre of the cordite by a reef knot.

Cartridge, Q.F., 4·7-inch, Marks I to IV guns, filled, 5-lb. 7-oz. Cordite. Size 20, Mark IV | C |.

Scale, ½.



§ 8873. The igniter (Mark III) consists of a cylindrical shalloon bag, containing 1¼ oz. of R.F.G.² or new blank F.G. powder, and stitched into a cordite cylinder, ·15-inch thick, which is inserted into the pocket of the bag, mentioned before, and fits up the centre of the charge. The weight of this cylinder (*see* page 23), is included in the weight of the charge.

Above the charge is placed a felt wad, to the underside of which a glaze-board disc is attached.

Lid. §§ 7215, 8732, 9624, 10951. The case is closed by a lid, which is formed by two pieces of white metal, soldered together and containing tallow and bees-wax in equal parts. It is weakened by radial and concentric grooves to ensure it breaking up easily, and has a recess in the centre in which a paper label is placed. Three notches are made round the rim for securing it and it has a small projecting flange by which it is supported on the top edge of the case. Before insertion it is painted round the edge with Pettman cement, to make a tight joint and it is retained in the case by the three tongues being bent over on it.

§ 7869. § 8501. On the lid of this and all cordite Q.F. cartridges, 12-pr. and above, is a label showing the size of the cordite, the word "Cordite," the weight of the charge, the lot No. of the cordite, and the numeral of the filled cartridge.

The numeral of the filled cartridge refers to the mode of filling, *not* to the empty case.

The electric primer is screwed into the base, the point of it projecting into the cordite cylinder. A description of the primer is given on page 313.

Mark IV, cartridge. § 9511. The Mark IV cartridge differs from Mark V in the following points: the lengths to which the cordite is cut; the shalloon bag is longer, and above the charge is a paper cylinder, with a disc of silk cloth on its underside, and above it a felt wad. (*See* woodcut.)

§ 10381. A certain number of Mark IV cartridges have been altered to Mark IV* by omitting the paper cylinder, and filling up the space by a glazed board disc and felt wads.

Mark III, cartridge. § 8419. The Mark III 4·7-inch cartridge differs from Mark IV in having the Mark II igniter and no shalloon bag or cordite cylinder.

The igniter Mark II consists of a paper and calico dome, choked at one end and perforated, and a shalloon bag containing 1¼ oz. R.F.G.² powder, which is fastened to the inside of the dome.

The cordite charge surrounds the igniter, which is secured to it by silk braid.

The charge is also secured in three places along its length by silk braid.

Mark III* cartridge. § 10323. Owing to the fact that portions of this igniter sometimes remained in the chamber, unconsumed, and caused the shell to jam, when loading the next round, Mark III cartridges are to be altered to Mark III*.

Mark III* cartridges are made to conform as far as possible to Mark V, but the cordite being shorter, the space above the felt and glaze-board wad is filled in by one or more felt wads.

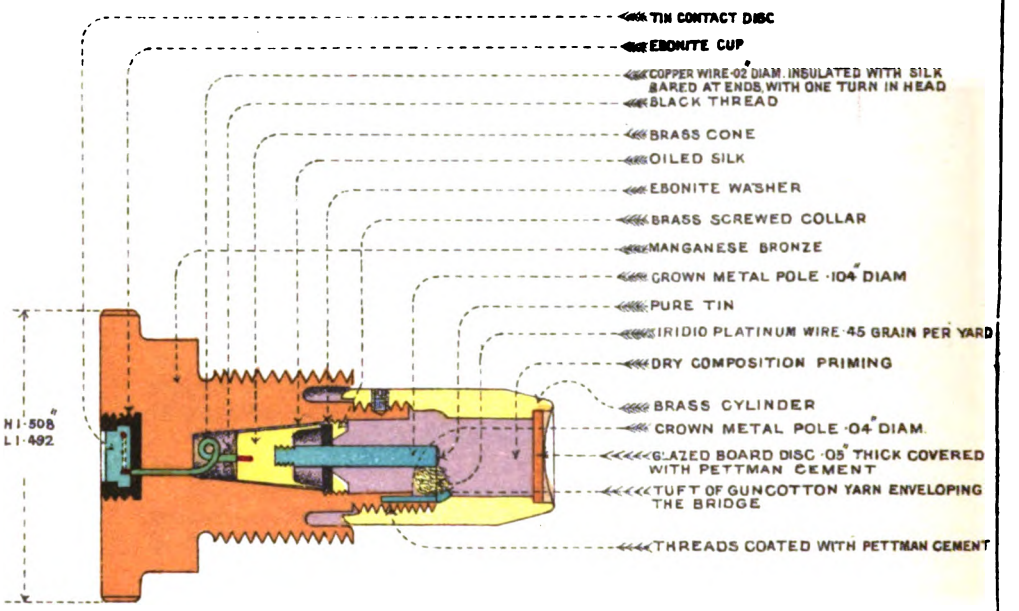
§§ 7399, 10784. The Mark II cartridge had the Mark I igniter, paper cylinder, and millboard and felt wads, converted to Mark III*.

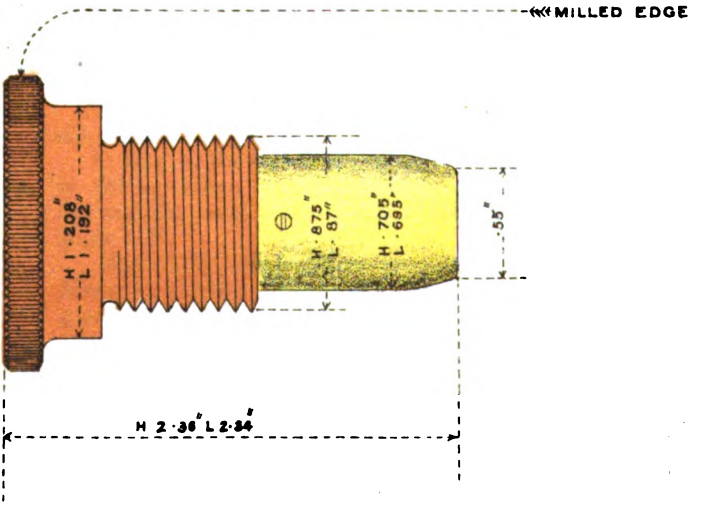
§§ 7399, 7568. The igniter, Mark I, consists of a paper cylinder, closed and pointed at one end and open at the other. It is filled with 1¼ oz. of R.F.G.², over which a millboard wad pierced with five fire-holes and a disc of shalloon are secured at a distance of ·6-inch from the end. The open end is for attaching it to the electric primer or adapter, and is strengthened by twine being wrapped round it outside.

CARTRIDGE Q.F. OR Q.F.C. PRIMER ELECTRIC LARGE MARK V C

MANGANESE BRONZE.

FULL SIZE.



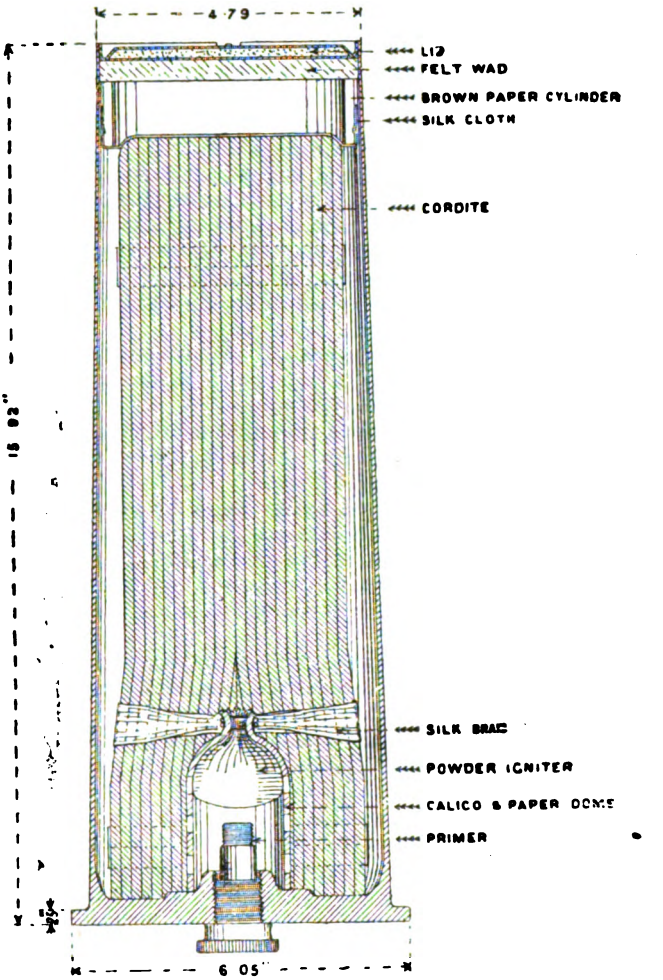


C 9.1900

E. Weller & Grahams, Ltd Litho. London.

Cartridge, Q.F., 4·7-inch, Marks I to IV guns, filled, 5lb. 7oz. Cordite, Size 20, Mark III, C.

Scale, ½.



Cartridge, Q.F., 4·7-inch, Mark V gun, filled, 7 lb. 8 oz. Cordite, Size 20, Mark I, differs from the Mark V cartridge for I to IV guns in weight and dimensions only.

Primer, Electric, Large, Mark V, consists of a body, cone, contact disc, ebonite insulator, two poles, iridio-platinum wire bridge, ebonite washer, screwed collar, brass cylinder, priming composition and glaze-board closing disc. (*See* Plate XXXI.) Electric primer. § 10900.

The body is of manganese bronze, made to the form and dimensions shown in plate, and screwed below the shoulder to fit the hole in the base of the Q.F. cartridges, the end of the body is reduced in diameter, and threaded to receive a brass cylinder; the face of the body between the screwed portions is cupped out to a depth of ·25 inch to form a gas-check. The head is recessed in the centre and screw-threaded to receive the insulator and contact disc, the inside

is bored out and the part near the head coned to receive the cone, and a small hole drilled through to the recess for contact disc.

Two slots are formed in the head to take a key by which the primer is screwed into the case.

The ebonite insulator is screwed into the recess in the body and is hollowed out and undercut. The contact disc is of pure tin; the top is smooth and slightly below the surface of the body.

The letter T, denoting pure tin, was stamped upon the head and also marked upon all packages containing such primers, in letters $\frac{3}{4}$ inch
§ 10900. in size, but this is now discontinued.

The cone is made of brass, cupped out in front to form a gas-check and insulated from the body by oiled silk. To the base of the cone a piece of insulated copper wire is soldered; a turn is taken in this wire and it is passed through the hole to the recess for the contact disc. At the bottom of this recess a thin disc of tin is laid. The wire, bared of its insulation, is coiled down upon this and the recess is filled up with molten tin.

The poles are of crown metal. One screws into the front of the cone and is kept central by an ebonite washer which in turn is kept in place by a brass screwed collar.

The other pole is fixed to the face of the body; and joining the two poles is a bridge of iridio-platinum, ·25 inch long and having a resistance of from ·75 to ·95 ohm.

This bridge is attached to the poles by pure tin. It is stronger than those fitted to earlier primers.

The cylinder is made of brass; one end is screw-threaded inside to fit the body, on to which it screws, the joint being made tight by Pettman cement. It is prevented from unscrewing by a small set screw.

The mouth is recessed to receive the glaze-board disc.

A tuft of guncotton is wrapped completely round the bridge and the interior of body and cylinder is filled with priming composition (2 parts guncotton dust, 3 parts mealed powder), and the top is closed by a glaze-board disc cemented in and covered with Pettman cement.

§ 8970. The primer is lacquered inside and out, except the exterior of the body below the shoulder. Primers have the initial of manufacturer stamped on the head; those of Ordnance Factory manufacture have the number of thousand and year of manufacture and those obtained from contractors, the month and year of manufacture only stamped on them.

Issue. These primers are packed 10 in a tin cylinder.

§ 7568. Action. On the circuit being completed, the current flows through the wire to the brass cone and so through the bridge, which becomes incandescent and fires the guncotton and composition priming which in turn fires the charge. The return path of the current is by the metal of primer, cartridge, gun, etc. to battery. The cone is driven by the force of the explosion into its seating, and the cupped out portion expands, thus effectually sealing any escape of gas through the head. The cupped out portion of the body expands and prevents any escape of gas over the exterior.

§§ 9625, 10147, 10235, 10299, 10352. Mark IV* differs from Mark V in having a bridge of platinum-silver, resistance 1·5 to 1·8 ohms. The early issues also had white metal contact discs instead of pure tin. These were found to corrode and become covered with a deposit of high resistance. The later issues with pure tin contact discs have the letter T stamped on primers and packages as in the case of Mark V.

Mark IV** has the iridio-platinum bridge as in Mark V. § 10542.
These are both conversions from Mark IV.

Mark IV differs from the above in the contact disc being made of white metal and the ebonite insulator not being screwed into the head. More particularly in having two bridges, resistance ·6 to ·9 ohm; in having no Pettman cement in the joint between body and cylinder, in being filled with mealed powder only and in the top being closed by a brass washer with a cork plug shellaced in above it. The guncotton tuft does not so fully envelop the bridges. Mark IV. § 9055.

The Mark III primer differs from Mark IV in the cone not being cupped out at the front and in having no ebonite washer or screwed brass collar. The wire leading from the cone to the contact disc is central instead of one side, and the contact disc is of crown metal. The ebonite insulator is in two parts, a ring and a disc, and is kept in place by the metal of the head being spun over it. Early Mark III primers had no guncotton tuft on the bridges. Mark III. §§ 8561, 8841.

These primers were converted to resemble Mark IV* as far as possible and were then known as Mark III*. The conversion consisted in the primer being fitted with a single bridge, surrounded by a tuft of guncotton; in the joint between cylinder and body being made tight with Pettman cement; in the primer being filled with priming-composition and the top closed by a glaze-board disc secured with Pettman cement. Mark III*. § 9813.

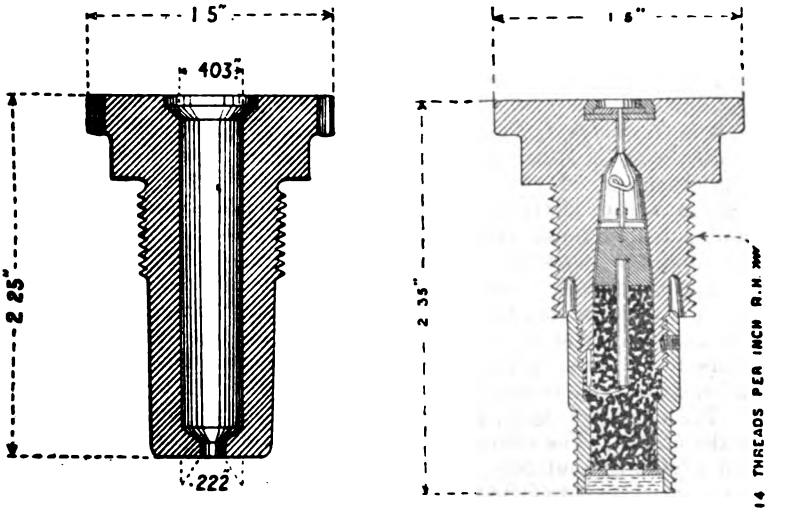
A further alteration has been made in addition to the above; the primer being fitted with the ebonite washer and brass collar round the central pole. The primers so altered are known as Mark III**. These are now being fitted with the strengthened iridio-platinum bridge, and are then known as Mark III*.*. Mark III**. § 10356.

The Mark II primer differs from Mark III in having the brass cylinder threaded externally at the point for half an inch. (*See cut.*) Mark II. §§ 7454, 7765.

Cartridge, Q.F., Adapter, Mark I, C., Steel.

Cartridge, Q.F., Primer, Electric, Large, Mark II, C., Manganese Bronze.

Scale, full size.



Mark II*. § 9813. Mark II primers are altered to agree with Mark IV* in the same manner as described for Mark III and are then known as Mark II*.

§ 10356. Mark II** have the addition of the ebonite washer and brass screw collar, similar to Mark III**.

Mark I. Mark II*** has the strengthened iridio-platinum bridge.

§§ 5979, 8874, 9813. The Mark I primer is described in the earlier editions of this Treatise. It is shorter, and its end is not screwed to take the igniter. Its internal arrangements differ. Mark I* is fitted with a cylinder like Mark III, and when further altered to agree with Mark IV,* is known as Mark I**.

To sum up, primers maybe divided into "unconverted," "converted," and those with strengthened bridges.

Unconverted primers are Marks I, I*, II, III, and IV. They have the double bridge of platinum-silver, resistance ·6 to ·9 ohms, body filled with mealed powder and the top closed by a brass washer and cork plug shellaced in.

§ 10542. *Converted* primers are Marks I***, I**, II*, II**, III*, III** and IV*. They have a single bridge of platinum-silver, resistance 1·5 to 1·8 ohms, surrounded by a tuft of guncotton, body filled with priming composition and top closed by a glaze-board disc secured with Pettman cement.

Strengthened bridge primers are Marks II***, III***, IV**, and V. They have an iridio-platinum wire bridge, resistance ·75 to ·95 ohm. For details, *see* Table 13, p. 487 *et seq.*

§ 7835.

During the operation of replacing a primer in a 4·7-inch (or 6-inch) Q.F. powder cartridge, care must be taken to ascertain before inserting the primer that there is a clear space for it in the cartridge, and that there is no liability of the end of the primer being screwed against a pebble or prism of powder, and so injured.

For proof of these primers, *see* Regulations for Army Ordnance Services, 1900.

§ 7400.

The *Adapter, Mark I,* is for use when the gun is fired by mechanical means. It is made of hardened steel, and is bored out to take the "Tube, V.S. percussion"; externally it resembles the Primer, Electric, in shape.

§ 6842.

§ 7400. The Rimer, vent, axial, (*see* p. 136), is used with this store.

The Mark II adapter is rather shorter, and is screwed externally to fit the igniter, like the Mark II primer. It is obsolete for future manufacture.

It is possible to use a wireless electric P tube with one of these adapters.

Reduced charge. § 9531. The *Cartridge, Q.F., 4·7-inch, Marks I to IV guns, filled, 2 lb. 2½ oz., Cordite, Size 7½, Mark I, N.*, is a reduced charge for Naval Service. The charge is of cordite in two lengths, made up in the same manner as the charges for the Mark V service cartridge, with a similar shalloon bag and igniter, but with ·05-inch cordite cylinder. The same brass case is used and as the reduced charge is very short, the space above it is filled up by a paper cylinder. This consists of a cylinder of brown paper, perforated, and fitted with double, perforated, discs at each end. A disc of glaze-board is attached by rivets to the end of the cylinder which is placed next the charge and the cartridge is closed by the white metal lid in the usual way.

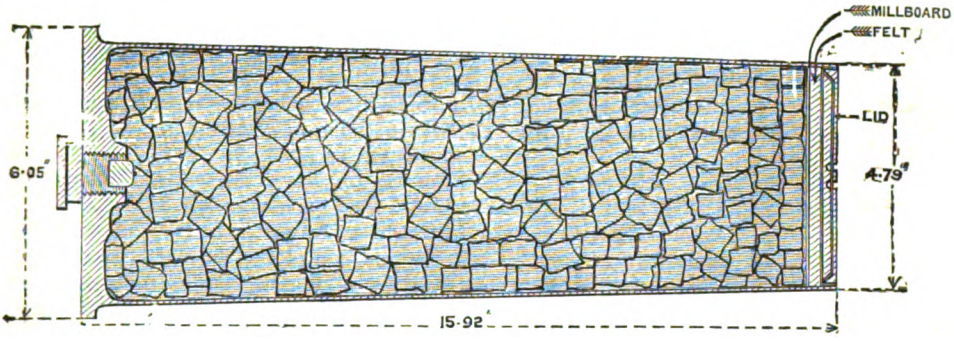
§§ 6244, 6278, 6420. The *Cartridge, Q.F., 4·7-inch, filled, 12 lb., S.P., Mark II,* is similar to the above. The charge is 12 lb. S P., covered by a millboard disc and a felt wad, but no cylinder. There is no igniter. The inside of the case is lacquered, with brown lacquer. The mouth of the case

is closed by a brass lid, with concentric and radial weakening grooves. § 6244.

Cartridge, Q.F., 4·7-inch, Marks I to IV Guns, Filled, 12½ lbs. of S.P., Mark I is similar to the above, but over the charge is a felt and glazeboard wad; this charge is for paper shot. § 10960.

Cartridge, Q.F., 4·7-inch, Filled, 12 lb., S.P., Mark II, Brass, Solid Drawn, with Lid and Primer, Electric.

Scale, ½.



Cartridge, Q.F., Blank, 4·7-inch, filled, Mark III.

The charge of 3-lb. blank L.G. is enclosed in a silk cloth bag with a dome-shaped igniter into which is secured a bag containing 8½ drams R.F.G.² or new blank F.G. powder. The bag is hooped in the ordinary way, but the hoops pass under strips of silk braid, which are attached to the bag so as to form loops, instead of through the silk cloth. This prevents the escape of powder dust from the bag into the interior of the brass case. The Service case is used, and the space above the charge is filled by a paper cylinder, similar to that used with the reduced cordite charge, but without the glazeboard disc. The mouth is closed in the usual way with the white metal lid. Blank cartridges. § 10324.

The Mark II blank cartridge differs from the above in the hoops passing through the bag and in wood and millboard wads over the charge. These wood wads are now obsolete. § 8476.

A description of the boxes, in which 4·7-inch cartridges are packed, will be found on page 322 *et seq.* Issue.

The 4·7-inch Q.F. armour-piercing shells, Marks I to III inclusive; pointed common, iron Marks I and II, and steel Mark III are fitted to take the Armstrong base percussion fuze. It is obsolete for L.S. and a description of it will be found in the last edition of this Treatise. Armstrong base fuze. §§ 6193, 7008, 8515.

There are two 12-pr. Q.F. guns, the one of 12-cwt., common to both services, and the one of 8-cwt., Naval only.

The projectiles are the same for both guns: they are shrapnel shell, pointed common, of cast steel and cast iron practice, and case shot. The 12-cwt. gun also uses a paper shot. 12-pr. Q.F. projectiles.

The shrapnel and case shot are those already described for the 12-pr. B.L. of 6-cwt., *see* pages 216, 225.

The *Cartridge, Q.F., 12-pr., 8-cwt., filled, 13¾-oz. Cordite, Size 10, Mark I, N,* is similar to the 4·7-inch Mark V cartridge. 12-pr. 8-cwt. cartridge. §§ 8514, 8610, 9268, 10095.

The cordite cylinder is ·05-inch thick.

Some of the earlier cartridges had a charge of 13½ oz. cordite and the paper dome igniter.

These are to be converted to resemble the 4·7-inch Mark V. § 10323.

12-pr. 12-cwt. cartridge. § 10619, §§ 8876, 9268, 10095.

The *Cartridge, Q.F., 12-pr., 12-cwt., filled, 1-lb. 15-oz. Cordite, Size 15, Mark II*, is similar to the 4·7-inch Mark V cartridge, except that it may have an extra felt wad if necessary.

Mark I is similar to the 4·7-inch Mark III but has no paper cylinder.

§§ 8420, 10323.

Its cordite cylinder is ·05-inch thick.

It is to be converted to Mark II in the same manner as the 4·7-inch Mark III is converted to Mark III*.

Some cartridges containing 1 lb. 9½ oz. cordite, Size 10, have been made.

Reduced. § 9531.

The *Cartridge, Q.F., 12-pr., 12-cwt., filled, 12½-oz. Cordite, Size 5, Mark I, N*, is a reduced charge for Naval Service. It is made up in a similar manner to the 4·7-inch reduced charge. It has the ·05-inch cordite cylinder.

Powder charge. § 10357.

A powder charge of 3¾-lb., S.P., has been introduced for use with paper shot for the 12-pr. 12-cwt. in the Land Service.

Saluting. §§ 8915, 9235.

The *Cartridge, Q.F., Saluting, 12-pr., filled, Mark I*, is for use with either 12-pr. gun. The charge of 1 lb. 8 oz. blank L.G. is enclosed in a silk cloth bag, with igniter in the base similar to that used with the 4·7-inch blank charge. This bag is completely covered, except the base, by a felt jacket, with a draw string at the bottom which is pulled in and tied. There is a loop of silk braid at the top and over the charge comes a felt wad to the underside of which a felt ring is attached. The loop on the jacket passes through a slit in the centre of the wad.

For Naval Service the 12-pr. 8-cwt. case is used for both guns, for Land Service the 12-pr. 12-cwt. case is cut down. Cases which may have become unsuitable for service charges can be so cut down. The charge is placed in the case with the wad above it. No lid is used.

Issue.

These charges are issued 50 in a whole M.L. case or 20 in a half M.L. case.

4-inch Q.F. projectiles.

The projectiles fired by the 4-inch Q.F. or Q.F.C. are:—Shrapnel shell; common; pointed common, cast-steel and practice, cast-iron; Lyddite and armour-piercing shell.

Cartridge. § 9532.

The *Cartridge, Q.F., or Q.F.C., 4-inch, filled, 3-lb. 9-oz. Cordite, Size 15, Mark II, N*, resembles the 4·7-inch Mark V: it has the same cordite cylinder.

§§ 8477, 9396.

The Mark I cartridge resembles the 4·7-inch Mark III but has no paper cylinder.

§ 10323.

It is to be converted to Mark II as already mentioned for the conversion of the 4·7-inch Mark III to Mark III*.

Reduced. § 9531.

The *Cartridge, Q.F., or Q.F.C., 4-inch, filled, 1-lb. 8-oz. Cordite, Size 5, Mark I, N*, is a reduced charge for Naval Service. It is similar to the 4·7-inch reduced charge already described, and has the ·05-inch cordite cylinder.

Blank. § 10324.

The *Cartridge, Q.F., or Q.F.C., Blank, 4-inch, filled, Mark II, N*, is made up in a similar manner to the 4·7-inch blank, Mark III. The charge is 3-lb. blank L.G.

§ 8476.

Mark I had the wood and millboard wad like the 4·7-inch Mark II. These wads are obsolete.

6-inch Q.F. or Q.F.C. projectiles.

The projectiles fired from 6-inch Q.F. or Q.F.C. guns are the same as those for 6-inch B.L. with the exception of Palliser and case shot.

Cartridges.

There are two brass cases for the 6-inch, the "long" and the "short." The former was introduced for powder charges and is still so used for Naval Service. It has also been filled with cordite

charges, but in future these will be made up in short cases. In consequence of this the word "long" or "short" is found in the name of each filled cartridge.

Those long cases which are not required for powder charges are cut down to the same length as the short cases, and take the same white metal lid, Mark I. § 10175.

The empty short case is known as Mark III and the long case as Mark II. When cut down the case is known as Mark II*, but some cut down cases of E.O.C. manufacture differ in dimensions at the mouth and require a slightly larger lid. These cases and lids are known as Mark III* and Mark I* respectively; and Mark I* lids must be used with Mark III* cases.

Cartridges.

The *Cartridge, Q.F., or Q.F.C., 6-inch, short, filled, 13-lb. 4-oz. Cordite, Size 30, Mark VII*, is similar to the 4·7-inch Mark V, except that the bottom of the bag and the pocket are made of silk cloth to give additional strength. § 9677.

The ·2-inch cordite cylinder is used.

The Mark VI short cartridge only differs from the above in having the bag made entirely of shalloon, exactly as in the 4·7-inch Mark V.

The Marks V and VI long cartridges had wood wads which are obsolete and the use of the cartridges has been discontinued. They were for Naval Service only. §§ 8875, 9696.

The Mark IV short cartridge is similar to the 4·7-inch Mark IV, but has no paper cylinder, and has millboard and felt wads over the charge. § 8875.

The Mark III short cartridge resembles the 4·7-inch Mark II, the cordite being loose and the Mark I igniter being used. § 8378.

The Mark II long cartridge resembles the last but the space above the cordite is filled up by a paper cylinder. §§ 6729, 6999, 7398, 7742.

Reduced.

The *Cartridge, Q.F., or Q.F.C., 6-inch, filled, 5-lb. 8-oz. Cordite, Size 10, Mark II, N*, is a reduced charge for Naval Service. It is similar to the 4·7-inch reduced charge Mark I, but takes a cordite cylinder ·1-inch thick. The Mark I 6-inch reduced cartridge has been withdrawn. §§ 9531, 9976.

Powder cartridge.

The *Cartridge Q.F., or Q.F.C., 6-inch, filled, 27¾ lb. powder, Mark II, N*, is a practice cartridge for use on gunnery ships. The long case is used and the charge is made up in four portions as follows. The bottom portion consists of a ring of shalloon, containing 2 lb. R.L.G.[4] powder, and this is placed at the bottom of the case. Above this comes a pad of shalloon containing 2¼ lb. R.L.G.[4] The middle and top portions consist of E.X.E. powder. The middle portion, of 6¾ lb., is built up in five layers, enclosed in a silk cloth bag, choked with silk twist. The top portion, of 16¾ lb., is built up in 13 layers, and also enclosed in a silk cloth bag, choked with silk twist. Over the top portion one or more felt rings are placed, the whole being covered by a felt wad and the top secured by a lid in the ordinary manner. The lid for this powder cartridge is made of brass instead of white metal. § 9646.

The Mark I cartridge only differs from the above in the bags for the middle and top portions being made of shalloon instead of silk cloth.

Cartridge, Q.F., 6-inch, Filled, 14 lb. P.[2], is used by gunnery ships as a reduced charge. The space between the powder and the lid is filled up by a millboard wad and a paper cylinder. The lid has "14 lb. P.[2]" stencilled in red on it. The manufacture of this cartridge has been discontinued. §§ 6906, 6999, 10502.

§ 10324. The *Cartridge, Q.F., or Q.F.C., Blank, 6-inch, filled, Mark III.* The charge consists of 7 lb. blank L.G., and the cartridge is made up in the same way as the 4·7-inch blank, Mark III.

§ 8476. The Mark II is similar to the 4·7-inch Mark II, having the wood wads which are obsolete.

Drill ammunition, 12-pr. Q.F. and above.

§ 9197. The *Cartridge, Drill, Q.F., 4·7-inch, Mark V*, is used at drill. The cartridge is made of teak, with a gun-metal base and end, of the same dimensions and weight as the service cartridge. The edge of the flange at the base is milled, to identify it from the service cartridge when packed. It is weighted with lead. A dummy primer screws into the rear end of a steel tube passing through cartridge.

§§ 6509, 7831, 9197. The Mark III has the edge of the flange plain, and is altered to Mark III* by having it milled.

§§ 9197, 8687. The *Primer, dummy, Mark III*, is a solid piece of metal of the same external shape as the Mark III service primer, except the head which is hexagonal, to readily identify it.

The head has a disc of india-rubber secured in it to ensure insulation of the striker. The head and shoulder are darkened by bronzing. The word dummy is stamped on the head.

§ 8687. Marks I* and II differ from the above in having a circular head. They are altered as above.

The *Shell, Q.F., 4·7-inch Drill, Marks II* and III.*

§ 7834. The shell is of wood weighted with lead. The base has a gun-metal plate, and on the body are two bands, the front of copper, the rear of gun-metal; the latter, which is placed 1 inch from the base, is of sufficient diameter to prevent the shell being rammed too far. The base is fitted with a recess to take an extractor.

12-pr. Q.F. § 7931. *Shell, Q.F., Drill, 12-pr., Marks I* and II*, are of gun metal, tapped at the head with the G.S. fuze-hole.

§ 9197. The *Cartridge, Q.F., Drill, 12-pr., Marks III and IV* resembles the 4·7-inch Marks IV and V.

§ 8459. Mark II resembles the 4·7-inch Mark III and is to be altered in a similar manner.

§ 9197. The 4-inch drill cartridge Mark IV and 6-inch short Mark IV

§§ 8140, 8154, 8459, 10502. resemble the 4·7-inch Mark V. The Mark II cartridges have not milled edges and are to be altered to Mark II*. The 6-inch long is to become obsolete when used up.

§ 8154, 8459. The drill shells for the 4-inch and 6-inch are similar to the 4·7-inch Mark III.

§ 9062. Drill cartridges are packed in service boxes which in the Navy are painted black to distinguish them.

Boxes and Cases for Q.F. Ammunition.

§§ 8285, 8686, 9622, 9769, 10270, 10407. The *Box, Ammunition, Q.F., 6-pr., Mark VI, C*, is made of teak or mahogany, with a lid working on gun-metal hinges and fastened by a hasp and turnbuckle of the same material, the latter being secured by a short lanyard of white line. Two strong cleats extend across the front and back and to these are attached handles of copper wire, 24 inches long, and covered with leather at the upper portion. These cleats also strengthen the box.

The box is lined with a zinc lining, having a channel formed round the top to receive luting and so make a water-tight joint. This lining is closed by a zinc lid, having a flanged edge to rest in the luting channel. Two diaphragms are soldered to the inside of the lining. These diaphragms are perforated by eleven holes to

support the eleven cartridges which the box will hold. Underneath the lower diaphragm is a wood bottom, consisting of eleven sections, each of which has a recess to take the point of a projectile. These sections are kept in position by a thin zinc plate, soldered to the lining and are capable of slight lateral movement so as to accommodate themselves to the points of the projectiles.

The wooden box is painted stone colour inside and out, but the zinc lining is neither painted nor varnished. Paint. § 9622.

The Mark V boxes have removable diaphragms, attached by screws to ledges of zinc which are soldered to the lining. These boxes are to be converted to Mark V* by having the diaphragms soldered to the linings. §§ 10270, 10407.

The Mark IV box is made of oak. The early boxes have shorter handles and the wood bottom in one piece for the points of the projectiles. The zinc lining is varnished black and a red cross is marked on the side of the box to distinguish it from one with unvarnished lining. In future linings will not be painted or varnished. Some of these boxes have the diaphragms soldered to the lining, and are then Mark IV*. §§ 8285, 8686, 9087, 9759, 10107.

The Mark III boxes had the diaphragms supported on metal corner pieces. They are converted by having these altered and are then Mark III*; but all boxes are to be altered by having the diaphragms soldered in, as they pass through Ordnance Factories. They then become Mark III**. §§ 5706, 5820, 6209, 6759, 10107.

Mark II boxes differed from the above as follows:— Mark II. § 5323.

1st.—The diaphragms were of wood instead of zinc, and were not removable.

2nd.—The cleats were weaker, and had rope handles attached to them.

Mark I boxes were similar in external form and dimensions to Mark II; they, however, were not fitted with a zinc lining. The junction of lid and body was protected by a waterproof cover or cap fitting over the top, and secured by a tape band shellaced on. Mark I. § 5057.

In future Mark I boxes will be used for dummy cartridges only. Service cartridges for L.S. packed in Mark I boxes will be repacked in boxes of later patterns as soon as the latter are available, the cartridges being examined, and, if necessary, repaired when repacked. § 6675.

Boxes containing drill cartridges for N.S. will be painted black. § 9062.

To close 6-pr. boxes, Marks II to VI, fill the channel round the top edge with Mark III luting, press the flange of the zinc lid well into the luting, then fill up the recess round the lid with luting, smoothing it well down with the thumb. Wipe off the surplus luting, and close the outer lid, securing the turnbuckle with the lanyard. Closing boxes.

The 3-pr. boxes differ from the 6-pr. in dimensions. They hold sixteen cartridges and in order to readily distinguish them from the 6-pr. they are painted lead colour. Dimensions, 22·775″ × 14·65″ × 12·375″. 3-pr. boxes. Paint.

The Mark VII 3-pr. box corresponds to the Mark VI, 6-pr. § 10407.
" " VI " " " " " " V " § 10270.
" " V " " " " " " IV " §§ 8686, 9322.

The Mark IV 3-pr. box differs from the 6-pr. Mark III in having no holes in the wood bottom for the points of the projectiles. The lid and bottom are also slightly thicker, giving greater strength. §§ 6026, 6209, 6769, 8235.

Marks VI*, V*, and IV* have the diaphragms soldered in. §§ 5057, 5323, 5821, 8235.

The Marks III, II, and I boxes follow the corresponding marks of the 6-pr. boxes.

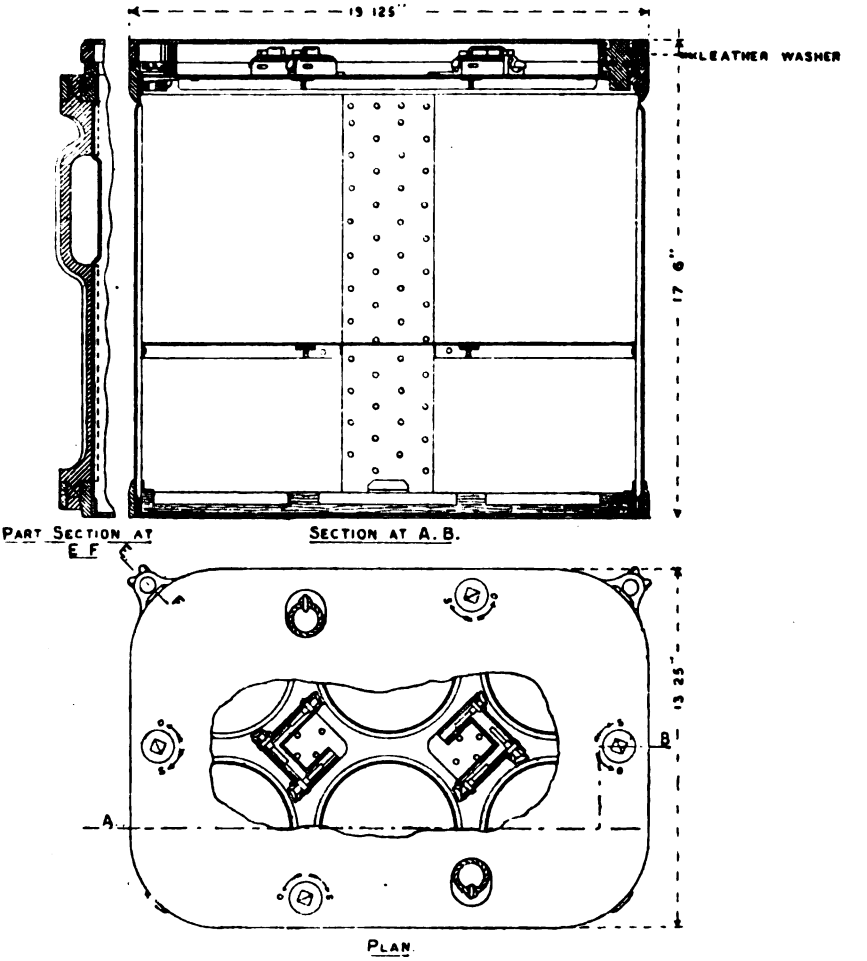
Closing. The boxes are closed in the same manner as 6-pr. boxes.

4·7-inch boxes and case. The 4·7-inch Q.F. cartridges for Marks I to IV guns are packed in "Cases, powder, rectangular, M," or in teak boxes for N.S. and in deal boxes for L.S. These packages each hold six cartridges and are described in detail below.

M case. §§ 5917, 7249, 7449. *Case, Powder, Rectangular, M, Mark II.*—The case is made of brass, the sides being corrugated. The bottom is strengthened with a gun-metal band, is lined with teak, and has recesses to receive the ends of the cartridges. The case is fitted with a false top and bottom, both of brass, each perforated with six holes to receive the 4·7-inch cartridges; the flange of the cartridge rests on the false top, and a spring clip projects over the head and secures each in position.

Case, Powder, Rectangular, M, Mark II, N., Brass, Corrugated, 4·7-inch, Q.F.

Scale, $\frac{1}{8}$.



The lid is the same length and breadth as the case, and is secured by bolts with feathers on the end, which lock, by a one-third turn, into holes in the top of the case. The bolts pass through the lid, the heads on the outside being square, so that they can be turned with the key. The lid has a projecting rim round the edge which fits into the groove in the top of the case; the latter being filled with luting when the case is packed. The lid is fitted with two twine loops for lifting it, and the case has a handle attached to each of the top corners of one side, so that when slung or lifted the cartridges in the case are horizontal.

The groove round the top edge of the case is filled with Mark III luting, the projection on the lid is placed in this groove and the lid tapped well home. The Mark IV key (*see* p. 76) is used to turn the bolts into the locking position, as indicated by the arrows. The surplus luting is then wiped off. For Extractor, Cartridge, M, powder case, *see* p. 328. Securing.

The Mark I case had copper wire handles at each end covered with leather, and the bottom was not strengthened by the gun-metal band.

Mark I cases will be altered to conform as far as possible to Mark II as they pass through the ordnance factories for repair, and will be known as Mark I*.

The *Box, Cartridge, Q.F., 4·7-inch, Naval, Transport, Mark I, N*, is made of teak throughout. Battens of the same material extend along the sides, top, and bottom, the ends and corners being strengthened by brass strips; rope handles are secured in the battens, the lid is fastened with brass screws, and attached to the box by two pieces of white line to prevent loss of lid. §§ 6027, 6445, 6613, 7298, 7517, 8285. 8643, 9087.

The box has a removable zinc lining, with a projecting beading round the top, which fits into a groove in the zinc lining of the lid; the groove is filled with luting to form an air-tight joint.

Some of these linings are varnished black, and when this is the case, the boxes are marked with a red cross to distinguish them from those in which the linings are unvarnished.

It contains six cartridges, which are packed horizontally, "heads and tails," six packing pieces of hard wood being placed between the mouths of the cartridges and the ends of the box to prevent movement. There is also a bottom packing piece. Each cartridge has two bands of canvas round it for lifting it out of the box.

The box is painted stone colour.

No more of these boxes will be made, and as soon as the existing stock is used up, they will become obsolete. § 9122.

Box, Cartridge, Q.F., 4·7-inch, Naval, Outfit, Mark I, resembles the transport box described above. The handles are of copper-wire rope covered with leather, and the lid is fastened by a locking plate. The locking plate engages four metal bolts in the body, and is moved by an eccentric turned by the Mark IV key used with rectangular brass cases. (*See* cut.) §§ 7035, 7247, 7298, 7517, 8192, 8285. § 8073.

The Mark II box only differs from the above in being fitted with six spring packing pieces of wood and metal instead of wood only. The Mark I box when fitted with these will be known as Mark I*. Mark II.

The *Box, Cartridge, Q.F., 4·7-inch, Marks I to IV guns, L.S., Mark II*, is made of teak or mahogany, with strengthening battens along the sides, top and bottom. Two rope handles are secured to the upper battens. Four gunmetal plates are attached to the upper battens, and hinged to these plates are studs carrying wing-nuts. § 10270, 10462.

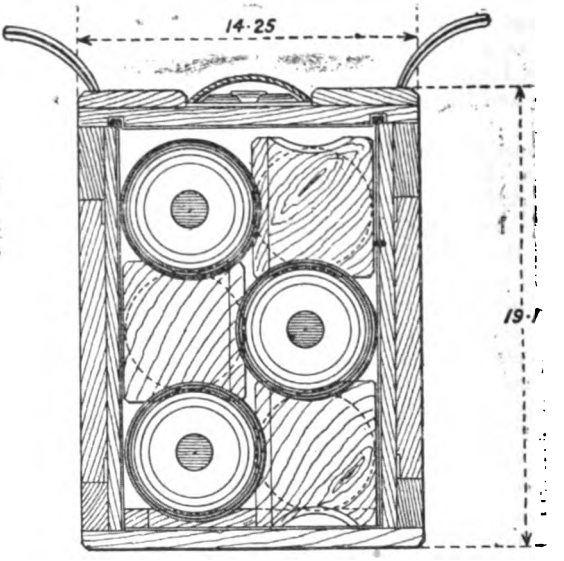
The body has a zinc lining, the top edges of which project slightly above the box.

The lid is lined with zinc, and in it a luting groove is formed, into which the top of the lining fits. It is strengthened by battens. Four slots are cut in the edge, and strengthened by metal plates for the wing-nuts to screw down on. The lid is also fitted with two handles of white line, for lifting it off. The outside dimensions are the same as for Naval Outfit box.

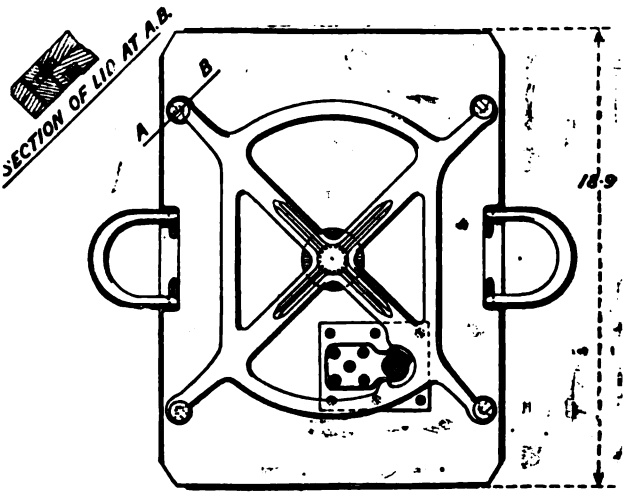
The box is fitted with seven packing pieces, one bottom and six

Box, Cartridge, Q.F., 4·7-inch, Naval Outfit, Mark I | N | , Wood, Zinc lined, with twelve lifting bands, and one bottom and six end packing pieces, for six rounds.

Scale, $\frac{1}{8}$.



Elevation with end removed. Showing packing pieces.



Plan with battens removed. Showing locking arrangement.

end pieces. The end pieces are made of wood with brass spring cups. The box is also provided with twelve canvas lifting bands, two per cartridge, and the six cartridges are packed heads and tails.

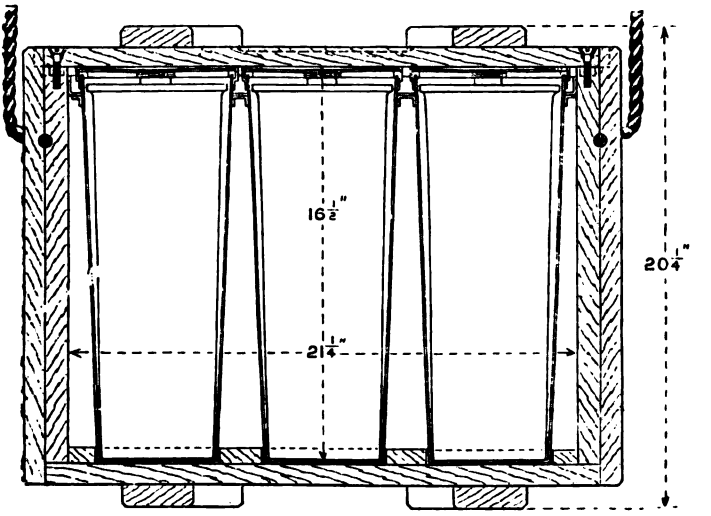
To close the box, fill the groove on the underside of the lid with Mark III luting. Place the lid in position and tap it home. Turn the studs, with wing-nuts, up into the recesses in the lid and screw down the nuts. Dimensions, 19·1″ × 18·9″ × 17·85″. Closing.

The Mark I box differs considerably from Mark II (*see* cut). §§ 6568, 8285.

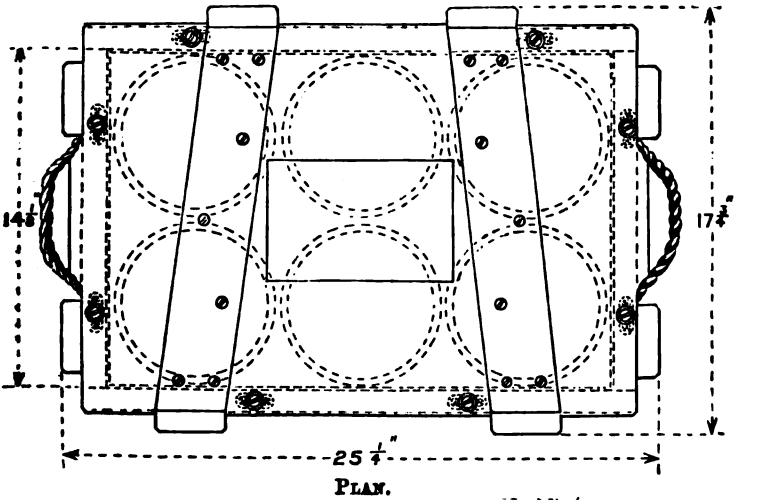
It is made of deal, with elm ends, the sides and ends being dovetailed, and the bottom secured by brass screws. It is strengthened by deal battens extending up the sides and across the bottom. At

Box, Cartridge, Quick-firing, 4·7-inch, Land Service, Mark I, Wood, with Zinc fittings, for six rounds.

Scale, 1½ inches = 1 foot.



Sectional Elevation.



Plan.

each end there are two cleats of elm, to which rope handles are attached. It contains six cartridges, which fit into zinc cylinders, which rest on the bottom of the box. These cylinders have lids, inside which are indiarubber rings for the purpose of making an air-tight joint. A zinc plate secured inside near the top by screws keeps the cylinders in position. The lid of the box is secured by eight brass screws, and is strengthened by two battens fastened diagonally across it. It is painted stone colour.

12-pr. Q.F., 12 cwt. §§ 7739, 8285, 8192.

Box, Cartridge, Q.F., 12-pr., 8 cwt., Mark I, N., is similar to the 4·7-inch Naval outfit box, but the locking frame of the lid has a longitudinal instead of a circular motion. It has one canvas lifting band with a loop at one end, one of the bottom cartridges is passed through the loop and the band is wound alternately above and below the other cartridges. The box holds 10 cartridges, and has 10 end and one bottom packing pieces. Dimensions, 21·1″ × 11·15″ × 11·0″.

§ 10462.

The *Box, Cartridge, Q.F., 12-pr. of 12-cwt. Mark II, N*, holds ten cartridges. It is similar to the 4·7-inch Naval outfit box, but the studs fit into slots in the lid instead of into holes. It has spring packing pieces. Dimensions, 20·625″ × 18·5″ × 11″.

§§ 7739, 8285, 8192.

Mark I is of stronger construction, has wood packing pieces, and the studs work in holes in the lid. When this box is fitted with spring packing pieces it becomes Mark I*.

§ 10462.

The *Box, Cartridge, Q.F., 12-pr. of 12-cwt., L.S., Mark III*, is made of teak or mahogany, and is similar to the 4·7-inch Land Service box, Mark II. It holds ten cartridges, and has one lifting band like the box for 12-pr. of 8-cwt. cartridges. It has spring packing pieces.

§ 10270.

The Mark II box differs from Mark III in not having spring packing pieces. When fitted with them it becomes Mark II*.

§§ 7908, 8285.

The Mark I box is made of yellow deal, and the lid is secured by four brass screws instead of the wing-nuts. When fitted with spring packing pieces it becomes Mark I*. Dimensions, 20·625″ × 18·5″ × 11″.

§ 10501.

Special packing pieces are used with these 12-pr. boxes in L.S. for packing saluting cartridges. The box will hold 20 cartridges, without primers, in five tiers of four each lying heads and tails.

§ 10462.

The *Box, Cartridge, Q.F. or Q.F.C., 4-inch, Mark II, N*, holds eight cartridges. It is similar to the 4·7-inch, Mark II, outfit box, having spring packing pieces but only one lifting band.

§§ 8193, 8285.

Mark I has wood packing pieces, and when fitted with spring packing pieces becomes Mark I*. Dimensions, 22·25″ × 17·75″ × 13·5″.

The *Box, Cartridge, Q.F., or Q.F.C., 6-inch, Naval, Cordite, Mark II*, holds four short cases packed vertically heads and tails. It has two wood packing pieces and the lid is fastened with a locking plate. The handles are on the sides of the box, so that when the box is lifted, the cartridges are on their sides. Wood battens are fitted to the side upon which the box will rest. Dimensions, 19·65″ × 18·725″ × 17·75″.

§§ 8285, 8598, 9469.

The Mark I box has the handles at right angles to the position described above, so that the cartridges are not on their sides when the box is lifted.

§§ 6729, 7247, 7516, 7604, 8192, 8285.

The *Box, Cartridge, Q.F., 6-inch, Naval Outfit, Mark II*, is of similar construction to the above, but takes three long cartridges. Mark I is similar to Mark I above. No more will be made.

§§ 7247, 7516, 7604, 8285.

The *Box, Cartridge, Q.F., 6-inch, Naval, Transport, Mark I*, also takes three long cartridges; the lid is attached by screws. No more will be made.

§ 9827.

These 6-inch Outfit and Transport boxes are converted by being cut down so as to make them suitable for three short cartridges.

The *Box, Cartridge, Q.F., 6-inch, L.S., Mark II*, holds four short cartridges, packed vertically heads and tails. The lid is fastened by wing-nuts, in the same manner as the Mark II 4·7-inch L.S. box. The box is made of teak or mahogany, with two packing pieces. § 10270.

The Mark I box is made of deal, and the lid is fastened by brass screws. §§ 8139, 8285, 8598.

Boxes used for blank cartridges in the Navy are painted red. Dimensions, 19·65″ × 18·725″ × 17·125″. Blank cartridges. § 9062.

Box, Cartridge, Q.F., 6-pr. and 3-pr. Saluting, Tools, Mark III.— The box for saluting tools, primers and wads is fitted inside to take a set of tools, and for the primers and wads. It is painted stone colour, and its contents are as under. These boxes have printed instructions for filling, and a lithograph showing method of filling, fixed on the underside of the lids :— § 6542.

Articles.	For 6-pr.	For 3-pr.	Remarks.
Primers, Mark III (20 in a tin cylinder)	100	200	
Wads, felt, Mark III	125	250	
„ paper, „	125	250	
Tools { rods 12·7-inch		1	
Tools { drivers, screw, primer.. ..		1	

Complete boxes only are issued.

The charges are issued filled in half metal-lined cases, which for N.S. are painted red. They hold 37 6-pr. or 50 3-pr. charges.

The cases when first issued had a primer screwed into the base, and when required for use a Mark IV charge is inserted in the case, and secured as described at p. 304. Issue.

Boxes, Cartridge, Cases, Q.F., 6-pr., Mark II, and 3-pr. Mark I, Saluting.—These boxes are made of deal with elm ends, having cleats and rope handles; the lids are hinged and fastened by a hasp and turnbuckle in front. They are fitted with two mahogany fittings, perforated with 20 holes for the cases, which stand base upwards. The underside of the lid is recessed so that safety clips may remain on the bases of the cases. § 5944, 8611, 9062.

Printed instructions for filling, and lithograph showing method of filling, are fixed on the inside of the lids of these boxes.

For Naval Service these boxes are painted red.

The following implements are used in connection with Q.F. ammunition.

Brush, fuze-hole, Mark I, | C |, wire-handled, for use in cleaning the fuze-holes of 6-pr. and 3-pr. shells when breaking up ammunition. § 10271.

Brush, primer-hole, Mark I, C, wire-handled, for cleaning the primer holes of Q.F. cartridges previous to filling. § 10083.

The *Extractor, Cartridge, Hand, Q.F., or Q.F.C., Large, Mark I*, for use with 6-inch Q.F. guns. It is made of steel, with jaw at one end to grip the head of the primer or adapter when withdrawing the cartridge. The other end is flattened, so as to fit under the forearm when the hand grasps the cross bar. §§ 6778, 7768.

The *Extractor, Cartridge, Hand, Q.F., Small, Mark I*, for use with 4·7-inch, 4-inch, and 12-pr. Q.F. guns, is made of steel, and intended for extracting the cartridge from the gun when necessary. It is provided with jaws at one end to grip the primer under the head. §§ 5918, 7768. § 5918.

The handle of the extractor is roughened, and is fitted with a loop of white line for placing over the wrist.

§ 6649. Another *Extractor, Cartridge, M, Powder Case, Mark I*, made of metal, has been approved for extracting the 4·7-inch cartridge from the M powder cases. It differs principally from the above in the material of which it is made.

§ 7329. *Gauges, Cartridge, Q.F., 6-pr. and 3-pr., Chamber, Low, Mark I*, are made of cast iron, to the low dimensions of the chamber of the gun, and are intended for use in gauging cartridges after being repainted, refilled, etc.

§ 8917. Similar gauges are used for cases, 12-pr. and above after rectifying.

§ 9355. *Gauges, Cartridge, ring, 2·5-inches diameter and 2·15-inches diameter, Mark I, N*, are of gun metal, for gauging 6-pr. and 3-pr. Q.F. saluting cartridges when enclosed in their felt jackets. The cartridges should be a tight fit in the gauges.

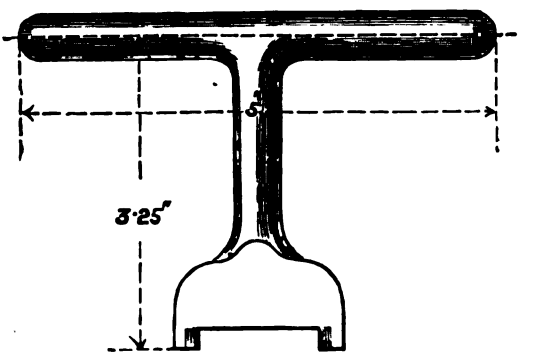
§ 9355. *Holder, Cordite charges, 6 and 3-pr. Mark I, N*, consists of a gun-metal pillar and stand which may be screwed to a table. It has a projecting arm fitted with a circular slot; the outer part being hinged and fitted with a spring catch for closing it. It is for use in tying up the cordite charges for 6 and 3-pr. cartridges.

Key, fuze, Hotchkiss, Mark I, for screwing in and removing the Hotchkiss base fuze.

Keys. §§ 5979, 6709, 7232, 9627. *Key, Inserting Primer, Electric, Q.F., or Q.F.C., Large, Mark I.*
Key, Removing Primer, Electric, Q.F., or Q.F.C., Large, Mark II.
These keys are issued for the purposes indicated by their names, with the 12-pr., 4-inch, 4·7-inch, and 6-inch Q.F. cartridges. They

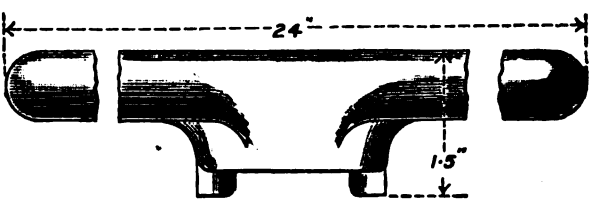
Key, Inserting Primer, Electric, Q.F., or Q.F.C., Large, Mark I.

Scale, ½.



Key, Removing Primer, Electric, Q.F., or Q.F.C., Large, Mark II.

Scale, ½.



are made of mild steel, to the form and dimensions shown in the woodcuts. They are also used with adapters.

The pins of the key, removing primer, are sloped so that the distance between them is slightly greater at the point than at the base. This makes them suitable for fired primers, the heads of which are liable to expand on firing.

Mark I key has straight pins and is altered to Mark I* which is similar to Mark II.

Tool, Opening, Cartridge, Q.F., Mark I, is a pair of curved pincers made of steel, and is intended for use with all Q.F. cartridges for prising up the clips over the lid when it is necessary to remove the latter. § 8286.

There are a number of implements used in connection with the Armstrong Base Fuze. These are described in the last edition of this Treatise.

Tools, reforming cartridges Q.F., or Q F.C. comprise a number of implements the use of which follows. They are:—

Drift.
Holder.
Mandril.
Plug, rectifying.
Press, screw.
Press, hydraulic.
Pump, pressure.
Set.
Tap.
Also for 6-pr. and 3-pr.
Drift wood.
Machine, extracting shells.
Machine, indenting.
Rods, 17-inch and 12·7-inch.

The Drifts are gun-metal rings for use in inserting the lids of Q.F. cartridges, 12-pr. and above. §§ 8421, 8917.

The Holders were formerly known as Clips. They are steel bands with handles and a link, and are used to grip the cases when unscrewing primers, etc. §§ 6576, 7273, 7723, 8916.

There is another Holder which consists of a wheel in the centre of which is a bolt screwed to fit the primer hole. It is used for turning the cases in the press. § 6756.

The Mandrils are for use in removing bulges etc., from the bodies of cases. §§ 6576, 8421, 8917.

The plugs are for use in rectifying the mouths of the cases if they are deformed. The plug is driven in with a wooden mallet; a lip on the upper edge prevents it being inserted too far. §§ 8421, 8917, 9397.

The screw press is for use in reducing the case to the correct size. It is fitted with dies for the different sizes of cases. §§ 6576, 8421, 9878.

The Hydraulic press is for the same purpose. §§ 8917, 9474, 9878.

It is issued for Naval Service.

The pump, pressure is for use with the above. §§ 8922, 9879.

The Set is for use in turning down the clips of cases in securing the lids. It is made of steel with a notch for turning over the clip. §§ 7019, 8918.

The tap is for rectifying the primer hole. § 6576.

The Machine, Extracting Shell, is for use with 6-pr. and 3-pr. ammunition. It consists of a body containing a steel bush, the whole being mounted on a cast-iron stand. The bush is secured to the body §§ 8421, 9999.

by two screws, and is bored to receive a 6-pr. cartridge. The bush is screwed on the outside at the front end, which projects from the body, and carries a hand wheel. Two jaws, adjusted by screws, the heads of which are prepared for a tommy, are held in a carrier, which is fixed by two bolts passing through it and the boss of the hand wheel, to a collar behind the latter. The bolts fit in keyways in the screwed parts of the bush and thus prevent the carrier from turning with the wheel, while it is capable of movement in and out.

A socket bored to receive the 3-pr. cartridge can be screwed on to the lower part of the bush.

The rear end of the bush or socket is covered by a metal cap and prepared so that the cartridge may be protected by its safety clip while in the machine.

A clip is always to be on the cartridge when it is in the machine.

§ 10208. This machine, when in use, is to be covered by a rope mantlet.

§§ 6576, 9910. The machine, indenting, 6-pr., consists of a cylindrical steel body, bolted to a bed plate, which can be bolted to a bench. The body is chambered to take the cartridge, and fitted with three spring indenting pins, actuated by a short lever and cam. The shell can be forced into the cartridge case, before the latter is indented, by a screw bolt and hand wheel. The machine is arranged so that the cartridge can be placed in it with its clip on, and the clip is always to be on the cartridge when it is placed in the machine.

A similar machine is issued for indenting 3-pr. cartridges.

§ 6576. The Rod is of steel, 17 inches long, and reduced in diameter at the point. It is for use in driving the fired cap out of 6-pr. and 3-pr. cartridge cases.

§ 6576. The Wood drift is for loosening and turning 6-pr. or 3-pr. cases in the press.

Storage of Q.F. Ammunition.

6-*pr.* *and* 3-*pr.*

This ammunition will always be stored by itself, either in a store not under magazine conditions or in a magazine. (*See* p. 437.)

The boxes will be placed on their sides, or upright in stacks of not more than 11 feet high, measuring from the lowest batten. The layers will be separated by thin wood battens placed across the boxes. When the boxes are on their sides the battens must be clear of the lids. During transport the boxes will *always be placed upright.*

The numeral of the cartridges, the nature, the number of the lot, the date of manufacture, *i.e.*, of filling, lot number and initials of manufacturer of powder or cordite and the initials of the manufacturer who makes up the complete ammunition, are indicated on the label, or are stencilled on the lid of the box, and the ammunition will be separately stacked accordingly, different natures or descriptions being kept distinct. Ammunition made up in the Royal Laboratory before June, 1890, has no lot number, so must be stacked by dates.

Cartridges of the oldest date will be issued first, unless a special order to the contrary be given.

As these cartridges contain their own means of ignition, great care should be taken in handling the boxes and cases containing them. When issued to foreign stations boxes will be contained in outer cases of deal, for protection in transit. These cases will be removed as the boxes are finally stacked in the stores.

12-pr., 4-inch, 4·7-inch, and 6-inch.

These cartridges being separate from the shells, and fitted with an electric primer only, will be treated as regards storage in the same manner as ordinary cannon cartridges filled with the same explosive (*see* p. 437). They may, however, be placed in an ammunition store.

The boxes and cases containing the cartridges will be stacked on their sides to a height not exceeding 11 feet.

The numeral of the cartridges, nature, lot, number, and initials of manufacturer of powder or cordite, monogram of station and date of filling, the numeral and initials of manufacturer of empty cartridges, and initials of maker, numeral and year of manufacture of the primer are stencilled on the lid of the box.

The various initials are as follows:—

King's Norton Metal Company	KN.
Kynoch and Company	K.
Elswick Ordnance Company	EOC.
Lorenz Ammunition Company	L.
Royal Laboratory	R⅄L.
Grenfell and Accles	G.
Birmingham Small-Arms and Metal Company	BSA.
Projectile Company	P.
Maxim-Nordenfelt Company	N or MN.
Hotchkiss	H.
Latimer, Clark, Muirhead and Company ..	CM.
British Munitions Company	BM.
Vickers, Sons and Maxim	V.S.M.

Treatment of Empty Cases.

Empty cases will always be cleaned immediately after firing. The fired cartridges should be immersed and well washed in clean fresh water, which should, if the cartridges have been fired with cordite, contain ½ oz. of soda to the gallon. They should then be rubbed inside and out with a mop, formed by a piece of rag tied to the end of a stick, rinsed in clean water and wiped perfectly dry. Soda may be used with cartridges which have been fired with powder, but its use is not essential in this case. When perfectly dry they will then be repacked in the boxes in which they were supplied, and returned to the Army or Naval Ordnance Department as soon as possible for relacquering and re-forming, which should be done with the least possible delay, as cartridges when left unlacquered deteriorate rapidly, the clips will be replaced on the cartridges which have them. The fired cartridge cases are not on any account to be repacked in boxes containing unfired cartridges.

Rectifying, Filling, and Packing Quick-Firing Cartridges.

Rectifying, 6-inch, 4·7-inch, 4-inch, and 12-pr. Quick-firing Cartridges.

Remove the primer with the "Key, removing primer," holding the cartridge in the holder, and clean the cartridge by immersing it in a solution of one part of sulphuric acid and nine parts of water for a few minutes, then rub clean, thoroughly wash in clean water, and dry in sawdust, which should, if possible, be hot.

Gauge the primer hole with the high screw gauge. If this gauge can be screwed through the hole, the cartridge will be returned to

Woolwich to be bushed, except at such stations as are approved for this to be done locally.

Remove all dents and fluting in the body of the cartridge by hammering them on the mandril with the copper hammer, commencing at the outside of the depression; and, if the mouth is distorted, rectify it with the "plug, rectifying."

Should the base of the cartridge be bulged out round the primer hole, place the cartridge in a lathe and turn off the projection. If a lathe is not available the projection may be removed by filing, or, in the 4·7-inch and smaller natures, by placing the cartridge in the press, and while thus firmly held, setting in the bulge with a few smart blows with the copper hammer until a straight edge placed across the base, shows that the bulge does not project beyond the edge. It is not necessary to *remove* the bulge by hammering.

Reduce the cartridge to correct size in the press until it will enter the chamber gauge so that a straight edge placed across the mouth of the gauge does not touch the base of the cartridge. To use the screw press, one man should hold the cartridge in the lower die, while another unscrews the press, raising the upper die as far as possible, and then swings round the weighted lever with his full force so as to screw down the upper die on to the cartridge, which is turned by means of the holder screwed into the primer hole. If necessary the base of the cartridge must be reduced with a file, or in a lathe.

Rectify the primer hole with the screw tap, holding the cartridge in the holder.

Place a lid in the mouth of the cartridge and mark on the latter where the flange of the lid is cut away; remove the lid and notch the mouth of the cartridge with the 4-inch round file to a depth of 0·1-inch, so as to leave a tongue 0·2-inch wide in the centre of each of the places marked. If the cartridge has been previously notched, the new notch should be commenced 0·2-inch from the old one, and only one need be made for each tongue. If, however, the original tongues are all in good condition, and not cracked, they may be used again. In the 6-inch quick-firing cartridge, the tongue must be tapered in thickness towards the point with a file.

Warm the cartridge as hot as the hand can comfortably bear, and paint both its interior and exterior with lacquer,* which should be applied with a camel-hair brush. The lacquer should be thinly laid on so as not to prevent gauging, but the whole surface, except the threads of the primer hole, should be covered.

Rectifying 6 and 3-pr. Quick-Firing Cartridge Cases.

Drive out the cap from the service cartridge case with the rod and a hammer, or unscrew the fired primer from the saluting case, and, if necessary, drive it out with the rod and hammer.

At stations supplied with tools for reforming, the cases will be cleaned, resized, and lacquered as already described, dies for the 6 or 3-pr. cases being fitted into the 4·7-inch screw press. A wooden drift is used to loosen the case in the dies in order to turn it, instead of a holder.

If the neck of the service case is perforated where it has been indented into the cannelure in the shell, the case must not be used again, the old indents should therefore be carefully examined to see

* The lacquer is composed of: seedlac, 5 lb.; turmeric, 2½ lb.; methylated spirit, 5 galls.

if a hole has been made through the neck both before and after removing the indents.

Insert a new cap in the service case, and drive it home with a drift and wooden mallet, or screw a new primer into the saluting case with the "driver, screw, primer."

If in a cordite cartridge the shell has considerable side play in the mouth of the case, or if in a powder cartridge it can be easily turned in the case with the hand the shell should be extracted in the apparatus supplied for the purpose, and the wad and charge removed from the case. The neck of the case will then be reduced in the press, and the cartridge will be refilled as described on page 335. On no account, however, is the fuze to be removed from the shell.

At stations not supplied with tools for re-forming, the saluting cases will be cleaned by washing in hot soda and water, thoroughly dried and fitted with new primers.

The cartridges will not be re-formed or used after firing 11 rounds with full or reduced powder charges. Any round fired with full or reduced cordite charge will be counted as two rounds with powder charges, so that if all the charges have been cordite, the cartridge will not be re-formed after six rounds. §§ 8228, 8500.

The number of times cartridges can be re-formed and used with blank charges will be left to the discretion of the Inspecting Officer.

When new cartridges are filled they will be stamped with the letter "P" or "C" to denote whether the charge consists of powder or cordite, followed by "F" or "R" in smaller letters to denote whether full or reduced.

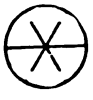
When again filled, should the explosive used be the same as in the previous charge, it will only be necessary to add a small "F" or "R" to denote whether full or reduced. Should the explosive used be different from that in the previous charge, the letter "C" or "P" should be inserted before the small "F" or "R," *e.g.*, P F F R C F R.

This would show that the—

1st was a full charge of powder.
2nd „ „ „
3rd „ reduced charge of powder.
4th „ full charge of cordite.
5th „ reduced charge of cordite.

The label on the box in which the filled cartridges are packed should notify when repaired cartridges are used.

Q.F. cartridges, 12-pr. to 6-inch, which are condemned for service, but are utilised for dummies, are stamped on the base, thus:— § 9269.



When so stamped they will on no account be again used as service cartridges.

Repainting 6-pr. and 3-pr. Quick-firing Cartridges.

The repainting of quick-firing cartridges will be carried out as a laboratory operation, special permission being obtained.

The rust must be carefully removed with a copper scraper or emery cloth, and the part wiped with a cloth moistened with a very little turpentine carefully wiped off with a cloth, in the outer room of the laboratory. The cartridges will then be removed to the inner room, and the shells, except the driving bands, painted.

When thoroughly dry, after painting, each cartridge will be gauged in the low chamber gauge, and repacked, the box being stencilled "Repainted," with the date and monogram of station.

Great care will be taken in carrying out the above examination to use all the necessary laboratory precautions, and especially not to allow too large an accumulation of ammunition in the laboratory. Also when the safety clip is removed, the cartridge must on no account whatever be placed in a box, or laid down without the clip being replaced, except when absolutely necessary.

Filling Quick-Firing Cartridges.

12-*pr. Q.F. and above.*

With charges that are made up and have a space at the base for the end of the electric primer, the primer will be screwed into the cartridge with the "key, inserting primer," after filling and securing the lid. With charges that are inserted loose the primer will be screwed into the cartridge first. The charges and wads will be inserted as detailed for the different natures.

Inserting lids. To close the cartridge, coat the edge of the lid with Pettman cement, insert it in the mouth of the cartridge so that the portions where the flange is cut away are opposite the tongues, place the "drift inserting lid" on it and drive it home with a few light blows from the mallet until the flange of the lid is on the edge of the cartridge; turn down the tongues of metal over the edge of the lid with the set, and hammer them closely down with the 12-oz. metal hammer, care being taken in securing the lid not to deform it or the cartridge.

Cordite charges. The service cordite charge is made up of sticks of cordite, tied together with silk braid, the base being thickened by bundling short sticks round that part of the main body of the charge. To afford room for the igniter, and for the end of the electric primer, the sticks in the centre of the base of the charge are separated from one another; they are kept together at the top end by two bands of silk braid, and at the broadened base by a shalloon bag, which also fits into the aperture formed in the centre of the base. This bag is bound by silk braids to the braids binding the sticks together, and the shape of the aperture in the base of the charge is maintained by the insertion of a cylinder of cordite, to the inside of which is stitched a shalloon igniter containing 1 oz. 4 drs. R.F.G.[2] or new Blank F.G. powder.

The bag for the 6-inch has its base and the pocket for the igniter made of silk cloth.

The charge is inserted in the cartridge and is prevented from moving by a felt wad, to the bottom of which is attached a disc of glaze-board, which is placed over the charge with the glaze-board next the charge.

The lid is then placed on as already described.

The naval practice charge is similar to the service charge but shorter and has above it a paper cylinder, consisting of a stiff central stem of brown paper, with a disc of the same material at each end, that which goes next the cordite being faced with a disc of glaze-board. A paper label on the lid gives the numeral of the filled cartridge the word "cordite," and the nature, weight, and lot number of the cordite.

6-inch Q.F. Powder Cartridges.

The 27¾-lb. charge for gunnery ships is inserted into the long cartridge case in four portions.

The two lower portions consist of a ring and a pad, both of shalloon. The former is filled through a hole in the side, with 2 lb. R.L.G.[4], the opening being afterwards sewn up. The pad is filled in a similar manner with 2¼ lb. R.L.G.[4].

The two upper portions consist of 6¾ lb. and 16¾ lb. E.X.E. respectively, built up and enclosed in silk cloth bags without hoops, no zinc envelope being required; the bags are choked with silk twist. The filled bags are then rolled to reduce the diameter by altering slightly the positions of the prisms

The portions are inserted in the following order:—ring, pad, 6¾ lb., and 16¾ lb. On the top is placed a felt ring, and then a felt wad, and the lid inserted.

4·7-inch Q.F. Powder Cartridges.

Weigh out and insert the charge, tapping the cartridge to ensure the setting down of the powder.

Place a millboard wad over the powder and if there is room one, or if necessary two, felt wads so as to fill the cartridge but allow for the lid.

6-inch, 4·7-inch, 4-inch Blank and 12-pr. Q.F. Saluting Cartridges.

The 7-lb. blank charge for the 6-inch, and 3-lb. for the 4·7-inch and 4-inch, are first enclosed in a silk cloth bag, hooped and choked in the ordinary manner, but recessed in the centre of the base, to allow space for the projecting end of the primer when placed in the cartridge. In the recess is fitted a small dome of calico and white paper, pierced with holes, and having a shalloon primer filled with 8½ drams of R.F.G.[2] or new Blank F.G. secured in the top with silk twist.

The charge is placed in the cartridge with a paper cylinder over it, and a lid secured.

The 1½-lb. blank charge for 12-pr. 12 and 8-cwt. is enclosed in a silk cloth bag, similar to that for the 6-inch, but a jacket of felt is drawn over it and secured by a piece of silk twist threaded round the mouth.

The service 12-pr. 8-cwt. cartridge, or the 12-pr. 12-cwt. cartridge cut down to the same length is used. The charge is inserted in the cartridge, the felt jacket uppermost, and then a felt wad, consisting of a disc and a ring stitched together, is placed over it with the ring next the charge, no lid being used.

6-pr. and 3-pr. Q.F. Cordite Cartridges.

The charges of size 5 cordite, 7¾-oz. for 6-pr. and 6⅜-oz. for 3-pr., are weighed out. An igniter of R.F.G.[2] or new Blank F.G., enclosed in a shalloon bag, is tied to the sticks near the centre. The bundle is then folded over, leaving the igniter on the outer side of the fold, and placed in the *Holder, cordite charges*, which keeps it together while it is tied in three places with silk twist. The charge is placed in the case which has a clip over the cap with the igniter next the cap, and a perforated cylinder, with paper and glaze-board discs at one end is placed over it, the glaze-board disc next the charge. The shell, which has been previously filled and fuzed, is inserted a short distance in the neck of the case, the body below the driving band

being coated with shellac varnish, and care being taken that the projecting head of the fuze fits inside the end of the paper cylinder. The cartridge, with clip on the base, is then placed in the indenting machine and the shell forced home by means of the hand-wheel till the driving band of the shell touches the mouth of the case. The neck of the case is then indented in three places, into the cannelure round the shell, by depressing the lever. The word cordite and the lot number are stencilled on the base of the cartridge in red.

The cartridge is then gauged in the chamber gauge, and at once placed in a box, with the clip still on. (The clip is removed for gauging.)

6-pr. and 3-pr. Q.F. Powder Cartridges.

The charge is weighed and inserted in the case by means of the funnel, the case being tapped with a wooden mallet to ensure the powder settling down. A felt wad is placed over the powder and the cartridge is completed as already described, for filling with cordite.

6-pr. and 3-pr. Q.F. Saluting Cartridges.

The cases are similar to the service cases but shorter and are fitted with a removable primer. The charge of blank L.G. 15-oz. for 6-pr. and 11-oz. for 3-pr. is enclosed in a shalloon bag hooped and choked in the usual manner, covered at one end with a felt jacket, to the centre of which is attached a loop of silk braid. The charge is inserted in the case with the felt-covered end uppermost. A felt and a millboard disc are placed over the charge, the loop on the jacket being passed through a hole in the wads. The charge is then secured by a piece of silk braid passed through the holes on each side of the mouth of the case, the ends being tied together over the charge.

Packing Quick-firing Cartridges.

The cartridges will be packed in a dry, warm room, care being taken that the packages are thoroughly dry inside. This is especially important with 6 and 3-pr. cartridges.

When packing filled Q.F. cartridges, 12-pr. and above, each package is to contain cartridges of one maker only, as indicated by the initials on the base.

6-inch quick-firing cartridges are packed upright, three long cartridges or four short in a zinc-lined teak box, a packing piece being placed over them to keep them in position; the box for outfit of ships is closed with a locking plate, that for transport or L.S. by screws.

To close the box, fill the groove round the lining of the lid with luting and smooth it off level with the top of the groove; place the lid on the box and tap it down. If the lid is fitted with a locking plate, turn the eccentric moving the plate by means of the Mark IV key for powder cases, so that the lid is securely locked. If it is fastened by screws, screw them home, or screw down the nuts of Mark II L.S. boxes.

To open the box, turn the eccentric with the key so as to unlock the plate, or remove the screws, and ease the lid by applying the flat end of the handle of the key in the slots at two of the corners on the under side of the lid, then lift off the lid by the twine loops.

4·7-inch cartridges are packed for the Navy in M rectangular powder cases or in zinc-lined teak boxes closed like the 6-inch above, and for Land Service in zinc-lined boxes or in boxes with a zinc compartment for each cartridge. Each package holds six cartridges.

In the M case the cartridges fit into perforated trays and are kept in position by spring bolts.

To close the case, fill the groove round the top of the case with luting and smooth it off level with the top of the groove. Turn the square-headed bolts in the lid with the Mark IV key (*see* p. 76) in the direction of the arrow marked O. Place the lid on the case, tapping it down and turn the bolts in the direction of the arrow marked S, so as firmly to lock the lid. The lids and cases bear corresponding numbers, and each lid should be replaced on its proper case.

To open the case, unlock the lid by turning the bolts in the direction of the arrow O. Ease the lid by applying the flat end of the handle of the key under the projections on the lid above the handles on the body and lift off the lid by the twine loops.

In the Naval 4·7-inch boxes and L.S. Mark II boxes the cartridges are packed heads and tails each with a packing piece at the mouth and two canvas bands round the body. The boxes are closed or opened in the same way as the 6-inch boxes.

In the Land Service Mark I box each compartment is closed with a separate zinc lid with indiarubber washer. The wood lid of the box is screwed down and compresses all the washers.

The 4-inch and 12-pr. cartridges are packed in zinc-lined boxes similar to the Naval and L.S. Mark II boxes for 4·7-inch. They contain eight 4-inch or ten 12-pr., a canvas lifting band being attached to the lowest cartridge, and brought up through the remainder. The boxes are closed or opened as already described.

Service cartridges are packed 6-pr. 11, and 3-pr. 16, in a box, zinc lined. To close the boxes fill the groove round the lining of the box with luting; put on the zinc lid and press it home, smoothing off the luting; close the lid of the box and fasten it with the turnbuckle, tying the latter down with the twine attached to the cleat for the purpose.

Some of the early supplies of 6 and 3-pr. Service cartridges are packed in unlined boxes with the junction of the lid and body protected by a waterproof cover. In future these boxes will only be used for dummy drill cartridges.

All quick-firing boxes are painted stone colour outside except the 3-pr., which are painted lead colour.

These packages are stencilled and labelled as follows:— § 10085.

Labels. (*See pp.* 443 *and* 444.)

Group and division label.
Government explosives label.
Packer's label, for interior of lid.
Instructions for handling.
Station label.

Contents label, 6-pr. and 3-pr. only in front of boxes and also inside the lid.

The Group and Division label for Group I, Division V, (Q.F. cartridges 12-pr. and above) has the words "To be handled with care" printed on it.

The Government Explosive and Station labels are pasted over the junction of lid and body.

Information to be stencilled.

Number of cartridges in the package.
Designation and numeral.

Nature, lot number and initials of the maker of powder, or size and lot number (which includes initials of maker) of cordite.

§§ 10299, 10428. Numeral and initials of manufacturer of empty cartridges (12-pr. and above), and the letter T when the contact discs are of pure tin.

Monogram of station, and date of filling.

Initials of maker, numeral and year of manufacture of primer (12-pr. and above).

The words "For practice only" or "For gunnery ships only" where service ammunition has been sentenced to be so used.

Tare and gross weight.

Colour of Stencilling.

Packages containing service cartridges.

Naval	.. ..	Red.
Land	.. ..	Black.

(Except the word cordite, which will be in red.)

Packages containing blank or saluting cartridges.

Naval only	.. .. ..	White.

(Except the letter N, which will be in blue.)

Packages containing 6-pr. and 3-pr. practice cartridges.

L.S. and N.S.	.. .. ..	Yellow.

The words "For practice only" or "For gunnery ships only" in black.

For boxes 12-pr. and upwards, the stencilling will be as far as possible between the battens on the lid, except the 12-pr. which are stencilled on the battens. The tare and gross weight are placed on the side.

For 6-pr. and 3-pr. boxes the stencilling is on the lid.

§ 10898. *Cartridge, Q.F. 2·95-inch, Star Shell, Mark I* (*see* p. 310.)

Body of shell is of F.S.; a recess in the base takes a bursting charge of 1 dram R.F.G.^{2} contained in a shalloon bag.

The head of the shell is of gunmetal with G.S. fuze hole gauge; it is attached to body by four brass screws and four twisting screws. A perforated brass tube is fixed to the bottom of the fuze socket by a nut, and into a perforated steel diaphragm over the bursting charge.

The shell is lined with a paper cylinder and contains ten stars (five in each tier). Over the cylinder is a felt washer to keep the stars from jolting against the head. Weight of shell filled 8 lb. 4 oz.

Cartridge, Q.F. Saluting, 2·95-inch filled Mark I. The cartridge consists of a service case, fitted in the base the Mark III 6-pr. or 3-pr. primer (§ 6542), *see* p. 305.

The charge is 12 oz. Blank L.G. contained in No. 1 silk cloth bag, which is enclosed in a felt jacket.

The mouth is closed by a ½-inch felt disc, to which is stitched a felt washer.

CHAPTER XX.—FILLING SHELL.

IMPLEMENTS, FUZE, SHELL, AND CARTRIDGE.—THEIR DESCRIPTION AND USE. SUNDRY STORES CONNECTED WITH PROJECTILES.—EXAMINATION OF EMPTY SHELLS.—PAINTING EMPTY AND FILLED SHELLS.—INSTRUCTIONS FOR FILLING SHELLS.—STORAGE, PACKING AND TRANSPORT, OF FILLED SHELLS.—EMPTYING SHELLS.—PREPARING AND FIXING FUZES.

The following articles used in filling shell, in boring, and preparing fuzes, etc., are grouped together under the general heading of "Implements, fuze, shell, and cartridge."

Bar lifting shell.
Bits, hook borer.
Blocks, Nos. 1 and 2.
Borers, gimlet.
Chisel, metal, Mark I.
„ preparing cannelures, Mark I.
Cylinder, common.
Discs, cleaning fuze hole.
Drifts, G.S., long and short.
Drivers, screw, shrapnel, large, Mark IV.
Extractor, fuze, small, rifled, Mark II.
Funnels, shell, copper, large and small.
Hammer, metal, 1 lb. 12 oz., Mark I.
Handles, hook borer.
Holders, shell.
„ „ studded.
„ „ B.L. and studless.
„ „ for laboratories.
Hooks, G.S. wad.
„ hook borer.
Instrument, deepening serrations, B.L., 12-inch heavy projectiles.
Key, fuze and plug, G.S.
„ plug, G.S.
„ fuze, Armstrong, E.
„ fuze, universal, Marks I, II and III.
„ fuze, Hotchkiss, Mark I.
„ base fuze and plug Marks I and II.
„ opening sensitive fuzes Marks I and II.
Pincers, shrapnel primer.
Rectifiers, gas-check, R.M.L., 13-pr.
Rods, filling shell, large and small.
Scrapers, shell.
Spanner, fuze, Q.F. 1-pr., Mark I.
Spanners, gas-check, nuts.
„ „ plugs (2).
Wrenches, base plug.
Wrench, opening fuzes Marks I and II.

Besides the above, the following articles, though not coming under the head of "Implements," are supplied to laboratories in which the shell are filled:—

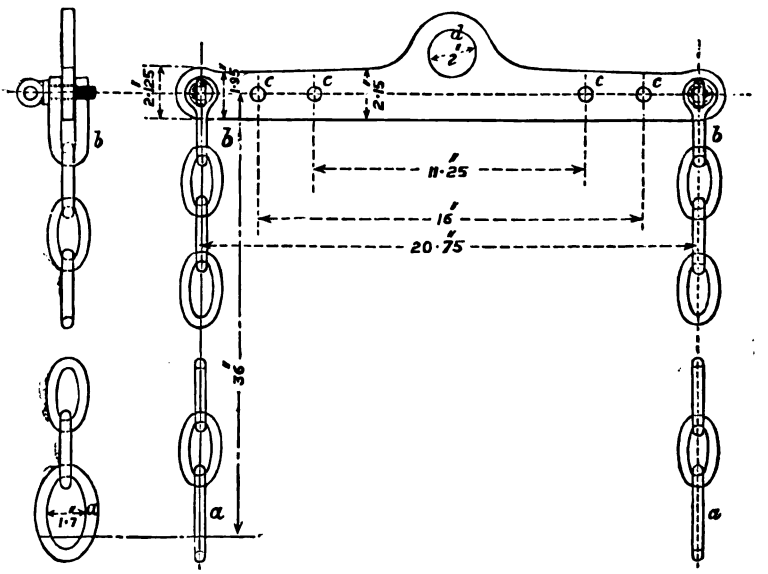
Blocks, wood, steadying shell.
Brushes, stencil.
Instructions, sheets.
Mallets, tent.
Plates, stencil.
Scissors, laboratory.
Scoops, powder.

§ 9160. *Bar, lifting shell Mark I* is for use with shell holders in laboratories for fuzing projectiles with base fuzes. It consists of a steel bar about 2 feet long with a central hole for the reception of the hook of the raising tackle, and 3 holes at each end to either of which can be attached a shackle holding chains about 3 feet long.

Method of Use.

Place the holder over the nose of the projectile, and fix it at the centre of gravity, by means of the screws and spanner supplied with the holder. Pass the bottom loops (*a*) of the chain on the bar over the trunnions of the holder, adjusting the chains so as to keep them parallel by attaching the shackles (*b*) into the required holes (*c*). The raising tackle will then be hooked in the bar at (*d*), and the projectile lifted and placed in position.

Scale $\frac{1}{6}$.



Hook borers. The complete apparatus for boring wood time fuzes consists of a "*Handle, hook borer*," "*Hook, hook borer*," and "*Bit, hook borer*," which are separate stores, though always necessarily used in conjunction. There are four patterns of the handles and hooks, and three of the bits.

§ 3698. *Mark IV* has the hook heavier and stronger than the previous

patterns (for details of which *see* former edition of this work), so as to prevent its opening out when the fuze is being bored. The screw is continuous and single (16 threads to the inch).

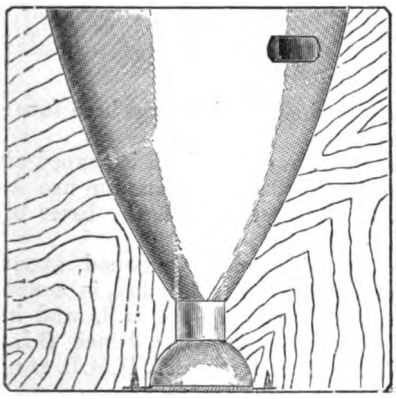
Mark III is a spoon-shaped bit, with a rather sharp point. Bits.

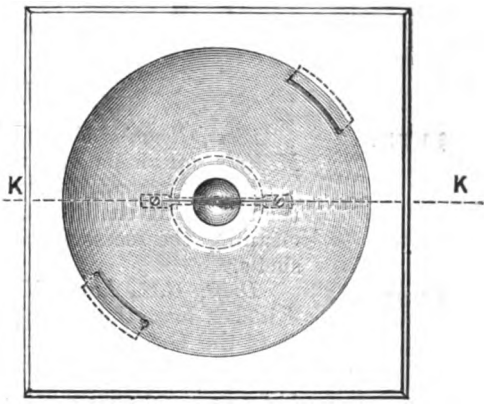
For details of Marks II and I *see* former edition of this work. § 3891.

Blocks, Nos. 1 *and* 2 *Mark I* are for use in fixing base fuzes and also gas-checks of R.M.L. pointed common shells. They may also be used for filling shell as required. No. 1 is for 12-inch calibre and above, No. 2 is for 8-inch to 11-inch. They are each a cubical block of wood, measuring 1 foot each way, bored out to take the head of the projectiles when placed base upwards. A hole will be made in the floor to receive the block, so that it is flush with the floor. When not required for use, the block will be inserted in the floor, with the hole for shell downwards. Two recesses are provided in the sides of the cavity, and a bar across the hole in the bottom (*see* drawing) to facilitate lifting the blocks out of the floor. §§ 9199, 10274, 10507.

Blocks for projectiles under 8-inch will be made locally as required, no fixed size being necessary, as they will stand on the floor or a bench at the most convenient height.

Section on KK.





Plan.

The *Borer, Gimlet, Mark II*, has a twisted gimlet, and the ferrule has a hollow in it to receive the dust, &c., caused by boring. §§ 1928, 2123.

The handle is fluted to give a good grip. *Mark I* has a plain wooden handle, an ordinary gimlet, and no hollow in the ferrule. Both patterns have a small shield attached by a line to protect the steel point when the borer is not in use.

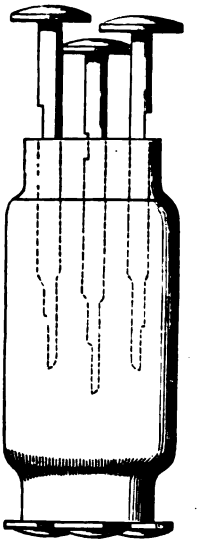
This gimlet borer must be used for boring 30-seconds fuzes, for which the hook borer is not suitable.

Chisel, Metal, Mark I.—This chisel is a cross-cut, about $7\frac{1}{2}$ inches long and $\frac{1}{4}$ inch wide, and is intended for cutting out the lead rings and base discs from B.L. or Q.F. or R.M.L. shells. §§ 6456, 7728.

Chisel, preparing cannelures, Mark I.—This chisel is of steel, about 6 inches long, ·4 inch wide at the point, and slightly curved. It is intended for preparing the cannelures of B.L. or Q.F. projectiles to take augmenting strips. (*See* p. 199.) § 5887.

Cylinders. The bits for the hook borer are contained in *Cylinder, Common*, thus:—

Cylinder, Common (Mark I), with Bits.



Bit, Hook Borer (Mark III).

§ 10842. *Discs, Cleaning Fuze Holes, Large*, for shells taking large base fuze; *Medium*, for shells with medium base fuze.

These are made of copper formed with a stem which is shaped at the end to fit the "brace magazine" (§ 9025), and are for use in cleaning the recess for the flange of the base fuze in the bases of shells.

§ 7602. *Drift, G.S., Long, Mark I*, is a round piece of boxwood, about 4 inches long, the lower portion, for a length of 1·6 inches, is coned to fit the G.S. fuze-hole. It is used for inserting the G.S. wad in the following shells, which have long fuze-holes, viz.: 4-inch B.L., Q.F., or Q.F.C. shrapnel, Marks V and VI, and 2·5-inch R.M.L. ring shell.

§§ 1928, 2045. *Drift, G.S., Short, Mark I*, is generally similar to the long drift, but the conical part is 1·35 inches long.

§§ 7717. The *Driver, Screw, Shrapnel, Large, Mark IV, | C | Phosphor Bronze*, supersedes Mark III, which was rather longer and narrower.

The *Extractor, Fuze, Small, Rifled, Mark II*, is shown in the cut and is suited to rifled ordnance only. It is lighter and cheaper than Mark I.

Scale, ½.

§§ 4107, 2493. The *Funnel, Shell, Copper, Large*, is intended for use with 16-inch and larger natures of shell filled with bags; the *Small* for lower

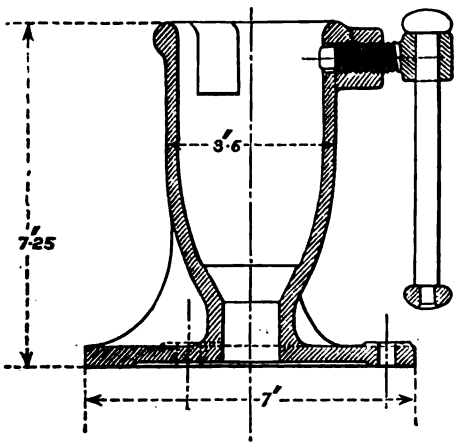
natures. Mark II, of the small pattern and the large one, are made without seam in cone or spout.

The *Funnel, Shell, Leather, Common, Large* and *Small*, are used for filling shells when no bags are used. They will become obsolete when used up. §§ 25, 9392.

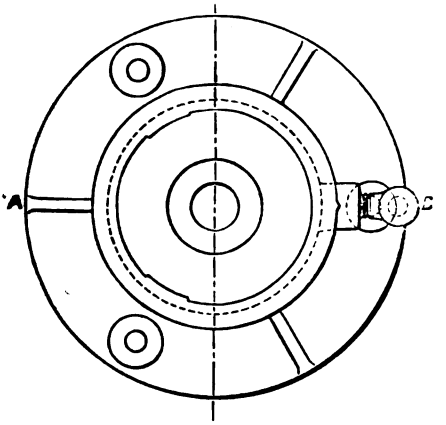
Holders, Shell, Q.F., 12-pr., Mark I; B.L. 5-inch or Q.F. 4·7-inch, Mark II; and B.L., Q.F., or Q.F.C., 6-inch, Mark II, are made of cast iron, to the forms and dimensions as shown in the woodcuts, those for 12-pr. 5-inch and 4·7-inch, having flat bases with three screw holes for securing them to a bench or table; a clamping screw (with lever handle attached) being provided for retaining the shell in position. § 9514.

Holder, Shell, Q.F., 12-pr., Mark I.

Scale ¼.



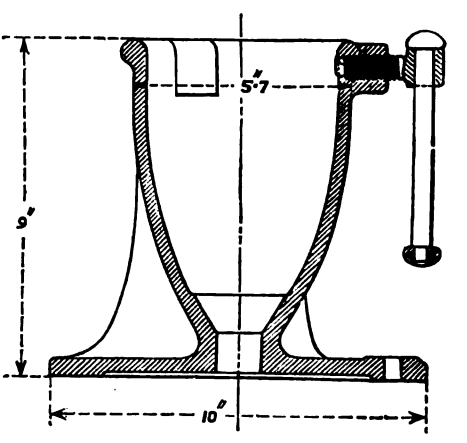
Section at AB.



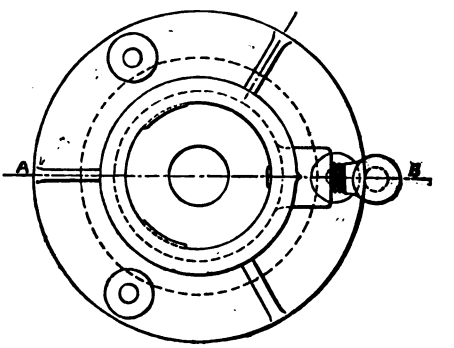
Plan.

Holder, Shell, B.L., 5-inch, or Q.F., 4·7-inch, Mark II.

Scale ¼.



Section at AB.

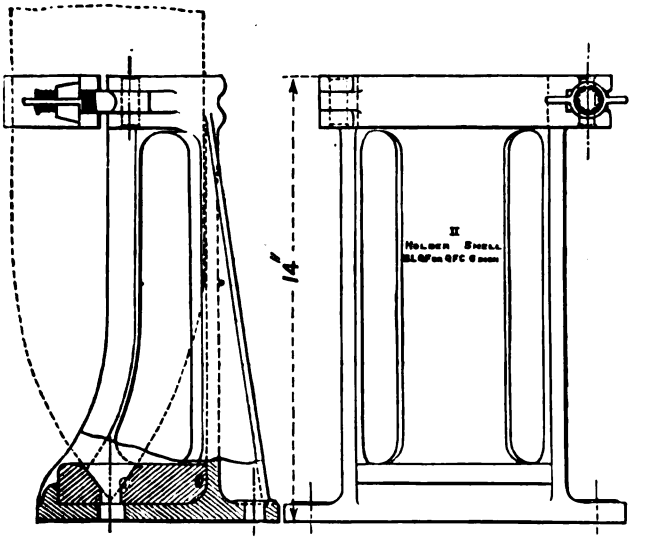


Plan.

The holder for 6-inch has a wood block fixed in the base for the reception of the point of the shell, and the semi-circular band, with fly nut, hinged to the top for retaining the shell in position.

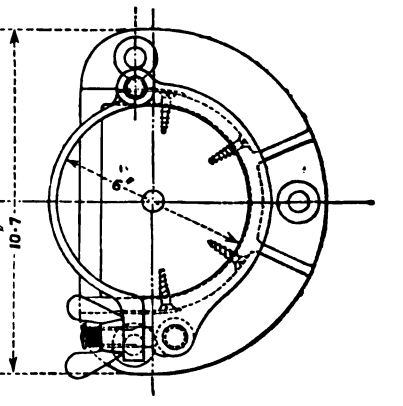
Holder, Shell, B.L., Q.F., or Q.F.C., 6-inch, Mark II.

Scale $\frac{1}{8}$.



Front Elevation.

Scale $\frac{1}{8}$.

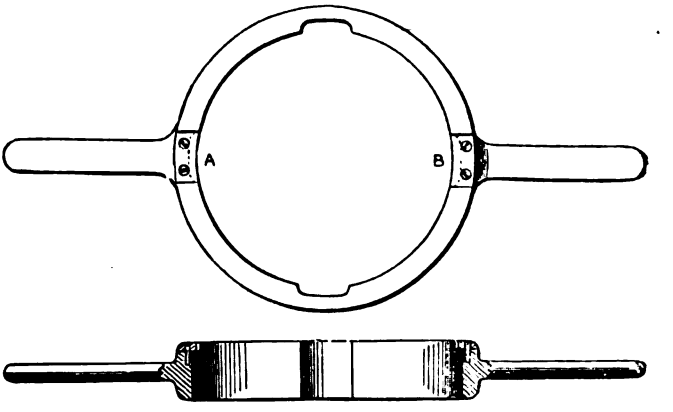


Plan.

§ 6456. *Hammer, Metal*, 1-*lb.* 12-*oz.*, *Mark I*, resembles an ordinary chipping hammer, and is for use with the metal chisel, as described at p. 341.

§§ 1483, 1682, 1696, 2412, 2990. *Holders, Shell, Palliser* (*see* cut), for the different natures of studded projectiles were provided of the pattern shown in the cut, having stops at A and B, which rested on the rear studs. But these

Holder, Shell, Palliser.



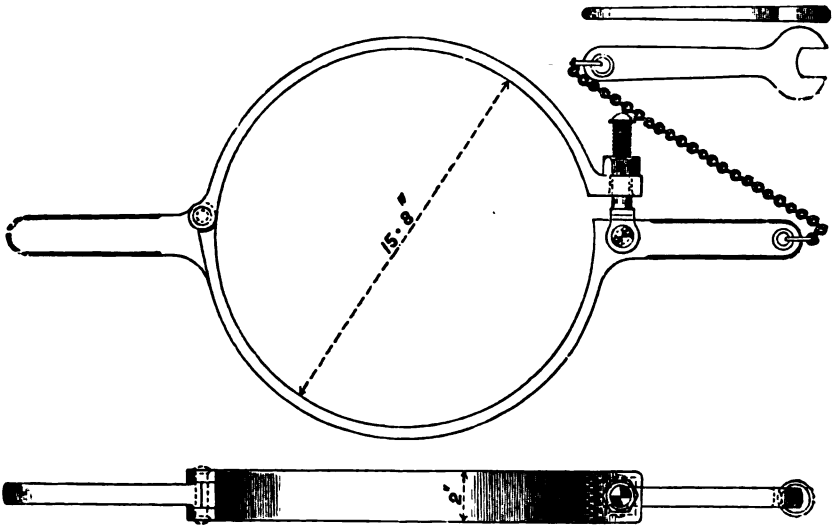
were unsuitable for use with Mark II gas-checks, the stops preventing them from passing the projections on the latter.

§ 4332. Accordingly those manufactured since August, 1883, have no stops, and instructions were issued for the local alteration of all existing ones, which is done by removing the two screws on the top of each stop and knocking out the latter with a hammer. At the same time the use of these implements with common shell was approved and the designation changed to *Holder, shell, studded.*

The above holders are evidently not applicable to a shell without projections, for which purpose a different pattern has been introduced and called *Holder, shell, B.L., and studless, with spanner attached.* (*See* cut.) §§ 4107, 4260, 4369.

Holder, Shell (with Spanner), 16-inch, Mark I.

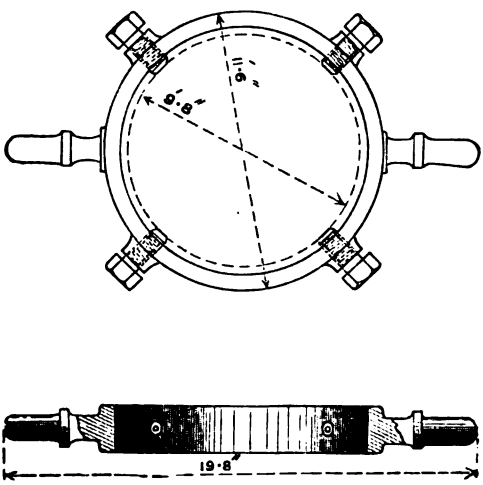
Scale, ⅛.



It consists of handles attached to a jointed ring, which is tightened by means of a nut working on a screw bolt. For use with the nut a spanner is attached by a chain to one of the handles. The same pattern of holder is used with R.M.L. studless, and with B.L. shell, and where the calibre is the same as in the 12-inch the same holder is supplied for both projectiles.

Holders, Shell, for Laboratories, are intended for use in holding and slinging shell when emptying them. (*See* cut.) §§ 6846, 7233.

Scale, ⅛.

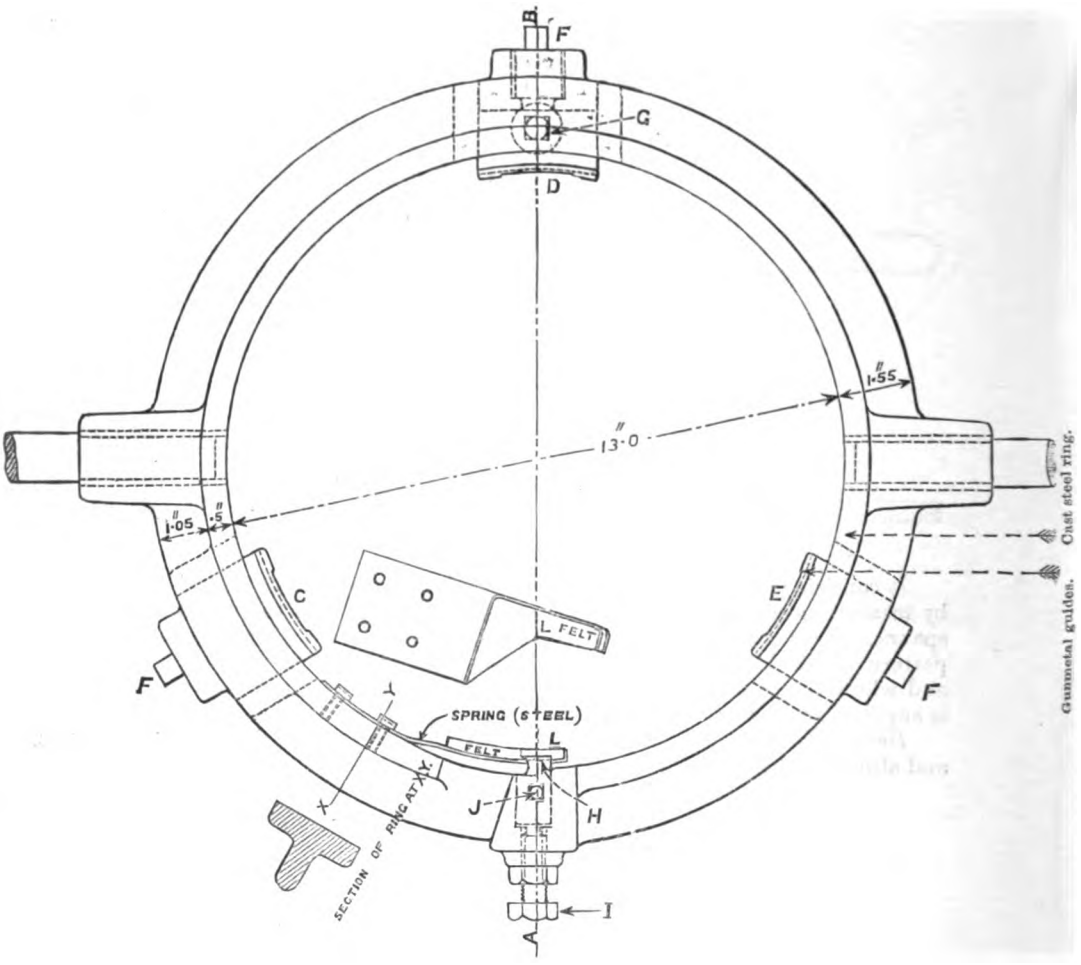


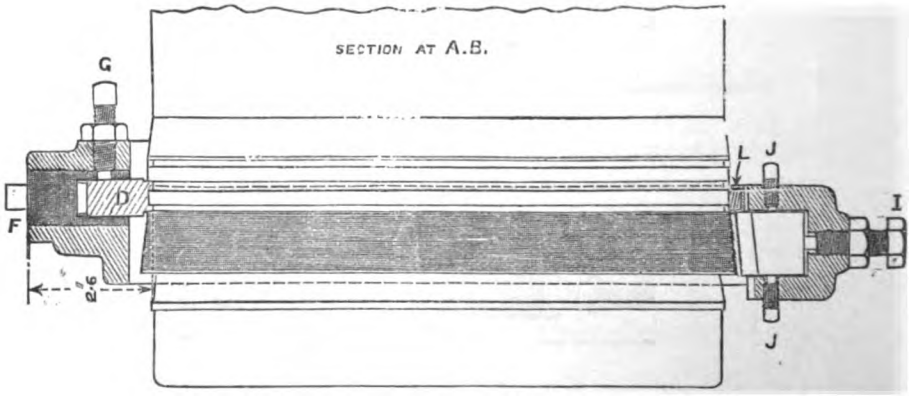
§§ 10238, 10359.

Instrument, deepening serrations B.L., 12-inch, Heavy Projectiles, Mark I is for use in deepening the serrations on the rear slope of the driving band of existing B.L. 12-inch heavy projectiles, in N.S.

FIG. 1.

Scale, ½





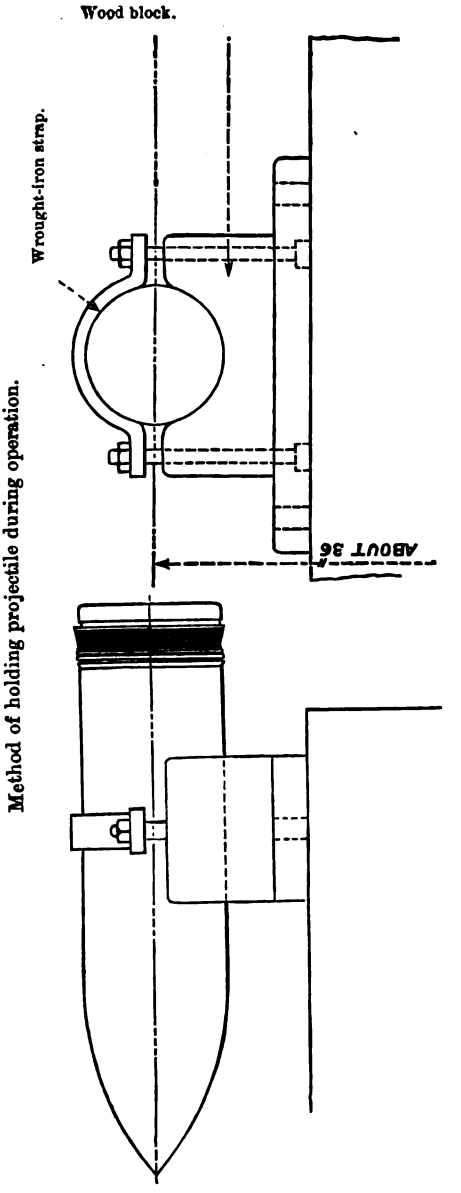


FIG. 2.
Method of holding projectile during operation.

The above-mentioned instrument consists of a flanged steel ring with two handles about 21 inches long. It is about 16 inches external and 13 inches internal diameter. Passing through holes in the ring are three gun-metal guides C, D, E, having projections on the inner surface which fit into the cannelures of the driving band, and to allow of the guides being adjusted, &c., there are three adjusting screws F, and three fixing screws G to secure them in position when required. A steel cutter H passes through the ring and this is also provided with one adjusting screw I, and two fixing screws J. On the inside of the ring, and close to the cutter, there is a steel spring K fixed, to which is attached a felt wad L.

To work the instrument, secure the shell to be operated upon as in Fig. 2. Place the instrument over the driving band and secure it there by means of the guides, moving the adjusting screws F as required and then screwing up the fixing screws G. The cutter H is then pressed against the serrations on the driving band by moving the adjusting screw I, after which the fixing screws J are tightened. When ready the instument is turned by the handles thus cutting into the serrations, the cuttings being removed by the felt wad L. This may be repeated until the depth of the serrations is found correct, which is ascertained by means of a small gauge which is supplied for the purpose.

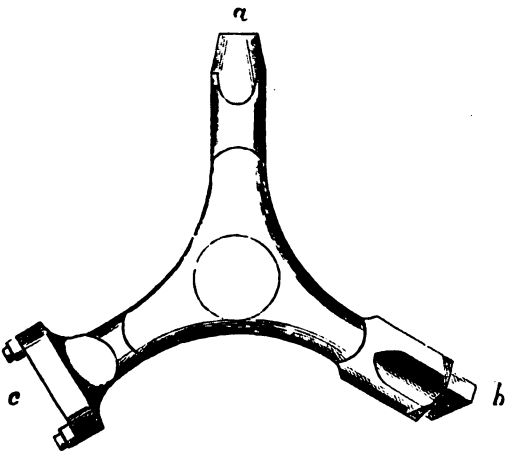
§ 3895. *Hook, G.S. wad,* is a piece of stout copper wire (·165 inch in diameter) having one end bent into a hook, and the other end fitted into a wooden handle. The total length is about 7 inches.

Keys. § 1308. *Key, Fuze and Plug, G.S.*—One arm *b*, originally intended for the obsolete pillar fuzes, is used for the G.S. plug and for adapters, the other arms *a* and *c* are used for the common gauge plug, and Pettman's L.S. and G.S. fuzes.

§ 1992. *Key, Plug, General Service,* is simply for screwing or unscrewing G.S. plugs, and R.L. and D.A. Marks I, I** and II, D.A. Delay, Mark III and D.A. Impact percussion fuzes.

§ 1683. *Key, Fuze, Armstrong, E,* is for use with the E time fuze. It may be distinguished from the Mark I universal fuze key by the points of the arm used for moving the collar being square instead of round, and by the smaller size of the circular arm used for screwing in the fuze.

§§ 8730, 9158. *Key, Fuze, Universal, Mark III.*—This key is made of steel of the



form and dimensions shown in the cut, and has a long lanyard attached. It will supersede all former keys (except the Armstrong, E); but it is to be understood that no supplies of these keys will be made until the existing store of universal keys is exhausted.

Hexagonal Hole A.

For clamping nuts of:—

Short time and percussion and Nos. 56 and 57, 60 and 61 fuzes.

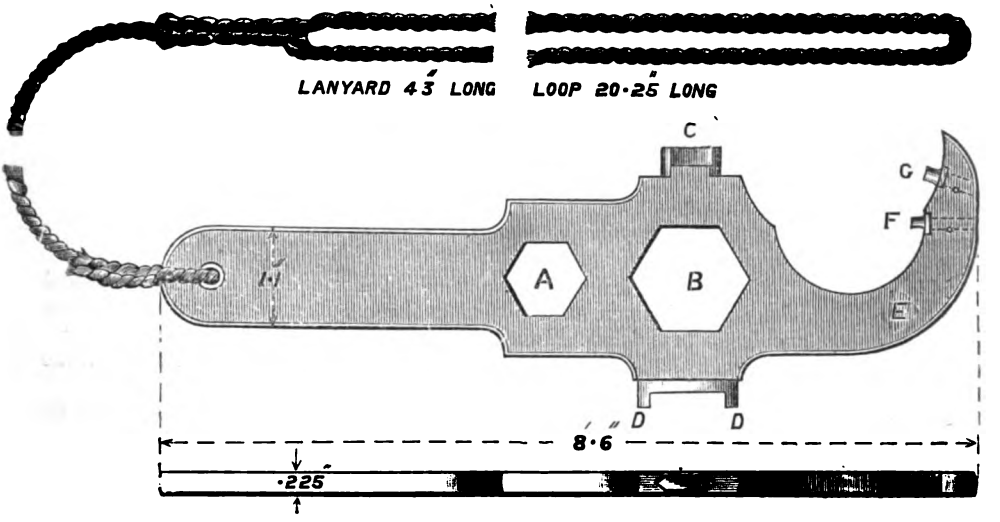
Hexagonal Hole B.

For clamping nuts of:—

Middle time and percussion fuze.
Middle sensitive time fuze.

Key, Fuze, Universal, Mark II.

Scale, ½.



Projection C.

For recesses in:—

General service fuze-hole plug, and R.B.L. F.S. plugs.
Royal Laboratory percussion fuze.
Cap of direct-action percussion fuzes Marks I** and II, D.A. Delay, Mark III, and D.A. Impact fuzes, Marks, I, I*, II, and III.
Safety plug in direct-action percussion fuze, Mark III.

Projections D.D.

For recesses in :—

Pettman, land service and general service fuzes.
Direct-action percussion fuze, Mark III.
Small percussion fuzes.

Arm E and Pin F.

For hole in side of:—

Short time and percussion fuze.
Time and percussion fuzes No. 56, Mark IV, and No. 57, Mark I, Nos. 60 and 61.

Arm E and Pin G.

For hole in side of:—

Middle time and percussion fuze.
Middle sensitive time fuze.

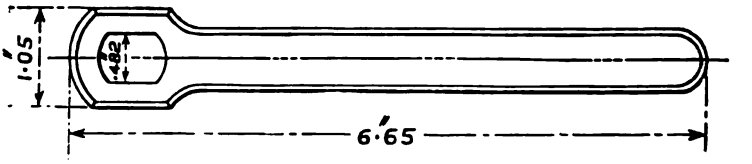
§§ 6040, 6617. *Key, Fuze, Universal, Mark II* differed from Mark III in being thinner and weaker.

§§ 4924, 6395. *Key, Fuze, Universal, Mark I* is of a different shape to Marks II or III and the existing store is to be used up.

§ 9909. *Key, Fuze, Hotchkiss, Mark I.*

The key is made of gun metal, to the form and dimensions shown in the accompanying woodcut, and is for use in inserting or removing Hotchkiss base percussion fuzes.

Scale, ½.



§ 9447. *Key, Base, Fuze and Plug, Mark II* is made of mild forged steel with projections on each side to fit the holes in bases of the medium and large base fuzes. It has also a projection to fit base plugs.

Key, Base, Fuze and Plug, Mark I, differed from Mark II in the handles being weaker.

§ 7347. *Key, Opening, Sensitive Fuzes, Mark I,* consists of a wood handle with a steel blade, fitted with two pins, and is intended for use in removing or replacing the side plugs in sensitive time fuzes.

§§ 3895, 4790. *Pincers, Shrapnel, Primers, Mark II,* are made of stout brass wire, and resemble a pair of round sugar-tongs. At the end of each branch of the fork the wire is flattened on the inner side and ends in a double bend to grip the primer and so enable it to be withdrawn from the shell when unscrewed.

The introduction of this pattern is necessary, as Mark I could not be used with the Mark III primers. Mark I pincers, having a short claw at the end only, will become OBSOLETE.

§ 5291. *Rectifier, Gas-check, R.M.L., 13-pr., Mark I,* consists of a steel punch, curved to fit the hollow between the rim and crown of the 13-pr. gas-check.

§§ 2493, 4107. *The Rod, Filling Shell, Large,* is of brass ·4 inch diameter, and about 5 feet long. It is intended for use with the 16-inch shell, and such others as the smaller one may be too short for. The *small* rod is ·3 inch diameter, and 3 feet long. Both have a wooden handle at one end, and at the other a brass knob for pressing on the powder.

§§ 2174, 2823, 3895, 4421, 6041, 9339. *Scrapers, Shell,* are used in removing powder from filled shell, or searching empty shells. They are copper rods, having both ends flattened out. One end is turned up nearly at right angles to the line of the rod, the other has a slight bend in the opposite direction. There are five sizes, viz.:—

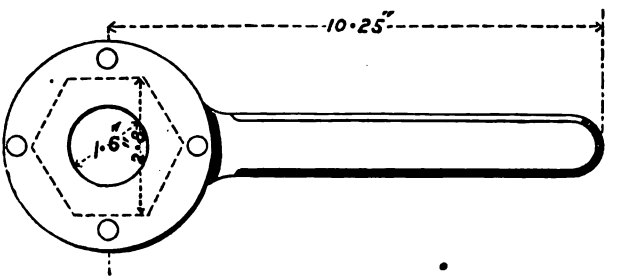
62 inches long	for	B.L., 16·25-inch to 12-inch. R.M.L., 17·72-inch and 16-inch.
42 „	„	B.L., 10-inch and 9·2-inch. R.M.L., 12·5-inch to 10-inch.
32 „	„	B.L., 8-inch to 5-inch. R.M.L., 9-inch to 80-pr. R.B.L., 7-inch. Q.F., 4·7-inch.

20 inches long for { B.L., 4-inch. / R.M.L., 64-pr. to 7-pr. B.L. 4-inch and 12-pr. / R.B.L., 40-pr. and 20-pr. N.S.

17 „ „ { B.L., or Q.F., 12-pr. / R.M.L., 16-pr. to 7-pr., and 2·5-inch.

When the existing stock of 17″ scrapers shall have been used up, they will be replaced by 20″ scrapers. § 9339.

Spanner, Gas-check, Nut, 9-inch to 12·5-inch, Mark I. It is used to screw and unscrew the nut. (*See* cut.) § 3374.



Spanner, Gas-check, Plug, is used for the plugs of the 8-inch howitzer (46 cwt.), and the 6·3-inch howitzer. It generally resembles that shown in the cut, but is of course smaller, and has two handles opposite each other. § 3380.

That for the 40-pr. is similar but smaller. § 3382.

Spanner, Fuze, Q.F. 1-pr. | L | Mark I. This is of steel, the jaw being shaped to fit the flats formed on the head of the Q.F. 1-pr. nose fuze. § 10957.

The *Wrench, Base, Plug*, is an iron arm about 13·5 inches long, from the centre of which projects a square key of the same size as the G.S. plug key. §§ 1490, 3529.

Wrench, opening Fuzes, Mark II, is for use of Inspecting Ordnance Officers. §§ 9393, 10088.

The "wrench" is of steel, and is fitted with two pairs of pins on one side having centres ·6 inch and ·5 inch apart, respectively. These pins are for use in removing the following plugs, viz.:—

——	·6-inch Pin.	·5-inch Pin.
Bottom plug ..	Fuze, time and percussion, middle.	Fuze, percussion, direct-action.
„ „ ..	Fuze, time and percussion, short, and T and P, 56 and 57, 60 and 61.	Fuze, percussion, R.L.
„ „ ..	Fuze, percussion, direct-action delay.	Fuze, time, sensitive, middle.
Top plug.. ..	Fuze, percussion, small ..	Fuze, percussion, Pettman, G.S.

On the opposite side of the wrench three pairs of pins are fitted with their centres 1·375 inches, 1·15 inches, and ·5 inch apart. The

latter pair are for the magazine plug of the medium base fuze, and the others are for the screwed caps of the large and medium base fuzes.

§ 7347. Wrench opening fuzes Mark I, differs from Mark II in not being fitted with pins for the base fuzes.

There are two sets of Instructions, viz. :—

(*a.*) Filling and securing shell for rifled ordnance.
(*b.*) Examination of shells for rifled ordnance.

These are always printed together and issued in three ways, viz. :—(1) The pamphlet form with Army orders; (2) Printed on sheets, which are pasted on a board and hung up in laboratories; and (3) Printed on calico for issue to H.M. ships.

§§ 2648, 8734. Plates, stencil, are issued cut with the word "Bag," and others cut with a series of numbers. Those having the circular 1-inch disc and the letter P are to be cut locally.

Miscellaneous Stores.

The following articles though not under the general heading of "Implements, fuze, shell, and cartridge," are used in connection with shells or shell-filling :—

Bags, burster.
„ primer.
Bearer, shot, B.L., 6-inch.
Bolt, eye, lifting projectiles, large and small.
Cage, shell, R.B.L., 7-inch.
Cage, projectile, B.L., Q.F., or Q.F.C., 6-inch.
Clip, lifting projectiles Marks I and II.
Drivers grummet.
Extractors, projectiles, R.M.L.
Gauges.
Horn, powder, miners.
Instrument, marking projectiles.
Lever, extracting, eye-bolt.
„ grummet.
Planks, stacking projectiles.
Plugs.
Primers.
Protectors, armour-piercing projectiles.
Protectors projectiles.
Screws, preserving, eye-bolt, holes, large and small.
Selvagees.
Strap, carrying projectiles B.L., 5-inch howitzer, Mark I.
Slings, lifting projectiles, B.L.
Wads.

§§ 2495, 3297, 3985, 4092, 4131, 4158, 4164, 4363, 4387, 4388, 4454, 4768, 5263, 5339, 8135, 5340, 5428, 5501, 5523, 5590, 5633, 5652, 5738, 5739, 5898, 5967, 6025, 6054,

Bags, burster, are used with common, common pointed, double, armour-piercing, and Palliser shells, for the following calibres :—

B.L., Q.F., or Q.F.C., 4-inch and upwards.
R.M.L., 16-pr. and upwards.
R.B.L., 40-pr. and 7-inch.

And with new pattern Palliser shells :—

R.M.L., 9-inch to 16-inch.

They are used, generally speaking, with shells which have bursting charges of powder 1½ lb. and above, to avoid premature explosion through friction when the powder sets back on discharge.

The latest pattern of *Bag, Burster*, for B.L. common and double shell 4-inch, 30-pr., and 5-inch, R.M.L. studded, 16-pr. to 12·5-inch and R.B.L., 7-inch, is made with body of dowlas, neck and shoulder of shalloon. The latter material is used to lessen the resistance to the penetration of the flash from the fuze. Those for the B.L., 16·25-inch Mark I, F.S. common and R.B.L., 40-pr., only differ in having an additional piece of material, called collar cloth, sewn over the base end to form a cushion. Bags for B.L. 8-inch and upwards and R.M.L. studless, cast-iron, or cast-steel, and 16·25-inch F.S. Mark II (except B.L. and R.M.L., 8-inch iron) are of dowlas except the bottom which is of shalloon. The latter is called the tip and comes next the fuze hole as these shells are filled through the base; and to form a cushion for the bag in the shell there is a thickness of collar cloth additional over the shoulder proper. 6381, 7299, 7421, 7447, 8411, 8412, 9004, 9270, 9301, 9314, 9344, 9912, 10206, 10207, 10331, 10383, 10413, 10417, 10506.

Earlier patterns of burster bags had bodies of No. 3 class silk cloth for cast-steel, and serge for cast-iron shells, each having shalloon tips. Still earlier patterns for studded shells were made entirely of serge, and for the 8-inch, 9·2-inch, and 12-inch F.S. common serge bodies with shalloon neck and shoulder.

Bags for B.L. 8-inch iron, R.M.L. 8-inch iron, and 6·6-inch, are exceptional owing to dowlas being used, in place of collar cloth for a cushion at the shoulder. The bags for B.L. 6-inch gun and howitzer cast iron and cast steel, have dowlas bodies and shalloon tips. Earlier patterns were made of serge for the iron, and silk cloth for the steel shells. The latest bag for 6-inch howitzer practice shell has dowlas body with shalloon neck. Exceptional bags.

The following burster bags are interchangeable:— Interchangeable bags.

R.M.L. 8-inch howitzer, 46-cwt., and 8-inch R.M.L. gun studded common shell.

The 6·6-inch gun and 6·6-inch howitzer.

The 64-pr. gun and 6·3-inch howitzer.

The burster bags for B.L., B.L. or Q.F., B.L., Q.F., or Q.F.C. and R.M.L., common pointed, armour-piercing, or Palliser shells, have dowlas bodies and shalloon necks, but no collar cloth.

It must, of course, be remembered that burster bags for iron or steel shells of the same calibre are not interchangeable, the capacities of shells of different material may vary considerably.

The following is an example of the marking on burster bags:— Marking.

R. ↑ L.	R. ↑ L.	R. ↑ L.	R. ↑ L.
II	II	II	II
6-IN.	9·2-IN.	64-PR. GUN	12·5-IN.
B.L.	B.L.	AND	R.M.L.
COMMON	COMMON	6·3-IN. HOW.	COMMON
CAST STEEL.*	IRON.	R.M.L.	STUDDED.
		COMMON.	

Bags, Burster, Shrapnel, have been made to contain the bursting charges of shrapnel shells of the following calibres, viz.:—B.L., 4-inch, Mark IV, and R.M.L., 2·5-inch, Marks I, I* and II. They are of red shalloon and marked for the calibres for which intended. The B.L., 4-inch, Mark IV and R.M.L., 2·5-inch, Mark I*, are cylindrical; the R.M.L., 2·5-inch, I and II, are circular. They are filled before insertion in the shell. Bags, burster, shrapnel.

Bags, Primer, 7 drams, Mark I, are small shalloon bags containing 7 drams of Service F.G. powder (pistol, F.G., R.F.G. or R.F.G.^{2}), or §§ 3722, 4 65, 4264, 6965, 9724, 10090.

* The material is always shown on the bag if a gun fires common shell of iron and steel.

blank F.G. new, or shell F.G. new. Two or more of these primers are inserted in all common, double, common pointed, armour-piercing or Palliser shells filled with bursting charges of powder in bags, except the 16-pr. and 17·72-inch, the former taking only one primer, and the latter a 10-oz. primer described below.

§ 4363. *Bag, Primer, 10-oz. Mark I*, is a shalloon bag containing 10 oz. of F.G. powder (pistol, F.G., R.F.G. or R.F.G.^{2}). This primer is special for the 17·72-inch common shell.

§§ 7770, 9859, 10176. Practice projectiles, for both N.S. and L.S., will, in future, be filled with salt and plugged.

A.C. 1884, Cl. 140. In places where firing live shell is permitted, 80-pr. and 64-pr. projectiles are fired under Service conditions.

Blowing charge. In places where no live shell can be fired, common shell take the place of the allowance of shrapnel, and are to be loaded with blowing charges and fuzed.

Bags, blowing, charge. § 6081. Two sizes of *Bags, Blowing, Charge*, have been introduced for use with common shell when blowing charges are used at practice.

The *Bag, Blowing, Charge, Large, Mark I*, is made of white calico, and has a metal ring in the mouth. It takes 1 lb. powder, and is for R.M.L. and R.B.L. guns, 64-pr. and upwards.

Now *obsolete*. § 10786. The *Bag, Blowing, Charge, Small, Mark I*, is similar to the above, and is intended for R.M.L. and R.B.L. guns under 64-pr., and will take 4 oz. powder.

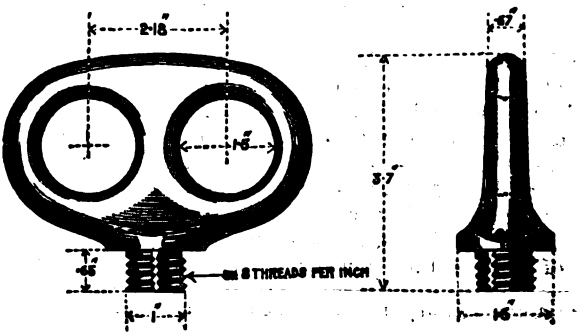
The latter bag was formerly called *Bag, Blowing, Charges, Common*, and was used for 7-inch R.B.L., and 80-pr. R.M.L., and lower natures, but its designation and uses have now been altered as given above.

§ 5196. Bearer. *Bearer, Shot, B.L., 6-inch, Mark I*, is made of ash, 4 feet in length, $2\frac{3}{4}$ inches in diameter at the middle, tapering to $1\frac{1}{2}$ inches at the end. A groove is cut in the centre to receive the selvagee by which the projectile is slung. It was used with 6-inch B.L. guns in the Land Service when mounted on H.P. carriages.

Eye-bolts. §§ 5741, 4135, 7727. A *Bolt, Eye, Lifting Projectiles, Small, Mark II*, made of wrought iron, is used in the N.S. for raising to the loading position the projectiles for the 12·5-inch and 16-inch R.M.L. guns, and for the 8-inch B.L. to the 13·5-inch. In the L.S. with 13·5-inch B.L. and 16-inch R.M.L. only. It has two eyes to facilitate the shifting of the tackle, and it screws into a hole tapped in the body of the shell, which allows it to hang at an angle suitable for loading. Three grooves are cut across the screw-thread to allow of the escape of any tallow, &c., with which the bolt-hole may be filled.

Bolt, Eye, Lifting Projectiles, Small, Mark II.

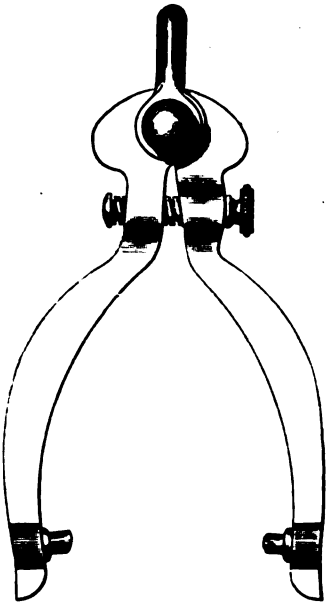
Scale, $\frac{1}{3}$.



Left-handed rope should always be used with this eye-bolt when lifting shells with single whips.

The *Bolt, Eye, Lifting Projectiles, Large, Mark I*, which is used in the N.S. for the 17·72-inch R.M.L., and 16·25-inch B.L. (in the L.S. 17·72 R.M.L. only), is similar in construction to the above, but stronger, the screw portion being 1¼ inches in diameter. §§ 5213, 5741, 7277.

Clip, Lifting Projectiles, Mark I.



A *Cage, Shell, R.B.L., 7-inch*, is supplied where specially required. It is made of brass and resembles the cages used for lifting cartridges (*see* p. 92), but has no chain or hook. The upper half is fitted with a brass ring which is slipped down over the shell to prevent its falling out of the cage. § 3539.

A *Cage, Projectile, B.L. or Q.F., 6-inch, Mark I*, similar in construction to the above, has been approved for use in circular lifts with 6-inch B.L. or Q.F. projectiles. § 6212.

A pattern of *Clip, Lifting Projectiles, 7-inch to 12·5-inch*, has been sealed to govern supplies. (*See* cut.) §§ 2418, 3437.

The studs on the inside of the arms fit into the extracting holes in the head of the projectiles, and are retained in their place by the screw-bolt which passes through both arms.

The *Clip, Lifting Projectiles, Mark II*, differs from the above in having the jaws slightly longer and less curved, in order to suit the longer heads of studless projectiles. The studs which fit into the extractor holes are made of steel. § 5487.

Driver, grummet, Mark I, is made of hard wood and is used in the L.S. for removing the grummets from projectiles with gas-check driving bands. § 9399.

Extractors, Projectiles.

R.M.L. Wrought Iron with Wood Stave.

The extractor now made for all heavy R.M.L. guns, 7-inch to 17·72 inch, is constructed to act independently of the grooves of the gun. §§ 1206, 1266, 1363, 1681, 1712, 2850, 3913, 3953,

4008, 6941, 4302, 4333, 4505, 4887.

It has two jaws and teeth for the two extractor holes of the projectile.

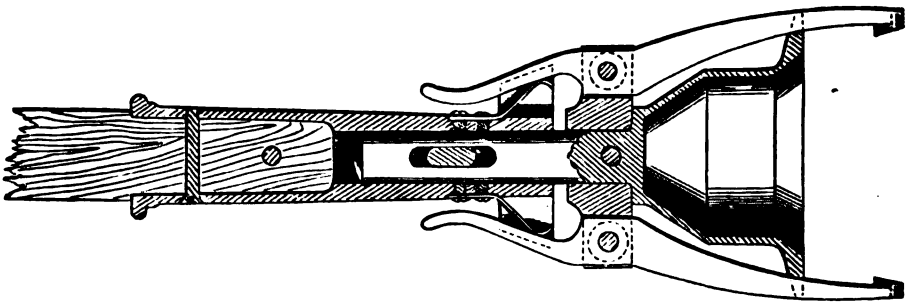
The jaws are closed by a strong spring acting on each counterjaw. The increasing twist prevents the use of guides. The extractor is pushed home until the edge of a cup in its head (*vide* figure) bears on the edge of the projectile. It is then turned round until the teeth spring into the holes, which are placed at a fixed distance from the ring on the head on which the cup edge will rest.

On withdrawing the staff the socket moves slightly in a slot in the shaft of the head, bringing two wedges, fixed on each side of each spring, to support each counterjaw.

This extractor has no means provided for releasing its hold while in the bore.

There are various patterns of extractors, differing principally from

Extractor, Projectile, R.M.L, 9-inch.



each other in the staves, either being plain or grooved, or in two parts as in the 12·5-inch, 16-inch, and 17·72-inch.

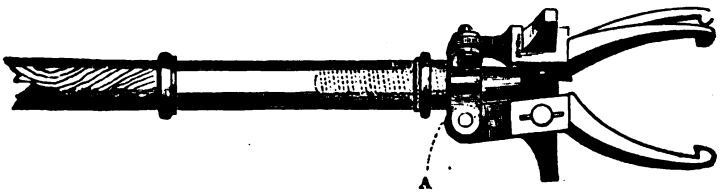
The 10-inch, 11-inch, and 12-inch require different extractors for their studded and studless shell. The same extractor is used for the studded shell for the 10-inch, 11-inch, and 12-inch, and the two latter use the same extractor for their studless shells.

The extractors for 8-inch calibre pieces are the same, only differing in length of stave for gun or howitzer.

The 6·3-inch howitzer, 6·6-inch gun and howitzer, and the 80-pr. gun take the same extractor, but the length of stave differs.

§§ 1205, 1712.

The *Extractor, Projectile, 64-pr. R.M.L. Gun*, differs from the pattern previously described. It has three guides, which keep in the grooves and bring the teeth of the jaws over the extractor holes; by turning the handle the collar, A, attached to the counter-jaws, recedes or advances, opening or closing the jaws by means of pins attached to the collar, which work in slots in the counter-jaws.



Bags. §§ 1734, 2912, 4020.

Bags, Extractor, are of canvas, painted black, the mouth constructed to draw round the stave and tie with a small cord

running through eyelet holes. There are two sizes, the larger for 12·5-inch to 10-inch, the smaller from 9-inch to 6·3-inch.

Each bag is marked I and R ⅄ L in white paint.

Gauges, Shell, Ring, B.L., B.L. or Q.F., B.L., Q.F. or Q.F.C., and Q.F., Body-high; Band-high and low, and Gas-check-high, are plain wrought-iron rings with handles formed on them.

Gauges, Shell, Cylinder, R.M.L., are high gauges for both body and studs. They are made of iron and for 7-inch and upwards fitted with two handles. A projectile which passes through it is sure to enter the bore of the gun; the diameters both of the cylinder and groove are ·045-inch less than the corresponding diameters of the gun.* § 2486.

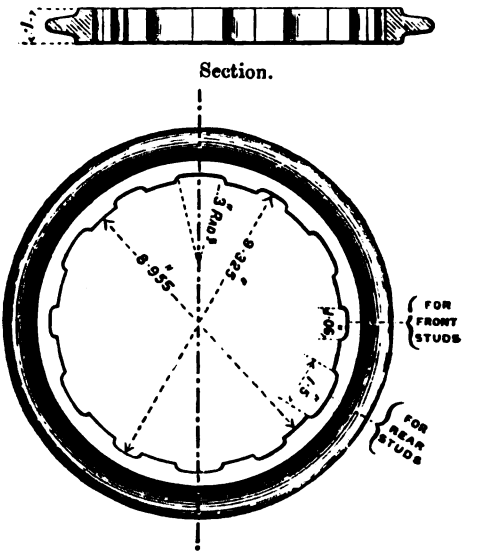
Guns with a uniform twist have the front and rear stud of their projectiles the same size, therefore only one set of grooves is required in the cylinder gauge corresponding to the grooves in the gun, the front stud in projectiles for guns having an increasing twist is smaller than the rear stud, hence for 8-inch guns and upwards a cylinder gauge is employed which has two sets of grooves of which one set narrows up towards the top so as to test the size of the front stud. A flange round the top of the gauge should rest on the front stud; a slot cut in the flange allows the front stud to be seen. §§ 1930, 3044, 4469.

Gauges, Shell, Ring; R.M.L. Body and Studs.—These gauges answer sufficiently well to test the shell as far as loading is concerned; they do not test the pitch of rifling, but are much more portable than the cylinder gauges. Ring gauges. §§ 2477, 2486, 3241, 9348, 9348.

The 8-inch and upwards have two sets of grooves, one for the rear and one for the front stud.

Gauges, Shell, Ring, R.M.L., Body, and Gas-check, are issued for §§ 4104, 4470, 5437, 8692, 9095, 9863.

Ring Gauge for 9-inch Rifled M.L. Projectiles.



* In manufacture the cylinder gauge has the advantage of detecting an eccentric stud which could not be found by ring gauges.

studless shell. They are similar to those for studded shell with uniform twist, and are made for all natures of studless shells.

Using. Some care is required to use a gauge properly; unless held quite fair it will not pass over the projectiles.

Gauges, Shell, Ring, R.B.L., are high and low gauges, the former passing over the projectile, the latter resting at the back end behind the cannelure.

Equipment Regulations, Part II, 1899. Supply of gauges for projectiles. Royal Artillery and Army Ordnance Department will be supplied as may be required, with ring gauges, body and gas-check, and ring gauges, body and studs, for R.M.L. projectiles; high gauges for B.L., and R.B.L. projectiles; and chamber gauges for 6-pr. and 3-pr. Q.F. ammunition.

Stations of inspection will, in addition to the gauges mentioned in the preceding paragraph, be supplied with cylinder gauges (or ring gauges, body and studs, if cylinder gauges are not available), and ring gauges, low over studs, for R.M.L.; and low gauges for B.L. and R.B.L. projectiles.

The dimensions of the high gauges for R.M.L projectiles are slightly in excess of those of the standard gauges by which the projectiles are received into the service; they, as well as all other high gauges, are issued for the purpose of indicating what projectiles are or are not fit for issue, or, if issued, whether, notwithstanding damaged studs, rings, thickened paint or rust on exterior, etc., they are still within such limits as will admit of their being properly loaded.

§§ 1125, 8457. *Horn, Powder, Miners'*, one is issued per battery for garrison guns. It contains 1½ lb. of F.G. powder, and is used for priming guns if required.

§ 8734. *Instrument, marking Projectiles, Mark I*, is to govern future manufacture in place of the copper stencil plates hitherto used for marking projectiles.

The complete instrument consists of a brass body to which is fitted a revolving wood handle, a radial arm, two guides, two keep pins, a wing-nut, washer and screw.

The body is slotted to receive the radial arm, which has a hole at one end to receive a brush, and is secured at the other end in any desired position in the slot by means of the wing-nut, washer and screw.

The two guides are for use with pointed and truncated projectiles respectively; both are secured by pins to the end of the body. That for pointed projectiles has three claws and a centering bit which works, by means of a spring, in a slot in the guide. That for truncated projectiles is made to fit into the key hole in the plug of the projectile.

The method of use is as follows:—

1. Fit the instrument with the guide suitable for the pattern of projectile to be painted.

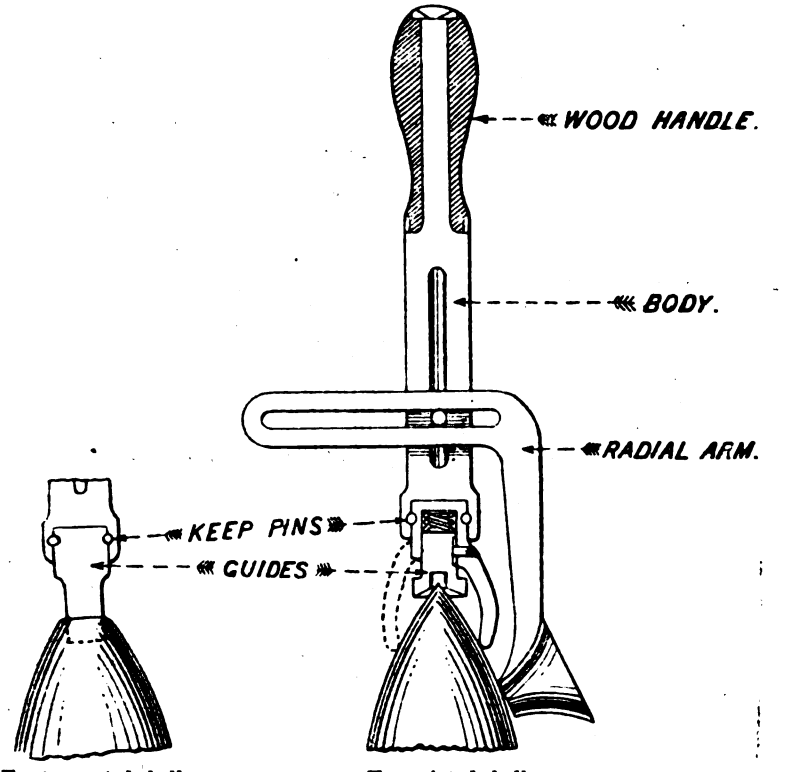
2. Place the projectile on its base, and the instrument on the point of the projectile.

3. Adjust the radial arm to the required position by means of the wing-nut.

4. Dip a hog's-hair stencil brush in paint of the required colour, place it in the hole in the radial arm, and paint the ring round the tip of the projectile; the radial arm acting as a guide. If necessary, finish off the ring after removing the instrument.

N.B.—The paint to be used should be of the consistency of stencil paint, care being taken that it does not run when applied.

Instrument Marking Projectiles, Mark I.



For truncated shells. For pointed shells.

Plates, stencil, copper ring.

Consequent on the adoption of the instrument described above no more stencil plates will be provided for marking projectiles, and so soon as the existing stock shall have been used up they will become obsolete.

Lever, Extracting Eye-bolt, Mark I, is intended for unscrewing the eye-bolt from projectiles so fitted. It is made of steel $\frac{7}{8}$-inch diameter and 3 feet 9 inches in length, and is flattened at one end. When existing store is used up it will become obsolete, and will be replaced by lever grummets. §§ 4890, 7727.

Lever, Grummets, is issued for the purpose of removing the rope grummets from the base of studless projectiles, and for removing eye-bolts from projectiles so fitted. It is made of steel 19½ inches in length; one end is pointed and the other flattened; both ends are slightly bent. §§ 4108, 7727.

Projectiles should not be stacked in contact with the ground, but a base should be formed of old shot or shell. Stacking projectiles.

Plank, stacking, projectiles, Mark I, is suitable for use in stacking all natures of projectiles for which planks are required. It is 7 feet by 12 inches by 3 inches, made of elm, bevelled at one end, and strengthened by iron bands at both ends. § 9005.

Another plank stacking projectile may still be met with, which §§ 2206, 4172.

differs from the above in being slightly wider and thicker. No more of these will be provided, the existing stock will be used up, and in the meantime considered interchangeable with Plank, stacking, projectiles Mark I.

Plugs. The following plugs will be found in various Service shell :—

§ § 7729, 8230, 8843, 10209. The *Plug, Fuze-hole, G.S., with Loop, Mark I,* | L | is a conical plug without shoulder, having a square hole in the head to take the G.S. key, and a loop of tarred white line about 1¼ inch long. It is for use with shells of G.S. gauge for field, mountain, and position guns.

§§ 7729, 10209. The *Plug, Fuze-hole, G.S., without Loop, Mark I* | *C* | differs from the above in having no loop; it is for use in shells of G.S. gauge, except those that take the G.S. plug without loop Mark II or G.S. plug with loop Mark I.

§§ 7729, 10209. The *Plug, Fuze-hole, G.S., without Loop, Naval, Mark II* | *N* | has a flange ·19 inches wide, under which is a leather washer, soaked in ozokerine, to make a water-tight joint. It is for use with all Naval shells of G.S. gauge.

The G.S. plug, as supplied by Sir William Armstrong, Mitchell & Co., has a shoulder with a leather washer and a loop. It is hollowed out at the top, and the hole for the key is at the bottom of the recess.

These plugs should, as much as possible, be retained for their own shell.

§ 8631. The *Plug, Fuze-hole, Special, Mark I,* resembles the G.S. plug, without loop, Mark II, but is longer. It has been superseded by the Mark II plug for lyddite common shells.

§§ 10031, 10306. The *Plug, Fuze-hole, Special, Mark II* | *C* | differs from Mark I in having the head recessed so as to leave a narrow rim round the edge.

This plug will be fixed in the socket, after being screwed into the shell, by "stabbing" the rim into the bush of the shell in three places at about equal distances. This operation can be performed with any pointed metal instrument.

Kit plasters will not be used on land service shells fitted with this plug, but they will, for the present, be used on all Naval shells.

§ 2090. *Plugs, Fuze-hole, Drill,* with lanyard attached, are issued for the purpose denoted by their name, and used with R.M.L. field service shell.

§ 6063. The *Plug, Fuze-hole, R.B.L., Mark II,* is used only with the 9-pr., 12-pr., and 20-pr. F.S. common and segment shells; it has a shoulder, and may also be easily known by having a coarse left-handed screw thread. The Mark I plug had a loop attached to it. Leather collars are issued with these plugs, and 5 per cent. spare are issued to field batteries.

§§ 8101, 9674, 10029. The *Plug, Base, Shell, No.* 1, *Mark I,* is a metal plug of the same gauge as the large base fuze, it is for shell fitted for base fuzes, 6-inch and upwards. It is stamped with the letter P, and has a recess to take the wrench base plug, or key, base, fuze, and plug.

§§ 8102, 9674, 10029. The *Plug, Base, Shell, No.* 2, *Mark I,* is a metal plug of same gauge as medium fuze, for shell fitted for medium base fuzes B.L. or Q.F. 5-inch to 12-pr. It is stamped with the letter P, and has a recess to take the key base plug, or key, base, fuze and plug.

§ 9674. *Plugs, Base, Shell, Nos.* 1 *and* 2, until recently were supplied with lead washers under the flange, these are now discontinued.

The *Plug, Base, Shell, No.* 3, *Mark I,* is used for shells taking base fuzes.

The *Plug, Base, Shell, No. 4, Mark I*, is for practice shell, B.L., Q.F., or Q.F.C., 6-inch and upwards, also for empty shells.

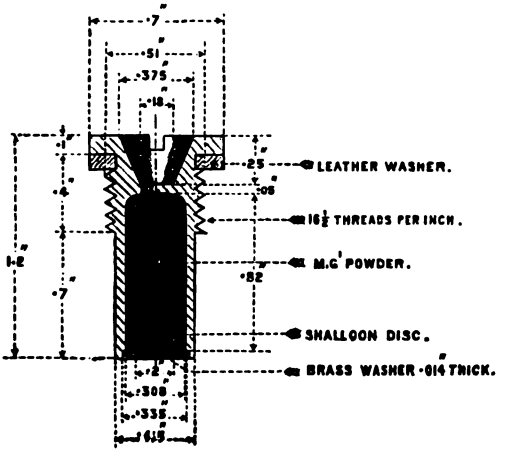
The *Plug, Base, Shell, No. 5, Mark I*, is for pointed practice shell, not powder shell, B.L., Q.F., or Q.F.C., 5-inch to 12-pr. § 10582.

These plugs resemble the two last-named, but are shorter, the inner ends being cut off flat at the termination of the screw thread.

A *Pocket, Fuze*, or pouch of buff leather, to hold five boxer fuzes, is issued for F.S. § 1994.

It is fitted with a strap to fasten round the waist. It also carries a borer.

Full Size.



Primers, Shrapnel Shell.—In shrapnel shell having the bursting charge in the base a primer is used; it serves to convey the flash from the fuze to the powder, and also prevents the powder from working up into the fuze socket. Primers.

For method of fixing it in the shell, *see* p. 375.

Mark I primer consisted of a metal cylinder tapped to screw into the pipe of the shell; the bottom was solid, pierced with a fire-hole, the top was open. It contained mealed powder, driven and pierced like a tube. § 1395.

This construction was found defective, as the flash had a tendency to pass upwards, and blind shell frequently occurred when it was used.

As all of this pattern, except those already fixed in shell, were ordered to be returned in 1873, very few should now be found. § 2521.

Mark II primer was introduced to remedy the defect. § 2268.

The top of this primer is solid, with a conical cup-shaped recess; the bottom of the cup is perforated with three small holes, communicating with loose powder, with which the body of the primer is filled. The bottom is closed by a thin annular disc of brass covered with shalloon.

There are two slots in the head for the screw-driver. Mark I had four slots, and in unscrewing a tight primer the head was apt to give under the screw driver.

When filled Service shell are carried on their sides, as in 13-pr. equipment, it was found that the bursting charge sometimes works through or past the primers and this led to the introduction of—

Mark III, which has a larger head and a leather washer underneath it (*see* cut). § 4538.

It is filled with M.G.[1] powder passed through an 8-mesh sieve, instead of L.G. powder passed through a 10-mesh.

Primers are issued in a tin cylinder holding 10, closed with a tin band.

For proof of primers *see* Regulations for Army Ordnance Services, 1900.

§§ 6518, 8658. *Protectors, Armour-piercing, Projectiles, B.L., Mark I.*—These were made for B.L. armour-piercing shot, 6-inch and upwards. The protector consists of an elm block cored out to receive the point of the projectile, fitted with an iron band to receive the screwed ends of an iron strap, which passes round the base, and is tightened by two nuts. This band has also two studs, which fit into the keyholes of the base plug, and retain the strap in position.

§§ 10328, 10622, 10901. *Protectors, projectiles*:—

B.L. 16·25-inch, or R.M.L., 16-inch Mark II.
„ 13·5-inch, Mark IV.
„ 12-inch, heavy, Mark III.
„ 12-inch, light, or R.M.L. 12·5-inch and 12-inch Mark IV.
„ 10-inch, or R.M.L., 11-inch, Mark IV.
„ 9·2-inch, or R.M.L., 10-inch and 9-inch, Mark IV.
„ 8-inch, or R.M.L., 8-inch, Mark IV.
„ Q.F., or Q.F.C., 6-inch, Mark IV.

The protectors are suitable for use with all B.L. pointed projectiles of the above-named calibres, and R.M.L. common pointed shells, as above.

They differ from the "protectors, armour-piercing projectiles" in the form of the strap, which is a band of hoop iron, in one piece, bent, and riveted at the bottom to a dish-shaped plate which fits over the base of the projectile. The top of the protector is secured to the band by two strap bolts, each fitted with studs, which engage in slots at the top of the band. By engaging any two opposite studs in the slots, the protector can be lengthened or shortened as required, being clamped on to the projectile by the nuts on the strap bolts; in earlier marks the band was in two pieces.

Certain issues of protectors (B.L. or Q.F. 6-inch to 13·5-inch) differed from the above in being provided with only two studs on the strap bolts. These were suitable only for B.L. armour-piercing, shot, and B.L., common pointed (except iron) shell.

Protectors of this description will, when converted to the later pattern (by having the additional studs added to the strap bolts), be distinguished by having the symbol* added to the numeral.

§ 6429. *Puff, Powder, 4-oz., Mark I, also Pin, Mark I*, have been approved for instructional purposes in judging the distance of burst of projectiles. The puff is of serge containing 4 oz. blank L.G. powder, and the pin is of iron 13·5 inches long, one end being bent at right angles, and having an eye to take the friction tube by which the puff is fired.

§§ 5064, 5741. *Screws, Preserving, Eye-bolt, Holes*, large and small, Mark I, have been introduced for projectiles having eye-bolt holes in the side. Their use is to prevent dirt, &c., filling up the hole. The large is for 17·72-inch R.M.L. and 16·25-inch B.L. guns, and the small for R.M.L. 12·5-inch and 16-inch and B.L. 8-inch to 13·5-inch.

§§ 3259, 4268, 9567. *Selvagees* are used for slinging projectiles in the L.S., when loading. In future, the sizes to which selvagees will be made up for L.S. purposes will be as detailed below. The existing stock, irrespective of sizes, will be used up.

Designation.	Service.	Detail. Length (inside when stretched straight).	Detail. No. of strands.	——
Salvagees—		(3-thread yarn.) in. in.		For projectiles, B.L. or R.M.L.—
29-inch ..	L	29 to 30	6	6-inch to 7-inch.
36-inch ..	L	36 to 37	12	9-inch and 9·2-inch.
43-inch ..	L	43 to 44	18	10-inch to 11-inch.
48-inch ..	L	48 to 49	27	12-inch to 12·5-inch, also for G.S. purposes.
53-inch ..	L	53 to 54	26	B.L., 5-inch howitzer.

Strap, carrying projectiles, B.L., 5-inch Howitzer, Mark I, is two stout leather straps with iron runners ; they are attached to a wrought-iron handle covered with leather.

Strap, carrying projectiles, B.L., 5·4-inch Howitzer, Mark I, is similar to the above.

Slings, Lifting, Projectiles, B.L., Mark I.—These slings are made for B.L. guns, 8-inch to 16·25-inch inclusive, and are intended for use with steel armour-piercing projectiles only. They consist of a band of spring steel, 4 inches wide, having at each end a lifting eye, one being made smaller than the other. The band fits round the centre of the projectile, the smaller eye being passed through the larger one, and the lifting gear attached to the former. §§ 5868, 5956, 10240.

The following wads are used with various shells. § 1708.

Wad, Fuze-hole, R.B.L. Sockets, is used in conjunction with the sockets of 9-pr., 12-pr., and 20-pr. R.B.L. common shell, and is used when the shell is carried filled. They are placed in the hole in the bottom of the socket, recessed part upwards.

Wad, Fuze-hole, Naval, with Loop, is a millboard wad,* saturated in beeswax, and fitted with a small loop of preller leather on the top. §§ 2370, 2413, 6348, 7427.

* As there is a considerable vagueness about the use of the terms "papier-mâché," "millboard," "pasteboard," here are introduced the definitions of them as understood in the trade.

Papier-mâché is formed by *glueing* together sheets of strong brown paper, the upper surface being sometimes coated with a surface of hard enamel. There is also a papier-mâché made by running pulp into moulds, and subsequently coating it.

Millboard is produced of any required thickness by successive dips into the vat of pulp ; in other words, millboards are really solid single sheets of paper.

Cardboard is formed by pasting together as many sheets of fine paper as will give the required thickness ; so that both "middles" and "facings" are of the same quality.

Pasteboard is made like cardboard, but the "middles" are of an inferior quality of paper and the "facings" only of a fine quality.

There are three patterns of this wad, differing only in the mode of attaching the leather loop. In Mark I it is riveted on with a copper rivet; in Mark II it is sewn on with waxed thread. In Mark III the loop is sewn to the centre of the wad.

It is fitted into the recess provided for it in shells, common and double, filled with powder and fuzed, or filled with powder and plugged with the Mark I G.S. plug. The wad is coated with Venetian red cement.

§§ 2075, 2527, 2627, 7602. *Wad, Fuze-hole, G.S., Mark II,* serves to prevent the powder from working up in the fuze-hole of shell. It is made of papier-mâché, and has a hole in the centre covered by thin black shalloon cemented to one side. It is unnecessary to remove the wad before inserting the fuze.

The side covered with shalloon is placed downwards in the shell.

Use. § 3160. It is used in all common and double shell for rifled guns which do not have their bursting charge contained in a bag, and which are not to be fired immediately after filling.

§ 10032. *Wad, fuze-hole, G.S., Mark III | L | Papier-mâché except 2·5-inch shrapnel Marks III and IV.*

The Mark III wad is only half the thickness of Mark II, and will be used with the long drift for B.L., Q.F., or Q.F.C. shrapnel, 4-inch, Marks V and VI and R.M.L. 2·5-inch ring shell.

It will also be used in all other shells without bags, except 2·5-inch shrapnel Marks III and IV, with the "Drift, G.S., short," when the existing stock of Mark II G.S. wads have been used up.

§ 10032. *Wad, fuze-hole, 2·5-inch, shrapnel, Mark I | L |* . This wad has been introduced for use with R.M.L. 2·5-inch shrapnel shell, Marks III and IV, the G.S. fuze-hole wad, Mark III, not being suitable for those shell.

§ 9818. *Wad, grummet, R.M.L., 7-pr., Mark I,* consists of a piece of 1-inch tarred rope, 7 inches long, bent in the form of a segment of a circle. The two ends, which are left about 1½ inches apart, are secured by twine. The grummet, about 2¾ inches external diameter, is used to prevent projectiles from slipping forward in R.M.L. 7-pr. guns when firing at angles of depression.

§§ 2686, 9773. *Wad, wedge, 9-inch, Mark I,* consists of two wood wedges 7 inches long connected by a piece of cane about 7·5 inches long. It is for use with 9-inch to 12·5-inch R.M.L. guns.

Wad, wedge, 8-inch, Mark I, differs from the above in the wedges being 5·5 inches long, and the cane 6·5 inches long. It is for use with 64-pr., 80-pr., 7-inch and 8-inch R.M.L. guns.

Wad, wedge, 8-inch, Mark I* differs slightly from the 8-inch Mark I pattern, it being a conversion from the 9-inch to the 8-inch.

These wads are to be rammed home separately after the projectiles and are used to prevent the latter from shifting when running the gun up.*

§ 6103. *Wad, 16-inch, Mark I,* consists of a front and rear ring of millboard glued on to a central tube of brown paper 6·5 inches long. The rear ring is cupped, as shown in the cut, so that any forward motion

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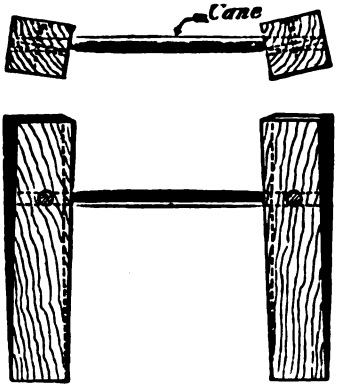
* The discontinuance of wedge wads was tried for a month at Shoeburyness. It appeared that the projectiles had a tendency to slip forward in all guns run up with more than ordinary rapidity. "Extracts," Vol. XVII, p. 79.

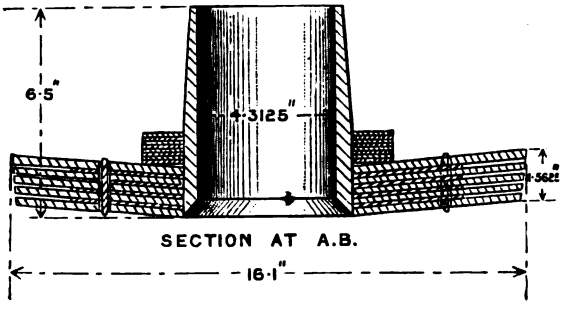
Wad, wedge, 9-inch, Mark 1.

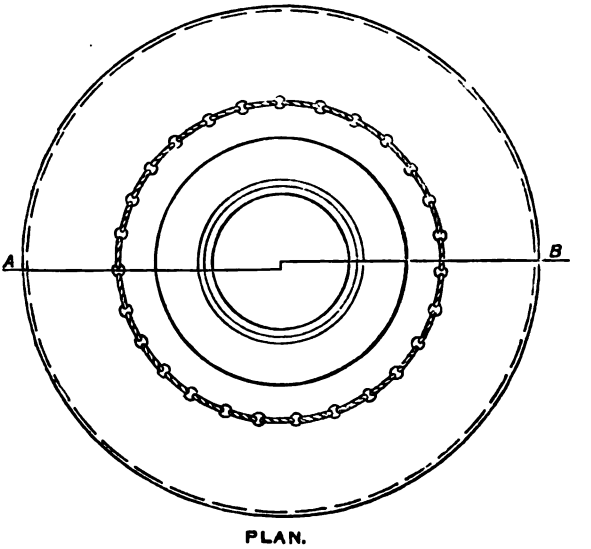


of the projectile is checked by the ring expanding and gripping the bore of the gun.

A certain number of wedge wads have been issued for use with the

Scale, $\frac{1}{6}$.





16-inch R.M.L. gun; these will be returned to store as soon as mill-board wads shall have been received in their place.

§§ 6525, 7378. *A Wad, 17·72-inch, Mark I*, nearly similar to the above, has been approved for the 17·72-inch R.M.L. guns. It differs chiefly from the 16-inch in having the central tube of wood, and secured to the mill-board ring by copper rivets.

Preparation.

Fixing Gas-checks.

Projectiles, fitted with Plug and Nut.

A.C. 1884, Cl. 175. Unscrew the nut and remove it, then apply the "Wrench, base plugs" to the gas-check plug and screw it well up in the direction of the arrow to ensure its being well home.

The heads of the gas-check plugs and the wrought-iron nuts are each stamped with an arrow to show the direction in which to turn, either when screwing in the gas-check plug, or when screwing on the wrought-iron nut.

If, when unscrewing the nut, there is any tendency for the plug to unscrew also, the "Wrench, base plugs" should be at once applied to the head of the plug and turned in the direction of the arrow, at the same time as the nut is being turned in the opposite direction.

Place the gas-check on the base of the projectile, with the concave or unpainted side next the base, then screw the nut on to the end of the plug with the "Spanner, gas-check nuts." With Mark II gas-check, plug, and nut, the nut will be screwed down to the shoulder on the plug.

Projectiles fitted with Plug with Hexagonal Head.

Unscrew the plug and remove it.

Place the gas-check on the base of the projectile, with the concave or unpainted side next the base (the saucer-shaped gas-checks for 6·3-inch howitzer with the concave surface to the rear), insert the plug and screw it well home with the spanner until it binds against the gas-check.

With gas-checks having projections, for studded projectiles, see that the projections are in the line of the studs before screwing the plug home; with the 6·3-inch howitzer shells, see that the radial projections on the gas-checks fit into the corresponding grooves in the base, before screwing the plug home.

Fixing Gas-checks to Studless Projectiles, except for 6·3-inch Howitzer.

Except for high angle and field guns these gas-checks are placed in the bore of the gun loose, and become fixed to the projectile when the gun is fired. For 9 and 10-inch high angle guns the gas-checks are attached to the shells before loading with an "instrument, fixing gas-check." For field service studless shells are issued with the gas-checks fixed on them, by being spun on.

For drill purposes, in order to facilitate unloading, the gas-check should be attached to the base of the shell by indenting it with a blunt tool at two or three points in that part which surrounds the neck of the projecting base of the projectile.

Instructions for Rectifying the Rim of Gas-check on 13-pr. R.M.L. Projectiles.

If the rim of the gas-check is less than 2·84 inches diameter, and will allow the gauge for gas-check to pass over it, it will be rectified as follows:—

The shell is to be held by one man, base uppermost, care being taken to protect the head, and not allow it to rest on any hard substance. The point of the rectifier is inserted between the rim and crown of gas-check, and driven down by means of a few light blows from a hammer. This is repeated all round until the edge of the rim is evenly expanded, so that the 2·985-inch gauge for body and gas-check will pass over it, but the 2·84-inch will not. Should the base of the lip at its junction with the shell be set out by this operation, so as not to allow the 2·985-inch gauge to pass over it, it must be reduced with a file to those dimensions.

Protection of Driving Bands with Gas-check.

All B.L. and Q.F. projectiles, fitted with the driving band with gas-check, will have tarred rope grummets placed one on each side of the gas-check portion of the band to protect it. The grummets will not be removed under ordinary circumstances until the projectiles are required for the service of the gun. A mallet and driver will be used in removing them, care being taken that the band is not injured during the operation. When removed the grummets should be returned to store.

Examination of Empty Projectiles.

All projectiles are examined by gauging.

In examining B.L. projectiles, special attention should be paid to the driving band; and care must at all times be taken not to injure them, especially when they envelop the base of the shell. If the ring is slightly set up, it may be filed down until of the proper diameter for loading, but care must be taken not to reduce it more than absolutely necessary.

Lead-coated projectiles should be carefully examined as to the attachment of the lead coatings. The high ring gauge should be passed over the shells, and the lead, if set up, can be filed down.

The fuze-hole of shells of garrison calibres should be examined.

In examining rifled common shells, the condition of the lacquer should be looked to, and also as to whether any loose iron filings may be present in the shell.

Any loose matter may be detected by "up-ending" the shell.

Studded projectiles should be examined by passing the cylinder or ring (body and studs) gauge over them.

In examining rifled shrapnel shells, special attention should be paid to the junction between the head and the body; loose heads may be met with, especially in F.S. shrapnel of early patterns. A loose head renders the shell unserviceable; also early patterns should be examined to see whether any resin has worked up into the socket, which might prevent the flash of the fuze from igniting the primer.

Palliser projectiles are sometimes damaged in transit; if the point is broken off, the shell becomes unserviceable. They can, however, be utilised at practice, if broken more than indicated by the plaster of Paris model B, *see* p. 252.

Case shot are sometimes damaged in transit, or by the jolting motion of a limber. They can generally be repaired by a tinsmith, a little solder is often all that is wanting.

Shells that have been stored in the open air are sometimes found to have admitted water. Common shell so wetted should be carefully dried, but shrapnel are unserviceable and must be exchanged.

Practice shells. §§ 5492, 7770.

All unbroken common shells recovered after firing will be returned to the Royal Arsenal, Woolwich, for examination. If, on examination, they are found to be sound, they will be repaired, and issued for practice purposes.

A.C. 1869, Cl. 143.

Nothing requires more care than the examination of shell returned into store as empty; frequently accidents have happened from the presence of powder in shells so returned; they are therefore received into store as *doubtful* and carefully examined. At out-stations shell so examined are marked with an E in red.

Piling Projectiles.

The bases of all piles should be firm and level, and formed of stone, concrete, or other hard material. Projectiles should never be piled on wood, sand, mud, or loose shingle, even when garlands are used. Unserviceable shell or shot form an excellent base, and iron rails with turned-up ends are sometimes used for piling elongated projectiles. When neither of these means are available, medium wood scotches will be allowed for scotching up the ends of piles of elongated projectiles.

Projectiles for rifled ordnance will be piled on their sides. Rifled shrapnel shells will on no account be placed on their bases when stored in the open air, as it is impossible to dry these shells thoroughly when water has once entered them.

Care must be taken not to burr the studs or driving bands of projectiles when stacking. Studded and banded projectiles should never be rolled on the ground or on stone floors; the planks supplied for this purpose will invariably be used. In the case of B.L., Q.F., and R.M.L. studded projectiles boards about $\frac{3}{4}$ inch or $\frac{8}{8}$ inch thick should be placed for the bottom layer to rest upon.

Scraping and Painting Shot and Empty Shells.

Shot runs and trestles are to be supplied to all working parties employed in cleaning shell or shot. If shot runs are not obtainable, suitable materials, such as strong wooden planks, &c., will be supplied, in order that the work may be properly carried on.

Shells will be placed on the run, the plugs removed, and the interior examined by the eye in the first place to ascertain if they contain any powder, and also searched with a copper scraper, or in the case of shrapnel shells, with a copper wire; shells containing powder will be at once carefully removed and dealt with under the instructions for filled shells.

Rifled shrapnel shells, before painting, will be examined to see if the fuze socket is secure; in the earlier patterns of shells it sometimes becomes loose, allowing the resin to work through into the socket; also at the junction of the head and body, to see that the head is secure. Any shell found defective will be put on one side for the decision of the Inspecting Ordnance Officer.

Lead-coated projectiles will be carefully examined as to the attachment of the lead coating; in very bad cases the eye will detect a loose coat and in doubtful cases tapping with a hammer will detect a loose place, as a peculiar dull sound is given out. If blisters appear on the surface they should be pricked, and the lead hammered down The high ring gauge should be passed over the projectiles, and the lead, if set up, filed down. Any doubtful cases will be set aside for the decision of the Inspecting Ordnance Officer.

Any shell having the obsolete Moorsom gauge fuze-hole (which can be readily known by the large plug with a shoulder and

cylindrical body) will be put on one side for conversion to G.S. gauge.

The leather collars on fuze-hole plugs will be examined, and if necessary replaced by new ones; and gas-checks attached to projectiles by nuts or plugs will be removed.

The shell or shot will be scraped with the swords provided for the purpose until quite free from paint or rust, care being taken not to injure the bands of B.L., studs of R.M.L., or lead coating of R.B.L. projectles.

The interiors of rifled shells being lacquered, will not be scraped, but the shells simply inverted to ensure their being free from water, and to shake out any loose dirt, &c.

The fuze and plug-holes of all rifled shells, the gas-check plugs and nuts of shells which have them and the loading-holes of diaphragm shrapnel shells, will be thoroughly cleaned and lubricated as at page 376.

The shell or shot will be painted with two coats of paint, the second not being given until the first has thoroughly set. The red rings, red tips, white tips, or white rings on shell should be painted with one coat only; the blue tips of segment and ring shell, however, require two coats. Tarpaulins will be supplied for placing over the projectiles after they have received the first coat.

The paint will be applied over the whole of the exterior surface, of the shell, socket and plug, except the lead coating, studs or driving band. In the case of lead-coated projectiles, however, the painting should extend at least half an inch over the junction of the iron and lead both at the base and shoulder.

Previous, and subsequent, to painting, the whole of the projectiles will be gauged with the proper gauges by the Non-commissioned Officer in charge of the party, and all that do not gauge properly will be put to one side, and the circumstances reported to the Commanding Officer.

Fixing Plugs, &c.

When plugs are screwed into empty shells, they will, unless required for immediate use, be lubricated with a mixture composed of equal parts (by weight) of Mark III luting and mineral jelly. The mixture is to be applied to the threads with a brush.

Projectiles fitted with plugs and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water, or otherwise, should have the plugs that are not covered by wads or lead discs occasionally unscrewed and re-lubricated as above, a coat of paint being applied over the junction of shell and plug, care being taken that this is only done when the hygrometric conditions are favourable. No plugs will be removed whilst moisture is condensing on the outside of the shell. Plugs covered with Naval wads or lead discs will not be removed, unless their wads or discs are loose or defective. If lead washers are found on any of the base plugs, they will be removed and brought to produce.

Instances have occurred in which fuze-hole plugs of common shells have been so jammed in as to be immovable, in consequence of using the "wrench, base plug." The "key, fuze and plug, G.S.," "key, fuze, universal," and "key, plug, G.S." are the only implements which should be used for screwing in the G.S. plug.

The "key, fuze, universal," must not be used with such force as to distort or damage them in removing plugs from projectiles.

Plugs which are found to have become so tightly fixed in shells

as to require undue force with the universal key will be loosened by means of the implements detailed below.

I *Naval service.* Wrench, base plug.

II *Land service.* Key, fuze, and plug, G.S., or, key, plug, G.S. in the Garrison Artillery and key, plug, G.S., in the Siege and Mountain Artillery.

The turnscrew on the limber boxes in the Field Artillery. If when endeavouring to remove a plug which is very tightly fixed, the bush is unscrewed, the projectile should be fired plugged.

Scraping and Painting Filled Shells.

The painting of filled shells will be carried out in a building or tent to which paras. A to K, p. 445 *et seq.*, will apply, except shells in 6 and 3-pr.Q.F. cartridges, which are dealt with on pp. 333 to 334; as regards shell in A.O.D. or R.A. charge, special permission for the work to be performed will be first obtained from the G.O.C.

The shells will be dealt with in a similar manner to empty shells, but they will first be examined to ascertain that the plugs are secure, and the plugs are on no account to be removed in the room where the painting is carried on, or during the repainting. No other work will be carried on in the room while the shells are being scraped and painted.

With shells fitted for gaschecks, when the shell is up-ended for the purpose of scraping the base, the gascheck nut and plug will be removed and re-lubricated, as laid down for fuze hole plugs at page 376. The lubricating of such plugs and nuts will not be carried out at any other time, unless found absolutely necessary.

If the shells are fuzed, the fuzes must be removed and plugs inserted as a laboratory operation, as laid down at page 452, before the shells are scraped and painted, the fuzes being replaced when the paint is dry.

While the first coat of paint is drying, the plugs, if necessary, should be removed, lubricated, and refixed, and after the second coat care must be taken to renew all the marks which were on the shell before re-painting, and such marks should be renewed whenever they become illegible.

Oiling Projectiles.

To preserve the paint on projectiles stored under cover, they will be coated with boiled linseed oil when necessary. If shell stores, however, are damp, the projectiles should be thoroughly oiled once a year, or oftener if there is any appearance of rust.

Filling Shells.

The shells to be filled will be placed outside the receiving hatch of the outer room, and will be thoroughly cleaned and brushed externally before being passed into the outer room. Planks will be laid down when the heavier shells are filled, in order to save the floor.

All shells, before being taken into the inner room, will be examined externally and internally, thoroughly cleaned from grit, and gauged. Care must be taken in this examination not to detach the lacquer, which is easily done by the careless use of the copper scraper. A.P. shells must also be carefully examined inside for cracks.

Special care must be taken that the shells and bags are dry.

Material, such as serge, silk cloth, &c., liable to absorb moisture, will be thoroughly dried by artificial heat or exposure to the sun before use, and great care must be taken that shells are thoroughly dry inside before filling, and that they are not colder than the air in the filling room, or moisture is liable to be deposited in them when they are brought in to be filled.

This is most important for shrapnel shells with a tin cup for the bursting charge, as if this gets damp it rusts, and renders the shell unserviceable for filling.

Shells should, if possible, be fuzed or unfuzed in a separate building from that in which they are filled, examined, or emptied, but if a separate building is not available, shells may be fuzed or unfuzed in the same room in which they are filled, but in all cases while fuzing, only one shell will be operated on at a time and no other shell will be brought into the room until it is removed.

All shells, up to the 7-inch inclusive, can be up-ended by hand for filling; heavier natures require a tackle and strap or holder.

Three kinds of powder are employed in filling rifled common, double, armour-piercing, and Palliser shells, viz., shell L.G., P. mixture, and a mixture of shell Q.F. and F.G. powders.

P. mixture consists of P. powder, with so much of a fine-grained powder as will fill up the interstices between the pebbles.

P. mixture is used for the bursting charges of common, double and armour-piercing shells, generally with the following exceptions.

Shell Q.F. and F.G. will be used with 12-pr. Q.F., C.S., common pointed shell, Mark I, and for all natures of common, double, and armour-piercing shells up to 6-inch B.L., and 40-pr. R.M.L. or R.B.L., if P. mixture be not available (except 3-pr. and 6-pr. Q.F.).

Shell L.G. will be used for filling 20-pr., L.S. 12-pr., and 9-pr. R.B.L. common shells, and 7-inch and 40-pr., R.B.L. segment shells.

The following are the proportions of P. and F.G. powders to be inserted at one time into the various natures of shells:—

Natures.	*Proportions.*
13·5-inch and above	about 8-lb. P. then 20-oz. F.G.
12·5-inch to 11-inch	„ 5-lb. P. „ 12-oz. F.G.
10-inch to 8-inch	„ 4-lb. P. „ 10-oz. F.G.
7-inch to 4-inch	„ 2-lb. P. „ 5-oz. F.G.
Under 4-inch, with bag	„ 1-lb. P. „ 2½-oz. F.G.
All without bag	Fill with P. or Q.F. and then fill up the interstices with F.G.

Shrapnel shells having the bursting charge in the base may be filled with R.F.G.[3], R.F.G., F.G., or Pistol powder; those with bursting charge in the head with L.G. or F.G. if contained in a bag, or with L.G. if without bag. Service powder, or new blank or shell powder (*i.e.*, blank or shell powder specially manufactured as such), will always be used.

Powder reduced in class to shell powder must not be used for shrapnel shells.

In all cases the bursting charges must be accurately weighed or measured out.

Up to the 64-pr. R.M.L. and 6-inch B.L. inclusive, the bursting charges for shrapnel are measured; heavier natures are weighed.

The quantity of loose powder (*i.e.*, in barrels and unplugged shell) in the filling room should not be more than is necessary for the

work in hand, and should never exceed 225 lbs. The number of shells under the operation of filling at any one time is not to exceed—

13·5-inch and upwards	1
11-inch and under 13·5-inch	2
7-inch and under 11-inch	3
12-pr. and under 7-inch...	6
Under 12-pr.	12

If, however, it is necessary to fuze the shell in the same room, only one will be dealt with at a time.

Each shell, when filled, is to be plugged or fuzed immediately and removed from the inner room as soon as possible.

Should a necessity arise for keeping plugged filled shells in the building, in addition to those under the operation of filling, the numbers so kept are not to exceed the following :—

11-inch and upwards	2
7-inch and under 11-inch	3
40-pr. and under 7-inch	6
Under 40-pr.	12

Filling Shells, Common and Double, without Bag.

R.M.L. 13-pr. and under.
R.B.L. 20-pr., N.S.
With P. Mixture, or Q.F. and F.G.

Remove the plug from the fuze-hole, drop the P. (or Q.F.) powder into the shell pebble by pebble until full, then insert the funnel and pour in the F.G. powder until the interstices are filled, tapping the shell with a mallet or piece of wood to ensure its being completely filled. After filling, carefully wipe every particle of powder from the fuze-hole, then lubricate plug or fuze and screw it in.

In shells that are liable to be moved, or that are not required for immediate use, and in shells for use in the field or boats in Naval Service, insert the "Wad, fuze-hole, G.S.," with the side on which the shalloon is cemented downwards, *i.e.*, next the powder, and drive it in with the "Drift, G.S.," as far as the shoulder on the drift will allow; then lubricate and screw in the fuze or plug as may be required.

R.B.L. 20-pr., L.S., 12-pr., and 9-pr.

Insert the leather funnel and carefully pour in the bursting charge of shell L.G. through the small hole at the bottom of the socket until the shell is thoroughly filled, then (care being taken that no powder remains in the socket) place the "Wad, R.B.L., socket," recessed part uppermost, in the hole at the bottom of the socket and drive it in flush; any flat-ended piece of wood larger in diameter than the wad can be used for this purpose, then fix the fuze or screw in the fuze-hole plug as may be required.

Filling Shells, Common and Double, with Bag, through the Fuze-hole.

B.L. or Q.F. 4-inch 30-pr. and 5-inch (iron and steel) and B.L. 8-inch, 9·2-inch, 12-inch, and 16·25-inch (Mark I) forged steel.

R.M.L. Studded 16-pr. and upwards, 6·3-inch howitzer, and 10-inch H.A. practice.

R.B.L. 40-pr. and 7-inch.

Remove the G.S. plug from the fuze-hole, place the filling rod in the bag, and insert it through the fuze-hole, taking care not to force

the end of the rod through the bottom of the bag; carefully push in the bag until the neck only is in the fuze-hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling, then withdraw the rod.

Weigh or measure the proportions of P. (or Q.F.) and F.G. powders, insert one portion of the former, lift up the bag and jerk it so as to set the powder well down to the bottom and to open the bag, insert the funnel and pour in the portion of F.G. powder, lightly stir and press with the filling rod, repeat the operation till the shell is filled.

When the shell is quite full, withdraw the funnel and filling rod and tie the neck of the bag with twine close to the top of the fuze-hole. A piece of twine is attached to the neck of the bag for this purpose; it must be shifted to its proper position if necessary. Cut off the superfluous choke and push the neck of the bag well down, and to one side of the fuze-hole; insert in every shell, except the 16-pr., two "Bags, primer, 7 drams" or more if there is room, then screw in the fuze or plug as required, taking care that the fuze-hole is clean and the fuze or plug lubricated.

In the 16-pr., only one "Bag, primer, 7 drams" is used.

Filling Shells, Common, with Bag, through the Base.

B.L. or Q.F. cast iron and cast steel 6-inch and upwards, and 16·25-inch forged steel, Mark II.

R.M.L. Studless, 80-pr. and upwards, guns and howitzers, except the 10-inch H.A. practice.

Fix the "holder shell" on the body, and place the shell upon its point, which may be inserted in a block of wood hollowed out for the purpose, or in Block No. 1 or 2, or in any other convenient place.

The handles of the "holder shell" are held firmly, while another man unscrews the base plug with the "Wrench, base plug." Drop in three "Bags, primer, 7 drams" (the 17·72-inch shell takes one "Bag, primer 10 oz."), then insert the bag and complete the filling, but no bags primer are to be inserted after filling.

In the case of B.L. shells which take a lead disc over the base plug, after screwing in the latter, insert a lead disc, and hammer it from the centre outwards so as to spread it into the undercut in the shell. The disc will then be painted black.

In the case of shells fitted with an adapter, the lead ring will not be cut out, nor the adapter removed for filling; but if the lead ring is damaged or loose it should be cut out and replaced.

Filling Shells C.S., Common Pointed, without Bag.

Q.F. 12-pr. (Q.F. and F.G. for Mark I, P for other marks).

Place the shell, point down, in the "holder, shell, Q.F. 12-pr." and clamp with the clamping screw. The base plug is removed by the "key, base, fuze, and plug," drop the Q.F. or P. powder into the shell until full, then insert the funnel and pour in the F.G. powder until the interstices are filled, tapping the shell with a mallet or piece of wood to ensure its being completely filled, leaving room for the plug or fuze, which should be lubricated (*see* page 377), and screwed in.

Filling Shells, C.S. Common Pointed, Armour-piercing, and Palliser.

B.L. or Q.F. 4-inch and upwards.

R.M.L. 8-inch and upwards.

The 4-inch, 4·7-inch, 5-inch, and 6-inch are placed, point down, in

their respective "holders shell" and clamped. The 8-inch and up will have a "holder shell" fixed on the body, and the point of the shell may be inserted in a block of wood hollowed out for the purpose, or in Block No. 1 or 2, or in any other convenient place.

The base plug is removed as above described. The bag is inserted and the filling completed. After the superfluous choke is cut off, push the neck of the bag well down, and to one side of the fuze-hole, then insert "bags, primer, 7 drams" as follows:—

Under 6-inch	4
6-inch and above	5
Except 10-inch and above, pointed common, which require	9

It may be necessary to exceed these numbers, as many primers being used as can be inserted after the bag has been choked. Care must be taken that a primer is opposite the end of the fuze.

In the case of shells fitted with an adapter, the lead ring will not be cut out, nor the adapter removed for filling; but if the lead ring is damaged or loose it should be cut out and replaced.

The following table gives the sizes of lead rings or discs for all natures of shell that take them:—

	Nature of Projectile— Shell.	Discs.		Rings.	
		Large.	Small.	Large.	Small.
B.L.	16·25-in. Common, Marks II and III	—	—	Yes	—
	16·25-in. „ Pointed I	—	—	Yes	—
	13·5-in. „ Marks I and II	—	—	Yes	—
	13·5-in. „ Pointed I	—	—	Yes	—
	12-in. heavy, Common, Pointed I	—	—	Yes	—
	12-in. light, „ Marks I and II	Yes	—	—	—
	12-in. „ „ Mark V.	—	—	Yes	—
	12-in. „ „ Pointed I	—	—	Yes	—
	10-in. Common, Mark I	—	—	—	Yes
	10-in. „ Pointed.	—	—	Yes	—
	9·2-in. „ Marks I and II	Yes	—	—	—
	9·2-in. „ „ IV and V	—	—	—	Yes
	9·2-in. „ Pointed I and II	—	—	Yes	—
	8-in. „ Marks I and II	—	Yes	—	—
	8-in. „ Pointed (Mark I)	—	—	—	Yes
	6-in. „ Marks I, II and III	—	Yes	—	—
	6-in. „ „ IV and V	Yes	—	—	—
	5-in., Common, Marks I and II	—	Yes	—	—
R.M.L.	17·72-in., Common II	—	—	Yes	—
	16-in. „ Pointed I	—	—	Yes	—
	12·5-in. „ II and III	—	—	Yes	—
	12·5-in. „ Pointed I	—	—	Yes	—
	12-in. 25-ton, Common II	—	—	Yes	—
	12-in. „ „ Pointed I	—	—	Yes	—
	11-in. Common, Marks II and III	—	—	Yes	—
	11-in. „ Pointed I	—	—	Yes	—
	10-in. „ Marks II and III	—	—	—	Yes
	10-in. „ Pointed I	—	—	Yes	—
	9-in. „ „ heavy I	—	—	—	Yes
	9-in. „ „ I	—	—	—	Yes
	8-in., Common, Pointed I	—	—	—	Yes

* *Filling Shells, Common, R.M.L. and R.B.L., with Blowing Charges.*

Remove the plug, insert a funnel, and fill with dry coal dust, § 10786. leaving sufficient room for the blowing charge. The filling rod will be used to facilitate the passing of the coal dust through the funnel, and to press it firmly down. Insert the calico bag, the large one for the 64-pr. and upwards, and the small one for under 64-pr., and fill with shell L.G. powder. The shells should not be filled until just before firing, as the G.S. plug cannot be inserted.

Filling Shells, Shrapnel, with Bursting Charge in the Base, through the Fuze-hole.

Remove the plug from the fuze-hole, and after seeing that the latter is clear of any dirt, &c., insert the funnel and pour in the bursting charge, which has been previously measured or weighed out. This must be done gradually, for if the whole of the powder is put in at once the tube will probably be choked. The shell should be tapped on one side with a wooden mallet until the whole of the bursting charge has passed down the tube, taking care that none of the powder is left at the bottom of the socket.

Drop in a "primer, shrapnel shell," and, by means of the "driver, screw, shrapnel, large," screw it firmly in the tube, and then lubricate and screw in the fuze or plug as may be required. Great care must be taken that the "primers, shrapnel shell," are not handled with greasy fingers, as a very small amount of grease may render a primer unserviceable. Mark III primers are to be used with Field Service Shrapnel, Mark II or III with other natures. If the primer is too tightly screwed home it is liable to jam so that is cannot be unscrewed.

Filling Shells, R.M.L. Shrapnel, 6·3-inch, 6·6-inch, and 8-inch Howitzers, through the Base.

First remove the plug from the fuze-hole and drop in the "Primer, shrapnel shell," and, by means of the "Driver, screw, shrapnel, large," screw it tightly into the tube and replace the plug. Then turn the shell on its point and remove the base plug. Carefully weigh out the bursting charge (Pistol, F.G., R.F.G., or R.F.G.^{2}), and pour it into the shell through the leather funnel, tapping the shell with a wooden mallet till the whole of the charge has been inserted. Then lubricate and replace the base plug.

Shells, Shrapnel, having the Bursting Charge in the Head.

The bursting charges (L.G. or F.G. powder), for the B.L., Q.F., or Q.F.C., 4-inch, Mark IV, and R.M.L. 2·5-inch Marks I, I*, and II, shrapnel shells, are contained in red shalloon bags, which are filled before insertion in the shells.

The bursting charges (L.G. powder) for the B.L., Q.F., or Q.F.C., 4-inch, Marks V and VI, and R.M.L. 2·5-inch, Marks III and IV, are put in loose. To fill the shell, remove the plug and place the funnel in the fuze-hole, measure the charge, and pour it into the shell; fix a "wad, fuze-hole, G.S., Mark III," in the bottom of the fuze socket, in the 4-inch Marks V and VI, using the "drift, G.S., long." For the 2·5-inch shrapnel, Marks III and IV, a "wad, fuze-hole, 2·5-inch, shrapnel" is used, as the G.S. wad Mark III is not suitable.

* Now *obsolete*, § 10786.

Shells, Star.

These shells are issued filled—they are ready for the insertion of the fuze when the plug is removed.

Filling Shells, Segment, R.B.L., and Ring.

R.B.L. 7-inch and 40-pr. segment will be filled with L.G. powder as directed for common shells without bag. R B.L. 20, 12, and 9-pr. segment have iron bursters, a wood plug covered with serge being placed on top to secure them whilst travelling; this plug will be removed when the percussion fuze is inserted.

Ring shells will be filled with a mixture of large grain and fine grain powder, as laid down for P. and F.G. for common, and the 2·5-inch with R.L.G.^{2} and R.F.G.

Lyddite Common Shells.

These shells are now issued filled, and plugged with Mark II plug, for both services; they are ready for the insertion of the fuze when the plug is removed.

In the N.S. the tip is covered with kit plaster. Formerly they were issued filled, and fuzed for N.S., and filled and plugged, with Mark I plug, for L.S., in both cases the tips were covered with kit plasters.

Filling Shells with Incendiary Stars.

The stars are put in through the fuze hole, the intervals between them when in the shell being filled with shell L.G., which should be inserted from time to time during the filling.

Filling Paper Shot.

The following instructions will be observed in mixing the waste shot and sawdust, and filling the case:—

(*a*) Take the required weight of waste shot (Nos. 1 to 5), or such proportion as is convenient, measure it by capacity, and place it in a receptacle for mixing with the sawdust.

(*b*) Measure by capacity a quarter as much sawdust as waste shot, and add it to the latter.

(*c*) Thoroughly mix the shot and sawdust.

(*d*) Insert sufficient of the mixture to bring the paper shot up to its required weight. Should this not completely fill it, the vacant space should be filled with sawdust only. The case should be lightly tapped during the insertion of the mixture. When full insert the cork bung in the filling hole.

Closing Filled Shells.

Before G.S. plugs are screwed into filled shells, they will, unless required for immediate use, be lubricated with a mixture composed of equal parts (by weight) of Mark III luting, and mineral jelly. The mixture is to be applied to the threads of the plug with a brush, in sufficient quantity to cover them, care being taken that it does not extend over the bottom, a coat of paint of the same colour as the tip of the shell being applied over the junction of the G.S. fuze-hole plug and shell, except in the case of the 15-pr. B.L. or Q.F. shrapnel, the plug of which is painted black.

Rifled common and double shells with ·2-inch recess in the fuze-hole, issued for Naval Service, will, when filled and fuzed, or filled and plugged with Mark I G.S. plug, have a red wad with loop cemented in the recess.

Before base plugs or fuzes are screwed into pointed shells, they will be lubricated under the flange with Mark III luting, unthinned, and on the threads with luting, thinned (½ Mark III and ½ mineral jelly).

If any base plug, or fuze, has a lead washer under the flange, it must be removed before applying the luting.

The Hotchkiss base fuze for Q.F. 6-pr. and 3-pr. shells is screwed in by the "key, fuze, Hotchkiss"; the Armstrong base fuze by the "key, fuze and plug, Armstrong"; the large and medium plugs, or fuzes, by the "key, base, fuze, and plug."

The "plug, fuze-hole, special," before being screwed into lyddite common shells, will have its threads lubricated with thinned luting, as mentioned above; if a Mark II plug, it will be fixed in the bush in the nose of the shell by "stabbing" in three places. For N.S. the tip of the shell will be covered with a kit plaster.

When lyddite common shells were issued filled and fuzed for N.S. the D.A. impact fuze was lubricated with thinned luting before being screwed into the shell.

Distinguishing Marks of Filled Shell.

Filled shells, except those in complete quick-firing cartridges, will be marked in red as follows:—

(*a*) The word "fuzed" if the shell is fuzed.

(*b*) A band, ½ inch wide round the head, 1½ inches from the top. In the case of steel shell, except lyddite, shrapnel, and star shells, this will come just below the white band, and in shrapnel it will be ½ inch below the red tip. In lyddite common shell for N.S. the red band will be ½-inch below the kit plaster; the latter was also painted red when these shells were issued filled and fuzed. Spherical star shell have no red band.

(*c*) The word "Bag" if one has been used.

(*d*) The monogram of the station (p. 52) except when filled by the Royal Artillery.

(*e*) The date of filling.

(*f*) A disc, 1-inch in diameter, if shalloon primers have been inserted.

(*g*) The letters P. or Q.F. (1½ inches long for 7-inch and upwards, and 1-inch long for smaller natures), if filled with P. and F.G., or Q.F. and F.G.

(*h*) The words "with oz. exploder," date, and monogram of station, in black, and a red disc where a primer is used, on lyddite common shells. When the exploder is enclosed in a paper cylinder inside lyddite shells and the picric powder is "dry-mixed," a red rectangle with the letters "D.M." in the centre will be stencilled at the back of the shell, also the letter A to denote aluminium top to paper cylinder.

(*i*) If the shell is fuzed with a base fuze, the head of the fuze or the lead cap covering it to be painted red.

(*j*) The word "salt" 1 inch high, date and monogram of station in white in the usual size of type, and a yellow band round the body, on practice shells (common and armour-piercing) filled with salt.

The sizes of the type, except the letters P. or Q.F., or the word "salt" are:—

7-pr. to 20-pr.	.. ..	$\frac{1}{4}$ inch.
25-pr. to 40-pr.	.. ..	$\frac{3}{8}$ "
64-pr. upwards	.. ..	$\frac{1}{2}$ "

Projectiles sentenced for practice only, except those in complete quick-firing cartridges, will be marked with a yellow band round the body $\frac{1}{2}$ inch wide to distinguish them from service projectiles, all the lettering indicated in (*a*) to (*j*) being obliterated, but the tip and bands, including the red band, if filled, being left.

The shells in *service* 6 and 3-pr. Q.F. cartridges will be marked with the white band if made of steel, and the red band denoting filled; they are always filled with powder and fuzed. If any *service* cartridges are sentenced for practice, no alteration will be made in the marking, the cartridges being issued and fired the first opportunity. In *practice* quick-firing cartridges, originally made for practice only, the shells are filled with salt and plugged, and will be marked with the yellow band, and the word "salt" in white.

Stencil plates for the letters and figures will be made locally. Stencil plates or an instrument for painting the tips and bands will be supplied from Woolwich.

Packing for Transport and Storage.

For transport (and, where stated, storage) purposes, the undermentioned projectiles will be packed as follows:—

(*a*) *Both Naval and Land Service to be boxed.*

(i) Pointed common, and armour-piercing shells, filled or empty, for B.L., Q.F., or Q.F.C. guns, 5-inch and under.

(ii) All star shell; spherical star shell will also be stored boxed.

(iii) B.L. 5-inch howitzer (field service) 15-pr., 12-pr. and 10-pr.; R.M.L. 16-pr., 13-pr., 9-pr., 7-pr., and 2·5-inch; R.B.L. 12-pr., and 9-pr.; all natures.

(iv) All filled shells for siege trains; these will also be stored boxed.

(v) Shells for batteries of position; those not in wagons and limbers will be stored boxed. This will apply to the actual equipment of batteries, and not to ammunition held in store for practice.

(*b*) *Naval Service only to be boxed.*

(vi) Studded shrapnel shells, R.M.L., 64-pr., and above.

(*c*) *Naval Service to be fitted with protectors.*

(vii) Pointed common, and Palliser, shells, filled or empty, and armour-piercing shot, for B.L., Q.F., Q.F.C., and R.M.L. guns, 6-inch and upwards.

(*d*) *Land Service.*

(viii) Armour-piercing shell; B.L. and Q.F., 6-inch and upwards, to be fitted with protectors.

(ix) Palliser shot, as heretofore, to be protected by the "bags, protecting Palliser projectiles."

(*e*) *Naval and Land Service, to be fitted with tarred rope grummets.*

(x) All B.L. and Q.F. projectiles, with the driving band with gas-check, will have one grummet on each side of the gas-check portion of the band, to be kept on also in store.

(xi) All R.M.L. studless Palliser shells (except Mark II), and the common and shrapnel 12·5-inch and upwards will have one under the lip at the base, to be kept on also in store.

(f) Transport and Storage of Shells fuzed with base fuzes.

(xii) Shells fuzed with base fuzes, and which are not boxed, will never be placed, either temporarily or permanently, with the point of one against the base of another, and the point protectors of projectiles, so fitted, should never be removed during transport so long as there is the least risk of the point of a projectile coming into contact with the base of a shell having a base fuze.

Special precautions will be taken to prevent movement of base-fuzed projectiles during transport.

Storage of Filled Shells in charge of the Royal Artillery.

B.L. or Q.F. filled shells 6-inch and upwards will be stored on their bases. In exceptional cases, however, where it is desirable to utilize existing accommodation which will not admit of the shells being so stored, they should be piled as may be found most convenient, a board being placed for the bottom layer to rest upon just in front of the driving band, and each layer pointing in the opposite direction to the one below, to prevent injury to the driving bands. B.L. and Q.F. filled shells below 6-inch will be piled in the same manner except those which are stored in boxes.

The grummets on B.L. and Q.F. projectiles fitted with the "driving band with gas-check" will be kept on the projectiles when in store, and under ordinary circumstances will not be removed until the projectiles are required for the service of the gun. A mallet and driver will be used for removing the grummets, care being taken that the band is not injured during the operation.

R.M.L. filled shells taking Mark II gas-checks, will have them fitted before being placed in the shell store. Shells taking automatic gas-checks will be stored unfitted, the grummet on the base being kept on until the projectiles are required for the service of the gun.

R.M.L. and R.B.L. shells, 7-inch and upwards, will be stored on their bases, except at Nova Scotia, where they will be piled. Shells fitted with Mark II gas-checks should rest on the gas-check plugs, being prevented from falling over by two pieces of wood, 9 inches by 1 inch square, placed one on each side of the nut. Shells under 7-inch will be piled, except those which are stored boxed.

Thin battens of wood will be placed under all filled shell which are stored on their bases (if not fitted with Mark II gas-check) when the floor is of stone or concrete.

Emptying Shells.

Shells filled with powder will only be emptied in a detached building, under the superintendence of an Inspecting Ordnance Officer, and in his immediate presence, or in that of the Laboratory Foreman or other person whom the Inspecting Ordnance Officer may certify as being duly qualified.* All shells, when emptied, will have any marking painted on them obliterated with black paint, except the white ring denoting steel, the blue tip denoting segment or ring,

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* At Shoeburyness, shells may be emptied in the Experimental Branch, but the work must be done in the immediate presence of an officer of that branch.

and the red tip denoting shrapnel. They will then have the letter E and the monogram of the station stencilled in red paint on the head.

The numbers to be brought at one time to the emptying room are not to exceed those laid down for the numbers of plugged filled shells which are allowed in a building in excess of those under the operation of filling, and will be kept outside the door until required.

The number of shells to be brought into the emptying room, and operated upon at one time, must not exceed the numbers laid down for the operation of filling at one time, but no shells are to be in the building, except those actually being operated upon.

In the case of *fuzed* shells from which the fuzes have to be removed in the emptying room, the shells brought there will be unfuzed, plugged, and removed outside, one at a time, after which they will be treated as plugged filled shells.

In removing fuzes from shells, only such tools as are provided for this purpose will be used.

When the fuze is removed in a separate building to that in which the shell is examined or emptied, a service metal fuze-hole plug will be screwed in to secure the gunpowder, and the shell will be conveyed to the proper place to be emptied.

Filled shell, from which the plugs or primers cannot be extracted, will, if possible, be fired at practice. If this cannot be done, a special report will be sent to the Storekeeper-General of Naval Ordnance for Naval, or to the Principal Ordnance Officer, Woolwich, for Land Service, that it may be decided whether the shells are to be returned to Woolwich, or destroyed locally; if the latter they will be thrown into deep water, or broken up with guncotton as described at p. 381.

Shells filled with lyddite will not be emptied locally.

Shrapnel (except those filled through the base) that have been washed out, and therefore are only available for practice, will be plugged with a fuze-hole plug and have a yellow band painted round the body.

If the shell is fuzed the fuze must be removed, and a plug inserted.

Emptying Common Shells.

Remove the plug from the nose or base, whichever was used for filling, extract the "Wad, fuze hole, G.S.," and "Bags, primer, 7 drams," if present, with the "Hook, G.S. wad," and draw out and untie the neck of the bag in shells which have one.

Fill the shell with water as hot as the hand can bear, and lay the plug on the hole. Allow the shell to stand for 5 minutes, then again fill it with hot water, allowing it to stand for 15 minutes.

With shells 6-inch and above, place the special holder with trunnions over the shell and fix it by means of the four screws at the centre of gravity of the shell. The shell will then be suspended by tackle attached to the trunnions of the holder so that it can be easily inverted.

Invert the shell, allowing the wetted powder and water to pour into a receptacle placed ready to receive it.

Continue to alternately pour in hot water (allowing it to remain in the shell for 5 minutes), and empty out the wetted powder and water, as above, until the charge is entirely removed.

The charge may be stirred and loosened with a wooden rod, after the second application of hot water.

If necessary, the copper scraper may be used to loosen the powder, but only when the shell is full of water. *The scraper is never to be applied to dry powder.*

With shells with bag filled through the base, which have also an opening at the nose, it will be found convenient to insert a rod right through the shell, after the powder has been thoroughly wetted, so as to pierce the bottom of the bag. The wetted powder can then be extracted from either end and the bag drawn out of the shell. The rod should not be forced through the powder; if it does not go through readily, the powder should be allowed to soak a little longer before re-inserting it.

The shells will then be stood, so as to allow the water to drain off, and finally will be wiped out with a piece of waste tied to a rod, and left to dry.

Emptying Shrapnel Shells.

Shrapnel shell filled through the nose with bursting charge in the base, or loose in the head, will have the plug or fuze and primer, or G.S. wad removed. The shell will then be turned nose downwards, and tapped with a mallet to cause the bursting charge to flow out. If the whole of the bursting charge cannot be extracted in this manner, which can be ascertained by measuring the powder, proceed as for common shells, using a copper or brass wire instead of a scraper. *On no account is the wire to be used in a dry shell.*

Shrapnel shell with bursting charge in the head, contained in a shalloon bag, will have the latter extracted by means of the "Hook, G.S. wad," care being taken not to tear the bag.

Shrapnel shell filled through the base, will be emptied from the base and in the manner laid down for common shell (*see* above), and if they are wetted, a dummy primer, with leather collar, will be substituted for the service primer, and tightly screwed down, to prevent any water getting into the socket. When dry these shells may be refilled.

Emptying Segment and Ring Shells.

The 7-inch and 40-pr. segment and all ring shells will be emptied as laid down for common shells.

Field service segment shells will have the plug or fuze removed, and the burster shaken out into a vessel of water. If it cannot be extracted thus, proceed as laid down for common shell.

Recovery and Destruction of Projectiles.

The following regulations relate to the disposal of projectiles fired at practice over land ranges:—

Immediately on the close of artillery practice each day, search will be made on the ranges for unexploded projectiles. All fuzed and filled plugged shell will be destroyed *in situ* as laid down hereafter. Plugged shell not filled with explosive will be returned to the ordnance department, being brought on charge as repairable, and sent to Woolwich.

A set of stores for the destruction of shells, as also such quantity of gun-cotton and detonators as are considered necessary, will be allowed to all land ranges.

The regulations for packing and storing gun-cotton and detonators will be strictly observed, and where there are no suitable buildings or sheds available for storage, tents will be used for the purpose.

The destruction of filled shells with guncotton will only be carried out under the superintendence of an officer.

In order to limit, as far as practicable, the possible projection of fragments of shells which are submitted to this treatment, the shell to be operated upon should, in the first place, be entrenched on all sides by throwing up the adjacent earth, sand, or fine shingle round it to a height at least double that of the shell.

A 1½-lb. slab of guncotton is to be placed upon the shell, and a dry guncotton primer with electric detonator, in it (previously coupled up with the conducting wires leading to an exploder, but disconnected from it), is placed upon the charge of wet guncotton.

A bag loosely filled with sand or dry earth is placed over the charge thus arranged, care being taken not to disarrange the conducting wires which are connected with the detonator.

The bare portions of the connections of the wires with the detonator must be carefully kept from contact with each other and with the earth. The shell should then be covered over with one or more bags.

When these preparations are complete, and the operators and all persons present have retired under cover (or if no cover is available to a distance of from 800 to 1,000 yards), the conducting wires are connected with the dynamo-exploder, and the charge is detonated.

The officer conducting the operation will see that no one remains within the above distance.

Materials Required for each Charge.

		No.
Bags, sand, common		4
Detonators, electric, No. 13		1
Gun-cotton	dry primers, one perforation, 1¼ inches by 1¼ inches	1
	wet slabs, two perforations, 6⅛ inches by 6⅛ inches	1

STORES.

Articles.	No.	Remarks.
Cloth, emery, fine.. .. .. sheets	6	Cleaning ends of wire.
Exploder, dynamo, electric, F.S... ..	1	
Knives, paring, telegraph jointers ..	2	
Pliers, side cutting, 6-inch .. pairs	1	
Solution, india-rubber, ¼-lb. tins ..	1	Repairing defective wire.
Tape, india-rubber .. .. coil	1	
Twine, choking, 3-thread.. .. lb.	1	Securing charge.
Wire, covered, C. 1 .. .. yards	2,000	Old field telegraph cable, unfit for general issue, would do if available.

Preparing and fixing Fuzes.

Fuzes, time, M.L., B.L., and 15-seconds with detonator.

These fuzes are prepared for any desired time of flight, by boring through the side-hole corresponding to the required time, into the composition, with a hook or gimlet-borer. For method of boring, *see* last edition.

These fuzes are fixed in the fuze-hole by screwing the fuze round

by hand until it is firmly held. On no account are they to be fixed in the fuze-hole by striking them with, or against, anything. They are uncapped, or the safety-pin is withdrawn, at the last moment before ramming home.

Fuzes, Time, Armstrong, E.

These fuzes are set after being fixed in the shell.

Loosen the nut and move the collar until the arrow points to the required graduation, then screw up the nut, steadying the collar at the same time. Should the fuze be taken from the shell, the collar must be set at the "blank" before it is replaced in the box.

Fuzes, Time and Percussion, Short and Middle, and Nos. 56 and 57.

These fuzes are set after being fixed in the shell. For method of fixing, and preparation of, *see* page 175.

Fuzes, Time, Sensitive, Middle.

The preparation of this fuze, as far as the setting is concerned, is identical with the T and P fuzes, but both safety pins must always be removed at the moment of loading.

Fuzes, Percussion, B.L., Plain.

These fuzes are prepared as at page 165.

Fuzes, Percussion, Pettman, G.S.

These fuzes require no preparation; they are simply screwed firmly into the fuze-hole by the fuze key.

Fuzes, Percussion, R.L., and Small.

These fuzes are screwed firmly into the fuze-hole by the fuze key, the safety pins being withdrawn at the last moment before ramming home.

Fuzes, Percussion, D.A., with Cap, Marks I, I, I**, and II, and Direct Action Delay, Mark III.*

These fuzes are screwed firmly into the fuze-hole by the fuze key, the cap being removed at the last moment before ramming home.

Fuzes, Percussion, D.A., with Plug, Mark III.

These only differ from the D.A. with cap, in having the safety plug removed by the fuze key.

Fuzes, Percussion, Base, Large, and Medium.

These fuzes are prepared as at page 167.

Fuzes, Percussion, D.A., Impact, Marks I, I, II, and III.*

These fuzes are screwed firmly into the fuze-hole by the fuze key, the safety pin being withdrawn and cap removed at the last moment before ramming home.

CHAPTER XXI.—AIMING RIFLE, MACHINE GUN AND SMALL ARM AMMUNITION.

AIMING RIFLE, MACHINE GUN AND SMALL ARM, SERVICE AND BLANK CARTRIDGES.—BOXES.—DISTINGUISHING MARKS.

THE aiming rifles at present in the Service are the Elswick, with G.G. or M.H. chamber, the Ewart and Morris with M.H. chambers, and the 1-inch electric and percussion. They are attached to B.L., B.L. or Q F., Q.F., and R.M.L. guns for imparting instruction in laying. All except the 1-inch take the ordinary M.G. cartridge (·45-inch or M.H.) suitable to the chamber indicated in the name of the rifle. The 1-inch aiming rifle takes an electric or percussion cartridge.

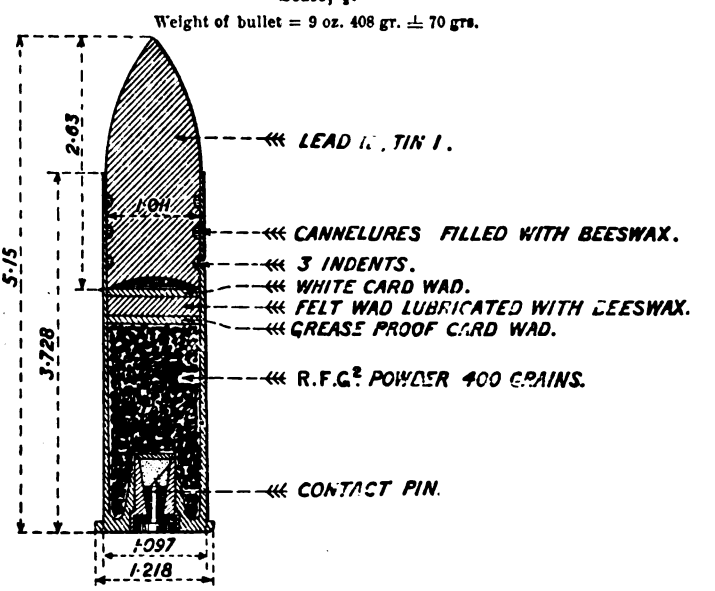
The machine guns at present in the Service are the Nordenfelt 1-inch, ·45-inch (G.G. chamber), and ·303-inch; the Gardner ·45-inch (G.G. chamber), and ·303-inch; the Gatling ·65-inch and ·45-inch; and the Maxim ·45-inch (G.G. chamber) and ·303-inch.

The Nordenfelt, Gardner, and Maxim machine guns, with M.H. chambers, and the Gardner ·4-inch are being converted to ·303-inch magazine rifle chamber.

The Gatling ·65-inch, though not obsolete, has been practically superseded by the Nordenfelt 1-inch.

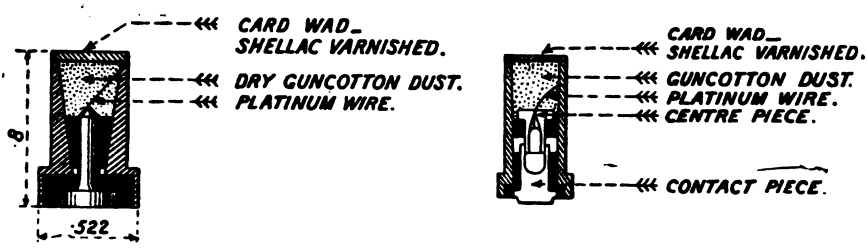
Cartridge, Aiming Rifle, 1-inch, Electric, Mark IV, M | C |.

Scale, ½.



Primer, Mark IV "M" Cartridge. *Primer, Mark IV "KN" Cartridge.*

Scale, full size.



The Gatling ·45-inch formerly took its own cartridge, but can be set to take the Gardner-Gatling cartridge which would now be issued for it. This latter cartridge is now employed with all the machine guns of ·45-inch bore, except the unconverted M.H. chambered guns.

At present in the Service there are ·303-inch calibre, Martini-Henry, and Snider small arms, and Enfield, Webley, and ·442-inch revolvers.

Cartridge, Aiming Rifle, 1-inch, Electric, Mark IV, M | C | consists of a brass case, primer, charge, wads, and bullet. §§ 9056, 9517, 10000.

The case is of solid drawn brass with a hole in the base for a primer. The interior of the case, except that part which envelops the bullet, is varnished with a hard brown varnish.

The primer consists of a brass tube with enlarged head, bored out to receive a brass contact pin, which is insulated with ebonite plugs, the front plug being coned to suit the coned seating in the primer. An iridio-platinum wire bridge is soldered, with pure tin, to the point of the contact pin and front edge of the body, the bridge being surrounded with guncotton dust, and the primer is closed with a card wad shellaced in.

The charge, which consists of 400 grains of R.F.G.[2] or other suitable gunpowder, is covered by a greaseproof card wad, a felt wad lubricated with beeswax, and a white card wad on top, next the bullet.

The bullet, of 12 parts lead and 1 part tin, weighs 9-oz. 408 grains, is pointed and has three cannelures which are filled with beeswax. It is secured in the mouth of the case by being firmly pressed in and by three indents of the case into the rear cannelure.

Cartridge, Aiming Rifle, 1-inch, Electric, Mark IV, KN, | C | differs from the above in the primer only, which is of different dimensions and internal arrangements. The primer (*see* cut) consists of a brass tube with enlarged head, bored out to receive a copper contact piece, which is insulated from the body by ebonite. The contact piece is cupped out in front, and into this fits a brass centre piece insulated from the body by ebonite. An iridio-platinum wire bridge is soldered, with pure tin, to the centre piece and into a slot in the front edge of the body, the bridge being surrounded with guncotton dust, and the primer is closed with a card wad shellaced in.

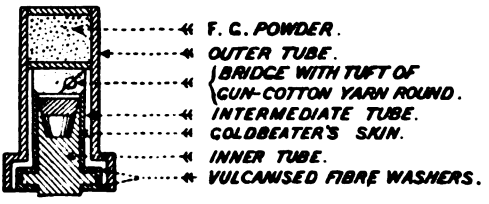
In order to facilitate identification of the pattern of primer in the Mark IV cartridges, the letters "M" or KN" will be found stamped on the cartridge, and printed on the wrapper, after the numeral, to indicate that the primers are, respectively, of the Morris, or Kings Norton Company's pattern.

Early issues of the Mark IV KN cartridge were made for Naval Service and designated Mark III.

8461. The *Mark II* cartridge only differed in the primer (*see* cut), which consists of outer, intermediate, and inner brass tubes, each having an enlarged head.

Primer, Marks I and II, Cartridges.

Scale, full size.



The inner tube is insulated from the intermediate one by goldbeaters' skin round the body and vulcanised fibre washers at the head, one on the inside and another on the outside, which leaves the centre of the head bare, forming a contact point.

The front end of the inner tube is cupped out and closed by a conical brass plug; it is secured to the intermediate tube by an iridio-platinum wire bridge soldered on. A tuft of guncotton yarn is placed on the bridge and the latter surrounded with guncotton dust covered by a paper disc.

The front end of the outer tube is filled with F.G. powder and closed with a paper disc.

§ 7605. The Mark I cartridge only differed from the Mark II in the bullet being made of brass, flat headed, with a lead core, and weighs 11 oz. 130 grains.

Packing. The cartridges are made up into bundles of 12, wrapped in brown paper, pieces of cardboard being placed along two sides of the bundle against the points of the bullets.

The distinguishing mark on the box and wrapper is a hollow black diamond with solid black diamond in the centre, the corners of the latter being connected with the outer one by thin black lines.

Issue. Eight bundles in Mark XI S.A.A. box.

§§ 9057, 10000. *Cartridge, Aiming Rifle, 1-inch, Percussion, Mark I | L |* consists of a brass case, cap, charge, wads and bullet.

The case is of solid drawn brass, with a cap chamber formed in the base, in which is an anvil made by a projection of the material, round the head of which there are three fire-holes.

The cap is a double one, the outer of brass, the inner of copper, and contains ·3 grain cap composition (*see* Table, p. 554) pressed in and varnished, and may be covered with a tinfoil disc.

The interior of the case is varnished (except where it envelopes the bullet), and contains a charge of 465 grains of M.G.[1] or 400 grains of R.F.G.,[2] gunpowder, which is covered by a greaseproof card wad, a felt wad lubricated with beeswax and a white card wad on top.

The bullet, of 12 parts lead and 1 part tin, weighs 9 oz. 403 grains, is pointed, and has three cannelures, which are filled with beeswax. It is secured in the mouth of the case by being firmly pressed in and by three indents of the case into the rear cannelure.

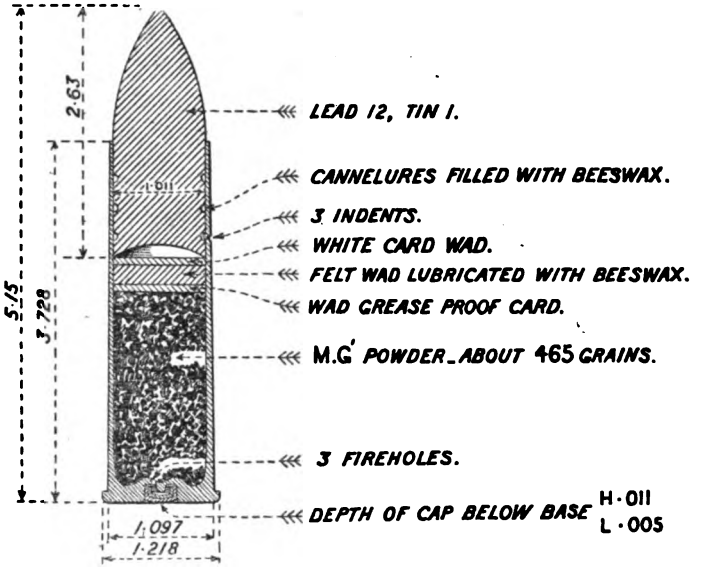
Packing and issue. These cartridges are packed like the 1-inch electric cartridges, viz.:—12 in a bundle, 96 in Mark XI S.A.A. box.

The distinguishing mark on the box and wrapper is a hollow black diamond with solid black diamond in the centre, the corners not being connected as for the 1-inch electric cartridge.

Cartridge, Aiming Rifle, 1-inch, Percussion, Mark I | L | .

Scale, ½.

Weight of bullet=9 oz. 408 drs.±70 grs.



Cartridges, aiming rifle, 1-inch, percussion. §§ 10000, 10845, 10902.

Cartridges in the L.S. may be refilled, they are cleaned as laid down for Q.F. cases, p. 331, and returned to Woolwich to be refilled, two felt wads being inserted. Electric cartridges in the N.S. on receipt at depôts will be examined and any unserviceable put aside. The cases fit for refilling will be cleaned, if necessary, sorted according to make, and sent to Woolwich at first convenient opportunity.

Cartridge for instruction, Aiming Rifle, 1-inch, differs from the service cartridge it represents, in having a wood block about 2·5 inches long, made to the form of the interior of the case, secured with shellac below the bullet instead of the charge. The bullet is secured by three indents of the case into the rear cannelure, and two holes are bored through the case at right angles to each other, so that it can at once be seen that the cartridge is not a service one. §§ 10094, 10327.

Cartridges, machine gun, and Small-arm, when manufactured for India, will be stamped on the base with the letter I immediately under the broad arrow, thus:— ↑ I § 8599.

There are four kinds of *Cartridge, Machine Gun, Nordenfeldt, 1-inch,* viz., Service, practice, blank, and dummy. §§ 6510, 7001, 7219.

The *Cartridge, Machine Gun, Ball, Nordenfeldt, 1-inch, Mark VI,* consists of a brass case and copper cap, charge, steel bullet, and brass envelope as shown in the wood cut. Construction.

The case is of solid drawn brass, very slightly tapered towards the front. The cap chamber is formed in the base, and the anvil is made by a projection of the material, round the head of which are three fire-holes. Case.

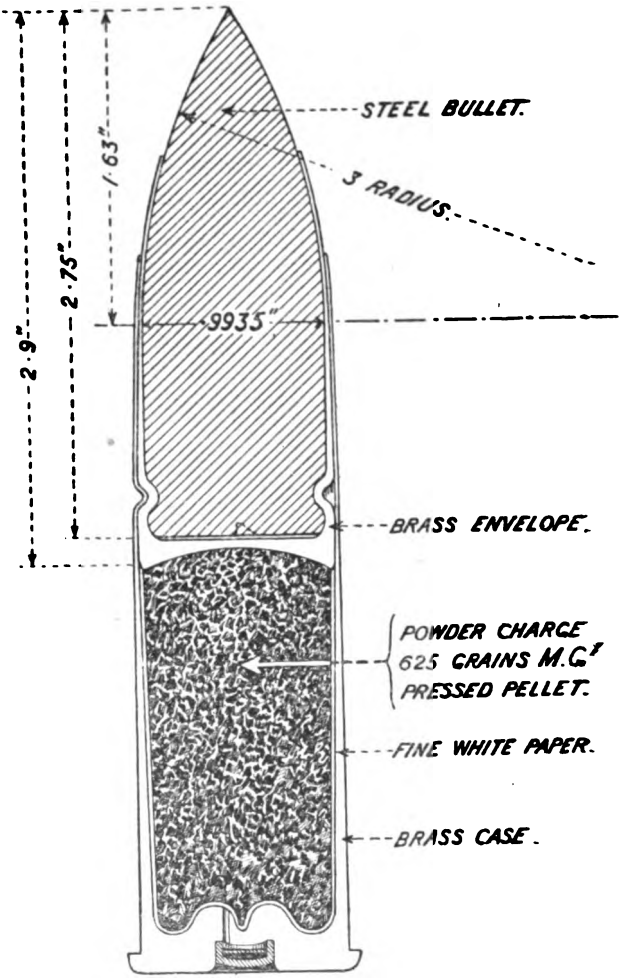
The cap is of copper, and contains ·5 grain of cap composition, pressed in and varnished (*see* Table, p. 554). Cap.

The charge is 625 grains M.G.[1] pressed into a pellet, so as to enable more powder to be put into the cartridge. By pressing lightly, so as Charge.

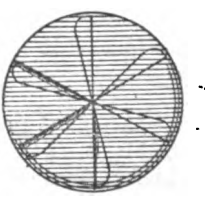
Cartridge, Machine Gun, Ball, Nordenfelt, 1-inch Steel, Mark VI.

Scale, ½.

Weight of bullet with envelope=3,170 grs.
Weight of powder charge=625 grs.



SECTION.



PLAN OF BASE OF BULLET.

to leave considerable interstices between the grains, it is found possible to increase the quantity without reducing the explosive quality of the powder. Contact between the powder and metal is prevented by varnishing the case inside, and by an envelope of fine white paper surrounding the powder pellet. At the base of this envelope is a hole to allow the free passage of the flash from the cap to the charge.

The bullet is of solid steel, having its head struck with a radius of three diameters; it has a cannelure near the base, and on the latter are six radial grooves designed to ensure the rotation of the bullet by the envelope. Bullet.

The latter is of soft brass formed by successive stamping in the same way as the case. Its function is to act as a gas-check, and it is attached to the bullet by being choked into the cannelure round the latter, and pressed into shape at the top. The cannelure thus formed round the envelope is filled with beeswax to act as a lubricant, and the base of the envelope is varnished. Envelope.

The weight of the bullet and envelope together is about 3,170 grains and the weight of the complete cartridge 4,900 grains.

Marks IV and V differed from the Mark VI in the cap composition and from each other in the size of the caps. §§ 4278, 5047.

Marks I, II and III, on return to Woolwich are re-capped and issued for practice. §§ 6488, 7001.

Nordenfelt cartridges are made up into bundles of 12, wrapped in brown paper, pieces of millboard being placed along two sides of the bundle to prevent the points of the bullets from perforating the tin lining of the S.A.A. box. Packing.

The distinctive mark is a solid green diamond for Marks III, IV, V and VI cartridges and a hollow green diamond for Marks I and II.

The wrappers for Marks I, II and III cartridges have *re-capped*, and the distinguishing labels *practice re-capped* 189 , printed across them in red. The descriptive label on top of box is printed in yellow.

The *Cartridge, Machine Gun, Blank, Nordenfelt, 1-inch, Mark I,* is similar to the Service cartridge, but the powder charge is covered by two discs of asbestos, secured by cement. The mouth of the case is slightly turned in to make it feed properly in the gun. § 5802.

These cartridges are made up in bundles of 12 wrapped in purple paper. Packing.

Nine bundles in a S.A.A. box. Issue.

A *Cartridge, Machine Gun, Dummy Drill, Nordenfelt, 1-inch, Mark II,* is made of phosphor bronze lined with wood, and is the same weight as the Service cartridge, the exterior being turned to the same dimensions. The base is closed by a screw plug of phosphor bronze having a conical hole in the centre to receive a piece of india-rubber, which serves as a cushion for the striker of the gun. To distinguish it from the Service cartridge, the outside is tinned all over. § 4077.

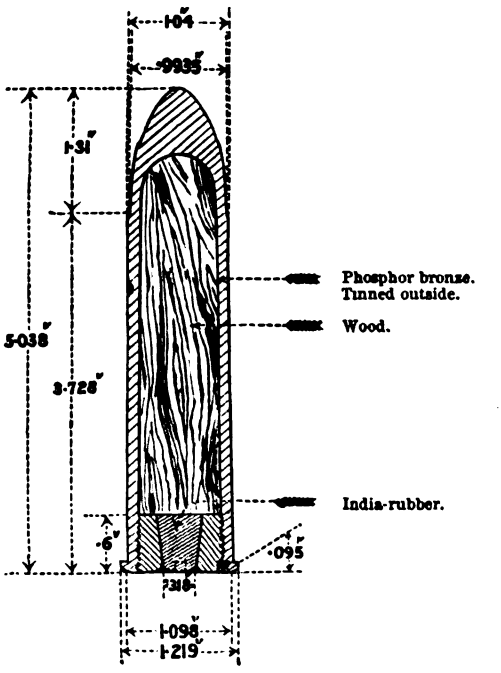
Mark I had a hardened lead bullet, a case filled with sawdust and tinned on the outside, and an empty percussion cap in the base. This pattern is to be used up. § 3934.

As for Service cartridges, but the S.A.A. box is painted drab all over. Packing and issue.

The distinguishing mark is a hollow diamond with a D inside printed in green on the exterior labels, and in black on the brown paper wrapper.

Cartridge, Machine Gun, Dummy Drill, Nordenfelt, 1-inch, Mark II.

Scale, half size.



§§ 3324, 5452, 2644. *Cartridges, Machine Gun, Ball, Gatling, ·65-inch and ·45-inch* are very little used now. For description, &c., see earlier editions of the treatise.

§§ 4193, 5023, 5074, 5452, 6544. *Cartridge, Machine Gun, Ball, ·45-inch, Mark IV,* | *C* | consists of a case, cap, charge, wads, and bullet.

Case. The case is made from solid drawn brass, with a cap chamber with raised anvil formed in the metal of the base and two fire-holes pass from the bottom of the chamber to the interior. The inside of the case where the powder charge rests is coated with hard brown varnish, which is removed from that part which envelops the bullet. This was in consequence of the liability of empty cases to stick in the gun after firing which was attributed to the surplus varnish at the end of the case. This practice of removing the varnish round the bullet is carried out in all aiming rifle and machine gun powder cartridges.

Cap. The cap is of copper, and contains ·3 grain of cap composition.

Charge. The charge is 85 grains of R.F.G.[2] powder.

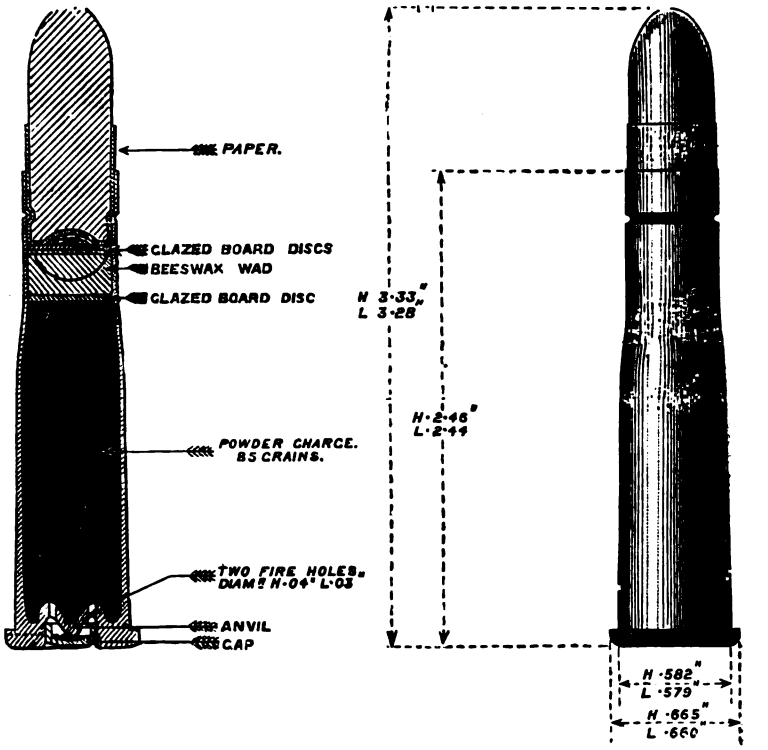
Wads. The wads are the same as those described with the M.-H. cartridges.

Bullet. The bullet is similar to the M.-H. bullet, but is slightly longer, and has one cannelure only formed near the base, it is secured in the neck of the case, by the latter being choked into the cannelure round it.

Packing and issue. These cartridges are packed by tens, heads and tails, in brown paper wrappers, and issued in S.A.A. boxes containing 680 rounds each. The distinguishing mark is a solid black triangle. The same

Cartridge, Machine Gun, Ball, ·45-inch, Mark IV, | C |, G.G., Nordenfelt and Maxims, except M.-H. Chambered Guns.

Scale, full size.



mark is also used for the Gatling ·45-inch cartridge, but whereas the latter cannot be used for Gardner, Maxim, and Nordenfelt guns, the one last described can be fired from Gardner, Gatling, Nordenfelt, and Maxim, the Gatling guns being set for the purpose.

Marks I, II, and III differ from the above only in minor details.

Cartridge, Machine Gun, Ball, ·45-inch Cordite, Mark I, | N |. § 8365.

The cartridge consists of a case, cap, charge, wad, and bullet. The case is similar to the powder case described above, but is no varnished inside, and the letter C is stamped on the base.

The cap is of copper, and contains ·7 grain of cap composition (*see* Table, p. 554) pressed in and varnished, and may be covered with a tinfoil disc.

The charge is about 38 grains of size 3 cordite in 100 strands, covered by a millboard wad paraffin waxed.

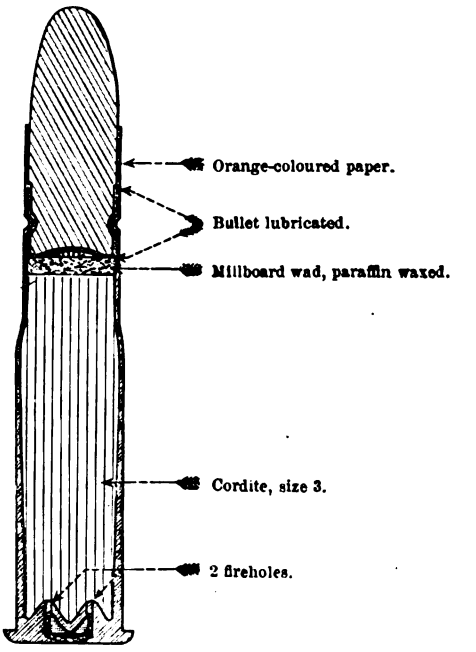
The bullet is similar to the one for the powder cartridge, but the paper patch is orange coloured; the mouth of the case is choked into the cannelure, the rim fitting against a small shoulder which is formed on the bullet.

The cartridges are packed in bundles of 10; 680 rounds in a Mark XI S.A.A. box. The distinguishing mark is a red triangle with the letter C in white in the centre. Packing and issue.

Cartridge, Machine Gun, Blank, Maxim, G.G. Chamber, Black § 7518.

Cartridge, Machine Gun, Ball, ·45-inch Cordite, Mark I, | N | Solid Case; All Gardner-Gatling Chambered Guns.

Scale, full size.



Powder, Mark II, consists of a case of the same dimensions as the black powder ball G.G. cartridge, with a charge of 65 grains of R.F.G.[2], covered by a glazed board cup secured with shellac. The top of the case is crimped over.

Mark I differs from above in dimensions only.

Packing and issue. The cartridges are packed in bundles of 10; 2,000 cartridges in a half-metal lined case.

§§ 4911, 5455. The *Cartridge, S.A., Ball, M.-H. Rifle, Solid Case, Mark II, also Machine Gun, M.-H. Chamber,* consists of a case, cap, charge, wads, and bullet.

Construction. Case. The case is made of solid-drawn brass with a cap chamber formed in the base as shown in the woodcut. The case has a paper lining up to the shoulder permanently fixed in.

Cap. The cap is of brass; it contains ·3 grain of cap composition pressed and varnished, and there are two fire-holes in the rim round the anvil.

Charge. The charge is 85 ± 2 grains R.F.G.[2] powder.

Wads. Above the powder is placed a glazed-board disc, then a wad of beeswax, cupped out to the front to ensure its expanding in cold weather, and then two more glazed-board discs.

Bullet. The bullet is made of 12 parts lead and 1 part tin, and weighs 480 grains. It has one cannelure, and is covered for about two-thirds up the body with white fine paper wrapped round it from right to left. The paper is lubricated for about half its length, and on its base, with beeswax; it is crimped over the centre of the base with a

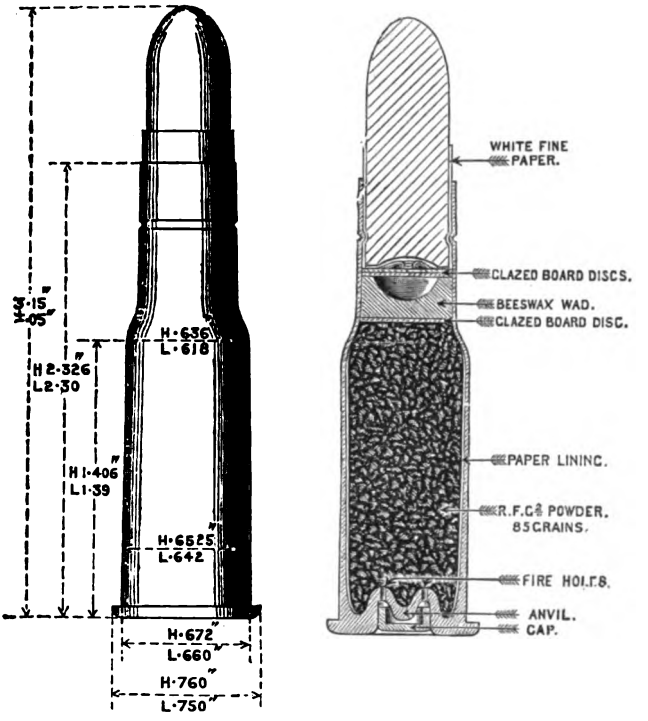
"rose" with a hole in the centre. The case is choked into the cannelure.

The cartridges are packed heads and tails in bundles of 10; 580 rounds in a S.A.A. box. The distinguishing mark is a solid rectangle in red on the box and black on the brown paper wrappers.

The Mark I cartridge is obsolete. §§ 4756, 5024.

Cartridge, Small Arm, Ball, Martini-Henry Rifle, Solid Case, Mark II. Also Machine Gun, Martini-Henry Chamber.

Scale, full size.



Cartridge, Machine Gun, Ball, M.-H. Chamber, Cordite, Mark I, | L |, was made for Maxim guns in India only. The charge is 41 grains of size 3 cordite, otherwise except in dimensions, and minor details it is similar to the ·45-inch cordite cartridge for G.G. chambered guns. The case is choked into the rear cannelure of the bullet. § 9300.

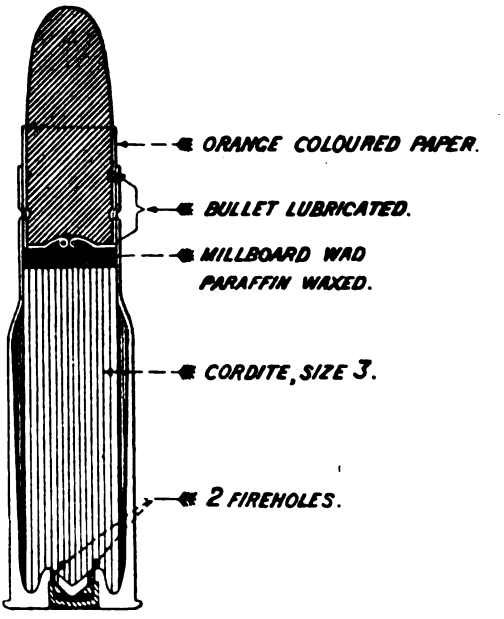
These cartridges are packed heads and tails in bundles of 10; 580 rounds in a S.A A. box. The distinguishing mark on the wrapper, or box, is a red rectangle with the letter C, in white, in the centre.

The *Cartridge, Small Arm, Ball, Martini-Henry Rifle, Rolled Case, Mark III*, consists of a case with cap, cap chamber, charge, wads, and bullet. §§ 2661, 7767. Construction.

The case is formed of two turns and a ·5-inch overlap of ·004-inch brass. It is lined with tissue-paper where the powder charge rests. Inserted between the folds at the base is a strip of brass (the same as that composing the body of the case) to give additional Case.

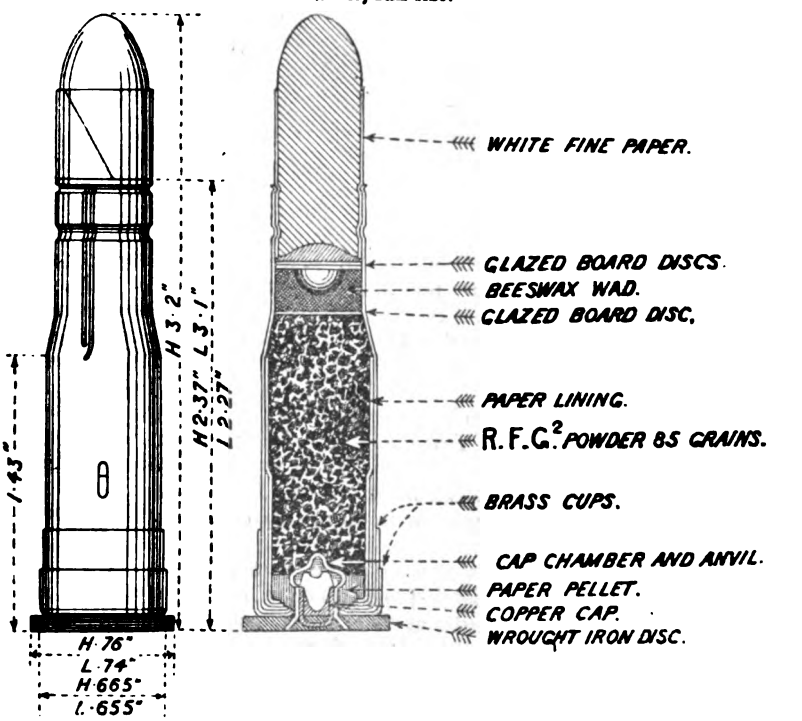
Cartridge, Machine Gun, Ball, M.-H. Chamber, Cordite, Mark I, | L |. Solid Case; For Maxim Gun.

Scale, full size.



Cartridge, Small Arm, Ball, Martini-Henry Rifle, Rolled Case, Mark III.

Scale, full size.



strength. A small "sight-hole" is punched in the case so as to allow the examiners to see that this inner strip is present. The cartridge is made of a bottle-necked shape by crimping in the upper part, so that the whole fits into the chamber of the rifle. The base is strengthened by an outer and an inner base cup of brass, and the bottom closed by a blackened wrought-iron disc. Inside, a paper pellet is pressed against the bottom of the cartridge, a brass cap chamber pierced with a fire-hole passes through the disc, cups, and pellet, and rivets the whole together, the top being bulged out over the paper pellet, and the base of the cap chamber being flanged to fit a countersunk recess in the iron disc. The cap chamber contains a brass anvil, on the shoulders of which rests the copper cap which contains cap composition. (*See* Table 47, p. 554.)

The charge is 85 ± 2 grains R.F.G.[2]. Charge.

Above the powder is placed a glazed-board disc, then a wad of beeswax, cupped out to the front, and then two more glazed-board discs. Wads.

The bullet is made of 12 parts lead and 1 part tin, and weighs 480 grains. It has two cannelures and is covered for about two-thirds up the body with white fine paper wrapped round it from right to left. The paper is lubricated for about half its length and on its base with beeswax, it is crimped over the centre of the base with a "rose" with a hole in the centre. The case is choked into both cannelures of the bullet. Bullet.

Marks II and I cartridges only differed in minor details. Mark I is obsolete.

The cartridges are packed heads and tails in bundles of 10; 600 rounds in a S.A.A. box. Packing.

The distinguishing mark is the same as for M.H. chamber solid case cartridges.

Cartridge, S.A., Ball, Martini-Henry Carbine, Rolled Case, Mark III, is identical with the Mark III rifle cartridge case; weight of bullet, 410 grains; charge of powder, 70 grains R.F.G.[2]. The bullet is of the same alloy and general construction as the rifle bullet, but is ·12-inch shorter. It is covered for about two-thirds up the body with red, instead of white paper, so as to enable it to be readily distinguished from the rifle cartridge. The paper is lubricated and crimped over the base as in the rifle cartridge, but after lubrication three longitudinal cuts ·5-inch long are made through the paper on the side of the bullet, the object being to facilitate the freeing of the bullet from the paper after the cartridge is fired. A thick paper lining is used to fill up the space which would be left in the case owing to the smaller charge. The wads, &c., are the same as with the rifle cartridge. §§ 3220, 3303, 3606, 3754, 4911, 5455.

Mark II differed from Mark III only in not having the slots cut on the paper round the bullet, and as misses occasionally occurred with this cartridge, it was considered that owing to the shortness of the barrel the paper did not free itself from the bullet.

Mark I differed from Mark II in having carded cotton over the powder below the lowest glazed board disc, and had no paper lining.

These cartridges are packed in the same way as those for the rifle. The distinguishing mark is a hollow rectangle printed in red upon the labels on the outside of the box, and in black upon the wrappers. A small arm ammunition box contains 630 rounds. Packing.

Cartridge, S.A., Ball, M.-H. Carbine, Solid Case, Mark I.—The case, cap, and wads are similar to those for the solid case rifle cart- § 5159.

ridge. The charge is 65 grains ± 2 grains R.F.G.[2] powder, and the case has a thick paper lining to make up for the less bulk of powder.

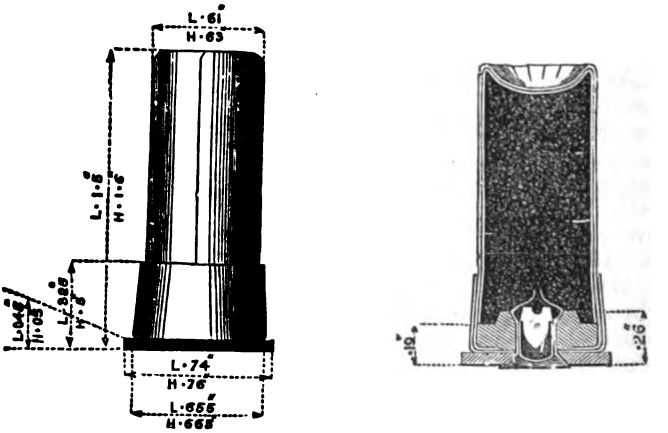
The bullet is made of an alloy of 12 parts lead and 1 part tin, and weighs 410 grains. It has no cannelures, but is held tightly by the mouth of the case. It is papered with red paper.

Packing. The mode of packing and the distinguishing mark used are the same as for the carbine cartridge, rolled case. A S.A.A. box contains 600 rounds.

§ 5454. *Cartridge, Machine Gun, Blank, M.-H. Chamber, Mark I,* consists of the Service case, cap, and charge. A hollow shell or mock bullet of brown paper is secured in the mouth of the case by shellac. A disc of brown paper only is placed over the powder. In order to distinguish it from the ball cartridge, the outside of the case is copper coloured and the point of the mock bullet is covered with white and the body with blue paper.

§ 6845. *Cartridge, S.A. Blank, M.-H., or Snider, Rifle or Carbine Mark IV.* The case is made of two turns and an overlap of brown paper; it has one base-cup and the base of the service cartridge. It contains about 68 grains of blank F.G. powder, which is not pressed into a pellet.

Cartridge, S.A., Blank, M.-H. or Snider Rifle or Carbine, Mark IV.



Mark I had the potêt base and is OBSOLETE. The intervening patterns are serviceable. The powder in them was pressed into the form of a pellet.

Besides the above, a large quantity of blank is converted from condemned ball cartridge, both for Martini-Henry and Snider. It may be recognised by the exterior of the case being similar to that of the Service cartridge for these arms, and is known as *Mark IV converted.*

Issue. 1,300 rounds packed in a quarter-barrel.

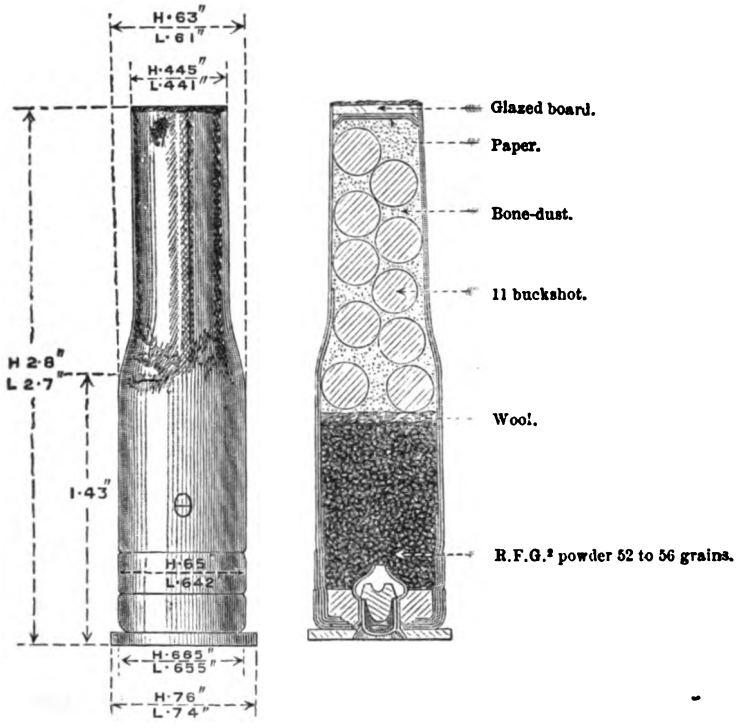
§ 7003. *Cartridge, S.A., Blank, M.-H. Rifle or Carbine, Rolled Case, Cordite, Mark I,* was made for India. The case resembles that of the rolled case ball cartridge but is only 1·55 inches long. A millboard wad is placed over the charge, 10 grains of sliced cordite, and the mouth of the case is turned over and crimped into the wad.

Packing. The cartridges are packed 10 in a bundle in purple paper printed in red.

§ 4268. *Cartridge, Small Arm, Buckshot, Martini-Henry, Mark II,* is available both with the rifle and carbine.

Cartridge, S.A., Buckshot, Martini-Henry, Mark II.

Scale, full size.



The case resembles the built-up one, Mark III, for the rifle, but is somewhat longer and is crimped over at the top on a glazed board wad, which retains 11 buckshot in the case. These are packed in bone-dust and are separated from the powder by cotton wool. Four buckshot rest on the wad, and the remaining seven are in the contracted part of the case (*see* cut). Construction.

The charge is 54 ± 2 grains R.F.G.².

Mark I had the Service case, and the eight bullets in front were contained in a paper bag soaked in beeswax.

By tens, heads and tails, in brown paper wrappers. The distinguishing mark is a solid rectangle containing three uncoloured discs, printed in red upon the outer label and in black upon the wrapper. Packing.

In S.A.A. boxes containing 600 each. Issue.

Cartridge, S.A., Ball, ·303-inch, Cordite, Mark V, consists of a case, cap, charge, wad, and bullet. § 9861.

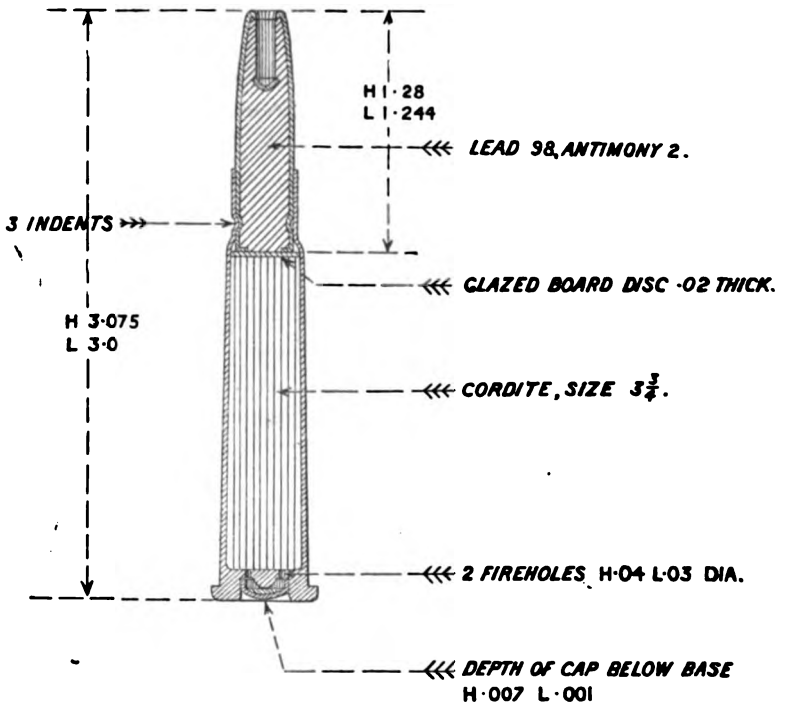
The case is of solid drawn brass, with a cap chamber formed in the base, in which an anvil is made by a projection of the material, and two fire-holes are drilled. It has the letter C stamped on the base and it is not lacquered.

The cap is of copper, and contains ·6 grain of cap composition (*see* Table, p. 554), pressed in and varnished, and it may be covered with a tinfoil disc.

The charge consists of about 31 grains of cordite, size $3\frac{3}{4}$, in 60 strands.

Cartridge, S.A., Ball, ·303-inch, Cordite, Mark V | C | Solid Case, all ·303-inch Small Arms and Machine Guns.

Full size.



A glazed board disc is placed on top of the cordite.

The bullet consists of a core (98 parts lead, 2 parts antimony), enclosed in a cupro-nickel envelope, and weighs about 215 grains. The envelope is solid drawn from an alloy of about 80 per cent. copper, 20 per cent. nickel, and ·5 per cent. iron, and the core is secured inside it by turning over the end of the envelope and pressing it into a groove formed round the base of the core. A cavity, about ·35-inch deep and ·1-inch diameter, is punched in the point of the bullet, the punch carrying a small disc of the envelope to the bottom of the cavity, and a cannelure runs round the bullet near the base. The bottom part of the bullet, except the base, but including the cannelure, is coated with beeswax. It is secured in the case by the latter being coned and indented in three places into the cannelure, and requires a force of not less than 60 lb. to extract it.

§ 9089. The Mark IV cartridge only differed from Mark V in the bullet being slightly shorter and in the core being of pure lead.

§ 9089. The Mark III cartridge, of which only a small number were made, differed from Mark IV in having a metal cup or tube, ·3-inch deep, inserted in the point of the bullet.

§§ 7278, 7905. *Cartridge, S.A., Ball, ·303-inch Cordite, Mark II | C |* differs from Mark V only in the bullet being slightly shorter and having no cavity at the point. (See cut.)

Mark I differed from Mark II in having a smaller cap, ·2 grain of cap composition, a separate anvil and one fire-hole.

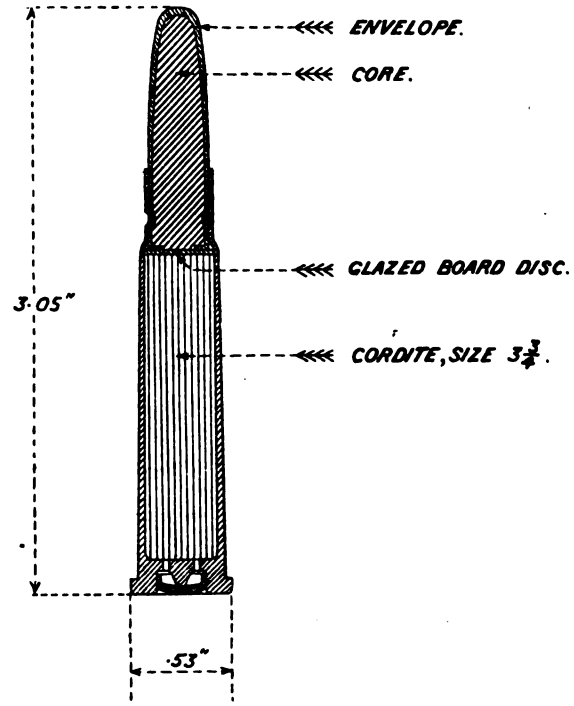
These cartridges are packed heads and tails in bundles of 10, 1,100 rounds in S.A.A. boxes, Marks XI or XIV. The distinguishing mark is a red rectangle with two uncoloured bars, on both wrapper and box, but for the latter the word "Cordite" is printed, in red, on each uncoloured bar. Packing and issue.

The *Cartridge, S.A., Ball, ·303-inch, Powder, Mark II*, differs from the Mark I cordite cartridge in having a charge of about 71½ grains of powder pressed into a pellet and with a central fire-hole through it, and in its bullet having no cannelure. §§ 6160, 6683, 7798, 7905.

The cap composition differs slightly. There is no letter C on the base. The case is varnished inside.

Cartridge, S.A., Ball, ·303-inch, Cordite, Mark II | C | Solid Case, all ·303-inch Small Arms and Machine Guns.

Full size.



It is packed and issued like cordite ball ammunition.

It is not to be used in Maxim guns, nor the Lee-Metford carbine.

The distinguishing mark is a rectangle enclosing two uncoloured bars printed in blue on the exterior labels, and black on the brown paper wrappers.

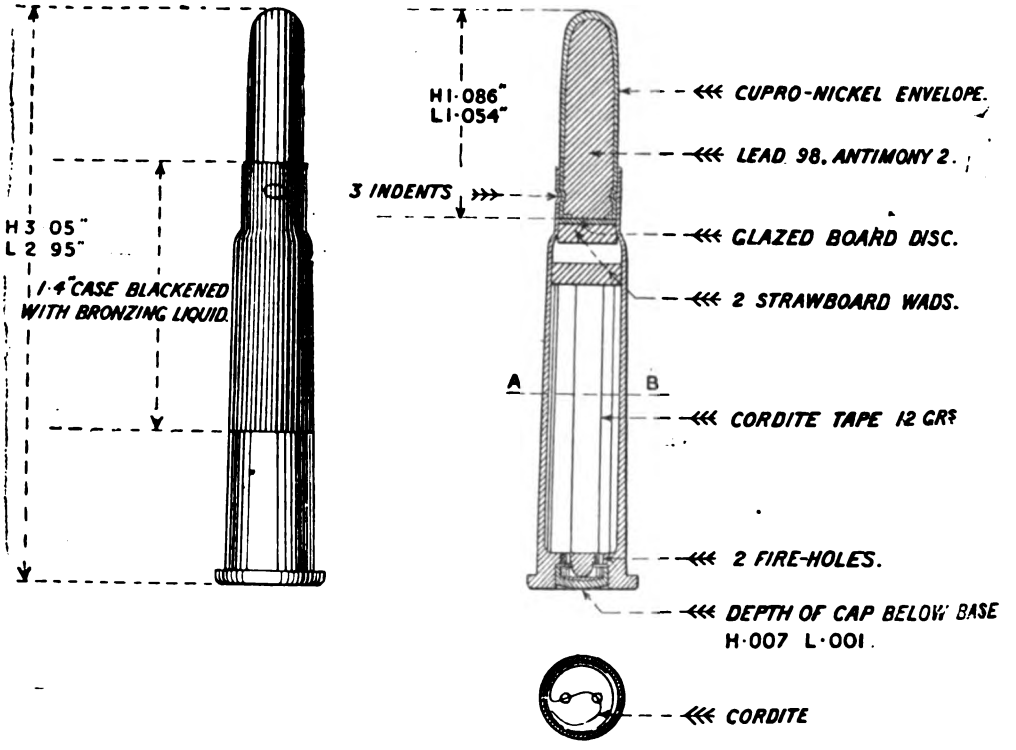
Mark I cartridge is obsolete.

Cartridge, S.A., Ball, ·303-inch, Cordite, Short Range, Practice Mark II, N, consists of a case, cap, charge, wads, and bullet. §§ 5883, 6683, 7541.

The case differs from the Service cartridge case in being blackened with a bronzing liquid for 1·4-inch from the mouth. § 9876.

Cartridge, S.A., Ball, ·303-inch, Short Range, Practice, Mark II, | N | . Solid Case; for use at certain Coastguard Ranges.

Full size.



SECTION AT A.B.

The cap is the same as that for the service cartridge and secured in a similar way.

The charge consists of about 12 grains of cordite tape.

Two strawboard wads are placed, one on top of the cordite, and the other in the neck of the case, and between this and the bullet a glazed-board disc.

The bullet is of similar construction to the Mark II service bullet, but is slightly shorter, more rounded at the point, and weighs 188 grains. It is lubricated at the base and secured into the case by being coned and indented similarly to the service ·303-inch cartridges and it requires a force of not less than 24 lb. to extract it.

§§ 7930, 7977, 8659, 8690, 8811, 9876.

Cartridge, S.A., Ball, ·303-inch, Cordite, Short Range, Practice, Mark I is obsolete for future manufacture. It differs from Mark II in having a charge of about 9 grains of size $\frac{38}{·007}$ cordite kept in position by a paper cap. The bullet is more pointed and weighs 150 grains.

Packing and issue.

The short-range cartridges are packed heads and tails, in bundles of 10, in yellow paper wrappers. The labels on the boxes are of yellow paper also, and the distinguishing mark on both is a rectangle containing two diagonal lines and the letter C near each end. The letters and distinguishing marks are printed in black.

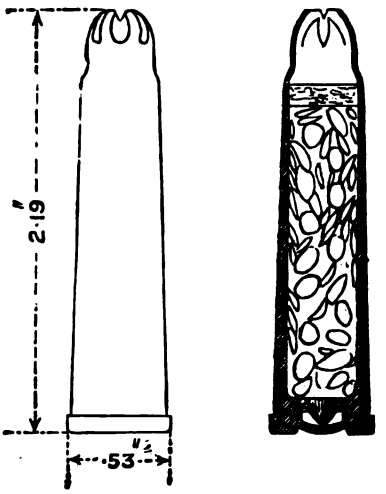
1,100 Mark I cartridges are packed in Mark XI, XII, or XIV S.A.A. box. The first supply was 1,160 in a box.

400 Mark II cartridges are packed in "box, A.S.A., pistol, Enfield, 600 rounds," for which special packing pieces will be provided as required.

Cartridge, S.A., Blank, ·303-inch, Cordite, without Bullet, Mark V, consists of a Service case crimped in at the mouth to retain the charge of 10 grains of $\frac{20}{S.C.}$ cordite. The charge is covered by a strawboard wad. §§ 7519, 8379.

Cartridge, S.A., Blank, ·303-inch, Cordite, without Bullet, Mark V.

Full size.



Cartridge, S.A., Blank, ·303-inch, Cordite, without Bullet, Mark IV, of which certain issues were made, differed from Mark V only in the explosive used containing no mineral jelly. § 7722.

Cartridges, S.A., Blank, ·303-inch, Cordite, with Paper Bullet, Mark I, were at one time issued, but it was ordered that they are to be converted to Mark IV without bullet, and until so converted are to be considered obsolete. §§ 7004, 7149, 7722.

The Marks IV and V cartridges are suitable for single loading only with ·303-inch rifles, and carbines. §§ 7221, 7458.

Cartridges, S.A., Blank, ·303-inch, Cordite, without Bullet, Marks I, II, and III are obsolete. §§ 7722, 8379.

The cartridges Marks IV or V are packed in bundles of 10, heads and tails, in purple paper, and issued in Mark XII boxes, 1,400 rounds, half barrel 3,200 rounds, or quarter barrels 1,900 rounds. Packing and issue.

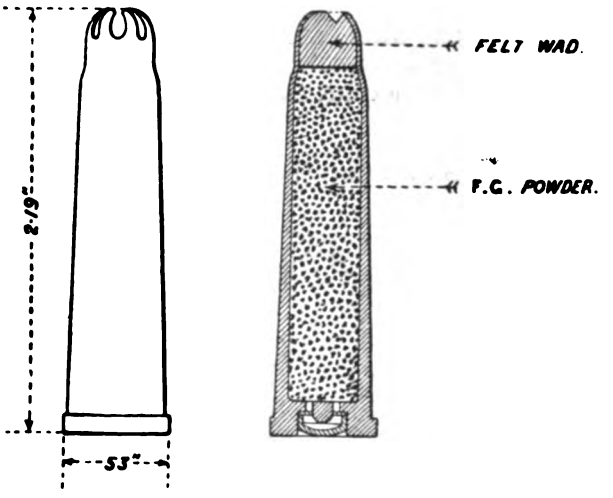
Cartridge, S.A., Blank, ·303-inch, Black Powder, without Bullet, Mark III, consists of the service case and cap, except that the latter contains only ·3 grain of cap composition (*see* table p. 554). The interior of the case is varnished. § 9352.

The charge is about 45 grains of F.G. powder, and is covered by a felt wad over which the mouth of the case is crimped.

Cartridge, S.A., Blank, ·303-inch, Black Powder, without Bullet, Mark II, had a case similar to the above but with a smaller cap. It may be a conversion from cartridge, S.A., blank, ·303-inch, black powder, without bullet, Mark I, which is obsolete in that form, or §§ 7722, 8379.

Cartridge, S.A., Blank, ·303-inch, Black Powder, without Bullet, Mark III, | N | .

Full size.



from the ·303-inch service powder cartridge. The charge may therefore be 71½ or 45 grains of powder covered by a felt wad and the mouth of the case crimped over.

§§ 6034, 7004, 7221, 7609, 7905. *Cartridge, S.A., Blank, ·303-inch, Black Powder, without Bullet, Mark I*, had a rolled case and a charge of 34 grains of black powder. It will become obsolete when the existing store is used up.

§ 7609. The Mark I cartridge, when available, can be used up with the ·303-inch rifles and carbines.

The Marks I, II, and III blank powder cartridges are suitable for single loading only.

Packing and issue. These cartridges are packed in bundles of 10, heads and tails, in purple paper, and issued 215 bundles in a quarter barrel, or 185 in a S.A.A. box.

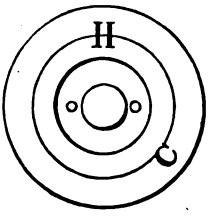
§ 7401. Blank ammunition for small arms may be issued in S.A.A. boxes (not Mark XIII) for manœuvres.

Blank cartridges for ·303-inch small arms when filled with cordite have the wrappers and labels printed in red, and the base of each cartridge marked with a C.

All aiming rifle, M.G. and S.A. cartridges have, stamped on the base, the initials or recognised trademark of the manufacturer, and a Roman numeral denoting pattern of cartridge.

Cartridge, S.A., Ball, ·303-inch, Cordite.

Scale ½.



In some ·303-inch cartridge cases the numeral on the base may not always be applicable to pattern of cartridge. For instance a case marked "IV" may be used for a Mark V service cartridge, or a Mark II case for a Mark V blank cartridge, or for the short-range practice Mark I cartridge. The wrong numeral will, in future, be cancelled by having a ring stamped on the base, over the numeral, as shown in woodcut. §§ 8659, 8768, 9861.

Cartridge, S.A., Dummy Drill, Magazine Rifle, Mark II, consists of an empty service case without cap or anvil. A hollow brass bullet, or the envelope of the service bullet, is secured in the case by coning and indenting the case into the cannelure as in the service cartridge. The exterior of the cartridge is tinned all over to distinguish it. § 9519.

The Mark I dummy drill cartridge differed from Mark II in the bullet not being so securely fastened to the case. § 6057.

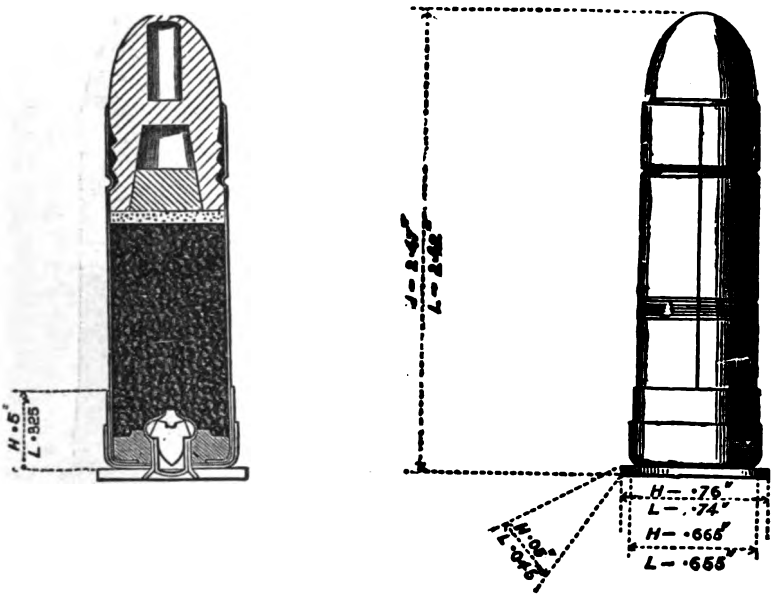
These cartridges are issued as required, loose in a packing case. Issue.

The distinguishing mark on the wrapper and box is a black rectangle with two uncoloured bars, and the letter D, in black, across the centre.

Cartridge, S.A., Ball, Snider, Mark IX is used with both rifle and carbine. Consists of a case, cap, charge, wads, and bullet. § 2105.

The case is formed of sheet brass covered with brown paper. It is lined with shellac and thin white paper to prevent corrosion from the powder. The case overlaps by about ¼ inch, and is cemented together with shellac and glue. The arrangement of the two base cups, iron disc, &c., are identical with those used in the M.-H. cartridge, Mark III. There is no strengthening strip in the folds.

Cartridge, S.A., Ball, Snider, Mark IX.



Mark IX may be distinguished by a single red ring round the outside of the case (*see* cut). Construction.

The charge is 70 grains (very nearly 2½ drams) of R.F.G.

The bullet is made from pure lead, weight 480 grains, the hollow in

the head is closed by having the lead spun over it, the hollow parts are necessary in order to get the bullet of a sufficient length for good shooting, without unduly increasing its weight, and to get its centre of gravity in the proper place, the hollow in the base is also used to give the expansive action to the bullet The plug, made of clay, and soaked in beeswax, closes the rear cavity, and on firing expands the bullet, which has three cannelures, the sides of the bullet as far as the front cannelure are coated with beeswax, the cannelures holding a sufficient supply of the lubricant in their recesses; by the expansion of the bullet the lubricant is squeezed out, and the bore is thoroughly cleaned out by the bullet passing through it.

Many patterns of this cartridge have been made, they are all serviceable with the exception of Mark I, which may be recognised by having a potêt base, formed by pressing out the rim of the base cup so as to form a beading round the edge instead of having a brass or iron base disc as the other marks have. (For details of them *see* former editions of this work.)

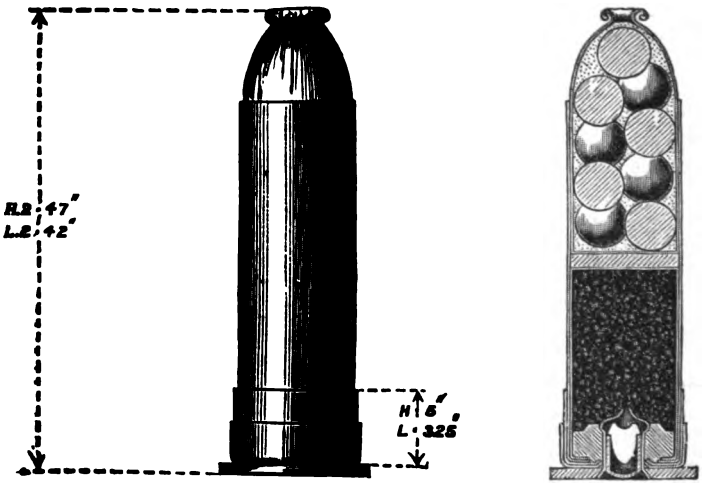
Packing and issue.

By tens, in brown paper wrappers, the bullets all one way to prevent indentation of the soft lead by the base discs. The distinguishing mark is a solid square printed in blue upon the outer label, and in black upon the wrapper. In S.A.A. boxes containing 560 rounds.

§ 2546.

A *Cartridge, S.A., Buckshot, Snider, Mark II, Rifle or Carbine*, has been issued for convict-guard service, and for service in Ashantee. The case is similar in construction to the Service ball cartridge for Snider arms.

Cartridge, S.A., Buckshot, Snider, Mark II, Rifle or Carbine.



The charge is from 52 to 56 grains of R.F.G. powder, on the top of which is a paper disc and a felt wad lubricated with beeswax.

The cartridge contains 13 buckshot in a paper bag, the interstices between the shot being filled with bone dust, the bag is secured in the case with shellac cement.

Mark I had the powder charge in a pellet, and plaster of Paris was used instead of bone dust.

The cartridges are packed in bundles of 10. The distinguishing mark is a hollow square printed in blue on the outside label, and in black on the wrapper. In S.A.A. boxes containing 560 rounds. Packing and issue.

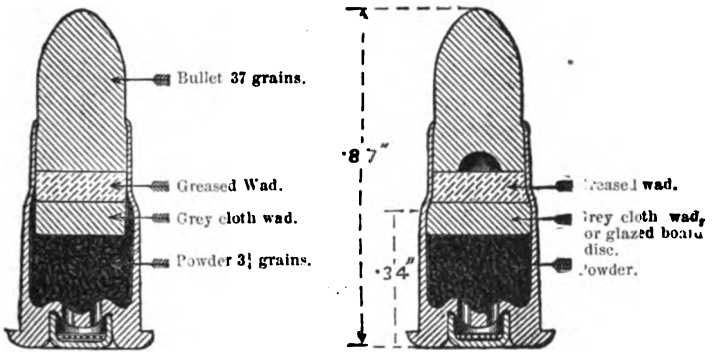
Cartridge, S.A., shot, Snider, special, Mark I is issued for convict-guard service. § 9343.

The case is of rolled-sheet brass, containing a charge of about 50 grains R.F.G.[2] powder, on the top of which is placed a millboard wad. About 28 lead shot (weighing altogether 300 grains) are inserted on top of the millboard wad and a felt wad is placed on top of the shot; the whole being secured by crimping over the edge of the case.

Cartridge, Aiming-Tube, Mark I.—This cartridge has been introduced to enable rifle practice to be carried on in confined spaces § 4158.

Mark I. *Mark II.*

Scale, $\frac{2}{1}$.



and without the expense entailed by using the Service cartridges in large numbers.

These cartridges should put 75 per cent. of their bullets in a circle of 3 inches diameter at 25 yards, the rifle being fired from a fixed rest. Accuracy.

The case is of solid-drawn brass with the cap chamber and anvil formed in the base. Two fire-holes in the latter, as shown in the cut, communicate from the brass cap to the powder charge.

The charge is 3¼ grains Curtis and Harvey's Diamond No. 2.

The bullet is of pure lead, and weighs 37 ± 3 grains, and there are two wads fastened to its base, that next the bullet being greased and the other of grey cloth.

Mark II differs only from Mark I in the arrangement of the wads and in having the base of the bullet slightly recessed (*see* cuts). § 6391.

100 rounds are packed in a cardboard box about the size of a bundle of 10 rounds of the Service ammunition, tied with string. The distinguishing mark on the wrapper or box is a black circle with a black dot in the centre. Issue.

Supplies of 20,000 have been made in deal boxes, zinc lined, and hermetically sealed. Smaller quantities are supplied in packing cases.

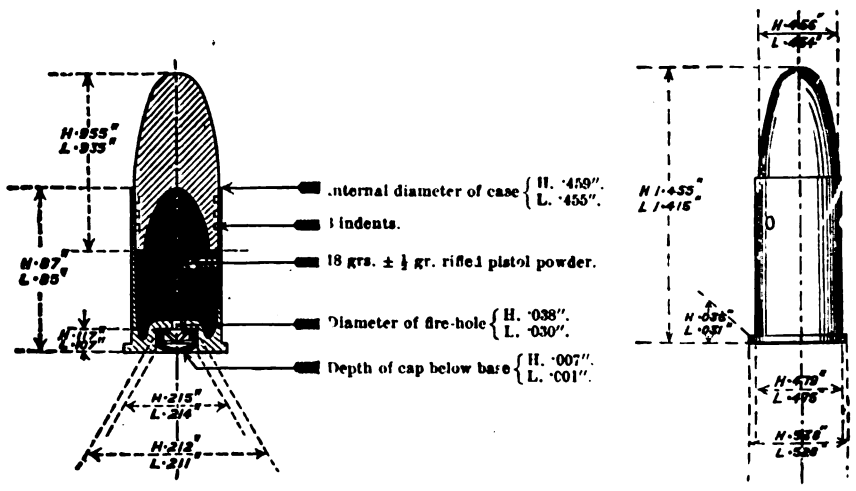
Future supplies of cartridges, aiming tube, will be made in tin-lined boxes, each containing 10,000 rounds, but when required for the Royal Navy they will be repacked in quarter metal-lined cases locally as required. §§ 6188, 6487.

§ 6844. A *Cartridge, S.A., Ball, Pistol, Webley, Mark I, also Enfield*, has been introduced for use with the Webley and Enfield revolvers. It consists of a case, cap and anvil, charge, and bullet.

Case. The case is made from solid-drawn brass (*see* cut). There is one fire-hole to allow the flash to pass from the cap to the charge. The

Cartridge, Small Arm, Ball, Pistol, Webley, Mark I, also Enfield.

Scale, full size.



interior of the case where the powder charge rests is coated with hard brown varnish.

Cap and anvil. The cap is of copper, and contains ·2 grain of cap composition pressed in and varnished. The anvil is of brass and fits inside the cap as shown in the woodcut.

Charge. The charge is 18 grains of rifled pistol powder.

Bullet. The bullet is made of an alloy of 12 parts lead to 1 of tin, with a cavity formed in the base and three cannelures round the body; these cannelures are filled with beeswax, it weighs 265 grains, and is secured in the case by three indentations made into the rear cannelure.

Packing and issue. They are packed in bundles of 12, heads and tails, in brown paper wrappers; and issued in the half S.A.A. which contain 768 rounds for N.S., and 240 rounds in the box, A.S.A., pistol, Enfield, for L.S.

The distinguishing mark is a circle with bar across, in black on the wrappers, and brown on the labels on the boxes.

§§ 9159, 10273. *Cartridge, S.A., ball, pistol, Webley, cordite, Mark II | C | also Enfield* consists of a case, cap, charge, wad, and bullet.

The case is of solid-drawn brass, with a cap chamber formed in the base, in which is an anvil made by a projection of the material, and two fire-holes. It has the letter C stamped on the base and the interior is not varnished.

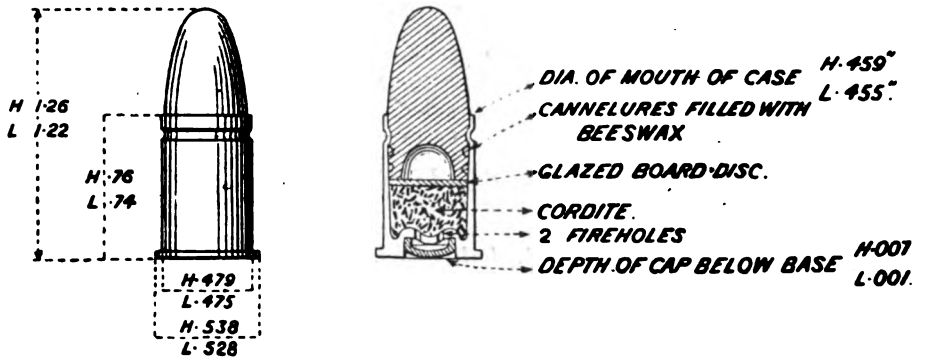
The cap is of copper, and contains ·4 grains of cap composition (*see* Table p. 554) pressed in and varnished and may be covered with a tin-foil disc.

The charge consists of about 7½ grains of cordite, size $\frac{1}{0\,8}$, a glazed-board disc is now placed on top of the cordite, but this was not used in the earlier issues.

The bullet, of 12 parts lead and 1 part tin, weighs 265 grains. It

Cartridge, S.A., Ball, pistol, Webley, cordite, Mark II | C | also Enfield.

Full size.



has a cavity formed in the base and three cannelures round the body, these cannelures are filled with beeswax, and the bullet is secured in the case by choking the latter into the front cannelure, and must require a force of 60 lb. to 80 lb. to extract it.

They are packed in bundles of 12 for L.S., 6 for N.S., heads and tails, in brown paper wrappers, and are issued, for L.S., 276 rounds in "box, A.S.A., pistol, Enfield"; for N.S., 828 rounds in "box, A.S.A., half, naval." The distinguishing mark is a circle with bar across and the letter C above and below the bar, printed in red on both wrapper and box. Packing and issue.

Cartridge, S.A., ball, pistol, Webley, cordite, Mark III differs from Mark II in having a somewhat smaller charge, in the bullet having a cavity in the head and weighing only 218½ grains. The manufacture of these cartridges has been stopped, and the existing stock, in the L.S., at home stations will be used up for practice; at stations abroad to be returned to Woolwich on receipt of supplies of Mark II. All service and mobilization pistol ammunition at home should be exchanged for Mark II. §§ 9159, 10,273.

Mark III ammunition in the N.S. will be withdrawn.

The Mark I cartridge differed from Mark II in the case having a separate anvil and one fire-hole. The charge consisted of about 6·5 grains of $\frac{3\frac{1}{2}}{\cdot 007}$ cordite, not covered with a glazed-board disc. The bullet was secured by choking the neck of the case into the centre cannelure, and the mouth into the front one. § 7608.

The packing was the same as that of the powder cartridge. Packing and issue.

Cartridge, S.A., blank, pistol, Webley, Mark II | L | also Enfield. § 9632.

The case is of solid-drawn brass, with cap chamber and anvil formed in the base and two fire-holes.

The cap is of copper and contains ·25 grain of cap composition pressed in and varnished and may be covered with a tin-foil disc. It is secured in the case by four indents.

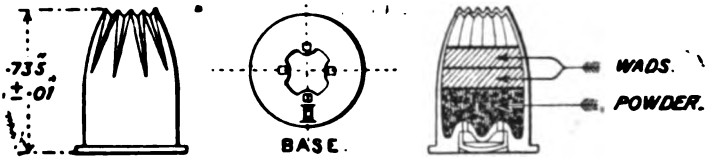
The charge consists of 8 grains R.F.G.² powder covered with two felt wads, over which the mouth of the case is crimped.

These cartridges are packed, in bundles of 12, in purple paper wrappers.

Cartridge, S.A., blank, pistol, Webley, Mark I differs from Mark II in having a charge of 10 grains of rifle pistol powder and only one felt wad. The fire-holes were also smaller. § 8842.

Cartridge, S.A., blank, pistol, Webley, Mark II | I. | also Enfield.

Scale, full size.



§§ 3970, 6844. The *Cartridge, S.A., Ball, Pistol, Enfield, Mark III*, is described in former editions, and will become obsolete so soon as the present supply is used up.

§ 7002. The *Cartridge, S.A., Ball, Pistol, ·442-inch, Mark I*, is intended for the Royal Irish Constabulary. The case is solid drawn with cap and anvil similar to M.-H. rolled case cartridge. The charge is 10 grains of rifled pistol powder covered by a glazed-board disc. The bullet, 219 grains, has one cannelure, is lubricated with beeswax, and is secured by coning the mouth of the case into it below the cannelure.

Packing. It is issued packed, heads and tails, in bundles of 12 in brown paper.

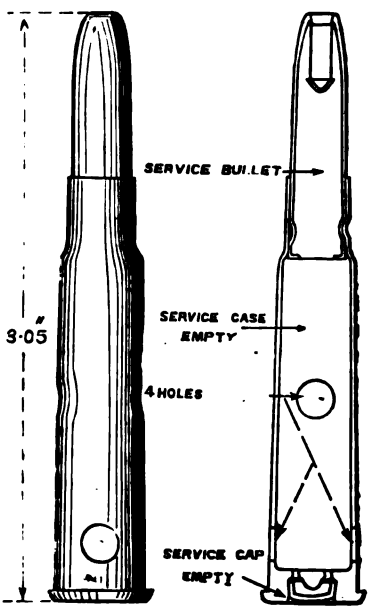
§§ 7002, 7107. The *Cartridge, S.A., Blank, Pistol, ·442-inch, Mark I*, is for use by Irish Constabulary, and may also be used in the Enfield pistol supplied to Royal Irish Mounted Constabulary. It is of solid-drawn brass, riveted to a brass base by the cap chamber and paper wad as in M.-H. rolled case cartridge. The charge is 11 grains of rifled pistol powder covered by a felt wad, the mouth of the case is crimped on to the wad.

Packing. Packed, heads and tails, in bundles of 12 in purple paper.

§ 10094. *Cartridges for instruction, machine gun, and Small arm*, which are issued for instructional purposes, will be pierced with two holes at

Typical.

Full size.



right angles through the case, so that it can at once be seen that the cartridge is not a service one.

S.A. Ammunition Boxes, &c.

Barrels, Cartridge, are of three sizes—half, quarter, and eighth; they have no copper hoops, and are used for conveyance and storage of S.A. ammunition. The half size is used for blank cartridge (the weight would be inconveniently great with ball cartridge), the quarter size for ball, and the eighth for small supplies. For the number of cartridges contained in these barrels, *see* Tables 45 and 46.

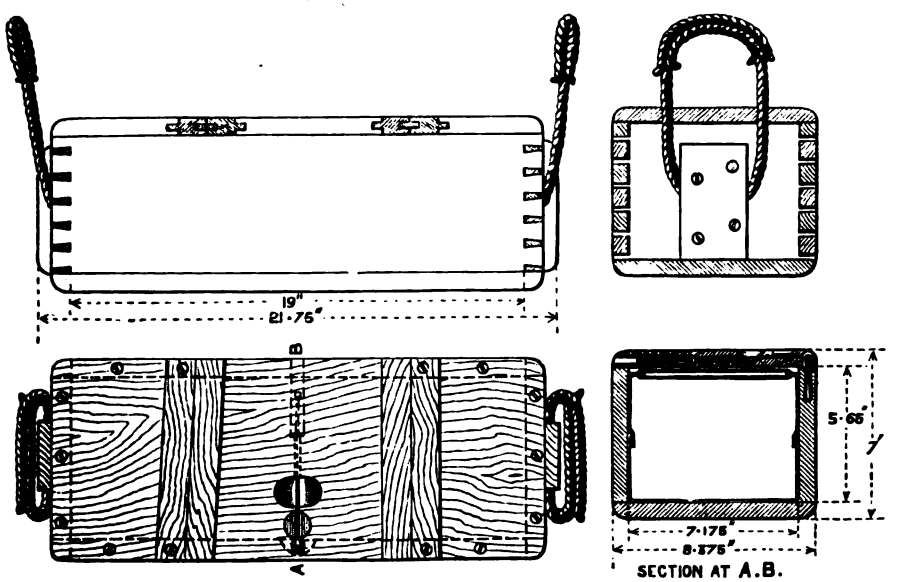
For ball cartridge they are superseded by boxes, but are still occasionally used for home service.

S.A.A. boxes. §§ 6963, 7455, 7488, 8285, 8767, 9087, 10844.

Boxes, Ammunition, S.A., G.S., Mark XI and Home and Special, Mark XII. The former is for general service, and is made of mahogany or teak; the latter is for home or special service, and is made of deal with elm ends and top of Kauri pine. They are provided with cleats of hard wood and rope handles. The lid and sides of the top are clamped with beech, as shown in the cut, which shows a previous pattern.

The sides and ends are dovetailed, and the top and bottom each secured by 14 tinned iron screws. The sliding lid is placed on the broadest side so as to facilitate unpacking, especially when carried as in pack transport. The lid is fastened by a split pin, which passes through the small hole shown in the woodcut down into the side of the box. The edges of this pin at the top are well rounded to prevent it cutting through a twisted copper wire, which is attached to the eye, and carried through a hole bored horizontally in the lid, and terminates in a knob at the other end to prevent its being drawn through and lost. The lid is also attached to the interior of the box by a piece of whipcord, which allows it to be taken off but prevents its being lost. The oval hole shown

Scale, 1 inch = 1 foot.



in the sketch is a thumb-hole over which a loop of preller leather is fastened to the twisted wire to facilitate withdrawing the pin, and between it and the pin is a circular recess in which the calico label is fixed by shellac over the twisted wire, so as to seal the box.

An inner case or lining of tin serves to keep the contents dry.

The lining is coated with copal varnish stained with vegetable black, and, to distinguish between these and such boxes as have unpainted or unvarnished linings, they will be marked with a red cross on one end adjoining the cleat. The lining is closed by a tin lid, or closing plate, soldered on and fitted with a wire handle, by means of which it is torn off when the box is to be opened, a *sharp pull* being given.

Some of the earlier patterns had the lids fastened with a brass screw, but the unscrewing occasioned loss of time, so the split pin was adopted.

On emergency the lids secured by screws may be opened by a good kick or a blow with a stone on the edge of the lid furthest from the screw.

For details of earlier patterns, *see* former editions of this work.

§ 5524. *Boxes, A.S.A., Old Patterns.*—In future all S.A.A. boxes, Marks I and III to X, returned to Woolwich, will, if found repairable, be repaired only, instead of being converted to Marks XI and XII as heretofore. They will be used only for S.A. ammunition, M.-H. rolled case or Snider.

Mark II is OBSOLETE.

§§ 6153, 6963, 7455, 7488, 8285 10030. *Box, A.S.A., Mark XIII* will become obsolete when the existing stock is used up. It is made of deal with elm ends, having a cleat at each end with rope handle attached. It is lined with tin, and the wood lid is secured by tinned iron screws. The lining is coated with copal varnish, &c.

It is for home service only, for the issue of *rolled case* cartridges M.-H. or Snider, of which it contains 1,000 rounds.

§§ 6588, 6963, 7455, 7488, 8767, 9087, 9516, 9772. 10505. *Box, Ammunition, S.A., Home and Special Service, Mark XIV.*—This box is intended to supersede Mark XII for the issue of S.A.A. for home and special service. In general construction it resembles Mark XII, but to reduce the cost of manufacture the sides and bottom are left unplaned, the ends are of elm without cleats, having rope handles for lifting secured to them. In future it will be fitted with a brass pin and copper wire loop for securing the lid instead of the galvanised iron pin and iron wire loop hitherto used.

Box, A.S.A., Mark XV | L | of which only a few were made, contained 1,100 ·303-inch cartridges, and only differed from Mark XIV in having a cheaper lid.

§§ 6383, 6963, 7455, 8285. *Box, A.S.A., ·303-inch, half, Naval, Mark I | N |* is similar in material and construction to the Mark XI box but has only one cleat and one rope handle. It is used in the N.S. for packing ·303-inch and pistol ammunition, of which it will contain 500 and 828 cordite cartridges respectively. It supersedes "Boxes, Ammunition, S.A., pistol, Adams," and "Enfield, 600 rounds," for future manufacture.

§§ 4094, 7455, 7488. *Box, Ammunition, S.A., Pistol, Enfield, 600 rounds, Mark II, Naval.*—This box is of the same construction as Mark XI, S.A.A. box, except that it is only half the length, and has only one end of the box fitted for a rope handle.

§§ 7455, 7488, 8285. *Box, Ammunition, S.A., Pistol, Enfield, 240 Rounds, Mark III | L |* is of the same construction as Mark XII S.A.A. box except that it is much smaller, has a top of teak, only one cleat and one rope handle. It will hold 240 Webley powder cartridges.

Distinguishing Marks for S.A. Ammunition Boxes.

§§ 7603, 9111, 9300.

Cartridge, Aiming Rifle. 1. Inch Electric

Cartridge Aiming Rifle. 1. Inch. Percussion

Cartridge M.G. Nordenfelt 1. Inch Steel

Cartridge M.G. Nordenfelt 1. Inch. Iron.

Cartridge. M.G. Dummy Drill. Nordenfelt 1. Inch.

Cartridge M.G. Ball·45 Inch

Cartridge M.G. Ball. Gatling ·65 Inch.

Cartridge M.G. Ball ·45 Inch. Cordite

Cartridge S.A. Ball. M.H. Rifle. Powder.

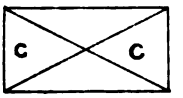
Cartridge M.G. Ball. M.H. Chamber, Cordite

Cartridge S.A. Ball M.H. Carbine, Powder

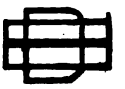
Cartridge S.A. Buckshot. M.H.

Cartridge S.A. Ball·303 Inch. Cordite.

Cartridge S.A. Ball·303 Inch. Powder.

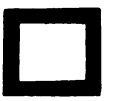


Cartridge, S.A. Ball·303 Inch. Cordite, Short Range Practice.



Cartridge, S.A. Dummy Drill, Magazine Rifle.

Cartridge S.A. Ball Snider.



Cartride S.A. Buckshot Snider

Cartridge Aiming Tube.

Cartridge S.A. Ball Pistol, Webley, Powder

Cartridge S.A. Ball, Pistol Webley, Cordite.

Cartridge S.A. Ball, Pistol, Enfield

E. Weller & Grahams. Ltd Litho. London.

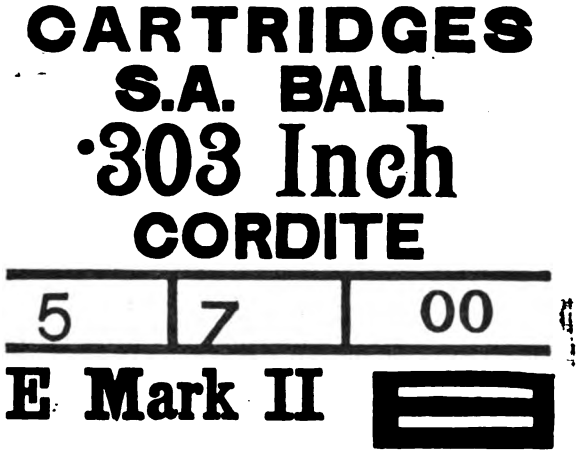
The Marks I and II boxes only differed from Mark III in minor details.

Camel and bullock boxes are special for India; but the first is also used for the issue of S.A.A. to Colonial Governments. Camel and bullock boxes.

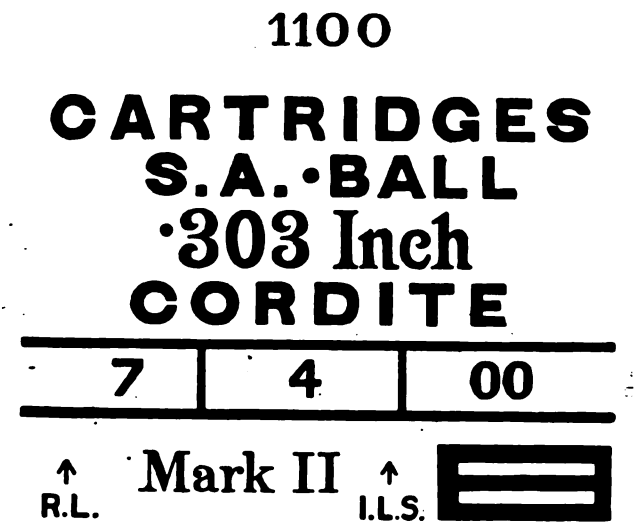
In order that the particular kind of ammunition packed in S.A.A. boxes may be readily distinguished, all such boxes issued from Woolwich have now labels with distinguishing marks of various colours. The distinguishing labels are placed on each side and on each end. The detail is given on the attached plate XXXII. Distinguishing marks on boxes. §§ 3757, 3812,

The device will be printed on the wrappers of each bundle of ammunition the same colour as the printing, *i.e.*, black for gunpowder (service), red for cordite (except ·303-inch short-range cartridges), and yellow for practice cartridges. §§ 7603, 7662.

Example of marking on a ·303-inch Cartridge Wrapper.



Example of marking on a descriptive Label on a S.A.A. Box.



The distinguishing mark will be printed on the distinguishing labels which are placed at the sides and ends of the box, also on the descriptive labels which are fixed, one to the centre of the closing plate of the inner lining, and one in a recess on the top of the box, in the colour shown in the plate.

The manufacturer's initials will always be found in the lower line of the descriptive label; when there are two initials as shown in the above example, that in the left hand corner is that of the manufacturer.

The initials are as follows:—

Manufacturer.	Initials.
Royal Laboratory	R⅄L, or ILS, with no other initials.
Kynoch	K.
Birmingham Small-Arms and Metal Company ..	B.
Eley	E.
Greenwood and Batley ..	GB.
Grenfell and Accles ..	GA.
Henry Rifled Barrel Company	HRB.

S.A.A. boxes have the following information stencilled on them; gross weight at one end, date of packing at each end; on top, the number of the box, and, if containing cordite cartridges, the word cordite and particulars of the batch. The number of the box and particulars of the batch of cordite are also stamped on the closing plate of the inner lining after it is soldered down. If the box contains powder cartridges, it will be stencilled on top with the nature of powder contained in the cartridges.

They have the usual Government Explosive Label sealing the junction of lid and box, and in addition a small calico label, instead of an ordinary station label, which fits in a circular recess over the wire attached to the pin, and seals the box. The classification label is placed on in the most convenient position.

All aiming rifle, machine gun, and small-arm cartridges for storage, are placed in Group II, Division I.

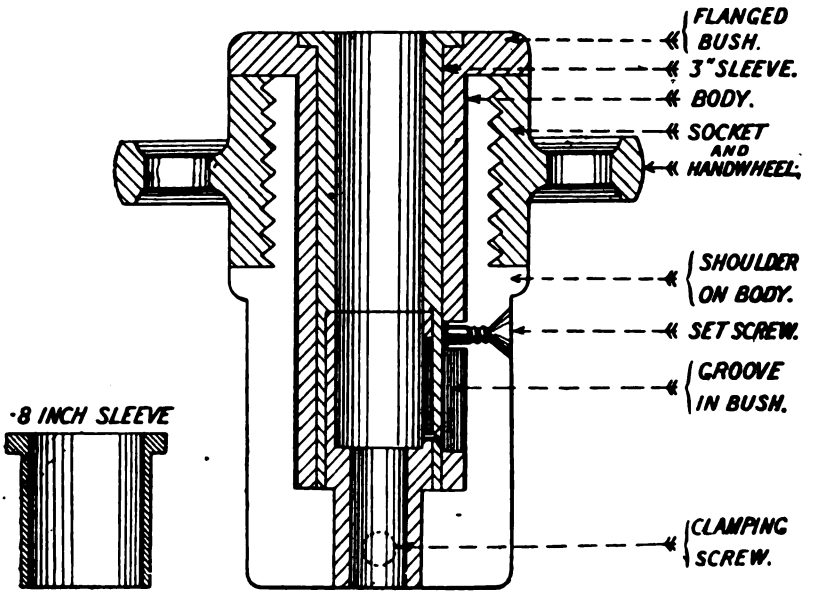
Proof. For inspection and proof of the above, see the Regulations for Army Ordnance Services, 1900.

A description of the tool used for opening cartridges is given here.

§ 7769. *Tool, extracting bullets, small-arm, Mark I*, is for the use of Inspecting Ordnance Officers in opening S.A. and ·45-inch M.G. cartridges.

The complete tool consists of the following parts:—

Tool, Extracting Bullets, Small-arm, Mark I.



Steel body; gun-metal socket, fitted with milled handwheel; steel flanged bush, secured in the body by a small screw; steel milled-headed clamping screw, and two steel sleeves ·8 inch and 3 inches long respectively.

The body has a shoulder on the outside, a screw thread being cut behind the latter to take the socket. The body is bored out (the diameter being greater in rear) to take the steel flanged bush. In this form the tool is adapted for use in extracting bullets from M.-H. rolled and solid case cartridges.

Instructions for use.

1. *M.-H. Rolled and Solid Case Cartridges.*—Insert the cartridge in the bush of the tool, and grip the bullet with the clamping screw; turn the handwheel, and withdraw the body of the cartridge from the bullet.

2. *G.G. Cartridges.*—Insert the ·8-inch steel sleeve in the bush, and proceed as in 1.

3. *·303-inch Cartridges.*—Insert the 3-inch steel sleeve in the bush and proceed as in 1.

Care must be taken in inserting the 3-inch sleeve that the arrows on it and on the head of the body of the tool coincide, so as to ensure that the clamping screw will pass through the hole in the sleeve and thus be free to grip the bullet.

CHAPTER XXII.—ROCKETS AND LIGHTS.

CAUSES OF MOTION.—WAR ROCKETS.—VARIOUS PATTERNS.—USE OF.—AGE AND EXAMINATION OF.—RANGE.—MACHINES.—LIFE-SAVING AND BUOYANT ROCKETS AND MACHINES.—SIGNAL ROCKETS AND MACHINE.—PORTFIRES.—LIGHTS.—QUICK AND SLOW MATCH.—SAFETY AND INSTANTANEOUS FUZE.

For many centuries rockets have been used for signalling, for display, and as weapons of war.* For these purposes they are used in our Service, and are employed, moreover, in the interests of saving life.

There are also in the Service sundry portfires and lights, the manufacture of which is analogous to that of rockets, and which will accordingly be described in this chapter.

Before proceeding to describe the different natures of rockets we will consider the causes of motion and certain matters which affect their flight.

Causes of a rocket's motion.

To understand the causes of a rocket's motion of translation, imagine a particle of rapidly-burning composition, such as is used in filling rockets, to be absolutely free in space, that is to say, acted on by no external forces whatever. If the particle be ignited it will generate an indefinite sphere of gas, of which sphere it will be the centre. This gas possesses tension. Suppose the particle on ignition to be surrounded by a sphere of small radius, of which it is the centre, and let this sphere be made of material strong enough to confine the gas generated within its limits.

Clearly there will then be a pressure due to the tension of the gas on every unit of area of the interior surface of this spherical envelope, but the latter will have no motion. Now, suppose that, instead of having a spherical envelope, the particle is at the centre of a hollow hemisphere.

Then one-half the sphere of gas generated will escape freely, but the other half, restrained by the pressure of the hemisphere, will exert a certain pressure against its interior surface, and tend to move it in a direction perpendicular to the plane of its bounding great circle. The same action will take place if for the particle and envelope we substitute a cylinder full of composition closed at one end and ignited at the other; the cylinder will tend to move in the direction of its longer axis. But other causes come into play and assist the motion.

* For a sketch of the history of rockets and description of the Congreve and Boxer-Congreve rockets, *see* former editions of this work, and the works to which references are therein made. They are omitted in this edition for the sake of economising space, as they do not immediately concern the stores now in the Service.

So far we have supposed the unconfined portion of the gas to escape perfectly freely, but this is not and cannot be the case, for apart from the reaction caused by the inertia of the particles of gas themselves, we have the escaping portion acting against the joint fulcra (so to speak) of its own dense atmosphere, and of the air against which the escaping column of gas impinges. The imaginary cylinder would move very slowly, but in a rocket we bore a conical hole up the middle of the composition and restrain to a certain extent the exit of the gas by regulating the size of the vents. The result of this is that we obtain a large amount of gas generated in a very short period of time, on account of the large surface exposed, and we cause the escaping column, or columns, of gas to issue with great violence. The propelling power varies inversely as the size of the vents, but their size cannot be diminished beyond a certain point, as the increased pressure in the interior of the rocket, caused by the diminution of the area for escape of the gas, necessitates a stronger and therefore a heavier envelope to resist it. This pressure varies inversely as the square of the area of the vents.

If the rocket were a simple cylinder it would in flight tend to turn round its shorter axis precisely as an elongated projectile would do if it were not put in rotation by rifling the gun from which it is fired. Owing to the peculiarity of the construction of a rocket and the constant variation of the position of its centre of gravity, caused by the composition burning out during flight, its course under such circumstances would be hopelessly erratic and unmanageable. It is clearly necessary to provide some means of keeping it point first in flight and this end has been obtained in two ways.

1st. The attachment of a stick, fixed on the base or side, by which the centre of gravity is brought so near the point that pressure of the air acts on the stick end with sufficient leverage to keep the point always towards the direction from which such pressure proceeds: thus on a still day the flight is tolerably direct, but on a windy day it is ever being deflected more and more up the wind, the action of the air being continually to point it in the direction of the resultant of the resistance due to its present line of flight and the pressure of the wind. It is clear, theoretically, that such a tendency of the wind is insatiable, its action being directed to carry the rocket into a line of flight eventually approximating indefinitely closely to the "wind's eye."

2nd. Rotation, imparted by some application of either the force of the gas escaping from the rocket, or of the resistance of the air.

As an incendiary projectile the rocket possesses great recommendations, and its moral effect is very great, but it labours under certain disadvantages that hardly seem likely to be removed.

1st. Its efficiency and safety depend on the complete contact of a very large surface of composition with a thin metal case; hence it is liable to deteriorate from any great variations of temperature, causing expansion of metal; from chemical action causing corrosion; and from vibration in travelling; any of these causes being liable to compromise the safety and efficiency of the rocket.

2nd. The method by which its velocity is gradually imparted to it entails the evil that its flight is very slow, and the rocket is consequently very susceptible to the action of gravity, wind, and accidental causes of deviation.

3rd. The same causes that thus make it peculiarly liable to be acted on by wind and gravity, aggravate the effect of deflection, for, unlike a projectile on which the force of the charge acts entirely in

the *desired direction*, a rocket is continually developing velocity in the direction in which it is at the moment pointed; thus, supposing it to be deflected one degree in the first second of time of flight, all the force next added will be applied one degree out of the proper direction, and so on with all impulses in succession; indeed, rockets have been occasionally deflected so as to come back, with very great and constantly increasing velocity, at the troops who fired them.

4th. From the fact of the composition burning away during flight, the position of the centre of gravity, and consequently the balance of the rocket, is constantly changing; but this is a slight matter compared to those previously mentioned.

Rockets, war, Hale's. In 1867 Mr. Hale's invention of rockets which imparted to themselves, on ignition, a motion of rotation as well as of translation, superseded for warlike purposes the Boxer-Congreve rockets, which had themselves a few years previously superseded the rockets introduced into the British Service by Sir W. Congreve in 1805.

Calibres. Several calibres were introduced but have been gradually reduced to one, viz., the 24-pr., though the 9-pr. is still occasionally issued for special service.

§ 4760. *Rocket, war, 24-pr., Mark VII, | C |* consists of a body, head, base piece, tail piece, and safety cap.

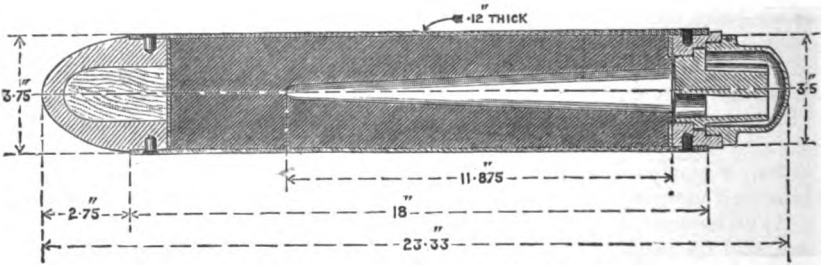
The body is made of steel tubing, cut to the required length, and tested internally by hydraulic pressure to 1 ton on the square inch. The interior is then roughened by scoring it spirally and scoured till it is quite clean and bright.

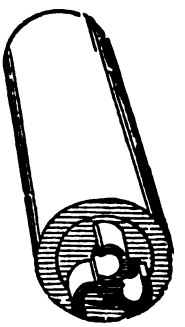
The head is of cast iron lined with wood, and is fastened to the case by 10 screws.

The base piece of wrought iron or mild steel fits into the end of the case and is secured by 10 screws. Its inside is bored out and

Rocket, War, 24-pr., Mark VII, | C |.

Scale, $\frac{1}{8}$.





screwed to receive the tail piece and also to receive the safety cap, as shown in the woodcut.

Tail piece.

The tail piece is of cast iron, and contains three conical vents, the larger part of the cone being towards the interior of the rocket. The vents are cut away on one side; hence the gas issuing from the vents meets with resistance on the side where they are prolonged, and, there being no counterbalancing resistance where they are cut away, rotation is given to the rocket.

Safety cap.

The safety cap is of mild steel and is screwed on to the base piece. Its object is to cause the rocket to burst, instead of becoming a dangerous missile, should it be accidentally ignited. Between the face of the cap and the base piece an asbestos washer makes a water-tight joint.

§ 5164.

An implement, *Rocket, War, Key, 24-pr., Mark I*, has been approved for unscrewing these caps.

All these parts are put together and marked with the number of the rocket, before the latter is sent to the filling buildings.

Filling.

The composition consists of ground saltpetre, sulphur, and alder charcoal (*see* p. 553).

This is first pressed into pellets for convenience of handling, and the hole for the tail piece having been filled up with a false base, the rocket is placed base downwards in the press and the pellets put in from the top and subjected to pressure.

An asbestos disc is placed over the top of the composition, the edges of the disc being turned up round a disc of millboard which is placed over the asbestos. The upper surface of the millboard and the interior of the top part of the case are coated with thinned luting (½ Mark III and ½ mineral jelly) and the head is pressed in on top of the millboard and fastened on. The false base piece is then removed and a conical hole 11·875 inches long drilled in the composition. Round the edge of the base piece inside there is a lead ring, so as to seal the joint and prevent the escape of gas in that direction and between the base piece and the composition a millboard washer.

When screwed in, the tail piece is retained in position by a keep screw.

Before screwing the safety cap into the base piece the threads are lubricated with thinned luting.

The numeral and date are stamped on the base of the rocket.

§ 1515. § 1985. § 2441.

Each rocket, also has a letter of the alphabet and a number stamped on both head and case. The numbers run up to 1,000, and then the letter is changed.

Paint.

All war rockets are now painted red.

Issue. § 3058.

War rockets are issued in wooden cases fitted to hold them without knocking about. The 24-pr. box used to hold six, but was found to be inconveniently heavy, and consequently liable to damage when hoisted in and out of boats. In consequence of this, a new box holding three rockets was introduced (Mark III), and, though at first intended for Naval supplies only, its use was afterwards extended to L.S.

§ 3298.

Use. A.C. 1884, Cl. 172.

The use of war rockets both for land and naval services is discontinued, except when required for special purposes, to meet which stores of machines and 24-pr. rockets are to be maintained at the undermentioned stations:—

Stations.	Machines.	Rockets.
Sydney	8	400
Simons Town	4	200
Ascension	4	200
Hong Kong	12	600
Bombay	4	200
Trincomalee	4	200

§ 5111. *Rocket, War, 9-pr., Mark VII, | C |* is similar in construction to the 24-pr. Mark VII, but the proportions of the ingredients of the composition are slightly different.

§ 5164. An implement, *Rocket, War, Key, 9-pr., Mark I,* has been approved for unscrewing the safety caps.

9-pr. rockets are issued in boxes holding four rockets each. Formerly they were issued in boxes holding 12.

Age of rockets. New war rockets will not be issued from Woolwich until one year after the date of their manufacture, and any war rockets more than 10 years old, reckoning from date of manufacture, will be destroyed locally. Earlier natures of rockets are not likely to be met with in the Service, and need not be described.

Care of. All possible care should be taken to prevent rockets from being exposed to excessive changes of temperature and from being roughly handled. Accidents with new rockets or those that have not been knocked about are very rare. It is also important that they should be stored in as dry a place as possible.

The following instructions have been issued as to examining, cleaning, and repainting rockets:—

Examining, cleaning, and repainting Hale's rockets. § 2441. *Examination.*—All Hale's rockets in store, will, at frequent intervals, be examined carefully over the surface and particularly along the seam and round the rivets, and those which show the slightest trace of rust or corrosion will be cleaned and repainted.

Cleaning.—The rockets will be placed in a convenient position for scraping, that is, on a couple of rails laid on a table, or a similar arrangement, and the whole of the corroded parts well scraped with a copper knife or scraper, and then rubbed with emery cloth until every trace of rust or corrosion is thoroughly removed (if emery cloth is not available a piece of cloth or serge with fine dry sand will be used); the rockets will then be well washed or rubbed with a piece of serge steeped in spirits of turpentine, and afterwards wiped dry with old linen cloths.

Repainting.—A coat of paint will be put over the parts which have been so cleaned, and the rockets then laid to dry; when quite dry they will receive a second coat of paint, and, after lying three or four days to become again thoroughly dry, they will be replaced in boxes.

Marking.—Rockets when repainted will be re-marked with the original date, &c., as well as with the date and station where they have been repainted; a pencil marking on the red paint, or a piece of paper pasted on, will be sufficient.

Range of war rockets. The average range of 18 24-pr., Mark III, rockets fired in proof in 1873, elevation 15°, was 1,562 yards; the average deviation was 39 yards.

The average range of 30 9-pr., Mark IV, rockets, elevation 15°, was 1,536 yards; the average deviation was 38 yards.

Rockets range further when the wind is from right to left across the range than when it is in the opposite direction.

The rotation is the same as that of a rifled projectile; if a

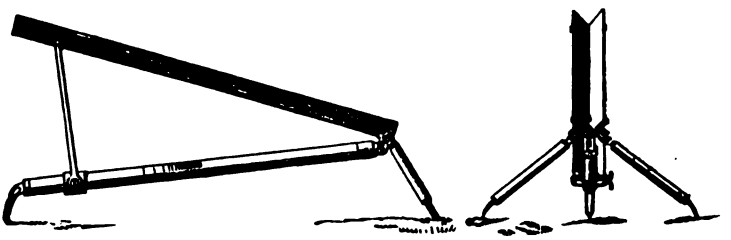
cylinder revolving in this direction is pressed on the right side there will be a tendency to run up, and the reverse if pressed on the other side; possibly this may account for the increased range of the rocket.

Rocket Machines.

Machines, rocket, war, 24-pr. and 9-pr., | *L* | differ from each other in dimensions and weight. § 1637, 1651.

The following general description applies to both:—

Each size consists of a sheet-iron V trough; the sides made at an angle of 80° with each other, supported at rear by three legs made of wrought-iron tubing, two short ones opening right and left, and one long one to the front beneath the trough, each terminating in a prong. On the front one runs a gun-metal ring connected by two bars with a V near the front of the trough, the bars pivot on V and ring; the



elevation is given by slipping the ring up and down the front leg, and clamping it with the arrow on the rear edge of the ring at the required line of graduation up to 15° of elevation for 9-pr., and 25° for 24-pr. machine, with reference to the plane on which the machine stands.

At the back end of the trough is an iron stop preventing the rocket sliding back; it is slotted to form a crutch for copper friction tube.

The "Tube, friction, copper, solid drawn," having been found too short for use with war rockets, the "Tube, friction, copper, L.S., short, Mark II," will be retained in the L.S. for use therewith. §§ 5598, 5747.

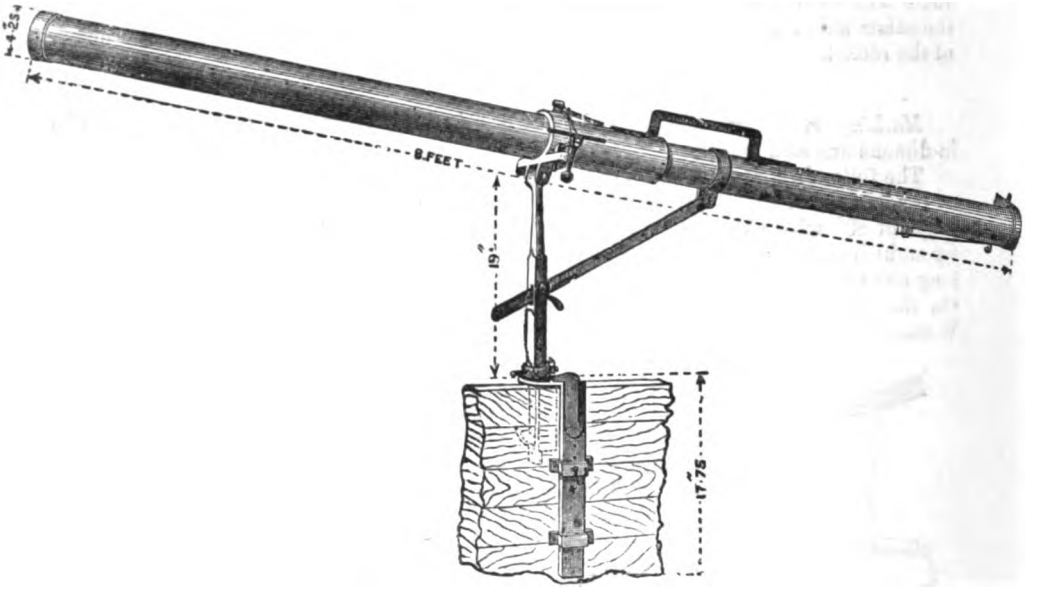
In firing the rocket with the friction tube, in order to prevent the machine being disturbed, the lanyard must be pulled smartly or else the foot pressed against the leg of the machine, or again the lanyard may be led under the foot.

Paint, black. Paint.

Each machine in a packing case. Issue.

The *Machine, Rocket, War, 24-pr., Naval,* is a tube attached at the centre by a vertical joint to a small iron stanchion which slips into a tabernacle* that can be fixed at pleasure to the stern, bows, or quarter of the boat; in the stem a socket is fitted to receive the stanchion. A keep pin secures the tabernacle and another prevents the stanchion unshipping from the tabernacle. §§ 1805, 1860.

* The word "Tabernacle" has been used for years to designate a short wooden stanchion having iron bands in which the wooden rocket stanchion was supported, the tabernacle itself being attached to the gunwale of the boat. Tabernacles were heretofore supplied by the dockyards, but it has been decided that in future supplies of the machine above described, the metal tabernacle (or socket into which the iron stanchion of the new fitment will fit) shall be supplied by the War Department.



To prevent the heel of the tube turning into the boat (when firing) a clutch is provided which does not allow of more than a few degrees of lateral motion. This clutch should be shipped when the bearing is roughly on.

The elevation is given by a straight bar marked in degrees, attached to the tube, and worked through a slot in the stanchion.

A spring catch in the rear of the tube prevents the rocket falling out when ready for firing.

When it is required to fire abeam or thereabouts, the stanchion should be shipped in the stem or stern according as the wind is from aft or forward, and when it is required to fire nearly ahead or astern, the stanchion should be shipped on the bow or quarter on the *lee* side.

§ 1931. The lanyard used with this tube is rove through two small single blocks so as to form a tackle, to the movable block of which is attached a short lanyard with the hook for the friction tube. The fixed block through which the running end of the lanyard passes is attached to the rocket tube by a swivel immediately over the stanchion. The object is to give additional power so that a violent pull may not be necessary.

§ 3134. The Mark II lanyard differs only in the form of the hook.

It may be observed that elevation (up to 30°) with this tube is given with reference to the horizontal plane; that is on the supposition that the stanchion is at right angles to the keel of the boat, and that the latter is horizontal.

Paint. Black.

Issue. Each machine in a packing case.

Proof. For inspection and proof of war rockets, see Regulations for Army Ordnance Services, 1901.

Life-saving Rockets.

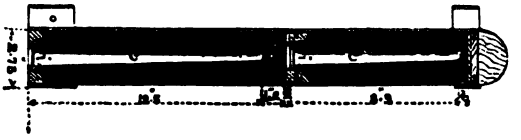
§ 10354. *Rocket, life-saving, Boxer, Mark VI,* | *L* | consists of body with pins and screws, 2 clips, front disc, head, and closing plug.

The body is of solid-drawn steel, in two parts, connected by a

wrought-iron or mild-steel connecting piece, which is secured to the front portion by pins and brazing, and to the rear portion by screws.

A wrought-iron or mild-steel base piece, threaded internally to receive a closing plug, is secured in the end of the rear portion by

Rocket, L. S., Boxer.



Section.

pins and brazing and burring over the edge of the case. The two parts of the body and the screws are blackened in burnt oil and the interior of the body receives three coats of white paint.

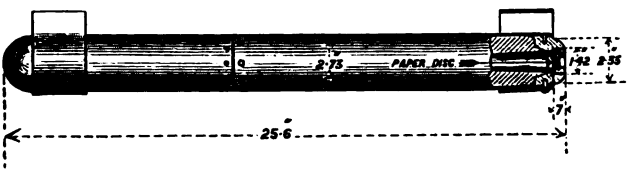
The clips for securing the stick are of sheet iron and connected to the body by screws.

The front disc is of wrought iron or mild steel, the head of wood, and the closing plug of gun metal. The latter has a square recess in the end to fit the G.S. key.

The composition consists of saltpetre, alder charcoal, and sulphur. This is pressed into pellets for convenience of handling and inserted into the front and rear parts of the body. A millboard disc is placed on top of the composition in the front part, the top of the disc and inner surface of case being coated with thinned luting. A lead disc, with its surface coated with thinned luting, is placed above the millboard disc, and above this the front disc which is subjected to pressure and secured to the case by screws. A conical cavity is formed up the centre of the composition as shown in the woodcut. The rear part of the body has the composition pellet at the top made quicker burning than the remainder, this is covered by a millboard washer with its upper surface, and the interior of the case, coated with thinned luting. Two lead washers, coated with thinned luting, are placed above. The two parts of the body are brought together, subjected to pressure, and secured by screws. A conical cavity is formed up the centre of the composition of the rear part and the bottom of cavity is covered by a paper disc, giving instructions to "break through before firing," shellaced on. The threads of the closing plug are slightly greased with thinned luting and the plug screwed in. The function of the plug is to ensure the rocket bursting, instead of being projected, if the composition should be accidentally ignited.

The front clip is secured by screws, and the wood head by tacks. The rear clip has its rear edge turned over the end of the body and the clip secured by screws.

Scale, $\frac{1}{6}$.



Marking. The numeral and manufacturer's initials, or trade mark, are stamped on the base piece, and the numeral and date of manufacture stencilled on the body.

Paint. Exterior of rocket, except the plug, painted red.

The reason for having the two rockets, one fixed in prolongation of the other, is to give great length of burning and continue the propulsion through a much longer period without any excessive strain upon the line.

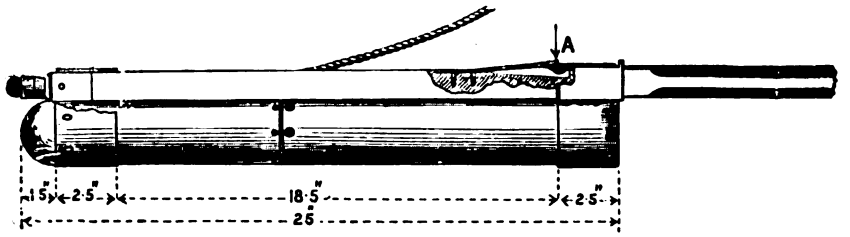
Earlier patterns. The Mark V differed from the above in being of mild steel, rounded, riveted, and brazed.

For details of Marks I, II, III, and IV, L.S. rockets, *see* previous editions of treatise.

Issue. Six rockets in a packing case.

§ 3988. Rocket, stick 9 feet 6 inches, Mark IV, | L | is of deal, square, with the corners rounded off. The upper part is recessed to fit close to the rocket, and has two iron plates, one close to the end, the other where the stick fits into the bottom clip. The latter has a flange to rest against the base clip of the rocket. Below this the rocket stick is plated with tin for a distance of 18 inches to prevent its being burned by the flame of the rocket. On the back of the stick is fitted in a slot a flat spring with a catch in such a position that when the front end of the stick is passed through the clips on the rocket, the catch springs up in front of the rear clip as shown in the cut, and prevents the stick from being pulled out again.

Scale ⅛.



The bottom end of the stick is bound with an iron ring, and the line is passed through a hollow in each end of the stick. After coming out through the top it passes through two indiarubber and one brass washer, and is secured by an overhand knot.

The indiarubber washers are intended to reduce the effect of the sudden jerk when the rocket is fired. A second knot is usually made in the rope near the hinder end of the stick in case the upper part of the line should be burnt through by the flame of the rocket. Marks I, II, and III were fastened to the rocket by an iron keep pin; and in the two first named the tin plating was only 14 inches long.

Earlier patterns. § 1985.

Miscellaneous stores. § 1271. The brass washer is 1 inch diameter, with a central hole ·5 inch diameter, and is ·15 inch thick.

The vulcanised indiarubber washers are 1 inch diameter, about ·75 inch thick, and have a central hole ·5 inch diameter.

Issue. Nine sticks in a bundle.

§ 10059. The *Machine Rocket, Life-saving, Boxer, Mark V* | L | consists of a bed to hold the rocket, in prolongation of which is fixed a pry pole, and from the rear end of which spring two legs, one opening to the right and one to the left. Both bed and pry pole are made of mild steel, the former being an open rectangular trough, the latter one of more rounded form.

The front end of the pry pole enters the bed, the upper edge of the former standing about ·2 inch above those of the latter, so that the bottom of the larger trough is beneath that of the smaller, to allow for the rocket resting in the bed while the stick lies in the

hollow of the pry pole. The two troughs are fixed together by three rivets on each side, the spaces between them on each side, owing to their difference of width, being filled up by a piece of wrought iron through which the rivets pass.

With the exception of a strengthening bar running from bed to pry pole, the rear end of the bed trough is left open beneath the front of the pry pole, so as to allow of a free passage to the gas escaping from the rocket base.

Two pieces of wrought iron are riveted along the after part of the sides of the bed, close to the angles formed with the bottom, their rear ends projecting sufficiently to allow of a bolt secured with a screw washer to pass through them, on which hinges a small flat piece of iron taking two other bolts screwed and nutted, and each long enough to allow of a socket (ending in flanges) which admit the flat iron between them to be hinged on it. Thus the flat iron hinges longitudinally on a bolt transverse to the direction of the troughs, whilst the leg sockets move transversely on hinges longitudinally placed. In each socket is fixed an ash leg with ferrule, having a foot projection and spike, while beneath the pry pole runs a strengthening bar from end to end, which is at the hinder extremity bent down to form a ground spike.

In both sides of the bed is cut an opening to admit of the entrance of a portfire to fire the fuze, and behind this is fixed a brass quadrant plate, on which is hung a plummet and line to give elevation.

Near the right foot is fixed by two screws a strong strap and buckle to enable the two legs and pry pole to be strapped together for more convenient stowage when not in use. The whole of the machine is made as free as possible from projections which might catch the line.

Mark IV differed from the above in the bed and pry pole being made of sheet-iron and in other minor details. § 2777.

Marks I, II, and III were fitted with a lock on the left side for firing the percussion quill tube which is now OBSOLETE, but as they have an opening on the right side of the bed, through which they can be fired by a portfire, they will not be withdrawn as long as they remain serviceable. § 2385.

One machine in a packing case. Issue.

The following combustible stores are also issued in connection with the life-saving rocket, viz.:— Other combustible stores.

Fuze Rocket, Boxer, Mark III. § 6490.

Light, Long, G.S., Mark I. When for use with the life-saving rocket, it is issued with metal handle. § 1017. § 1271.

Portfire, Life-saving.

A metal handle is issued with this portfire. § 1271.

Fuze, rocket, Boxer, No. 20, Mark III.—The exterior is conical to fit into the vent of the life-saving rocket. The body is of paper, 2·75 inches long, and is driven with composition, which burns 10 seconds. The exterior of the fuze is covered with kamptulicon. Over the priming there is a waterproof paper cap tied on with twine, which need not be removed before firing. § 6490.

Mark II was shorter and thicker, which caused a difficulty in fixing it in the vent of the rocket.

Mark I burns 5 seconds. §§ 1271, 2777.

The fuzes, &c., are issued in a *Box, Life-saving Fuze, Mark III*, of tin, which contains 12 fuzes, 12 indiarubber washers, six brass washers.

The lights are issued in a yellow deal box, closed with hinged lid,

secured by hasp and staple, called *Box, Life-saving Lights, Mark II,* which contains 12 long lights, two handles, and 15 G.S. primers in a tin cylinder.

A similar *Box, Life-saving Portfires, Mark I,* contains 24 portfires, two handles, and 30 G.S. primers in a tin cylinder.

Caution. The life-saving rocket must, like other stores of a similar nature, be treated with due care and respect. If accidentally ignited when pointed in the wrong direction, or when lying about on the ground, it may become a life-destroyer instead of a life-saver. A lamentable accident which happened some few years ago at Brighton points out the necessity for caution in dealing with these rockets as well as with any other combustible store. It is well then to remember that the life-saving rocket is not a mere firework, but a powerful missile, safe when used properly, but dangerous when accidentally or carelessly misused.

Range and accuracy. These rockets range from about 300 to about 470 yards, giving a mean range of about 375 yards, and a mean deviation of about 37·5 yards down wind.

Two points are to be considered in firing these rockets as regards their flight:—

1st. That the wind will carry the rocket and line with it, because it will not have the power to deflect its axis so as to point the rocket up the wind.

2nd. It is very desirable to start the rocket at a momentary lull. For if the first action of the wind carries the rocket to one side it will exert its force afterwards in prolongation of this incorrect direction.

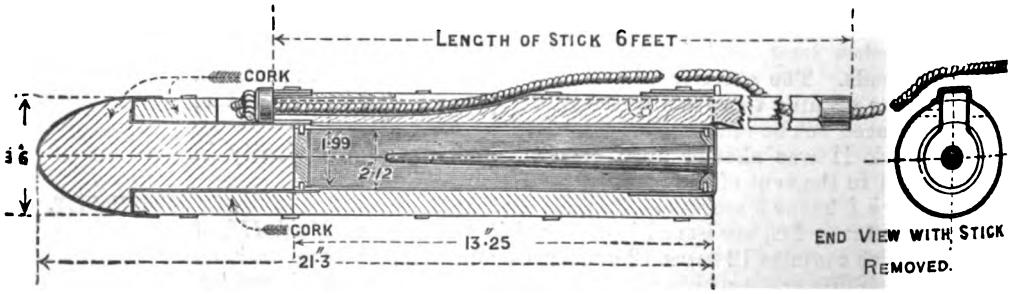
If the rocket machine be brought into action on uneven ground, causing the foot on one side to be lower than that on the other, or if one foot sink deeper than the other, as might occur in yielding sand, the effect will be to cause the rocket to carry towards the lower side.

Buoyant rocket. § 3634. *Rocket, Life-saving, Buoyant, Mark I.*—This rocket is issued to the Board of Trade. It is intended for use as a means of communication from lighthouses, &c., when unapproachable by boats owing to rough weather or from other causes.

The rocket consists of a cylindrical case of Atlas metal 2·12 inches in diameter, and 13·25 inches long. It has a single central vent. It is fitted at the side for a stick with rope attached, much in the same way as the Boxer life-saving rocket is fitted, but the stick is shorter (6 feet long) and lighter than that of the latter rocket. The body is covered with cork, and is furnished with a cork head, as shown in the cut.

Rocket, Life-saving, Buoyant, Mark I.

Scale, 2 inches = 1 foot.



Mark II only differs from the above in having the vent closed by a gun-metal screw plug similar to that used with the Boxer life-saving rocket Mark V, and with the same object. Inside the plug is a paper disc, which must be broken through after the plug has been removed with the G.S. key. Mark III is made of solid drawn tubing. § 4509. § 10616.

The rocket will carry a 1-inch or 1¼-inch coir line for a distance of about 100 yards, and then has buoyancy enough to float with the line attached in water.

The *Fuze Rocket, Buoyant, Mark I*, is of the same construction as that of the Boxer life-saving rocket, but smaller in diameter to suit the smaller vent. § 3634.

The *Machine Rocket, Life-saving, Buoyant, Mark I*, is of the same construction and size as that for the Boxer life-saving rocket, with the exception of the trough, which is wider and deeper, in order to suit the increased diameter. § 3634.

Signal Rockets.

The *Rocket, Signal, 1 lb. Service, Mark III*, has a case made of brown paper, rolled into a cylinder. The composition is driven by hand, and the conical hollow is made by a former placed in temporarily. § 4572.

A light paper case is attached to the head, terminating in a cone; this serves to contain the stars and some mealed powder which serves to open the case and scatter the 28 stars. The star chamber is separated from the rocket composition by some clay driven in at the top of the composition, having a central hole forming a communication; the rocket is choked near the base, and has a priming made up of L.G. powder and isinglass.

The vent is closed during manufacture by a wooden screw-plug, intended to reduce the area over which the destructive effect of the accidental ignition of a store of rockets would extend, as rockets so fitted will burst, instead of being projected in the usual way.

Marks I and II differed from the above in having no wood plug, the vent being secured by a paper cap, and from each other in the method of attaching the stick. In Mark I the copper socket, which is attached to all Service signal rockets, was fringed at the top, and when the stick was inserted in the socket this fringe was bent down so as to bite into the wood. In Mark II there is a notch in the stick and the socket, which is not fringed, has a small projecting piece of copper at the top which can be bent down into the notch. §§ 1709, 2436.

The composition is given on p. 553. The dogwood charcoal is used, as it gives more sparks, making a brilliant tail to the rocket. The stars consist of small pellets of composition (*see* p. 553). Composition.

The sticks are 8 feet 2 inches long, tapered to the end. For Naval Service, the stick is only about 1 foot 6 inches long, and has a rope tail 5 feet long. This is more convenient than the long stick for use in confined spaces, such as boats, &c. Stick.

The *Rocket, Signal, ½ lb. Service*, has followed the 1 lb. rocket in all its changes, and resembles it in every respect except in size, in having the paper case larger in diameter than the body of the rocket, and containing only 20 stars. ½ lb.

The sticks are tapered, and 6 feet 6 inches long. All signal rockets without wooden plugs issued since 20/7/67, have a label of directions pasted on their sides, with the words, "Before firing remove the paper cap over the vent of the rocket." Stick.

Issue.
§ § 4909, 5852.

Each rocket is packed in a tin cylinder, the lid of which is secured by a tape band shellaced on. Fifteen of these cylinders are issued in a deal box. The wooden screw plug referred to above is removed from the base of the rocket before the latter is placed in the cylinder.

The sticks are issued tied up in bundles of 50 or less, corresponding with the number of rockets.

Coloured rockets.

Rocket, Signal, 1 lb., Red, are made for the purposes of display. They resemble the Service signal rockets, but the heads are more rounded, and contain coloured stars.

These rockets are made in the ½-lb. as well as in the 1-lb. size, and to contain red, blue, or green stars.

Mark I resemble the Mark II signal rockets; Mark II have the wooden screw base plug.

The heads are in all cases opened by quick-match packed in with the stars.

Issue.

The 1-lb. size in whole metal-lined cases containing 42, and the ½-lb. 84 in a whole metal-lined case.

§ 4652.

The *Rocket, Signal, 1 lb., Red and White, Mark II,* differs somewhat from the above. It is the same in external form as the 1-lb. red signal rocket, Mark II, and has the head painted in longitudinal stripes of red and drab. It contains 25 red and 24 white stars. In order to avoid the danger involved in firing the other signal rockets over the heads of crowds, from the metal socket remaining on the rocket stick and causing it to fall swiftly point first like an arrow, the socket in this case is made of paper instead of copper, and contains at the top end a puff of powder which communicates by a fire-hole with the top of the composition, and is exploded at the same time that the rocket opens, and thus separates the stick from the case. Mark I of this rocket, which was not mentioned in "Changes," had this arrangement for ejecting the stick, but no wooden plug in the base. The red and white rocket is not made up in the ½-lb. size.

Sticks.
§ 7486.

The sticks for all coloured rockets are shorter and less tapered than those for Service signal rockets. The sticks for the 1-lb. red and white rocket are 5 feet long without a notch, the sticks for the 1-lb. red, blue, or green are 5 feet long with a notch, and the sticks for the ½-lb. red, blue, or green are 4 feet 2 inches long with a notch. The notch takes a tongue of metal in the socket, and so prevents the stick falling out.

Issue.

Sixteen red and white rockets in a packing case.

The sticks are issued in bundles to correspond with the number of rockets.

§ 4652.

Rocket Light, ½ lb., Mark II, and *Rocket, Sound, ½ lb., Mark II,* are issued to the Board of Trade.

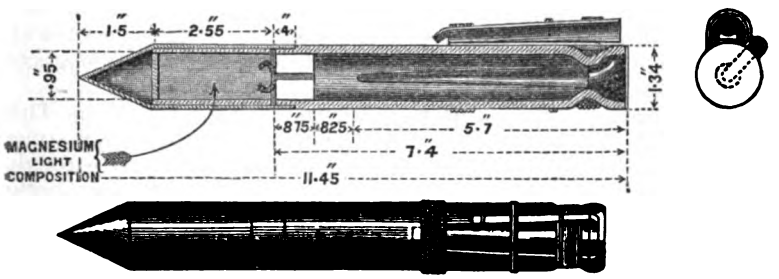
The body of the rocket proper, paper-case, and the fitting of the stick are similar to those of the ordinary ½-lb. signal rocket. They have, however, a different arrangement for firing. About 4 inches of safety fuze is laid up alongside the copper socket for the stick. One end of this fuze passes into the vent round the lower edge of the case; the other end, protected by a paper cap, may be ignited by a vesuvian or other convenient means.

The base of the rocket is closed by the usual wooden plug screwed in.

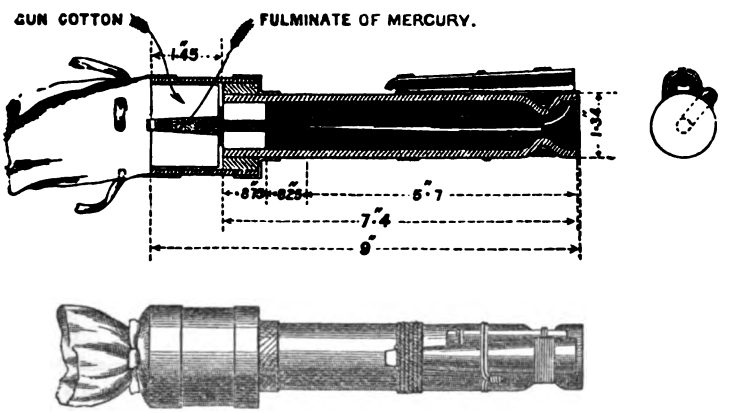
The light rocket has the head filled with a single star of magnesium light composition (*see* Table, p. 552) contained in a paper case, and matched and primed. It is ignited and blown off when the rocket has reached its maximum height. The star burns about 15 seconds.

The sound rocket has instead of a star a 2-oz. primer of dry gun-cotton, coated with paraffin, and a detonator. These are carried separate from the rocket and from each other until required for use. The head is a cylindrical paper case, rather larger in diameter than the body of the rocket. It has a piece of calico at the top fitted with a tape. When the gun-cotton is inserted into the head the calico and tape fasten it in, the calico being tied up by the tape like a bag. The detonator is a small tin tube, containing fulminate of mercury, and is ignited by quick-match passing into the top of the rock·t composition.

Rocket, Light, ½ lb., Mark I.



Rocket, Sound, ½ lb., Mark I.



Mark I of both rockets shown in the cut differs only in having no wooden plug, the vent being covered by a disc of paper only. Should the safety fuze get damp and refuse to act, the rocket may be ignited by a portfire after removing the plug or breaking through the paper covering according to the pattern. § 3329.

The stick used with these rockets is the same as that used with the ordinary ½-lb. rocket, but is 12 inches shorter, for more convenient firing in a restricted space, as the gallery of a lighthouse, &c.

The above rockets are intended for use in giving signals from lighthouses, lightships, &c. Use.

The *Light* and *Sound* rockets are packed in half metal-lined cases containing 42 of the former and 25 of the latter. Issue.

The above-mentioned signal service, light, and sound rockets are painted drab; the red, red and white, blue, and green signal rockets, also have the bodies painted drab, but the heads are painted the same Paint, and marking.

colour as given in the nomenclature of the rocket. They have the numeral, date of manufacture, and manufacturer's initials or recognised trade-mark stencilled in blue paint on the body. The latter is also stamped on the wooden plug along with the numeral.

A label showing the method of fixing the stick, &c., is pasted on the body.

Method of firing.

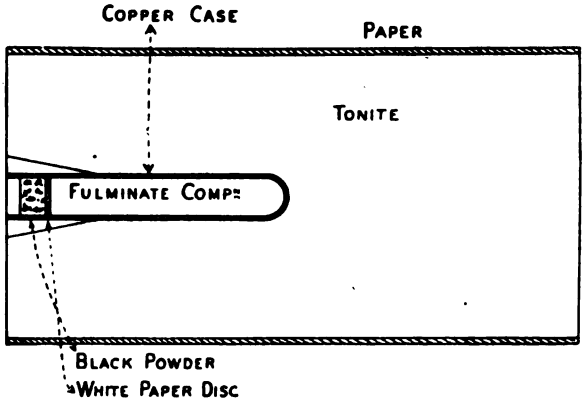
Signal rockets may be fired from a T-frame with cleats, from off a nail in a post, or even with the end of the stick stuck into soft ground, there is, however, a signal rocket-tube machine, for firing 1-lb. and ½-lb. signal rockets from boats, and under circumstances when the back rush of flame might do injury.

Rocket, Sound, Trinity House, charge Tonite, Mark I | N | .—This consists of 1,729 grains of tonite (equal parts guncotton and barium nitrate), recessed to receive a detonator. It is covered with paper, except the top and bottom. Dimensions, 2·95 inches long and 1·55 inches diameter.

Rocket, Sound, Trinity House, Detonator, Mark I | N | .—This is made of copper and is filled with fulminate composition (fulminate of mercury, chlorate of potash, and guncotton) strongly pressed in. It is primed with mealed powder, a disc of paper being placed between the mealed powder and composition. Dimensions, 1·25 inches long and 0·256 inch diameter.

Rocket, Sound, Trinity House, and Detonator.

Scale ½.



§ 1373.

The *Machine Rocket, Signal, Mark II,* consists of an oval tube of sheet iron (2·8 inches × 2·3 inches) to take the rocket with the portion of the stick at its side, a round tube of sheet iron being fixed on to it to take the remainder of the stick in its interior.

The two tubes are joined together by being entered into the opposite ends of a middle piece of gun-metal about 6·2 inches long, to which both are riveted.

The larger part of the finished tube is about 1 foot 8 inches, and the smaller 7 feet 6 inches long.

The metal at the mouth of the finished tube is wire edged, at the opposite end is a ground spike.

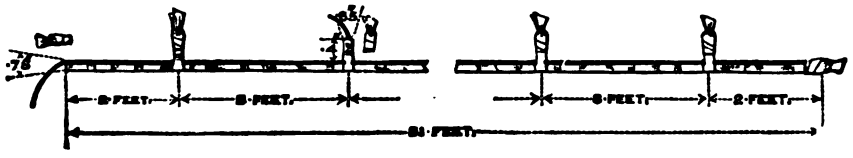
A vent is made in the close portion of the base of the oval tube opposite to the vent of the rocket to take a quill tube for firing, which is prevented from falling out when the tube machine is pointed up

into the air, by a hinged piece of gun-metal which shuts in behind its head.

A quill friction tube is used with this machine and is fired by the bell crank lever, lanyard, and toggle shown in the cut.

In Mark I machine the detonating cross-headed tube was used, which was fired by the blow on the side of its head given by a hammer worked on a hinge and made to descend by the pull of a lanyard, in a manner very similar to the hammer formerly fixed on guns fired by detonating cross-headed tubes.

A *Leader Rocket, Mark I*, for firing a number of rockets simultaneously has been approved. §§ 1675, 1793.



It consists of 9 short quick-match leaders projecting at right angles from a leader 34 feet long, which has 5 feet clear at each end. The "tubes" are of linen, painted on the exterior to preserve them from damp, and the projecting ends of quick-match are covered with caps of fine white paper.

For inspection and proof of signal rockets, see the Regulations for Army Ordnance Services, 1900. Proof.

The *Cartridge, Signal, Very, Marks II and III* are issued for signalling purposes and contain a single green, red, white or blue star. The cartridge consists of a brass case, rolled for Mark II, solid drawn for Mark III, lined with brown paper which projects beyond the mouth. The case is provided with a percussion cap and the charge consists of gunpowder. Above the charge is the star, the mouth of the case being secured by felt and cardboard wads. Very signal cartridges.

The portion of the lining, which projects beyond the case, is painted the same colour as that given by the star in the cartridge.

The rim of the base of the cartridge for a green star is smooth; for a red star is milled all round; for a white star is milled half way round and for a blue star is milled in opposite quarters.

When fired from a Very pistol, the star should ignite and rise to a height of 300 feet without breaking up, and should burn brightly for about 9 seconds.

For proof see Regulations for Army Ordnance Services, 1900. Proof.

Signal, Fog, Mark I | L | consists of two concentric compartments of tin each containing gunpowder. The inner one is fitted with three, and the outer with four percussion caps as shown in the woodcut. § 9395.

A clip of lead is soldered to the top by which the signal is attached to a rail.

In a tin cylinder containing 12. Issue.

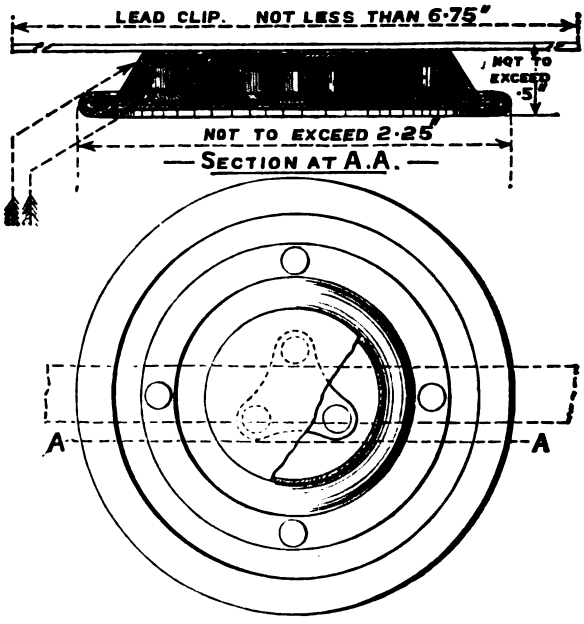
The cylinder is of tin with a lid closed by a bayonet joint, and it is furnished with tin D's to take a strap for transport purposes.

Lights.

The *Portfire, Common*, consists of a cylinder 16 inches long, and rather more than $\frac{1}{2}$ inch diameter. It is made of stout brown paper Common portfire.

Signal, Fog, Mark I | L |

Scale ½.



Plan, with outer cover removed.

pasted, rolled, and, when dry, turned it at one end to form a bottom. The empty case or cylinder is supported in a mould and driven with portfire composition, *see* p. 552.

The top has a small hole bored in the composition, and is primed with mealed powder to make it light easily. They burn from 12 to 15 minutes, and are generally lighted by a slow match.*

Issue. In bundles of 12, packed in deal boxes; the exposed ends are secured by a paper cap tied on with twine.

§ 1271. *Portfire, Life-saving.*—Differs from a common portfire in being 8 inches long, and in being made so as to ignite by means of a detonating primer in the same way as the G.S. long light, the end being closed by a paper cap, and strengthened by a tin band, perforated to take the detonating primer, which enters into a small space beneath the paper cap. The composition is primed in the usual method with mealed powder, perforated in the centre. This portfire is used with a metal handle similar to that for the G.S. long light.

§ 3893. *Case, containing Phosphide of Calcium, Mark I.*—This is a tin case painted red, about 8 inches long and 2·725 inches in diameter. The

* They may be lit also by any means handy, as a vesuvian, a burning stick, &c. In the field, if no other means are handy, put a friction tube on the ground, under a brick or stone, leaving the ends out. With one hand pull the lanyard to ignite the tube, keeping the stone firmly pressed down under the foot, and with the other hold the end of the portfire to the end of the tube, so that the flash of the latter may ignite it.

top is curved and has a small hole in the centre. The case holds 12 oz. of the phosphide. The small hole is closed by a copper plug lightly soldered in, so as to make the case air and water tight.

Two cases are used with each life-buoy, and are contained in brass holders attached to the bottom of two vertical tubes, one on each side of the *standard* of the lifebuoy. The holders are fitted with hinged doors fastened by pins secured by short pieces of chain, and are perforated round the lower part with two rows of small holes, nine in a row. Buoys, life, night, fitted for. § 4022.

Two short copper wire lanyards, fitted with small iron balls at one end and short steel screws at the other, pass through small holes in a fitment fixed to the side of the ship.

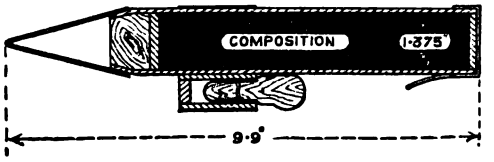
The screws are fastened into the copper plugs in the cases containing the phosphide.

When the life-buoy falls from the side of the ship the lanyards run through the holes in the fitment until they are brought up by the iron balls. This pulls out the copper plugs in the top of the tin cases, which float below the surface of the water and into which the latter enters through the perforations in the side of the brass holder and the hole in the top of the tin case. The gas produced inside the cases passes up the tube and shows a flare at the top for about half an hour. Action.

Light, Coastguard, Mark II, | *N* | burns about five minutes. The spike at the end is to enable the light to be stuck in the ground, as a man holding it might be fired on. Coastguard light. § 1724.

The composition (*see* p. 552) is contained in a paper case fitted with Brock's patent igniting arrangement. A wooden plug with composition at one end is contained in a paper cylinder attached to one side of the light. The top of the light is primed with composition and covered and protected by a paper disc. To ignite the light tear off the disc, pull out the plug, and draw its primed end smartly across the exposed surface of the light, holding the latter so that it points away from the body. § 6911.

Light, Coastguard, Mark II, | *N* | .



Issue.

One in a tin cylinder.

Case, light, coastguard, Mark II | *N* | is made of leather cylindrical in shape and is fitted with a leather cap or lid. The case is provided with a loop and stud, to enable it to be carried on the waistbelt. §§ 9972.

A small thong is sewn on the case and secured to the lid to prevent the latter being lost.

The case will hold one coastguard light with its tin cylinder.

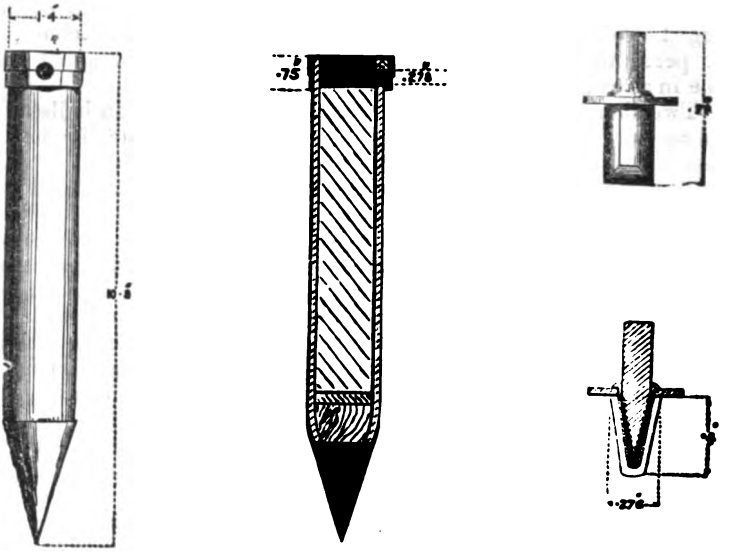
The Mark I differs from the Mark II coastguard light in its means of ignition. The cap of this light need not be removed before lighting. The top of the composition is primed with mealed powder and the flash blows off the cap.

The light is ignited by placing a G.S. primer in the hole in the head marked with a black dot, the wedge-shaped paper-covered part G.S. primer. §§ 1271, 1725.

of the primer is inserted, and the pin projects; a sharp blow struck with this pin on a hard substance ignites the light.

Issue. In tin cylinders containing four.

Light, Coastguard, Mark I. *G.S. Primer.*



The primer (*see* cut) is made on a similar plan to the head of the copper friction tube, the pin is roughed and coated with the friction tube composition, and the blow driving it through the wedge-shaped copper case explodes it. The case is open at one end and protected
§ 1725. by varnished paper. Primers are issued in tin boxes holding 5, 10, or 15.

§ 1271. A *Primer, Portfire, Life-saving*, similar in construction to the G.S. primer, only smaller, is issued for igniting the life-saving portfire.

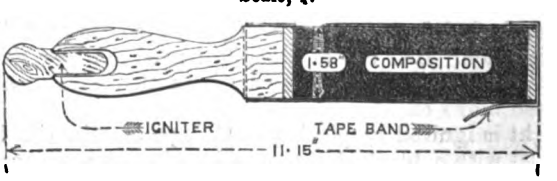
§§ 6911, 7719. *Light, Long, G.S., Mark II*, burns about five minutes. It has a wooden handle fixed to it containing a wooden plug coated with Brock's composition. It is fired the same way as the Mark II coastguard light.

Light, long, G.S. The Mark I light is ignited by G.S. primer as described with coastguard light; it has about $6\frac{1}{2}$ inches of the same composition. A
§§ 1271, 1721, 1726, 8654. hollow wooden handle with a screw at the end holds eight primers, the handle fits into the projecting socket of the light and is fastened by a wooden pin which is tied on to the handle. The old long light was lit by a cap.

They are used for signalling and illuminating, both in L.S. and N.S., and also in connection with the life-saving rocket apparatus; but in the latter case they are used with a hollow metal handle

Light, Long, G.S., Mark II.

Scale, ¼.



closed by a screw cap, to which is hinged a copper covered piece of wood, pierced with seven transverse holes to contain one primer each.

In tin cylinders containing one. They formerly were packed four in a cylinder. Issue.

Lights, Long, Blue, Green, and Red, Mark II burns as follows, blue and red lights from 2 to 2¾ minutes, the green light from 1½ to 2¼ minutes. Externally, except paint, they are somewhat similar to the G.S. long light, Mark II as regards method of ignition, &c. § 6911.

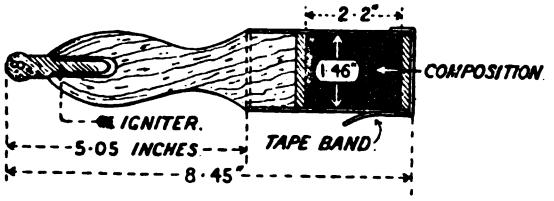
The Mark I lights differed in the igniting arrangements, having fuze composition primed with quickmatch at one end, covered with a calico and paper cap twisted to a point, and they had solid wood handles. § 5658.

Light, Short, G.S., Mark I, | N |, burns from 1 minute 30 seconds to 2 minutes; its method of ignition, &c., is the same as the long light, Mark II. It has about 2¼-inches of composition. § 10390

In tin cylinders containing one. Issue.

Light, Short, G.S., Mark I | N | .

Scale ½.



Light, Signal, Magnesium, Mark II, burns one minute with a very brilliant white flame; its method of ignition, &c., is the same as described with the long light *Mark II*, it has about 2¼ inches of composition. The handle is the same as that for the long light. They are to be used up for signalling or illuminating, and are obsolete for future manufacture. Light, signal, magnesium. § 1723. §§ 6911, 7719.

The Mark I is similar to the Mark I long light.

In tin cylinders containing one. Issue.

No more magnesium lights will be made, and they will become obsolete when the existing stock is used up. § 10390.

The above-mentioned lights, except lights blue, green, and red, are painted drab, and have the name, numeral, and date of manufacture, stencilled in black paint on the body. The blue, green, and red lights are painted the colour they will burn and have the numeral and date of manufacture stencilled in white on the body. They all have the date of manufacture, manufacturer's initials, and numeral stamped on the handles. Paint, and marking.

A label giving directions for lighting, &c., is pasted on the body.

Light, Illuminating Wrecks, Mark IV.—The present pattern of this light is 2·65 inches diameter and about 30 inches long. It is made up of 10 rings of sheet iron, each about 3·25 inches long. One end of each ring is increased in diameter so as to form a cap to fit over the other end of the next ring, to which it is attached by solder. At the point where the enlargement begins there is an internal diaphragm in each ring having a central hole 2·1 inches diameter, the function of which is to prevent the composition burning up the side. Each ring is filled with composition (*see* p. 552). §§ 2488, 2723, 2839, 3727, 4099.

A small hole is made in the adjoining faces of the composition to

ensure the continuous burning of the whole, and the faces are themselves roughened with the same object.

One end of the light is fitted with a hemispherical piece of wood, through which passes a loop of iron wire, by which to suspend the light from the stand when burning, as shown in the cut; the other end is primed with mealed powder and covered with a disc of millboard and a cap of kit plaster.

§ 2488. *Stand, Light, Illuminating Wreck, Mark I*, is a simple tripod, consisting of three wooden legs, about 6 feet in length, connected at the top by a piece of iron wire, having a small hook attached to it, on which the light is suspended; there are three iron rods which are hooked to and connect two of the legs, forming an incline for the light to rest on, so as to hang in a sloping direction, not vertically downwards.

The light, if hung as described, clears itself of dross when burning, and is kept further clear by the case separating each joint, as the heat of the burning composition successively melts the soldering of the rings.

The light burns from 22 to 33 minutes. Some of the earlier patterns burned rather longer, but were liable to go out if not attended to. Mark I was made of tin instead of sheet iron; and must be handled with care, as it is liable to break at the junction of the rings, which are connected only by a tin band soldered over adjacent ends.

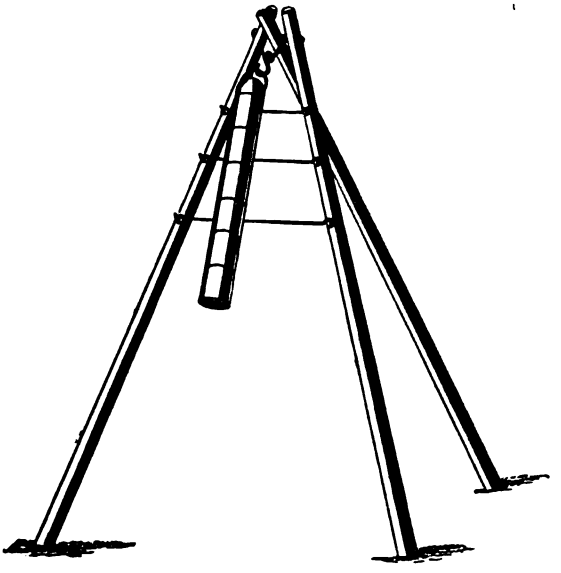
Paint. Red, the enlarged diameters of the rings being painted white and forming rings of that colour on the red ground. The object of this is to distinguish it from the life-saving rocket, which it nearly resembles in size.

Issue. In packing cases containing three each.

Proof. For inspection and proof of lights see the Regulations for Army Ordnance Services, 1900.

Quick-match. *Quick-match* is made of cotton wick boiled with a solution of

Stand, Light, Illuminating Wreck, Mark I.



mealed powder and gum, and afterwards dusted over with mealed powder before it is quite dry. For proportions, *see* Table, p. 553.

Unenclosed it burns at the rate of about 1 yard in 13 seconds; when enclosed in a tube of any kind it burns much more rapidly, the pressure causing the gas to rush forward and fire the whole length practically simultaneously. Quick-match is made up in paper or calico tubes when this rapid action is required, and when so made up is termed a "leader."

The proportions of powder, &c., vary with the number of threads in the wick. Quick-match is largely used for priming fuzes, &c.

Either in packing, or metal-lined cases, it should be demanded by weight. Issue.

Slow-match is made of pure hemp slightly twisted and boiled in a ley of water and wood ashes in the proportion of water 50 gallons, wood ashes 1 bushel; this serves for 100 lb. of yarn. It burns at the rate of 1 yard in 8 hours; it is used for lighting portfires, &c. Slow-match may be equally well made by boiling in a solution of 8 oz. saltpetre to 1 gallon of water. Slow-match.

Loose, in skeins or parts of skeins, placed in a case with other stores. When large quantities are demanded it is issued in bales or casks. It should be demanded by weight; about 4 yards go to 1 lb. Issue.

Fuze, Safety, No. 9, | *C* |, consists of a train of F.G. powder enclosed in jute yarn covered by waterproof tape. §§ 4513, 7515, 9391.

Fuze, Safety, No. 7, differs from No. 9 only in being without the additional outer covering of waterproof tape.

Both should burn when dry and in the open air at the rate of 60 to 75 seconds per yard. They are easily ignited by a portfire or vesuvian, but not always by a lighted piece of paper. To prepare the fuze the gutta-percha must be removed by an oblique cut, and the powder laid bare, both at the end in contact with the charge and at that which is to be ignited. It is also ignited by the pistol mentioned below, in the R.N., under certain circumstances.

Old fuze should be tested before use as it sometimes deteriorates, and instances have occurred where it has burned much too rapidly.

In tin cylinders containing 8 fathoms each. Issue.

N.B.—*Fuze, Safety*, was formerly called *Bickford's Fuze*, but the name was altered by W.O. authority, 10/5/80.

Fuze, Safety, Tangye's, Mark I, | *L* | consists of a core of lead piping containing composition, surrounded by jute yarn bound with cotton. When dry it burns in the open air 70 to 80 seconds a yard. It is painted white. § 7425, 9391.

It is obsolete for future manufacture, the existing stock will be used up at home stations.

In tin cylinders containing 8 fathoms. Issue.

Fuze, Instantaneous, Mark III, | *L* | consists of two or more strands of quick-match, enclosed in a tube of waterproof tape, round which cotton is twisted, the whole being contained in a gutta-percha covering. The gutta-percha covering is braided with yellow worsted and varnished red on the outside, it burns at the rate of about 30 yards per second, or practically it is instantaneous. It can easily be ignited by a portfire or vesuvian, but it is unsafe to hold it in the hand like the safety fuze when lighting it. §§ 6052, 7188. § 3630.

Mark I, which differed only in minor details, may be known by its being unpainted. It can be distinguished from safety fuze by the snaking of yellow worsted. Mark II is obsolete. § 8399.

It is issued in 100 yards lengths on a wood reel, packed in a zinc box. Issue.

Instantaneous fuze is used by the Royal Engineers in connection with No. 8 detonator. It is fired with a special pistol which was formerly used in the Royal Navy for the same purpose, but as the use of instantaneous fuze has been discontinued for naval service, and the pistol with its cartridge were retained for igniting safety fuze instead, the nomenclature of both is as shown below.

§§ 3868, 4272, 6757. *Pistol, B.L., Safety Fuze, Mark IV,* | *N* | , has a split cramping tube inside the brass barrel which secures the fuze when the barrel is screwed home on the body.

Cartridge, Pistol, Safety Fuze, Mark I, | *N* | is a solid drawn brass case with a cap chamber formed in the base, containing an ordinary pistol cap and anvil such as are used with the Service revolvers (*see* p. 406). The cap chamber has one firehole. The charge is 3 grains of R.F.G. powder. On the top of the charge is a thin glazed millboard washer covered with a disc of white fine paper, secured by turning over the edge of the case all round and coating it with shellac varnish. They are issued in tin cylinders, each containing 25 cartridges.

War and life-saving rockets for storage are placed in Group II, Division III.

Signal rockets, lights, primers, light, G.S., and portfire, L.S., and safety fuze for storage are placed in Group II, Division I.

Fuze instantaneous and quickmatch, for storage are placed in Group I, Division I.

APPENDIX.

EXTRACTS FROM REGULATIONS FOR MAGAZINES, 1899.

Nomenclature of Magazines and Stores.

"*Magazine.*"—Building or buildings with passages leading thereto, in which powder and cordite in bulk, filled cannon cartridges, forming the equipment of three or more guns, and other explosives detailed in Group I, may be stored, and which should be under magazine conditions.

"*Main Magazine.*"—The principal magazine in a work or battery in which there is more than one magazine.

"*Store Magazine.*"—A magazine in charge of the Army or Naval Ordnance Department.

"*Shifting Lobby.*"—The chamber or portion of the entrance passage to be devoted to putting on or taking off magazine or laboratory clothing. Any portion on the clean side of the barrier is subject to magazine conditions.

"*Magazine Entrance.*"—The entrance provided with a shifting lobby, through which those going to the magazines must pass. Where there is more than one they must be distinguished by their positions, thus—"North Magazine Entrance"; "West Magazine Entrance."

"*Ammunition Entrance.*"—The entrance to the magazine for ammunition only.

"*Magazine Store.*"—A chamber within a magazine (if provided), in which the hides, wadmiltilts, and spare magazine clothing may be kept.

"*Ammunition Store.*"—A building in which explosives in Group II are, and those in Divisions III, IV, and V, Group I, may be stored, and which should not be under magazine conditions.

"*Cartridge Store.*"—A chamber in a work in which filled cannon cartridges forming the equipment of a gun or group of guns are stored, and which should be under magazine conditions.

"*Shell Store.*"—A chamber in a work in which filled shells or explosives in Division III, Group II, p. 444, are stored, and which should not be under magazine conditions, unless it and adjacent cartridge stores have a common entrance.

"*Fuze and Tube Store.*"—A chamber appropriated for storing fuzes and tubes, or other explosives given in Division I, Group II, p. 444.

"*Powder Passage.*"—A passage along which powder or cordite (in cartridges or in bulk) is transported.

"*Shell Passage.*"—A passage along which shells are transported.

"*Ammunition Passage.*"—A passage along which both natures of ammunition are transported.

"*Lighting Passage.*"—A passage by which access is gained to the lamp recesses.

"*Cartridge Serving Room.*"—A chamber on or about the same level as the gun, into which the cartridge lifts lead, and from which the service of cartridges is conducted.

"*Shell Serving Room.*"—A chamber on the same level as the gun, into which the shell lifts lead, and from which the service of shells is conducted.

"*Cartridge Recess.*"—A small receptacle for the storage of a few cartridges for the immediate service of a gun.

"*Shell Recess.*"—A small receptacle for the storage of a few shells, fuzes, and tubes for the immediate service of a gun.

"*Issue Hatch.*"—An opening through which filled shells or cartridges are passed.

"*Shell Issuer.*"—A hatch or opening in a wall through which shells are passed.

"*Cartridge Lift.*"—A lift up which cartridges are hoisted.

"*Shell Lift.*"—A lift up which shells are hoisted.

"*Ammunition Lift.*"—A lift up which both cartridges and shells are hoisted.

"*General Lift.*"—A larger description of lift, through which powder in bulk may be passed, and projectiles returned to store after drill.

"*Laboratory.*"—A building or buildings, with passages leading thereto, in which all the operations connected with the examination, filling or emptying of shells or cartridges are carried on, and which should be under magazine conditions.

"*Head Quarter Laboratory.*"—A laboratory, the operations in which are carried out under the superintendence of an inspecting ordnance officer or such other laboratories as may be so classed under special W.O. authority.

"*Inner Room of Laboratory.*"—A room in the laboratory in which shells or cartridges are filled or examined.

"*Outer Room of Laboratory.*"—A chamber attached to the inner room in which shells or empty cartridges are finally examined before filling, shells are marked after filling, or packages are closed, secured and marked.

"*Shell Emptying Room.*"—A building under magazine conditions in which shells are emptied.

"*Receiving Hatch.*"—An opening in the door or wall of a cartridge or shell-filling room, through which empty shell or powder or cordite in bulk is passed.

"*Examining Room.*"—A chamber at, or near, the entrance to the enclosure surrounding the magazine, through which all barrels, cases, &c., are passed for external inspection, previous to their admission into the magazine, and which should be under magazine conditions.

"*Empty Barrel Store.*"—A chamber for the storage of empty barrels and cases.

"*Lamp Store.*"—A chamber or place in a fort or battery allotted for the storage of lamps, and for the use of the lampman.

"*Cooperages, Workshops, &c.*"—Such buildings connected with magazines, where explosives are not dealt with, are not to be kept under magazine conditions.

"*Tropical Stations.*"—The following are tropical stations:—

Barbados.	Mauritius
Bermuda.	St. Helena.

Ceylon.	St. Lucia.
China.	Straits Settlements.
Egypt.	West Coast of Africa.
Jamaica.	

The following instructions, although not actually forming part of the Regulations for Magazines, &c., are of such importance that it is considered desirable to make them as widely known as possible, and they are therefore embodied herein as a preface to these Regulations for the information of all concerned:—

Locality of Store Magazines.

The general principles that should govern the arrangement of new establishments are as follows:—

A site should be chosen remote from residences and populations, and from embankments for preventing inundations, as well as from property of value which might be injured by an explosion; the site should also afford easy communication to and from it by water.

No public thoroughfares, or buildings having chimneys, should be permitted in the vicinity of the magazines or works; and such an extent of land should be acquired round the magazines as would preserve the isolation of the site and prevent danger from extraneous causes.

Two points should be considered in the question of isolation of magazines, and their distance from other buildings, viz.:—

I. The danger to a magazine arising from too close proximity of other buildings.

II. The danger to those buildings from the effect of the explosion of the magazine.

In certain favourable conditions as regards freedom in selection of sites and proper extent of land available, the best protection is afforded by intervening heights of ground; or failing that, much protection is afforded by massive traverses of earth; and lastly, close plantation of trees will considerably reduce the effects of explosion.

Care should be taken that the subsoil is not of a slippery or treacherous character, particularly when heavy traverses have to be constructed.

As regards the distance at which houses or buildings in which fires are used should be permitted, 200 yards may be generally assumed sufficient. In all new storage magazines, however, except under special conditions where the exigencies of the service do not permit, the rules and regulations of the Home Office regarding the distances of such buildings from one another and from other buildings should be adhered to.

Store magazines should not be within a fort or battery, except for special reasons dictated by the requirements of security.

Construction of Store Magazines for Gunpowder.

The number of barrels each separate magazine should contain should not exceed 8,000, the bays being constructed to take, say, 228 barrels, viz., 8 high, 10 in length, and 3 in depth; provision being made for travellers to stack the barrels. The passages should

be of sufficient width to allow of a narrow tramway being laid down, so as to lessen the amount of handling as far as possible. In store magazines in which packages exceeding 200 lb. in weight have to be dealt with, special arrangements for lifting, moving, and storing must be provided.

The buildings should be solidly constructed with an arched roof, the sides and ends of the magazines should be battened up to spring of arch, and the roof rendered in cement. In any new storage magazine for gunpowder, wood should enter into the construction as little as possible. A suitable asphalt, devoid of grit, is well adapted for floors, and a rendering of "neat" cement for linings. Removable wooden dados may be provided to prevent the cement becoming detached by packages knocking against the walls.

Store Magazines for Cordite in bulk.

As a general rule the quantity of cordite to be stored in any one magazine building should be limited to 100 tons.

The magazines for cordite in bulk in wooden boxes should be of as light a form of construction as possible compatible with sufficient strength for stability, resistance to weather and unlawful entry; and the material used must not be of an inflammable character. The buildings should be also of such construction that the internal temperature can be maintained between 45° and 120° Fahrenheit.

Magazines in Fortresses and Defensive Works, including Expense Magazines.

These magazines from their position must usually be more or less exposed to an enemy's fire. They must therefore be of sufficiently strong construction to keep out projectiles. If not so exposed, and if space allows, the instructions laid down for store magazines will apply equally to them. They should be traversed so far as possible.

The use of Iron in or near Magazines or Laboratory Buildings.

In buildings classed as "clean," that is, which are under magazine conditions, all rails and their fastenings, as also the fastenings of floors, all hinges, bolts, locks, keys, and window fastenings should be of wood, copper, or copper alloy, but bars outside windows may be of iron. Precautions should be taken to prevent metal fastenings of roof from falling accidentally into the buildings.

Trucks when used in such buildings should have wheels and their fastenings of copper or copper alloy.

All rails inside a magazine enclosure, but outside of the "clean" buildings, may be made of iron. All trucks used on these rails may have iron wheels and fastenings, provided arrangements are made to prevent them entering the "clean" buildings.

Travellers or cranes:—

Inside.—Standing parts may be of iron, but in the case of new travellers and cranes, the iron will be galvanized. All working parts should be of copper or copper alloy, or of wood or rope. Where iron work is galvanized, it should be frequently inspected, in order to detect any wearing away of the outer surface.

Outside.—On piers, wharfs, &c., iron may be used for both standing and working parts.

Steam or Hot-Water Apparatus.

Steam at a pressure not exceeding 15 lb. to the square inch or hot-water warming apparatus may be used in magazines and laboratories. The pipes may be of iron, but they should, if possible, be fixed at a height of not less than 6 feet 6 inches above the floor. They need not be galvanized, nor otherwise coated, nor boxed in with wood, but should be quite detached from the walls, and not less than 6 inches from any timber work. They should be frequently wiped so as to prevent an accumulation of dust.

Doors and Windows.

All doors and windows of buildings under magazine conditions should be made to open outwards.

Copper sheeting for magazine doors and windows may be dispensed with, provided that the portion of the platform abutting upon the door be made removable for a length of 6 feet. When doorways are protected by rope mantlets the latter will be soaked with a solution of chloride of calcium.

Regulations regarding construction of Magazines and Partitioned-off Spaces for transport of combustibles on board ship.

Magazines and partitioned-off spaces must be so placed that their doors open out to a hatchway.

No iron of any sort is to be used in their construction, and no fastenings but copper or metal nails. All iron inside is to be carefully covered with wood.

All feather-edge boarding is to be an inch on one edge and ¼ of an inch on the other, and to lap over 2 inches.

When any part of the ship's side is in the magazine or partitioned-off space and there are cargo battens fitted, feather-edge boarding is to be nailed against them, but in their absence, uprights 3 inches square are to be fitted against the side 3 feet apart, and the feather-edge boards nailed against them.

The whole of the floor is to be covered with feather-edge boarding.

The top is to be made of feather-edge boarding securely nailed, running along under the beams, and secured as directed by the Surveyors.

Magazines.

The bulkheads are to be made of fir uprights 3 inches square, placed 3 feet apart, running from deck to deck, firmly secured top and bottom, covered on the inside with 1-inch boards placed close together, running from upright to upright, and securely nailed with 3-inch nails, three to each board on each upright. The outside to be covered with feather-edge boards. The covering is to be from deck to deck, and to fit closely between beams.

Scuttle to magazine to be 3 feet by 3 feet in the clear, sliding door to be 3 feet 8 inches by 3 feet 8 inches, made of two parts of 1-inch boarding crossed and nailed with 2½-inch copper nails through and turned.

Door to work between two rabbeted cant pieces of 3 inches by 3 inches, to be fitted on outside of bulkhead with four 5-inch copper nails to each cant piece, driven through and turned before the inside 1-inch boards are put up.

Two cants of 3 inches by 3 inches secured as above to act as stops.

A hinged metal hasp to be well secured to door, and a metal eye to be clinched through stanchion, with a good metal padlock and key to secure it.

A hinged metal handle to be fastened on outside of sliding door for opening and shutting.

When any quantity over 30 tons is to be placed in one magazine, uprights, 3 inches wide and 2 inches thick, are to be fitted from deck to deck, and so placed, 3 feet apart, that not more than about 20 tons (as near as can be managed without breaking stowage) is in one undivided space.

When a magazine runs right across the vessel, uprights must be placed 3 feet apart along the centre line (fore and aft), and across the deck from side to side every 12 feet of the length.

Should the height of the proposed magazine exceed 8 feet, the construction will be specially determined by the Surveyors.

Partitioned-off Spaces.

In partitioned-off spaces, the uprights will be just the same as for magazines, but they will be boarded up on the inside with 1-inch boards, placed close together, running from upright to upright, and securely nailed with three 3-inch copper nails to each board, to each upright. Doorway to be 2 feet 10 inches wide, 3 feet 3 inches high, and door of 3 feet by 4 feet, made of two parts of 1-inch boards, crossed and fastened with 2½-inch copper nails, points well turned, to work between two uprights in a groove at the upper end formed between the lining, and an inch board 9 inches wide securely fixed to uprights, the lower end secured by a metal hasp and lock. In the case of filled shells, 3-inch deals are to be used, and extra deals for side supports are to be added when necessary, these to be properly cleated and secured to the satisfaction of the Surveyors.

Magazines and Partitioned-off Spaces built on Cargo.

When it is necessary to build magazines or partitioned-off spaces on the cargo, the selected space is to be levelled off and the bottom formed of 3-inch by 3-inch quartering, placed 2 feet 6 inches apart, covered with 1-inch boarding securely nailed and then covered with feather-edged boards properly nailed. Uprights, 3 inches by 3 inches, 3 feet apart running from the boards to the deck above, to fit taut and to be well driven in, cleated at the bottom and well tommed off at the top.

Remainder of magazine or partitioned-off space to be as detailed above.

Box or Portable Magazine for any Quantities up to two tons.

(Size in accordance with the dimensions of the packages to go into it.)

A frame to be made with 2-inch by 3-inch quartering, floored and boarded up on the inside with 1-inch boarding, nailed with metal nails. Lid to be fitted with cleats on the inside to keep it in its place when shipped.

CLASSIFICATION OF EXPLOSIVES.

For purposes of storage and transport all service explosives are classified as in the following table, and all packages* containing

* By package is meant:—
(1) Boxes or packing cases containing cylinders, boxes, or cases of explosives.
(2) Barrels, boxes, cases, and cylinders containing cartridges, shells, rockets, or any explosive in bulk.

explosives will have a classification label showing the group and division to which the contents belong, and also one with "Government Explosives" in red round a broad arrow, which should be placed so that it will be torn or removed in opening the package. Packages with this "Government Explosives" label are not subject to the Explosives Act as regards packing or quantity of explosive in a package. Any packages that are not already labelled will have the labels attached to them before issue from any store.

Classification of Explosives.

Group.	Division.	Stores.
I.	..	***Explosives which must be placed in a magazine, each division in a separate compartment, in which magazine conditions must be observed, except that Divisions I and V may be placed in the same compartment, and Divisions III, IV, and V may be placed in an ammunition store (vide page 437) not under magazine conditions.***
	I.	Cordite in bulk.
		Ballistite.
		Gunpowder, except that which has been wetted.
		Cannon cartridges filled with gunpowder or cordite, except Q.F. cartridges but including Q.F. saluting charges.
		Puffs, powder.
		Bags, primer, filled.
		Charges and primers, impulse torpedo.
		Fuze, instantaneous.
		Quick match.
		Stars, incendiary.
	II.	Guncotton, dry.
		Picric powder.
		Dynamite.
		Blasting gelatine.
		Tonite.
		Gelignite.
	III.	Guncotton, wet (except in mines).
		Picric acid.
		Lyddite.
	IV.	Filled Q.F. cartridges, 6-pr., and 3-pr., 1-pr., and 2·95-inch, service and saluting, when complete.
	V.	Filled Q.F. cartridges, 12-pr., and above, packed in metal or metal-lined cases or boxes, and cartridges, impulse torpedo.
II.	..	***Explosives that must be stored in shell, small-arm, mine, or fuze and tube stores, but not in magazines.***
	I.	Balls, light, parachute.
		Bursters, segment shell.
		Caps, percussion.
		Carcasses.
		Cartridges, small-arm „ machine gun „ aiming tube „ signal, Very. } which are safety cartridges.
		Cases, cartridge, quick-firing, capped and empty.
		Composition, priming.
		Fuzes, time.
		„ percussion.
		„ time and percussion.

Classification of Explosives—continued.

Group.	Division.	Stores.
		Fuzes, electric.
		„ safety.
		Match, slow.
		Portfires.
		Primers, light, G.S., and portfires, life-saving.
		„ electric.
		„ shrapnel shell.
		„ vent.
		Rockets (except war and life-saving).
		Service lights of sorts.
		Tubes, electric.
		„ friction.
		„ percussion.
	II.	Gunpowder, wetted.
		Mines and countermines, containing wet guncotton only.
	III.	Shells, filled and fuzed.
		Rockets, war and life-saving.
		Shells, filled, but not fuzed.
	IV.	Detonators.
		Matches, Vesuvian.

Classification labels.

On the classification labels Group I will be denoted by a red disc, and Group II by a red diamond, the number of the division being in each case shown in the centre the same colour as the paper on which the group mark is printed. For naval explosives the labels will be printed on white, for land service on blue paper.

A list of the explosives which may be placed in each compartment of a magazine or store will be attached to a board and hung up at the entrance of the compartment. Copies for this purpose, printed on Army Form G 884, will be supplied on demand.

General Regulations for Magazines and Ammunition Stores.

Explosives in Divisions I and II, Group I, will always be stored in magazines or buildings under magazine conditions, which will be vigilantly guarded by day and night.

Explosives in Group II are *not* to be stored in magazines, but in ammunition stores which are not under magazine conditions; paras. B, C, and J will, however, apply to all such buildings, and no unauthorized person will be allowed to enter them. Local arrangements will be made for the safe custody of these buildings. Explosives in Divisions III, IV and V, Group I, may be stored the same as Group II, or in magazines, whichever is most convenient.

No two divisions in either group are to be placed in the same compartment of a magazine or store without special authority, except Divisions I and V, Group I, which may be stored in the same compartment of a magazine, and fuzes and tubes for the equipment of guns, which may be kept in the expense shell stores adjoining the guns, provided that a cupboard or box, to contain them only, is fixed in the expense shell store above the shells.

Different compartments of a store or of a magazine containing different divisions, may be under one roof, provided they are separated by a substantial brick wall, without any opening in the same.

The various explosives in any one division may all be stored in

the same magazine, compartment, or store, as the case may be. The maximum amount of explosives of Divisions I and II, Group I, to be stored in any magazine must be determined locally, with regard to surrounding buildings, &c., and must in no case be exceeded. It should be posted in a conspicuous place in the magazine.

The following explosives, being affected by high temperature, should not be stored in magazines the temperature of which exceeds 120° F.:—

Dynamite.
Blasting gelatine.
Ballistite.
Tonite.

The following, though capable of standing considerably higher temperature, should not be stored in magazines, the temperature of which habitually exceeds the undermentioned:—

Cordite.	100° F.
Dry guncotton.	120° F.

Magazine conditions.

The regulations which refer to safety contained in paras. A to K are termed "*magazine conditions.*"

A. No one, except those employed therein, will be permitted to pass the entrance barriers, except in the presence of the Officer or other person in local charge, who will be responsible that all who enter comply with the necessary precautions hereinafter detailed.

B. Lighting fires or smoking is strictly prohibited in or near any of these buildings; any person employed on the premises infringing this rule, or attempting to enter with tobacco pipes, lucifer matches, or with any combustible, or exposed iron or steel articles in his possession, or having the least appearance of intoxication, will, if a soldier or sailor, be made a prisoner, and if a civilian employed by the Naval Ordnance Department he will be excluded and immediately dismissed.

B i. Civilians employed in the Army Ordnance Department, if guilty of any of the offences specified in paragraph B, will also be immediately excluded and dismissed, unless in the opinion of the officer in charge there may be extenuating circumstances. Should the officer in charge, after very careful consideration, be of opinion that such extenuating circumstances exist, he will cause the man to be suspended in place of being dismissed, and bring his case in writing to the notice of the General Officer Commanding, who, if he approves, will submit it to the War Office with a view to the man being allowed to resign his position instead of being dismissed; but this will not apply to men employed in magazines, laboratories, or ammunition stores of the Naval Ordnance Department.

B ii. The whole of the men employed in magazines, laboratories, ammunition stores, and other buildings under magazine conditions, or to which the general regulations are to be applied, will be subjected to a thorough search at the entrance gate, both at morning and afternoon calls. This search will be made by the police, leading hands, or warder detailed for the purpose, in presence of the storeholder, or foreman in charge of civilians, or non-commissioned officer in charge of military party.

B iii. The private clothing of the men—taken off and left in the shifting room—will further be carefully examined after each muster by the storeholder, foreman, or non-commissioned officer in charge. In cases where the Metropolitan Police are employed to guard the establishment this examination will be made in presence of the police, by whom examinations may also be made in the presence of the storeholder or other responsible person.

B iv. Officers in charge are responsible that all men, whether military or civilian, employed in the laboratories or magazines are acquainted with the foregoing regulations.

C. Oiled cotton, rags, and waste, and any articles whatever liable to spontaneous ignition, will not be taken into these buildings, except for the purpose of immediate use therein, and upon the cessation of such use will be forthwith removed.

D. The interior, benches, shelves, and fittings in such building, will be so constructed, or so lined or covered, as to prevent the exposure of any iron or steel, and the detaching of any grit, iron, steel, or similar substance, in such manner as to come into contact with the explosive in such building.

E. No cultivation is to be permitted inside magazine yards, nor are any animals to have access to them.

F. All persons employed will, before entering, change their outer clothes, viz., overcoat, coat, waistcoat, trousers and boots, for the special clothing, consisting of jacket, trousers, cap, and shoes (also woollen jersey and drawers where especially authorised), provided for them, in the following order:—

(*a*) Before passing the barrier, boots to be wiped on mat and taken off. Uniform or private clothing to be taken off and hung up.

(*b*) Pass through barrier and put on magazine clothing and shoes.

G. Uniform, private clothing, or boots must never be taken inside, nor magazine clothes or shoes outside, the barrier, but the non-commissioned officers will be permitted to wear their forage caps inside the barrier. It will not be sufficient for men to put the magazine clothing over their own garments.

H. Officers and visitors will, at the barrier, step into special overshoes provided for them, and leave there any tobacco-pipes, lucifer matches, combustibles, or exposed iron or steel articles, in their possession.

I. The diagram and instructions (Plate XXXIII) show the place where the change of clothes should be effected. Copies of this form will be attached to boards and hung up in convenient positions for the information of those concerned.

J. The floors and platform will be kept scrupulously clean, and the latter frequently watered in dry weather. The interior, benches, shelves, and fittings will, so far as is reasonably practicable, also be kept free from grit and otherwise clean.

K No person whatever is to be permitted to walk upon any *clean* floors or platforms (that is such as are within the barrier and under magazine conditions), unless wearing the special shoes above referred to; nor, while wearing these shoes, are they to walk *anywhere except* upon the *clean* floors and platforms.

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Whenever powder is to be moved, or cartridges and shells filled or examined, hides or wadmiltilts will be laid down: these should be frequently dusted. Hides or Wadmiltilts.

The door mats are for use solely outside the barriers of the magazines; they should therefore be placed at the entrance in the most convenient places for use, and sheltered from the weather. They should frequently be taken up and shaken, at a distance from the barriers, to prevent any accumulation of mud and grit. Door mats.

No package containing explosives in Group I will ever be opened in any magazine or store in which such explosives are kept. Packages not to be opened in magazines.

Should no examining room or lobby be available for use in opening packages of filled cartridges, such packages may be opened in expense magazines for inspection or issue.

Great care is to be taken that all doors and shutters are kept closed, unless it be considered necessary to open them to carry on such operations as may be required in accordance with these regulations, and a responsible person will then always be left in charge of the building. When practicable the entrance door or gate is to be closed before the magazine door is opened. Doors.

Any defects or necessary repairs either to the interior or exterior of the buildings will be promptly reported and receive immediate attention; all explosives being first removed and the interior thoroughly washed. Cranes and lifting apparatus should be examined and tested periodically at intervals of not more than six months to ascertain that they are in a safe and efficient condition. Repairs to buildings.

Inventory boards, showing the contents of the magazines will be hung up in convenient positions.

The keys will be labelled, and deposited in a secure place when not in use.

Every package will be carefully examined externally on arrival to ascertain that it is perfectly closed, and to discover if its exterior presents any objectionable substances (such as iron nails or grit). If necessary, the contents should be shifted, and a defective package must not be admitted into the magazine. Defective packages.

All packages will have the contents properly marked thereon, and will be so stacked that the marking may be seen as far as practicable; they will also have classification and explosive labels on, the latter sealing the lid, and all Naval packages will be marked with the letter "N." Contents to be marked on packages.

When emptied, packages which have contained explosives in Group I, will have a label, giving the station, date, and name of person responsible for seeing that the package is empty, secured to the package so that it cannot be opened without tearing the label. Empty cases and barrels will not be allowed in a magazine in which explosives are stored. Empty packages.

When powder barrels are emptied, all hoops which remain serviceable are to be replaced on the barrels. Such hoops as are broken or damaged will be returned into store with the empty barrels. Under no circumstances are powder barrels to be stripped of their wooden hoops.

All empty packages will be carefully examined externally and internally before being used for packing any explosives whatever, to ascertain that there is no foreign matter nor objectionable article inside. A similar examination will be made of all packages containing explosives returned from the troops, which have been opened by them, before they are re-admitted into magazines or stores.

Packages will be securely stacked in the several bays, and a clear Stacking packages.

space left between them and the walls, to allow of the free circulation of air and prevent injury from damp. All packages containing cordite should be so stacked that at least one end or side is free from contact with other packages, or with a wall or partition. The interval or space so required need not exceed three inches.

Filled cartridges will be stacked separate from powder or cordite in bulk, and each particular kind of powder or cordite, and each nature of filled cartridges, will be kept together, where practicable.

Wet gunpowder.

Gunpowder which has been wetted should not be placed in powder magazines, but stored in a cool place, and, if possible, upon a stone floor.

Implements of iron or steel prohibited in magazines.

No implements of iron or steel are admissible for use in magazines or laboratories, and the use of iron or steel in any form is strictly forbidden in the construction of packages intended for explosives which are placed in magazines. Any exception to this rule must be specially authorized. The hoops of powder barrels will be secured with copper rivets only.

When defects are found in any stores of sufficient importance to form the subject of a separate report, samples of the defects should always accompany such report when such samples are not so dangerous, bulky or heavy as to entail undue difficulty in transport.

Whenever a magazine, or other place used for the storage of explosives, is emptied for any purpose, it will, without delay, be thoroughly washed out and cleaned, so that all trace of explosives may be removed.

To be observed when explosives in Divisions I and II, Group I, are necessarily kept in buildings other than regular Magazines.

Every building in which explosives in Divisions I and II, Group I, are kept, will be under magazine conditions, and will be used only for the keeping of such explosives, and of receptacles for them, or tools or implements for work connected therewith.

Before repairs are done to, or in, any room in such a building or other part of it, that room or part will, as far as practicable, be cleaned by the removal of all explosives, and the thorough washing out of such room or part.

There will be constantly kept affixed in every such building, on the inside of the door in such manner as to be easily read, a statement of the quantities of explosives allowed to be in the building, which must not exceed 200 lbs.

Due provision will be made, by searching or otherwise, for preventing the introduction into any such building of fire, lucifer matches, or any substance or article likely to cause explosion or fire, and for preventing the introduction of any iron, steel, or grit, into any part of such building where it would be likely to come into contact with explosives; but this rule will not prevent the introduction of an artificial light of such construction, position, or character, as not to cause any danger of fire or explosion.

A person under the age of 16 years will not be employed in or enter any such building, except in the presence and under the supervision of some authorised adult person.

All explosives will be kept in substantial cases, bags, canisters, or other receptacles, made and closed so as to prevent any from escaping.

Precautions against Fire.*

Local regulations will be invariably drawn up showing the duties allotted to each person in case of fire, and such persons will be occasionally exercised in the performance of their duties.

When an alarm of fire has been given, every person connected with the magazines will repair at once to his appointed post. The same precaution will be adopted in the event of a fire breaking out in the neighbourhood of the magazine, &c.

The fire engines, hydrants, engine hose, ladders, fire hooks and other appurtenances, will be kept in perfect repair, and so placed that they may be at all times ready and fit for use.

The person in charge of the fire engine house should know perfectly the arrangement of its contents, and the whereabouts of each article, so as to be able to find it at once in the darkest night.

The supply of water for the extinction of fire is at all times to be ready for immediate use.

The lightning conductors are to be frequently examined, as any imperfection will be a source of danger. They will be thoroughly overhauled by the Royal Engineers or Admiralty Works Department once a year.

Should any repairs be needed to the fire engines, or apparatus, the water service, or lightning conductors, an immediate requisition will be made for the performance of the work.

Every magazine or other building containing explosives will be closed during thunderstorms.

Ventilation.

The dryness of any building depends greatly upon its proper ventilation, and as gunpowder possesses in a high degree the property of absorbing moisture, great attention should be paid to this subject.

For ventilation purposes magazines will be divided into two classes, viz.:—

Class A.—Magazines, the walls of which are exposed to the outer air on all sides.

Class B.—Magazines, any wall of which is not exposed to the outer air.

At every station where there are magazines, and in every Artillery Sub-District, there will be provided one or more sets of common and wet and dry bulb thermometers or hygrometers, according to the extent and distribution of the magazines. If a magazine is artificially heated or liable to rise above 100° F., or is used for cordite in bulk, a maximum and minimum thermometer will be substituted for the common thermometer. Commanding Officers concerned should demand as many as may be necessary to meet the requirements of each station or district.

The wet and dry bulb thermometers will be permanently placed in the open air. They should be protected from direct, and as far as possible from reflected rays of the sun, also from rain and wind. The latter especially may cause the wet bulb to read lower than it should, making the air appear drier than it really is.

A common or maximum and minimum thermometer will be

* Further instructions for military precautions will be found in the King's Regulations.

placed inside every magazine; it should be, if possible, so placed that a reading may be taken without opening the inner doors.

One thermometer per work will also be issued to the R.A. for use in one of the cartridge stores of the work. The cartridge store selected should be one with the least favourable conditions for ventilation, and the readings of the thermometer in it will govern the ventilation of all the cartridge stores in the work.

Before using the thermometer it should be compared under the same circumstances with the dry bulb of the hygrometer, to see if any correction is necessary, which should be recorded and invariably applied to the common thermometer when taking a reading. If this is neglected, errors in ventilating may occur.

The scale attached to the *dry* bulb thermometer of the hygrometer will show the temperature of the external air, while that of the *wet* bulb will read more or less below the other, accordingly as the air is dry or damp.

The ratio of the amount of moisture in the air to that which it is capable of containing at any given temperature is called its *degree of humidity*, or *of moisture*, or its *percentage of moisture*.

The percentage of moisture in the air is decreased by a rise and increased by a fall of temperature, the weight of water vapour per cubic foot remaining the same unless the dew point is reached.

The *dew point* is that temperature at which air containing any given weight of water vapour per cubic foot is saturated, when any reduction of temperature will cause the excess of vapour to be precipitated as fog or deposited as dew.

Care must be taken to keep the wet bulb well supplied with water, and to see that its muslin covering and strands of wick are always wet. The water should be the purest obtainable; clean rain water will generally be most suitable, if distilled water cannot be procured. The muslin should cover the bulb completely, and notice should be taken that it is wet before taking a reading.

No accurate readings can be taken if the muslin on the wet bulb is frozen, and under no circumstances, if the thermometer is in a serviceable condition, can the reading of the wet bulb be above that of the dry. Should the muslin or wick become unserviceable from dirt or any other cause, it should be removed and replaced by new material.

With a view to the magazines being open as long as possible on favourable days, the wet and dry bulb thermometers should be observed twice a day, morning and afternoon, and the readings recorded in Army Form G 944. A record will also be kept of the readings of the thermometer inside the magazine; also the maximum and minimum temperatures when a maximum and minimum thermometer is used, such being set after the reading. Copies of this form, attached to boards, will be hung up in each magazine and signed weekly by the Officer in charge.

The actual times at which the wet and dry bulb thermometers are to be read, and the details of the arrangements for opening the various magazines, must depend, more or less, on local conditions. It will be necessary for the Officer Commanding to issue his own orders to meet the circumstances of each case.

Dampness in magazines is generally due to one or both of the following causes:—

(*a*) *Condensation*, on the cold walls, of moisture held in suspension by warm damp air when such air is introduced into the magazines by the opening of doors and ventilators.

This moisture collecting on the floors in a Class B magazine keeps the air locked up in it in a state of saturation until it is again ventilated under favourable conditions, when the moisture collected will be again evaporated. In a Class A magazine the walls will be of nearly to the same temperature as the outside air and any difference will quickly disappear when opened, so that any moisture which may be at first deposited will rapidly evaporate.

(*b*) *Percolation* of moisture through the walls. In many magazines under ground or under earth traverses, moisture from the damp earth outside will be drawn through the walls and will be taken up by the interior air which will thus become saturated unless ventilation is resorted to.

Class A magazines should be ventilated whenever the weather is fine, but should the temperature of the outside air be over 40°, there must be a difference of 3° or more between the wet and dry bulbs.

Class B magazines should be opened for ventilation—

(*a*) When the reading of the thermometer inside the magazine is higher than the reading of the *wet* bulb thermometer outside and the difference between the wet and dry bulbs is not less than 3°.

(*b*) When the temperature of the air outside is at or below 40° and the day is fine.

(*c*) When a magazine has been left closed for a month owing to the conditions in (*a*) and (*b*) not having been satisfied, and the walls, roof or floor are found to be damp, it should be ventilated on all subsequent fine days when there is at least 6° difference between the wet and dry bulb thermometers. If, after being closed for a month, the walls, floor, and roof are found to be dry, the magazine may remain closed for another month, or until there are suitable conditions for ventilation. At the end of each succeeding month it should be examined again and similarly treated.

Great care must be taken that the magazine is securely closed as soon as the above conditions cease to apply, or when that point is approached.

Subject to the conditions above detailed, magazines should be opened as often and for as long a time as possible, and every means should be adopted to secure a thorough circulation of air. But care must be taken to provide for their being immediately closed, in case a sudden change of temperature renders it necessary to do so.

The provision of quick-lime in magazines is of no practical use, and is to be discontinued.

A copy of the foregoing regulations will be attached to a board, and hung up in a convenient position for the information of those concerned. Copies for this purpose, printed on Army Form G 879, can be obtained on demand. The strictest care is to be taken by Officers in charge of magazines or laboratories to keep these regulations up to date, recording every alteration which may be made in them from time to time.

Lighting.

On no account will any but the authorised lamps be used for the purpose of lighting magazines, cartridge and shell stores, laboratories, and their passages.

Such lamps will be lighted only when absolutely necessary.

A magazine copper lantern will be used for the inspection of the cartridge and shell stores and underground passages, and on no account will the passage lamps be used for the purpose.

One or more men, as may be required, will be specially detailed as "lampmen" for each work, to attend to all the lighting arrangements and stores connected therewith.

Before the lamps are used, lampmen will be careful to ascertain the length of candle in each lamp, so that the possibility of the whole of the lamps going out at the same time may be avoided.

As all lamps required for lighting magazines and cartridge stores can be placed in position without entering the "clean" portions of the buildings, the lampmen will on no account pass beyond the barriers.

When it is impossible to clean the glass of the lamp recess from the passage, such glass will be cleaned by one of the magazine men from the inside. This may in some cases necessitate unscrewing and removing the frame; if so, care must be taken that it is properly replaced. This operation will be effected in the presence of the Officer or other person in charge.

Chimneys should not be used with the lamps if the candles burn regularly without them, but only if from want of air, or too much draught, the candles show a tendency to smoke or gutter, and the chimneys will be likely to improve the burning. No detailed instructions can be given regarding their use, which must be regulated by local circumstances.

Lamp barrows and trays are provided for the carriage of the lamps to and from the lamp room; care must be taken that they are always used, and that the lamps are not placed on the ground or floor, as the glasses are thus likely to be broken.

All lamps, when not in use, and stores required for them, will be kept in the lamp room.

Should special instructions be required in any particular work or magazine, for the guidance of the lampmen in the management of any peculiar lamp recess, they will be added in manuscript.

A copy of these instructions, attached to a board, will be hung up in each lamp room. Copies for this purpose, printed on Army Form G 877, can be obtained on demand. The strictest care is to be taken by Officers in charge of magazines or laboratories to keep these Regulations up to date, recording every alteration which may be made in them from time to time.

Laboratory Operations.

The operations of filling, examining, and emptying shells or cannon cartridges and work connected with dry guncotton are carried on in a laboratory under magazine conditions. The examination, weighing, and rewetting of wet guncotton need not be carried out in a laboratory, but if wet guncotton be repacked, the operation must be done under magazine conditions. This does not apply to the operations of loading and unloading submarine mines by the Royal Engineers, but the precautions specified on page 445, paras. B, C, and J, are to be adopted in the place set apart for the purpose.

Laboratory.

Laboratories will vary in size according to the work to be performed in them, but will, as a rule, consist of one or more buildings for filling and examining shells and cartridges, and, at headquarters,

a building for emptying shells, all being under magazine conditions and connected with the shifting lobby and barrier by platforms under magazine conditions, or each building may have a shifting lobby with barrier attached to it.

A building for filling and examining shells and cartridges will consist of an inner and an outer room, both under magazine conditions, with entrance, shifting lobby, and barrier. In these rooms *either* shells *or* cartridges may be dealt with, but on no account are both to be in the building at the same time. Great care must be taken to thoroughly clean the rooms when changing from shells to cartridges, or *vice versâ*, and shells must be carefully cleaned externally before being taken into the outer room. Buildings for examining shells or cartridges.

The inner room will communicate with the outer room by a door, the former being for the actual operations of filling or examining, the latter for examining before filling, marking, and securing packages. The inner room will be fitted with a receiving hatch for receipt of powder or cordite for filling and filled cartridges for examination. The outer room will be fitted with a receiving hatch or door for the receipt of shells and empty packages, and an issuing hatch or door for the issue of filled shells and packages, doors being used only when there is a *clean* platform outside on to which they open. Inner and outer rooms.

In some stations the laboratories will be supplied with heating or drying apparatus to ensure the rooms being dry.

Where no laboratory exists a tent may be used which must be situated at a safe distance (not less than 400 yards unless effectively traversed) from the magazine and ammunition stores.

The destruction of combustible stores by fire, or other means, will in no case be effected within the precincts of a laboratory. Stores not to be destroyed in laboratories.

Laboratory operations will be carried on under magazine conditions in accordance with the following instructions, although the details may necessarily be modified according to circumstances, and the means available. Work under magazine conditions.

The work will be under the superintendence of an Officer, Manager, Master Gunner, or Foreman, who must satisfy himself that the several men understand the duties entrusted to them.

Only steady and intelligent men will be employed, preference being given to those who have passed through a course at Woolwich. Steady men required.

The men will be detailed—

(*a*) As magazine men to issue and receive gunpowder and filled cartridges in packages at the magazine.

(*b*) For conveying gunpowder, filled cartridges and shells to and from the laboratory.

(*c*) For the inner room, to open the packages, weigh out charges, fill cartridges or shells, as required.

(*d*) For the outer room, to receive shells, examine if empty, and pass them to the inner room, and mark and issue filled shells and packages.

The number of men employed in any building used for laboratory operations is not to exceed 8, and the quantity of gunpowder or cordite in the building at any time is not to exceed 500 lbs. Number of men.

If a laboratory building is divided by a substantial brick or stone wall, without any opening or access through it from one part to the other, each part will be considered as a separate building as regards the restrictions as to shell and cartridge filling, number of men employed, and in the following paragraph.

Gunpowder and cordite will never be allowed in the filling room Gunpowder and cordite

not allowed together.

at the same time, except such small quantities of gunpowder as are required for priming cordite cartridges when the latter are being filled.

Whenever a change is made from gunpowder to cordite or *vice versâ*, the filling rooms (inner and outer) will be emptied and thoroughly cleaned before the new explosive is introduced.

No greater quantity of gunpowder or cordite than is absolutely necessary to keep the work going will be at any time allowed in any laboratory building, or in transit to or from the magazine.

Air to be dry.

Laboratory operations with gunpowder will only be carried on when the air in the room or tent used is sufficiently dry. This is ascertained by means of a wet and dry bulb thermometer, which should show a difference of at least 5° at 60° F., increasing or decreasing with the temperature to 10° at 100° F., or 2° at 35° F., while in fine frosty weather operations may always be proceeded with.

Material, such as serge, silk cloth, &c., liable to absorb moisture, will be thoroughly dried by artificial heat or exposure to the sun before use, and great care must be taken that shells, cartridge cases, &c., are thoroughly dry inside before filling, and that they are not colder than the air in the filling room, or moisture is liable to be deposited in them when they are brought in to be filled.

Cleanliness of laboratory.

The greatest attention will be paid to cleanliness in all parts of the laboratory, and the ways leading thereto, also in the wagons and barrows used for the conveyance of the explosives to or from the laboratory. Special care will be taken to clean any beams or ledges where powder or guncotton dust is likely to lodge.

Any loose grains of powder or guncotton dust spilt on the floor or otherwise exposed to possible admixture with iron filings, grit or dirt of any kind, and any dust or grit will at once be swept up and thrown into a bucket or tub containing water, which, with a stick for the purpose of stirring, is to be kept just outside the laboratory.

No barrow, tool, or tackle used outside, will be admitted within the barrier at the entrance of the laboratory.

Nothing will be kept inside the barrier of the laboratory but the necessary articles for a laboratory, and no stores, such as barrels, cases, cylinders, &c., will be admitted without being thoroughly cleaned externally.

Issue of cartridges or filled shells.

Made-up cartridges, or filled shells, will not be issued by the same door or hatch through which the loose powder or empty shells are passed in.

Gunpowder packages will be conveyed to the laboratory, and cases or cylinders to the magazine or cartridge store, in covered barrows or trucks, in order to keep them free from dirt or grit; if uncovered barrows are used, the packages must be protected by wadmiltilts.

The floor of the inner room when in use will be covered with hides or wadmiltilts.

During laboratory operations the doors and windows of both inner and outer rooms must not be fastened in any way.

Empty powder packages will be passed out at once, and stored in a clean place; and in the event of a package not being emptied, it will be re-closed and returned to the magazine.

Gunpowder from broken up cartridges.

Gunpowder from broken up cartridges will in all cases be sifted before being returned into store, so that extraneous articles may be detected. Moulded powders will be picked over by hand.

When gunpowder or cartridges are packed or repacked at a station, a label will be affixed to the inside of the lid, showing—

(1) Station.
(2) Date of packing.
(3) Names of foreman and men who packed and closed the package.

These men will be made responsible should any extraneous substance be found in a barrel packed by them. Should such barrels be opened for inspection at any time, an additional label will be added, giving—

(1) Station.
(2) Date of inspection.
(3) By whom inspected and reclosed.

Similar labels will be affixed on inspection of new gunpowder, or on any occasion of breaking bulk.

The operation of wetting gunpowder will be carried on in the most convenient place where a supply of clean fresh water can be obtained, and where the barrels in which the gunpowder has been stored can be kept clean.

Wetting gunpowder.

The gunpowder to be wetted will be poured slowly into a barrel, which has been previously cleaned and well wetted. Old powder or saltpetre barrels are always to be used when available. A stream of water from a watering pot with rose should be kept playing on the gunpowder, which should be stirred with a stick, so that all the grains may be wetted, and prevented from floating on the top of the water. About three gallons of water thus applied will be found sufficient for a barrel of 100 lbs. of gunpowder.

When time is an object, the surest method of wetting gunpowder is to continue pouring water on it gradually until the water rises on the top of the gunpowder. Five gallons applied in this manner will be required for a barrel of 100 lbs. of gunpowder. It must be remembered that gunpowder thus wetted, will, on drying, recover some of its explosive power, the wetting should therefore be repeated when necessary.

Gunpowder that has been wetted will still be treated as an explosive, it will not be retained on R.A. charge, but will be issued to the Chief Ordnance Officer at the station for disposal.

Copy of foregoing regulations to be hung up.

A copy of the regulations for laboratory operations will be attached to a board and hung up in a convenient position for the information of those concerned. Copies for this purpose printed on Army Form G 940 can be obtained on demand. The strictest care is to be taken by Officers in charge of magazines or laboratories to keep these regulations up to date, recording every alteration that may be made in them from time to time.

INSTRUCTIONS FOR THE DISABLEMENT OR DESTRUCTION OF GUNS BY MEANS OF GUN-COTTON.

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1. *The Destruction of Heavy Guns when time is immaterial.*
2. *The Hasty Disablement of Siege Guns and of Field Guns.*

A.C. 1886, Cl. 137.

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1. The Destruction of Heavy Guns when Time is Immaterial.

1. This duty will be performed by the Royal Artillery the stores marked (*a*) in the following list being obtained from the Royal Engineers; and the remainder taken from the siege train equipment.

2. The materials required are as follows:—

Gun-cotton (1 lb. slabs), perforated, to receive a dry primer, two slabs for each charge, and spare slabs at the rate of two spare for every five (or less number) of guns to be destroyed.

The wet gun-cotton (1 lb. slabs) mentioned above, is the "Gun-cotton Wet, Slab R."

(*a*) Gun-cotton primers, dry, weighing 1 oz., 1¼ inches in diameter, coated with paraffin; one primer for every two slabs.

Bags, gun-cotton, waterproof, to contain 2 lb. of gun-cotton, one for every two slabs carried.

(*a*) Exploder, dynamo-electric, F.S.

(*a*) Solution, india-rubber, in tin cylinder.

(*a*) Twine, stout, 1 lb.

This is sufficient for about 20 *charges.*

(*a*) Detonators, No. 13, in a cylinder containing 25 detonators, with a rectifier.

Each cylinder will suffice for 20 *charges, with* 5 *spare detonators.*

(*a*) Wire, insulated, lengths of 40 yards each.

Five additional yards are required for each charge after the first operation, to replace the wire blown away by a discharge.

Tackle and selvagees, with rollers, skidding, handspikes, &c., for lowering the gun into a pit, or up-ending it under the branch of a tree.

The exact proportion of these cannot be given. It will depend upon the size of the guns to be destroyed, upon local circumstances, &c.

*Directions for carrying out the Operations.**

3. Plug up, with a peg of wood, the vent of the gun to be disabled, driven well in so as to make the vent watertight.

4. Up-end the gun on its breech, either by digging a pit for its reception, or by other convenient means.

5. The officer in charge of the operations must be guided by local circumstances, but the more the gun is raised vertically on its breech the better.

6. Clean the terminals of the insulated wire, and of the wires attached to the detonators, by scraping. The detonator is then to be connected with the insulated wires. To secure perfect electrical circuit the junctions must be insulated from each other by smearing them over with india-rubber solution, and wrapping them with tape (india-rubber or calico).

7. Insert the detonator, after securing it to the wires, into a dry primer, first using the rectifier to ensure the hole in the primer being of a proper size to admit the detonator, which should be set home to the head.

8. *On no account whatever should a detonator be twisted or roughly forced into a primer.*

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* *See* note at end.

9. Insert the dry primer, fitted with detonator, into the perforation in one of the 1 lb. slabs, pushing it gently in until the hole in the slab is quite filled by it.

10. Place the slab thus prepared, together with another slab, in a waterproof bag.

11. Choke the neck of the bag with twine closely round the insulated wires; plaster the inner portion of the choke round the wires with the india-rubber solution, and choke again round and above the solution, so as to make the whole as watertight as possible.

12. Attach to the wires a small sinker of any heavy material, so that its weight comes on them above the choke. The sinker should be small in bulk, so as to allow the charge to settle home to the bottom of the bore; and, when hanging freely from its point of support, it should be just below the bottom of the bag.

13. Attach to the choke a piece of stout twine long enough to reach to the bottom of the bore of the gun, and lower the charge by it carefully to the bottom of the bore, paying out the insulated wires at the same time and taking care that no strain comes on them.

14. In operating upon guns of the heavier natures, it is advisable, in order to ensure their destruction, to employ two charges, to be fired simultaneously in different parts of the gun's bore. These charges should be prepared as directed, and should then be firmly attached to a stick of such length that, when inserted into the gun one of the charges shall be at the breech of the gun while the other should be just above the trunnions. One of the wires from the exploder should be attached to the detonator in the lower charge, the other wire from the exploder being attached to one of the wires of the detonator in the upper charge. The other wires of the detonators should be connected together by a piece of insulated wire. The whole of the connections must be carefully insulated as in para. 6.

(The sinker, which should be attached to the stick, or the lower charge, must be sufficiently heavy to prevent the charges floating.)

15. Fill up the bore with water; connect the free ends of the insulated wires with the binding screws of the exploder, and after seeing that all is clear, fire the charge by turning, or pressing down, sharply the handle of the exploder.

16. This should be done immediately after lowering the charges into the gun, so as to give the water as little time as possible to effect an entrance into the bag.

17. The operator should be careful to place himself and his party under cover, and the terminals of the conducting wires are not to be connected to the exploder until all present have placed themselves under cover.

18. In the event of a detonator failing, at once disconnect the wires from the exploder. The charge must then be taken up and re-made with a fresh detonator. Great caution must be exercised in slowly extracting the detonator from the primer.

Cautions.

19. Care should be taken to see that the insulation of the wire is perfect, that the connections are clean and good, and that they are afterwards thoroughly insulated, according to the directions given at para. 6.

20. If any part of the wire is accidentally denuded of its insulation, prop up the adjacent insulated portion, so that the bared portion will not touch the ground. If time allows, it is better to wrap the defective place thoroughly in india-rubber tape.

21. Detonators by themselves must always be handled with the greatest care and freedom from rough usage and still more so when they are fitted into gun-cotton. The latter by itself is harmless.

22. Immediately after an explosion, detach the wires from the exploder, and do not re-attach them till just before firing the next charge, as directed at para. 17.

2. The Hasty Disablement of Siege Guns and Field Guns.

23. The hasty disablement of siege guns will be carried out by the Royal Artillery, and of field guns by the Royal Horse Artillery.

Stores Required.

24. The necessary supplies of gun-cotton for the disablement of siege guns will be obtained from the Royal Engineer Siege Park.

25. The following stores will be carried with each unit of the Siege Train :—

Boxes ..	gun-cotton slabs, to hold 16 half slabs*		1
	stores, disabling, ordnance, siege		1
	vesuvian matches		1
Cases ..	detonator, for 8†		2
	gun-cotton primers†		2
	gun-cotton slabs†		4
Cylinders	detonator, No. 8, for 8		2
	gun-cotton primer, dry, 1¼″ × 1¼″, for 8		2
Detonators, No. 8			16
Gun-cotton	dry primers, 1 perforation, 1¼″ × 1¼″		16
	wet slabs, 2 perforations, 6⅛″ × 6⅛″ × 1⅛″ ..		8‡
Pouches, match-box†			1
Rectifiers, gun-cotton primers			2
Twine, choking, 3-thread		pieces	1

Instructions for carrying out the Operations.§

26. In the case of guns of 64-pr. and larger calibres two slabs must be employed.

27. Insert a detonator into a dry primer.

28. *On no account should a detonator be twisted or roughly forced into a primer.*

29. Insert the dry primer fitted with detonator into the perforation in one of the slabs, pushing it gently in until the hole in the slab is quite filled by it.

30. Tie a piece of twine round the detonator, pass the ends round the slab, and then tie them together; the object being to prevent the primer slipping out of the slab.

31. Place the slabs lengthways on the chase, their long sides touching, about a foot from the muzzle. Tie them on tightly with twine to prevent them slipping from wind or other disturbing cause.

32. The exact position must depend on the form of the gun. The great thing is to have as much of the surface of the cotton *in actual contact* with the gun as possible. Hence the slabs should not ride on an astragal or moulding, but should always be placed on a plain part of the chase.

33. Observe the direction of the wind, and arrange the slab containing the detonator so that the tail of the safety fuze is away from the slab and to leeward of it. This is to lessen the chance of

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* Copper, tinned. † Leather.
‡ In half slabs, 1 perforation in each. § *See* note at end.

a spark igniting the gun-cotton before the detonator is fired, in which case, in all probability, no effect whatever would be produced on the gun.

34. If projectiles belonging to the gun are available, and time allows, it is advisable to ram one up the bore; so that when the gun is dented by the explosion it may be imprisoned there and prevent the gun from being used even to fire a bag of bullets.

35. Tear or cut the little calico cap off the end of the safety fuze and ignite the fuze by the vesuvian matches provided, or other convenient means. An ordinary flame does not readily ignite it. The fuze ignites most easily when cut obliquely with a sharp knife.

36. Retire under cover, and await the explosion. The length of safety fuze will burn about 45 seconds.

37. Should circumstances permit, the effect of the detonation will be increased by placing a filled sand bag or a sod of turf on the gun-cotton, when lashed in position on the chase. Great care should be taken in this operation not to strike or bend the detonator.

38. It is also advisable, after the explosion, to try if the gun is so dented as to prevent loading. If the dent is not sufficient, the operation should be repeated, putting the fresh slabs in the same place as the first.

Caution.

39. Never roughly bend or kink the safety fuze. If it has apparently gone out without firing the detonator, allow at least half an hour to elapse before meddling with it, if time will admit, but if not, the greatest care must be taken in touching it, to avoid accident by a "hang-fire."

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40. The above instructions apply equally to the hasty disablement of field guns, but with them only one slab of gun-cotton need be used.

NOTE.—The above instructions have been prepared with special reference to the disablement or destruction of muzzle-loading guns. Breech-loading guns can generally be temporarily disabled by the removal or destruction of portions of the breech apparatus. In destroying such guns, or rendering them permanently disabled, officers will, while being guided generally by these instructions, use their discretion as to the application of the charges in such positions as may appear most suitable, according to the particular construction of the gun to be operated upon.

It is probable that revised instructions having reference to breech-loading guns will be issued shortly.

Table No. 1.

Dry Guncotton Charges and Primers.

	Designation.	Service.	Detail.	Weight dry.	Remarks.
	Guncotton, Dry.		In tin cylinder.	lb. oz.	
	Charges, priming—				
§ 4883.	A	L	3 primers A; S.M. ..	4 8	In cylinder "G."
§ 4883.	B	L	4 „ B; „ ..	2 4	In cylinder "H."
§ 4883.	C, 2¼ lb.	N	4 „ B; Naval	2 4	In cylinder "J."
§ 10120.	2¼ lb., Mark I ..	N	4 „ K; „	2 4	In brass case; for boat mine.
			Cylindrical. Diameter, thickness.		
	Primers—				
§ 4883.	A	L	5 in. × 1·95 in.; two perforations; S.M.	1 8	
§ 4883.	B	C	3·1 in. × 1·95 in.; two perforations; Naval and S.M.	0 9	
§ 9670.	C	N	1·5 in. × 1·97 in., unperforated.	0 2	
§ 9670.	D	N	1·5 × 1·97 in.; one perforation; for Marks I and II plugs.	0 2	
§ 9670.	E	N	1·5 in. × 1·97 in.; one perforation; for Mark III plug.	0 2	
§ 4883.	F	L	1·75 in. × 1·375 in.; one perforation; G.S.	0 2	
§ 4883.	G	C	1·25 in. × 1·25 in., unperforated.	0 1	
§ 4883.	H	C	1·25 in. × 1·25 in.; one perforation; G.S.	0 1	
§ 4883.	J	N	1·25 in. × 1·25 in.; partial perforation.	0 1	
§ 10289.	K	N	3·1 in. × 1·95 in.; one partial preparation for boat mine.	0 9	
			In case.		
	Primers, torpedo—				
§ 8195.	A, 12¾ oz.	N	5 C and 1 D primers; R.G.F. and Fiume short torpedoes.	0 12¾	In tinned brass cylinder.

TABLE 1—*continued.*

Designation.	Service.	Detail.	Weight dry. lb.	Weight dry. oz.	Remarks.	
B, 1 lb. 1 oz. ..	N	7 C and 1 D primers 18-in. R.G.F., and Fiume (except short) 14-in. Berlin, R.G.F. Mark X, and Weymouth, Mark I torpedoes, for primers with Marks I and II plugs.	1	1	In tinned brass cylinder.	§ 6662.
C, 1 lb. 1 oz. ..	N	7 C and 1 E primers; 18-in. R.G.F., and Fiume (except short) 14-in. Berlin, R.G.F. Mark X and Weymouth, Mark I torpedoes, for primer with Mark III plugs.	1	1	do.	§ 6662.
D, 6 oz.	N	5 G and 1 J primers; 16 and 14-in. R.L., R.G.F. and Leeds Marks IV* to IX, and 14-in. Fiume torpedoes, except Mark I Fiume.	0	6	In copper cylinder.	§ 6662.
Brennan	L	Brennan torpedo ..	—		In brass cylinder.	

TABLE No. 1(A).

WET GUNCOTTON, TORPEDO CHARGES.

Designation.	Service.	Detail.	Weight dry.	Remarks.
			lb. oz.	
GUNCOTTON, WET.				
Charges, boat mine 16¼ lb.	N	Slabs, in brass case with brass packing piece.	16 4	§ 10522.
Charges, naval, 16¼ lb.	N	In tin case. Outrigger torpedoes.	16 4	
Charges, torpedo —		Whitehead.		
Berlin, 14-inch—				
Long-head, Mark I ..	N	In torpedo head ..	39 1¾	
Short-head, „ I ..	N	„ „ ..	31 12	
Fiume, 14-inch—				
Mark I	N	.. ..	26 8	
„ II	N	.. ..	30 0	
„ III	N	.. ..	37 9¼	
„ IV	N	In torpedo head ..	59 13½	
Fiume, 18-inch—				
Long-head Mark I	N	In torpedo head	197 10	
Long-head „ II	N	In torpedo head	186 10½	
Short-head Mark I	N	In torpedo head	94 0	
Short-head „ IA	N	In torpedo head	88 0	
Short-head „ II	N	In torpedo head	88 0	
R.L. 14-inch—				
Marks I, I*, I** ..	N	.. ..	32 0	
„ II, II*, III ..	N	.. ..	34 0	
„ IV, IV*, V, V*, VI, VI*	N	In torpedo head ..	60 0	
„ VII	N	„ „ ..	70 0	
„ VII*	N	Also Leeds, Mark VII* in torpedo head.	65 0	
„ VIII	N	Also Leeds, Mark VIII in torpedo head.	65 0	
R.L., 16-inch, Mark I..	N	In torpedo head ..	91 0	
R.L., 14-inch—				
Mark VI*A	N	In torpedo head	58 13	
„ VIIA	N	In torpedo head	69 0	
„ VII*A ..	N	In torpedo head	64 0	
„ VIIIA.. ..	N	In torpedo head	64 0	
„ IX	N	In torpedo head	76 15	
R.G.F., 18-inch—				
Long-head—				
Mark I	N	In torpedo head	188 0	
„ IA	N	In torpedo head	188 0	
„ II	N	In torpedo head	188 0	
„ III and IV ..	N	In torpedo head	170 15	
Short-head—				
Mark I	N	In torpedo head	85 8	
„ IA	N	In torpedo head	85 8	
„ II	N	In torpedo head	—	
Brennan, Mark I, long	L	In torpedo head	—	
„ „ short	L	In torpedo head	—	

TABLE No. 1(B)

WET GUNCOTTON, SLABS.

Designation.	Service.	Detail.	Weight dry.	Remarks.	
		Rectangular.	lb. oz.		
Slabs—					
A	*L*	*Shapes cut from slabs O locally for S.M. Not supplied from Woolwich; the descriptive letters are used in S.M. Manual.*			§ 9670.
B	*L*				
C	*L*				
D	*L*				
E	*L*				
F	*L*				
G	*L*				
H	C	$6\frac{1}{8} \times 3\frac{1}{16} \times 1\frac{1}{4}$ in.; unperforated; Naval and S.M.	1 4		§ 4883.
J	*L*	(*See remarks A to G*)			
K	L	Slab O with quadrant cut to radius, 2·7 in., S.M.	2 2		§ 8313.
L	N	Slab O with semi-circle cut to radius 1·8 in., Naval.	2 2		§ 4883.
M	*L*	(*See remarks A to G*)			§ 9670.
N	L	Slab O with quadrant cut to radius 1·7 in., S.M.	2 5		§ 9670.
O	C	$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{1}{4}$ in., unperforated; Naval and S.M.	2 8		§ 4883.
O (torpedo)	C	$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{1}{4}$ in., unperforated.	2 8		§ 4883, 10704.
P	*L*	*$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{1}{8}$ in.; two perforations, for primer H, R.E.*	*2 0*	No more of P and Q will be made. When existing stock is used up they will be replaced by S and T.	
Q	*L*	*$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{1}{8}$ in.; two perforations, for primer H, R.E.*	*1 8*		§ 4883.
R	L	$6\frac{1}{8} \times 3\frac{1}{16} \times 1\frac{3}{8}$ in.; one perforation, for primer H, R.A.	1 0		§ 9670.
S	L	$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{3}{8}$ in.; one 2-in. perforation, and one perforation for primer H, R.E.	1 12		§ 8415, 10705.
T	L	$6\frac{1}{8} \times 6\frac{1}{8} \times 1\frac{1}{8}$ in.; one 2-in. perforation, and one perforation for primer H, R.E.	1 8		§ 8415.
U	N	$6\frac{1}{8} \times 3\frac{1}{16} \times 1\frac{1}{4}$ in.; with semi-circle cut to radius 1·8 in., Naval.	0 14		§ 9370.
V	L	$6\frac{1}{8} \times 3\frac{1}{16} \times 1\frac{3}{8}$ in.; one perforation for primer F; Cavalry Pioneers.	0 14		§ 8313.

Table No. 2.

Showing the Guns, Howitzers, Small Arms, &c., in which the various sizes of Cordite are used.

Nature of Gun.	50	44	40	30	20	15	10	7½	5	3¾	3	1 / ·05	Tape.	20 S.C.
	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.
B.L. Guns.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	gr.	gr.	gr.	gr.
13·5-inch, I to IV	..	177 8	..	..	..	..	..	..	..	10 0	(composite)			
12-inch, I to VII	..	..	..	88 8	..	..	..	..	..	..	..	..	..	..
12-inch, VIII	166 8	..	..	..	..	..	..	..	..	7 8	(composite)			
12-inch, IX	201 8	..	..	..	..	..	..	..	..	9 8	(composite)			
10-inch, I to IV	..	..	..	76 0	..	..	..	..	..	..	..	..	..	..
9·2-inch, I and II	..	..	..	42 0	..	..	..	..	..	..	..	..	..	..
9·2-inch, III to VII	..	..	..	53 8	..	..	..	..	..	..	..	..	..	..
9·2-inch, VIII	..	..	63 0	..	..	..	..	..	..	..	..	..	..	..
9·2-inch, IX and X	..	99 0	..	..	..	..	..	..	..	4 0	(composite)			..
8-inch, III	..	..	..	..	28 12	..	..	..	..	..	..	..	..	..
8-inch, IV and VI	..	..	..	..	32 10	..	..	..	..	..	..	..	..	..
8-inch, VII	..	..	..	..	22 0	..	..	..	..	..	..	..	..	..
6-inch, III (chase-hooped), IV to VI	..	..	..	..	14 12	..	..	..	..	..	..	..	..	..
6-inch, VII and VIII	..	..	..	..	20 0	..	..	..	..	..	..	..	..	..
6-inch, IX and X	..	..	..	20 0	..	..	..	..	..	..	..	..	..	..
5-inch, II to V	..	..	..	..	..	..	..	4 7½	..	..	..	..	..	..
4-inch, II to VI	..	..	..	..	..	..	..	..	3 1	..	..	..	..	..
4-inch, jointed	..	..	..	..	..	..	..	..	2 14	..	..	..	..	..
30-pounder, I	..	..	..	..	..	..	2 6	..	..	..	..	..	..	..
15-pounder, I to IV	..	..	..	..	..	..	..	..	0 15¾	..	..	..	..	..
12-pounder, 6 cwt., I to IV	..	..	..	..	..	..	..	..	0 12 7/16	..	..	..	..	..
10-pounder, B.L.	..	..	..	..	..	..	..	..	6 1/16	3 9/16	..	..	..	..
5-inch, B.L.C.	..	..	..	..	..	..	5 4	2 4	..	..	..	..	..	..
B.L. Howitzers.														
6-inch, 30 cwt., I	..	..	..	..	..	..	..	..	1 12	..	..	..	..	..
6-inch, 25 cwt., I	..	..	..	..	..	..	..	..	..	2 1	..	..	..	..
5·4-inch, I	..	..	..	..	..	..	..	..	..	0 13½	..	..	..	..
5-inch, I	..	..	..	..	..	..	..	..	..	0 11 9/16	..	..	..	..

TABLE No. 2—*continued.*

SHOWING THE GUNS, HOWITZERS, SMALL ARMS, &c., IN WHICH THE VARIOUS SIZES OF CORDITE ARE USED—*continued.*

Nature of Gun.	50	44	40	30	20	15	10	7½	5	3¾	3	1 / ·05	Tape.	20 / S.C.
	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.	Charge.
Q.F. GUNS.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	gr.	gr.	gr.	gr.
6-inch, Q.F. and Q.F.C.	..	..	..	13 4	..	..	5 8	..	..	..	..	..	..	..
4·7-inch, Q.F., I to IV	..	..	..	..	5 7	..	..	2 2¼	..	..	..	..	..	..
4·7-inch. Q.F., V	..	..	..	..	7 8	..	..	..	..	..	..	..	..	..
4-inch, Q.F. and Q.F.C.	..	..	..	..	..	3 9	..	..	1 8	..	..	..	..	..
12-pounder, Q.F., 12 cwt.	..	..	..	..	..	1 15	1 10	..	0 12½	..	..	..	..	..
12-pounder, Q.F., 8 cwt.	..	..	..	..	..	..	0 13¾	..	..	..	..	..	..	..
6-pounder	..	..	..	..	..	..	..	..	0 7¼	..	..	..	..	..
3-pounder	..	..	..	..	..	..	..	..	0 6⅜	..	..	..	..	..
1-pounder	..	..	..	..	..	..	..	..	..	1 oz. 90 grs.	..	..	..	..
R.M.L. (FOR CASE SHOT ONLY FOR 12·5-INCH AND 9-INCH.)														
12·5-inch, I	..	..	..	..	..	..	48 0	..	..	..	..	..	..	..
12·5-inch, II..	..	..	..	..	..	..	62 0	..	..	..	..	..	..	..
11-inch	..	..	..	..	..	..	25 4	..	..	..	..	..	..	..
10-inch	..	..	..	..	..	..	20 6	..	..	..	..	..	..	..
9-inch, I to V	..	..	..	..	..	..	..	14 0	..	..	..	..	..	..
SMALL ARMS AND MACHINE GUNS.										gr.				
·45-inch G.G. chambered machine guns	..	..	..	..	..	..	..	..	..	..	38	..	..	..
·303-inch small arms and machine guns	..	..	..	..	..	..	..	..	..	31±2	..	..	..	..
·303-inch, short range practice	..	..	..	..	..	..	..	..	..	..	..	..	12	..
·303-inch, blank	..	..	..	..	..	..	..	..	..	..	..	..	..	10
Webley pistol	..	..	..	..	..	..	..	..	..	..	..	7½	..	..

TABLE No. 6.

CORDITE CARTRIDGES, B.L. AND R.M.L.

Calibre.	Mark.	§Changes in War Stores.	Length.	Diameter.	Weight and Description of Cordite.	Primer R.F.G.[2] or Blank F.G. new.	Number of Hoops.	Number Packed and Description of Package.	Remarks.
B.L.			ins.	ins.					
12-pr. 6-cwt.	I	8137	5·7	2·2	12-oz. 7-drams, 5	4-drs. at each end.	No hoops.	110 in a whole metal-lined case	Shalloon.
,, ,, ...	II	p. 580	5·7	2·2	12 oz. 7 drams, 5	1-dr. guncotton priming.		110 in a whole metal-lined case	,,
15-pr.	I	7597 8314 8499	11·5	1·9	15¾-oz., 5	2-drs. guncotton yarn near each end.		75 in a whole metal-lined case...	,,
30-pr.	I	...	11·5	2·75	2-lb. 6-oz., 10	½-oz. at each end		35 in a whole metal-lined case...	No. 1 silk cloth.
4-inch	I	7596 10463	11·5	3·2	3-lb. 1-oz., 5	½-oz. at each end		37 in a whole metal-lined case... 20 in a half metal-lined case ...	,, ,, ,, ,,
4-inch jointed	I	25/6/00	11·5	3·3 over primer, 3·0.	2-lb. 14-oz., 5	...		... ...	,, ,,
5-inch	I	7595 7634	11·4	Base, 4·75 Neck, 3·0	4-lb. 7½-oz., 7½	1-oz. at the base		20 in a whole metal-lined case, or 24 in A case.	,, ,,
5-inch	II	9334	11·8	3·84	4-lb. 7½-oz., 7½	1-oz. at each end	3	26 in a whole metal-lined case...	,, ,,
5-inch B.L.C....	I	...	12·5	4·25	5 lb. 4-oz., 10	12-drs. at each end	3	48 in G case.	
5-inch B.L.C....	I	10972	6·45	3·75	2-lb. 4-oz., 7½	1-oz. each end ...	...	142 G case, 20 half M.L. case ...	,, ,,
5-inch howitzer	I	9224	3·2	3·8	11-oz. 7-drs., 3¾. Full. Core, 3-oz. 12-drs. 3 rings, 2-oz. 9-drs. each. Size 3¾.	8-drs.	...	80 in whole, 36 in half, or 12 in quarter metal-lined case.	Shalloon.
5-inch howitzer	II III	9263 10579	3·2 3·2	3·8 3·84	11-oz. 7-drs., 3¾. Full. Core, 3-oz. 12-drs. 3 rings, 2-oz. 9-drs. each. Size 3¾.	8-drs.	...	80 in whole, 36 in half, or 12 in quarter metal-lined case.	,,
5·4-inch howitzer	I	22/2/96	3·2	Base 3·75	13½-oz., full. Core, 4½-oz. 3 rings, 3-oz. each. Size 3¾.	8-drs.	...	100 in a whole metal-lined case	,,
5·4-inch howitzer	II	14/1/97	3·2	Base 3·75	13½-oz., full. Core, 4½-oz. 3 rings, 3-oz. each. Size 3¾.	8-drs.	...	100 in a whole metal-lined case	,,
6-inch 25-cwt. howitzer ...	I	1/4/96	10	Base 4·3	2-lb. 1-oz., full. Core, 15-oz. 3 rings, 11-oz., 5-oz., and 2-oz. Size 3¾.	12-drs.	...	30 in whole, 16 in half, 5 in quarter metal-lined case.	,,

§ 10579. 5-inch and 5·4-inch howitzer cartridges Mark III are similar to the Mark II cartridges but have the primer of 2-drs. of guncotton yarn.

Size … (n)verted Cord(… Ma)rk II /C/		Remarks
$\frac{50}{17}$		Size $\frac{1}{\cdot 05}$ packed loose, 80^{lb} in Case. Cordite 100^{lb} Mark I.
	60 lb	Size $\frac{20}{\ldots}$ packed loose 50^{lb} in Case

Cases, Powder.																								
Metal-lined.					Pentagon.				Cylindrical.															
e.	Half.		Quarter.		Whole.		Half.		L.		S.		T.		U.		V.		W.		X.	
Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.
...	...	...	...	...	...	...	...	...	...	...	4	684	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	4	684	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	2	463	...	...	2	467	...	...	3	791
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...	4	...	...	...
Mark I in being made of No. 3 lass silk cloth.							...	...	...	...	...	...	...	...	4	447	4	446	4	529	...	...
Mark II in having a lining of 2 Class silk cloth.							...	...	...	...	...	...	...	...	4	450	4	449	4	532	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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...	...	...	...	...	...	...	...	...	24	363	...	...	...	...	...	...	...	...	...	...	...	...
78	6	79	...	...	14	175	...	...	37	371	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
57	3	67	...	...	9	170	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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8	...	30	...	18	...	61	...	43	...	70	...	196	...	143	...	148	...	147	...	290	...	293

76004, 6997, 7658. §§ 5784, 6216, the ex
p the Land Service, § 6346.

Number Packed, and Weight of Filled Package in Pounds. (Approximate.)
Cases, Powder.

Brass.

Rectangular.																Cylindrical.	
Plain.		Corrugated.														(b)	(a)
		A		B		C		D		E		F		G		X	Z
Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.		
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...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	306	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	381	...	...
...	...	...	...	...	...	...	...	2	292	...	...	2	295	...	...	...	...
...	...	...	...	...	...	2	226	3	329	...	...	3	330	3	336	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	3	221	...	...	...	..	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	2	227	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	3	237	...	...	...	...	...	...
...	...	...	...	2	191	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	3	183	...	...	...	...	...	...	...	...	...	...	...	...
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...	...	4	178	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	174	3	151	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	6	172	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	159	4	163	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	5	156	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	7	165	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	69	...	46	...	51	...	56	...	72	...	57	...	75	...	81	293	

ally become obsolete, being superseded by 50 lb. E.X.E. §7659.
nders to hold two of these ½-charges are supplied for special use in the fort at Dover.
Inflexible.

...ZERS.

...d Package in Pounds. (Approximate.)
... Powder.

	Brass.															
	Rectangular.															
	Corrugated.															
	C.		D.		E.		F.		G.		H.		I.		L.	
Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.
...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
211	20	256	28	352	20	257	30	375	...	...	...	...	...	...	...	...
219	16	248	24	360	19	285	24	363	28	417	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
211	20	256	28	352	20	257	30	375	30	381	12	170	20	260	30	370
216	24	244	35	361	24	255	35	364	40	411	16	182	24	258	36	367
220	30	253	46	371	30	252	47	381	52	414	19	174	30	255	45	363
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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261	16	296	25	447	17	312	26	465	...	...	...	...	...	...	...	...
261	16	296	26	462	18	327	27	480	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
246	15	283	22	402	15	282	23	420	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
246	15	283	22	402	15	282	23	420	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
51	...	56	...	72	...	57	...	75	..	81	...	60	...	60	...	70

...tridges.
...e full charge for 7-pr. steel gun of 200 lb., for instructional purposes in the N.S., when specially authorised.

TABLE No. 6—*continued.*

CORDITE CARTRIDGES, B.L. AND R.M.L.—*continued.*

Calibre.	Mark.	§Changes in War Stores.	Length.	Diameter.	Weight and Description of Cordite.	Primer R.F.G.[2] or Blank F.G. new.	Number of Hoops.	Number Packed and Description of Package.	Remarks.
B.L.—*continued.*			ins.	ins.					
6-inch 25-cwt. howitzer ...	II	20/10/96	10	Base 4·75	2-lb. 1-oz., full. Core, 15-oz. 3 rings, 11-oz., 5-oz., and 2-oz. Size 3¾.	12-drs.	...	30 in whole, 16 in half, 5 in quarter metal-lined case.	Shalloon.
6-inch 25-cwt. howitzer ..	III	22/9/97	10	Base 4·75	2-lb. 1-oz., full. Core, 15-oz. 3 rings, 11-oz., 5-oz., and 2-oz. Size 3¾.	12-drs.	...	30 in whole, 16 in half, 5 in quarter metal-lined case.	,,
6-inch 30-cwt. howitzer ...	I	9002	6·5	Base 4·4	1-lb. 12-oz., full. Core, 14-oz. 3 rings, 8-oz., 4-oz., and 2-oz. Size 5.	12-drs.	...	50 in whole metal-lined case ...	,,
6-inch 30-cwt. howitzer ...	II	9263	6·5	Base 4·4	1-lb. 12-oz., full. Core, 14-oz. 3 rings, 8-oz., 4-oz., and 2-oz. Size 5.	12-drs.	...	50 in whole metal-lined case ...	,,
6-inch, Mark III, C.H., and Marks IV to VI.	I	7594	14·6	Base 11·4 to 11·8 Neck 4·5	14-lb. 12-oz. Size 20	1-oz. at base ...	Nil	5 in whole metal-lined case ...	No. 2 silk cloth.
6-inch, Marks IV to VI ...	II	9770	17·5	5·5	14-lb. 12-oz. Size 20	2-oz.	4	7 in whole metal-lined case ...	,, ,,
6-inch, Mark VII	I	...	11·75	5·52	11-lb. Size 30 (½ charge) ...	2-oz.	3	... ...	,, ,,
6-inch, Mark VII	I	...	23·5	5·52	22-lb. Size 30 (full charge) ...	2-oz.	6	... ...	,, ,,
6-inch, Mark VII	I	...	11·75	5·52	9-lb. 9½-oz. Size 20 (½ charge)...	2-oz.	3	... ...	,, ,,
(A) 6-inch, Mark VII ...	I	...	23·5	5·52	19-lb. 2½-oz. Size 20 (full charge)	2-oz.	6	... ...	,, ,,
6-inch, Marks VII and VIII	I	10408	11·75	5·75	10-lb. Size 20 (½ charge) ...	2-oz.	3	L.S. 2 laced together in No. 34 cylinder; 14 in B case.	,, ,,
6-inch, Marks VII and VIII	I	10408	23·5	5·75	20-lb. Size 20 (full charge) ...	2-oz. at each end	6		,, ,,
6-inch, Marks IX and X ...	I	10409	23·6	5·75	20-lb. Size 30 (full charge) ...	2-oz. one end ...	...	1 in No. 34 cylinder	,, ,,
6-inch howitzer	I	16/2/99	...	...	4-lb. 2-oz. Size 7½	12-drs.	Nil	... ...	Shalloon.
8-inch, Mark III	I	9740	8·5	Base, 7·0 Neck, 5·0	7-lb. 3·oz. Size 20 (¼ charge) ...	6-oz.	3	12 in H case	No. 2 silk cloth.
8-inch, Mark III	I	9740	15·0	Base, 7·0 Neck, 5·2	14-lb. 6-oz. Size 20 (½ charge)...	6-oz.	4	6 in H case	,, ,,
8-inch, Marks IV to VI ...	I	8513	8·5	Base, 7·2	8-lb. 2½-oz. Size 20 (¼ charge)...	6-oz.	3	12 in H case	,, ,,
8-inch, Marks IV to VI ...	II	9645	8·5	Base, 7·2	8-lb. 2½-oz. Size 20 (¼ charge)...	6-oz.	3	12 in H case	,, ,,

A.—When these cartridges are converted to conform, as far as possible, to the 20-lb. cartridge, they will be designated Mark I*, and used up as half charges for practice in L.S. during the year 1901-2.

TABLE No. 6—*continued.*

CORDITE CARTRIDGES, B.L. AND R.M.L.—*continued.*

Calibre.	Mark.	§Changes in War Stores.	Length.	Diameter.	Weight and Description of Cordite.	Primer R.F.G.[2] or Blank F.G. new.	Number of Hoops.	Number Packed and Description of Package.	Remarks.
B.L.—*continued.*			ins.	ins.					
8-inch, Marks IV to VI ...	I	8513	16·5	Base, 7·2	16-lb. 5-oz. Size 20 (½ charge)...	6-oz.	5	6 in H case	No. 2 silk cloth.
8 inch, Marks IV to VI ...	II	9615	16·5	Base, 7·2	16-lb. 5-oz. Size 20 (½ charge)...	6-oz.	5	6 in H case	,, ,,
8 inch, Mark VII	I	9805	15·0	Base, 7·0 Neck, 5·125	14-lb. 2-oz. Size 20 (½ charge)...	6-oz.	4	1 in cylinder, cartridge, No. 18	,, ,,
8 inch, Mark VII	I*	9805	15·0	Base, 7·0 Neck, 5·125	14-lb. 2-oz. Size 20 (½ charge)...	6-oz.	4	1 in cylinder, cartridge, No. 18	,, ,,
8 inch, Mark VII	II	9805	15·0	Base, 7·0 Neck, 5·125	14-lb. 2-oz. Size 20 (½ charge)...	6-oz.	4	1 in cylinder, cartridge, No. 18	,, ,,
9·2-inch, Marks I and II ...	I	9766	9·5	Base, 7·5	10-lb. 8-oz. Size 30 (½ charge)...	8-oz.	3	12 in I case...	No. 1 silk cloth.
9·2-inch, Marks I and II ..	I	9766	19·0	Base, 7·5	21-lb. Size 30 (½ charge) ..	8-oz.	6	1 in cylinder, cartridge, No. 22 (L.S.). 6 in I case (N.S.)... ...	No. 2 silk cloth.
9·2-inch, Marks III to VII...	I	9766	9·75	Base, 7·5	13-lb. 6-oz. Size 30 (½ charge)...	8 oz.	3	12 in I case	No. 1 silk cloth.
9·2-inch, Marks III to VII...	I	9766	19·5	Base, 7·5	26-lb. 12-oz. Size 30 (½ charge)	8-oz.	6	1 in cylinder cartridge, No. 22 (L.S.). 6 in I case (N.S.)... ...	No. 2 silk cloth.
9·2-inch, Marks III to VII...	I*	9766	19·5	Base, 7·5	26-lb. 12-oz. Size 30 (½ charge)	8-oz.	6	1 in cylinder cartridge, No. 22 (L.S.). 6 in I case (N.S.)... ...	,, ,,
9·2-inch, Marks III to VII...	II	9766	19·5	Base, 7·5	26-lb. 12 oz. Size 30 (½ charge)	-oz.	6	1 in cylinder cartridge, No. 22 (L.S.). 6 in I case (N.S.)... ...	,, ,,
9·2-inch, Mark VIII ...	I	8512	12·5	Base, 7·5	15-lb. 12-oz. Size 40 (½ charge)	8-oz.	4	9 in I case	,, ,,
9·2-inch, Mark VIII ..	I*	9719	12·5	Base, 7·5	15-lb. 12-oz. Size 40 (½ charge)	8-oz.	4	9 in I case	,, ,,
9·2-inch, Mark VIII ..	II	9645	12·5	Base, 7·5	15-lb. 12-oz. Size 40 (½ charge)	8-oz.	4	9 in I case	,, ,,
9·2-inch, Mark VIII ..	I	8512	21·5	Base, 7·5	31-lb. 8-oz. Size 40 (½ charge)...	8-oz.	5	5 in I case	,, ,,
9·2-inch, Mark VIII ...	I*	9766	21·5	Base, 7·5	31-lb. 8-oz. Size 40 (½ charge)...	8-oz.	5	5 in I case	,, ,,
9·2-inch, Mark VIII ...	II	9766	21·5	Base, 7·5	31-lb. 8-oz. Size 40 (½ charge)...	8-oz.	6	5 in I case	,, ,,
9·2-inch, Marks IX and X...	I	10233	16·5	Base, 8·25	24-lb. 12-oz. Size 44. 1-lb. Size 3¾ (½ charge).	8-oz.	5	L.S., 2 in cylinder cartridge, No. 36. N.S., 8 in N case.	,, ,,

TABLE No. 6—*continued.*

CORDITE CARTRIDGES, B.L. AND R.M.L.—*continued.*

Calibre.	Mark.	§Changes in War Stores.	Length.	Diameter.	Weight and Description of Cordite.	Primer R.F.G.² or Blank F.G. new.	Number of Hoops.	Number Packed and Description of Package.	Remarks.
B.L.—*continued.*			ins.	ins.					
9·2-inch, Marks IX and X ..	I	10233	33·0	Base, 8·25	49-lb. 8-oz. Size 44. 2-lb. Size 3¾ (¼ charge).	8-oz.	10	L.S., 1 in cylinder cartridge, No. 36. N.S., 4 in N case.	No. 2 silk cloth.
9·2-inch, Mark IX	I	9767	16·5	Base, 8·25	25-lb. Size 44 (½ charge) ...	8-oz.	5	2 in cylinder cartridge, No. 36...	,, ,,
9·2-inch, Mark IX	I	9766	33·0	Base, 8·25	50-lb. Size 44 (½ charge) ...	8-oz.	10	1 in cylinder cartridge, No. 36...	,, ,,
10-inch...	I	8558	13·5	Base, 8·25	19-lb. Size 30 (¼ charge) ...	8-oz.	4	6 in J case ... ... / 2 in cylinder cartridge, No. 27	,, ,,
10-inch...	I*	9719	13·5	Base, 8·25	19-lb. Size 30 (¼ charge) ...	8-oz.	4	6 in J case ... ... / 2 in cylinder cartridge, No. 27	,, ,,
10-inch...	II	9645	13·5	Base, 8·25	19-lb. Size 30 (¼ charge) ...	8-oz.	4	6 in J case ... ... / 2 in cylinder cartridge, No. 27	,, ,,
10-inch...	I	8558	22·5	Base, 8·25	38-lb. Size 30 (¼ charge) ...	8-oz.	6	4 in J case ... ... / 1 in cylinder cartridge, No. 27	,, ,,
10-inch...	I*	9719	22·5	Base, 8·25	38-lb. Size 30 (¼ charge) ...	8 oz.	6	4 in J case ... ... / 1 in cylinder cartridge, No. 27	,, ,,
10-inch...	II	9671	22·5	Base, 8·25	38-lb. Size 30 (¼ charge) ...	8-oz.	6	4 in J case ... ... / 1 in cylinder cartridge, No. 27	,, ,,
10-inch...	II*	9719	22·5	Base, 8·25	38-lb. Size 30 (¼ charge) ...	8-oz.	6	4 in J case ... ... / 1 in cylinder cartridge, No. 27	,, ,,
10-inch	III	9671	22·5	Base, 8·25	38-lb. Size 30 (¼ charge) ...	8-oz.	6	4 in J case ... ... / 1 in cylinder cartridge, No. 27	,, ,,
12-inch, Marks I to VII ...	I	8685	11·5	Base, 9·2	22 lb. 2-oz. Size 30 (¼ charge)...	8-oz.	4	2 in cylinder cartridge, No. 16...	,, ,,
12-inch, Marks I to VII ...	I*	9719	11·5	Base, 9·2	22-lb. 2-oz. Size 30 (¼ charge)...	8 oz.	4	2 in cylinder cartridge, No. 16 ..	,, ,,
12-inch, Marks I to VII ...	II	10205	11·5	Base, 9·2	22-lb. 2-oz. Size 30 (¼ charge) ..	8 oz.	4	2 in cylinder cartridge, No. 16...	,, ,,
12-inch, Mark VIII	I	8512	16·5	9·5	41-lb. 14-oz. Size 50 (¼ charge)	8-oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17	,, ,,
12-inch, Mark VIII	I*	9719	16·5	9·5	41-lb. 14-oz. Size 50 (¼ charge)	8-oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17	,, ,,
12 inch, Mark VIII	II	9739	16·5	9·5	41-lb. 14-oz. Size 50 (¼ charge)	8-oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17 / 2 in cylinder cartridge, No. 33	,, ,,

TABLE No. 6—*continued.*

CORDITE CARTRIDGES, B.L. AND R.M.L.—*continued.*

Calibre.	Mark.	§Changes in War Stores.	Length.	Diameter.	Weight and Description of Cordite.	Primer R.F.G.[2] or Blank F.G. new.	Number of Hoops.	Number Packed and Description of Package.	Remarks.
B.L.—*continued.*			ins.	ins.					
12-inch, Mark VIII	II*	9739	16·5	9·5	41-lb. 14-oz. Size 50 ($\frac{1}{4}$ charge)	8-oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17	No. 2 silk cloth.
12-inch, Mark VIII	III	9739	16·25	9·5	41-lb. 14-oz. Size 50 ($\frac{1}{4}$ charge)	8-oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17 / 2 in cylinder cartridge, No. 33	,, ,,
12-inch, Mark VIII	I	9739	32·5	9·5	83-lb. 12-oz. Size 50 ($\frac{1}{2}$ charge)	8-oz.	9	1 in R case ... ... / 1 in cylinder cartridge, No. 33	,, ,,
12-inch, Mark VIII	I	9927	16·25	9·5	41-lb. 10-oz. Size 50 / 1-lb. 14-oz. Size $3\frac{3}{4}$ ($\frac{1}{4}$ charge)	8 oz.	5	2 in R case ... ... / 1 in cylinder cartridge, No. 17 / 2 in cylinder cartridge, No. 33	,, ,,
12-inch, Mark VIII	I	9927	32·5	9·5	83-lb. 4-oz. Size 50 / 3-lb. 12-oz. Size $3\frac{3}{4}$ ($\frac{1}{2}$ charge)	8-oz.	9	1 in R case ... ... / 1 in cylinder cartridge, No. 33	No. 3 silk cloth.
12-inch, Mark IX	I	10367 / 10388	16·75	10·25	50-lb. 6-oz. Size 50 / 2-lb. 6-oz. Size $3\frac{3}{4}$ ($\frac{1}{2}$ charge)	8-oz.	9	2 in Q case	... ...
13·5 inch	I	9738	11·5	11·7	46-lb. 12-oz. Size 44 ($\frac{1}{2}$ charge)	8-oz.	5	2 in P case	No. 2 silk cloth.
13·5-inch	I	9738	23·0	11·7	93-lb. 8-oz. Size 44 ($\frac{1}{2}$ charge)	8-oz.	4	1 in P case	No. 3 silk cloth.
13·5-inch	I	10593	23·0	11·8	88-lb. 12-oz. Size 44 / 5-lb. Size $3\frac{3}{4}$ ($\frac{1}{2}$ charge)	8-oz.	5	1 in P case	... ...
13·5-inch	I	10593	11·5	11·8	44-lb. 6-oz. Size 44 / 2-lb. 8-oz. Size $3\frac{3}{4}$ ($\frac{1}{4}$ charge)	8-oz.	4	2 in P case	... ...
R.M.L.									
9-inch	I	...	19·75	7·15	14-lb. Size $7\frac{1}{2}$	8-oz.	4	1 in cylinder cartridge, No. 20...	No. 1 silk cloth.
10-inch	I	...	26	7·5	20-lb. 6-oz. Size 10	2-8-oz.	5	1 in cylinder cartridge, No. 28...	No. 2 silk cloth.
11-inch...	I	...	26·75	8	25-lb. 4-oz. Size 10	2-8-oz.	5	1 in cylinder cartridge, No. 28...	,, ,,
12·5-inch, Mark I	I	...	19	8·2	24-lb. Size 10	2-8-oz.	3	1 in cylinder cartridge, No. 20...	,, ,,
12·5-inch, Mark II	I	...	20·625	8·5	29-lb. 8 oz. Size 10	1-lb.	5	1 in cylinder cartridge, No. 20...	,, ,,

Table No. 7.

Powder Cartridges, B.L. and R.M.L. Reduced (Silk Cloth) for Use in Gunnery Ships.

Calibre, Nature, and Mark.	Para. in Changes of War Stores.	Charge.	Length when filled not to exceed	Diameter. when filled not to exceed	Number and Description of Hoops.	Remarks.
B.L.			ins.	ins.		
9·2-inch, 31 lb., E.X.E., Mark I	8575	Reduced	13·5	9·5	10 broad.	½ charge.
9·2-inch, 53 lb., S.B.C., Mark I	10858	Reduced	12·25	11·7	7 „	½ charge.
8-inch, 22 lb. 8 oz., E.X.E., Mark I	8575 / 9530	Reduced	11·8	8·25	8 „	½ charge.
6-inch, 22 lb. E.X.E. (large prisms), Mark I ..	10959	..	16·0	6·6	7 „	½ charge, paper shot, Marks VII and VII^{v} guns.
6-inch, 24½ lb. P^{2}., Mark I	6773	Practice	15·25	7·5	9 narrow.	
6-inch, 12 lb. E.X.E. (large prisms), Mark I ..	10745	Practice	7·1	7·2	6 „	⅓ charge, Marks IV to VI guns on H.P. mountings.
5-inch, 8 lb. 6 oz. P^{2}., Mark I	6939	Practice	12·0	5·2	7 „	
R.M.L.						
10-inch, 47 lb. P^{2}., Mark I	6804	Practice	18·5	9·5	8 broad.	

TABLE No. 8.

POWDER CARTRIDGES, SERVICE AND SALUTING, R.B.L. GUNS.

Nature.	Description.	Charges in War Stores.	Charge.	Length.	Diameter.	Paper Cylinder. Length.	Paper Cylinder. Diameter.	No. and Nature of Braid Hoops.	Number Packed and Weight of Package in Pounds. Cases, Powder. Copper-lined. Whole. Number.	Whole. Weight.	Half. Number.	Half. Weight.	Quarter. Number.	Quarter. Weight.	Remarks.
			lbs.	inches.	ins.	ins.	ins.	Narrow.							
7-inch	Full, I	1038–9	11* R.L.G.[2] ...	10 to 11	7·03	4·5	3·25	5	8	141	3	65	...	...	Serge.
		662	10† ,, ...	10 ,, 11	,,	,,	4·1	,,	8	133	3	62	...	...	,,
		4460	11 ,, ...	10 ,, 11	,,	,,	3·25	,,	8	141	3	65	...	...	Silk cloth.
			10 ,, ...	10 ,, 11	,,	,,	4·1	,,	8	133	3	62	...	...	,,
	Blank, I ...		7 L.G. ...	6 ,, 6·5	,,	...	...	...	15	156	5	60	...	...	,,
40-pr.	Full, I. L.S....	407–3435	5 R.L.G.[2] ...	10 ,, 10·75	4·77	4·5	3·25	5	15	131	5	57	2	29	Serge.
	,, I ...	..	5 ,, ...	10 ,, 10·75	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	Silk cloth.
	Blank, I ...	4460	3 L.G.	5·65 ,, 6·25	,,	...	...	...	37	162	...	...	...	...	,,
20-pr.	Full, I ...	234–408	2½ R.L.G.[2] ...	10 ,, 10·75	3·77	4·25	2·5	5	26	134	12	69	4	31	Serge.
	,, I ...	4460	2½ ,, ...	10 ,, 10·75	,,	,,	,,	5	,,	,,	,,	,,	,,	,,	Silk cloth.
	Blank, I ...	,,	1½ L.G.... ...	4·75 ,, 5·25	,,	...	...	2	...	...	...	...	...	...	,,
	,, II ...	5484	1½ ,, ...	10 ,, 10·75	3·77 to 3·6	...	...	2	26	...	12	...	4	...	Silk cloth. braid loop, same as 9 and 12-prs.
12-pr.	Full, I ...	409	1½ R.L.G.[2] ...	8 ,, 8·5	3·02	...	...	4	50	142	25	77	9	35	Serge.
	,, I ...	4460	1½ ,, ...	8 ,, 8·5	,,	...	...	4	,,	,,	,,	,,	,,	,,	Silk cloth.
9-pr.	,, I ...	410	1½ ,, ...	6 ,, 6·5	3·07	...	...	3	70	154	32	78	12	36	Serge.
	,, I ...	4460	1½ ,, ...	6 ,, 6·5	,,	...	...	3	,,	,,	,,	,,	,,	,,	Silk cloth.
12 or 9-pr....	Blank, I ...	,,	1 L.G.	8·25	3·125 & 2·87	...	...	6	50	100	...	...	...	...	,,

* For 7-in., 82-cwt. † For 7-in., 72-cwt.

N.B.—The discontinuance of the use of L.G. powder in rifled guns (§ 5271) will not extend to the existing store of R.B.L. cartridges filled with L.G., which will be used up.

TABLE No. 9.

POWDER CARTRIDGES, B.L., SALUTING.

Calibre, Nature, and Mark.	§ in Changes of War Stores.	Charges in lb., Blank, L.G.	Length, filled.		Diameter, filled.		Number and Description of Hoops.
			From	To	From	To	
			inches.	inches.	inches.	inches.	
6-inch B.L., Mark I	8458, 4213, 1369, 1415	7 lb.	7·3	7·8	6·0	..	4 narrow.
5-inch gun or howitzer, Mark I	4313, 5636, 5743, 7074, 8458	3 lb.	6·25	6·75	4·5	..	4 „
4-inch, Mark I	4805	4 lb.	12·0	13·0	3·3	..	6 „
15-pr. Mark II	8225, 5527	1¼ lb.	5·75	6·25	top 1·5, bottom 3·6	..	3 „
12-pr., Mark I, 6-cwt.	8311, 10541	1 lb.	..	4·7	..	3	2 „ to become obsolete.
*15 or 12-pr., Mark I	10427	1¼ lb.	..	5·5	.	3	3 „

* Packed for ordinary transport and storage in case, powder, M.L., whole 90, half 40, quarter 18 (without paper covers).

Table No. 10.

Powder Cartridges, Blank or Saluting (Silk Cloth), R.M.L. Guns and Howitzers.

Calibre, Nature and Mark.	§ Charges in War Stores.	Charges in lb., Blank L.G.	Length filled, not to exceed	Diameter filled, not to exceed	Number and Description of Hoops.	Service empty cartridges to be used.	Remarks.
Guns.			inches.	inches.			
16-inch, Mark I, Saluting; also 17·72-inch	6089 / 9905	55-lb.	16·0	12·0	8 broad		
12·5-inch, Mark I	6089	40 „	15·5	10·0	8 „		
12-inch, „ I	6806	35 „	12·5	11·5	8 „		
11-inch, „ I	6806	30 „	11·5	10·5	5 narrow		
10-inch, „ I	6089	25 „	14·9	8·25	7 „		
9-inch, „ I	6089	20 „	12·5	8·25	6 „		
7-inch, „ I*	2838	10 „	9·25	6·4	3 „		
„ „ II	3912	10 „	13·25	5·2	6 „		
80-pr., „ I	2633	5 „	6·5	5·8	2 twist		
„ „ II	2838	5 „	6·5	6·0	2 narrow		
64-pr., „ I	2283	5 „	6·5	5·8	2 twist		
„ „ II	2888	5 „	6·5	6·0	2 narrow		
40-pr.†	7345	3 „	10·75	3·3	6 „		
16-pr., Mark I	2212	1½ „	5·5	3·3	3 twist		
„ „ II, also 25-pr.	6189 / 2838	1½ „	5·5	3·3	3 narrow		
13-pr., „ I	4172	1¾ „	8·75	2·73	6 „		
9-pr., „ I	2047	1 „	5·75	2·6	3 twist		
„ „ II	2838	1 „	5·75	2·6	3 narrow		
2·5-inch, Mark I	4772	12-oz.	7·0	2·1	4 „		
Howitzers.							
8-inch, 70-cwt. or 46-cwt.†	7345	3-lb.	—	—	—	3-lb., Mark I.	
6·6-inch†	7345	2 „	—	—	—	5-lb., „ II.	
6·3-inch†	7345	2 „	—	—	—	4-lb., „ III.	

* Mark I was liable to set up past the vent on being rammed home, and thereby causes misfires.
† For use with movable armaments.

Table No. 11.

Cylinders, Zinc, for Cartridges.

Description of Cylinder.	Numeral.	§ Changes in War Stores.	Cartridges packed in each.	
			Cordite.	Powder.
Cylinder cartridge.				
No. 1 ..	I	6513, 7078, 8947, 9233	.. .. ..	B.L., 16·25-inch, one 120-lb., S.B.C.
„ 1(*a*)	II	8947, 9233	.. ..	„ „ „ „
„ 2 ..	I	6513, 7078, 8947, 9233	.. .. ..	B.L., 13·5-inch, one 157½-lb., S.B.C.
„ 2(*a*)	II	8947, 9233	.. ..	„ „ „ „
„ 3 ..	I	4195, 7078, 8947, 9233	.. .. ..	R.M.L., 17·72-inch, or 16-inch, one 112½-lb., Prism.
„ 3 ..	II	4195, 7078, 8947, 9233	.. ..	„ „ „ „
„ 3 ..	IV	6513, 7078, 8947, 9233	.. ..	„ „ „ „
„ 3(*a*)	V	8947, 9233	.. ..	„ „ „ „
„ 4 ..	I	4773, 7078, 8947, 9233	.. .. ..	B.L., 12-inch, one 73¾-lb., Prism[1], brown.
„ 4 ..	II	6513, 7078, 8947, 9233	.. ..	„ „ „ „
„ 4(*a*)	III	8947, 9238	.. ..	„ „ „ „
„ 5 ..	II	6393, 7078, 8947, 9238	.. .. ..	B.L., 10-inch, one 63-lb., Prism[1], brown.
„ 5 ..	III	6393, 7078, 8947, 9233	.. ..	„ „ „ „
„ 5(*a*)	IV	8947, 9233	.. ..	„ „ „ „
„ 6 ..	I	4195, 7078, 8947, 9233	.. .. ..	R.M.L., 12·5-inch, two 52½-lb., Prism or one 82½-lb., Prism, or one 80-lb., P[2], or two 50-lb., E.X.E.

TABLE No. 11—*continued.*

CYLINDERS, ZINC, FOR CARTRIDGES—*continued.*

Description of Cylinder.	Numeral.	§ Changes in War Stores.	Cartridges packed in each.							
			Cordite.				Powder.			
Cylinder cartridge.										
No. 6 ..	II	4709 7078 8947 9233	..	..	..		R.M.L., 12·5-inch, two 52½-lb., Prism or one 82½-lb., Prism, or one 80-lb., P², or two 50-lb., E.X.E.			
„ 6 ..	III	6·07 7078 8947 9233	..	..	..	..	„	„	„	„
„ 6(*a*)	IV	8947 9233	..	..	..	..	„	„	„	„
„ 7 ..	I	6513 7078 8947 9233	..	..	..		B.L., 9·2-inch, 83-lb., Prism[1], brown.			
„ 7(*a*)	II	8947 9233	..	..	..	..	„	„	„	„
„ 8 ..	II	4195 7078 8947 9233	..	..	..		R.M.L., 12-inch, one 110-lb., P² or P, or two 35-lb., blank, L.G.			
„ 8 ..	III	4709 7078 8947 9233	..	..	..	..	„	„	„	„
„ 8 ..	IV	8947 9233	..	..	..	..	„	„	„	„
„ 8(*a*)	V	8947 9233	..	..	..	..	„	„	„	„
„ 9 ..	II	4195 7078 8947 9233	..	..	..		R.M.L., 12-inch, one 85-lb., P² or P.			
„ 9 ..	III	4709 7078 8947 9233	..	..	..	..	„	„	„	„
„ 9(*a*)	IV	8947 9233	..	..	..	..	„	„	„	„
„ 10 ..	II	4195 7078 8947 9233	..	..	..		R.M.L., 12-inch, one 55-lb., P., or one 35-lb., blank, L.G.			
„ 10 ..	III	4709 7078 8947 9233	..	..	..		R.M.L., 12-inch, one 55-lb., P., or one 35-lb., blank, L.G.			
„ 10(*a*)	IV	8947 9233	..	..	..	..	„	„	„	„
„ 11 ..	IV	7078 8947 9233	..	..	..		R.M.L., 11-inch, one 85-lb. P.			
„ 11(*a*)	V	8947 9233	..	..	..	..	„	„	„	„

TABLE No. 11—*continued.*

CYLINDERS, ZINC, FOR CARTRIDGES—*continued.*

Description of Cylinder.	Numeral.	§ Changes in War Stores.	Cartridges packed in each.	
			Cordite.	Powder.
Cylinder cartridge. No. 12 ..	II	4195, 7078, 8947, 9233	.. .. ..	R.M.L., 11-inch, one 60-lb. P.
„ 12 ..	III	4709, 7078, 8947, 9233	.. ..	„ „ „ „
„ 12 ..	IV	8947, 9233	.. ..	„ „ „ „
„ 13 ..	I	6513, 7078, 8947, 9233	.. .. ..	B.L., 8-inch, two 29¼-lb., Prism[1] brown, or one 45-lb., or two 22¼-lb., Prism[1] black.
„ 13(*a*)	II	8947, 9233	.. ..	„ „ „ „
„ 14 ..	I	5215, 7078, 8947, 9233	.. .. ..	To be converted, as required, to No. 37.
„ 14(*a*)	II	8947, 9233	.. ..	„ „ „ „
„ 15 ..	III	4195, 7078, 8947, 9233	.. .. ..	R.M.L., 10-inch, one 70-lb., P.
„ 15 ..	IV	4709, 7078, 8947, 9233	.. ..	„ „ „ „
„ 15 ..	IV*	6547, 7078, 8947, 9233	.. ..	„ „ „ „
„ 15 ..	V	7078, 8947, 9233	.. ..	„ „ „ „
„ 15 ..	VI	8947, 9233	.. ..	„ „ „ „
„ 16 ..	I	8728, 8947, 9233	B.L., 12-inch, 44½-lb., cordite, or two 22-lb. 2-oz.	.. ..
„ 17 ..	I	8113, 8947, 9233	B.L., 12-inch, wire, one 43¼-lb. cordite, or one 41-lb. 14-oz.	.. ..
„ 17(*a*)	II	8947, 9233	„ „ „ „	.. ..
„ 18 ..	I	5241, 7078, 8947, 9233	B.L., 8-inch, one 14-lb. 2-oz., cordite.	B.L., 8-inch, two 22¼-lb., E.X.E., or one 45-lb., or two 22¼-lb., Prism[1] black.
„ 18(*a*)	II	8947, 9233	„ „ „ „	„ „ „ „

TABLE NO. 11—*continued.*

CYLINDERS, ZINC, FOR CARTRIDGES—*continued.*

Description of Cylinder.	Numeral.	§ Changes in War Stores.	Cartridges packed in each.	
			Cordite.	Powder.
Cylinder cartridge. No. 19 ..	III	4195, 7078, 8947, 9233	.. ..	R.M.L., 10-inch, 44-lb., P.
„ 19 ..	IV	4709, 7078, 8947, 9233	.. ..	„ „ „ „
„ 19(*a*)	V	8947, 9233	.. ..	„ „ „ „
„ 20 ..	III	4195, 7078, 8947, 9233	B.L., 10-inch, one 38-lb. cordite; or R.M.L., 12·5-inch, one 29¼-lb. cordite, or one 24-lb. cordite, or R.M.L., 9-inch, 14-lb. cordite.	R.M.L., 9-inch, 50-lb., P.
„ 20 ..	IV	4709, 7078, 8947, 9233	„ „ „ „	„ „ „ „
„ 20 ..	IV*	6547, 7078, 8947, 9233	„ „ „ „	„ „ „ „
„ 20 ..	V	7078, 8947, 9233	„ „ „ „	„ „ „ „
„ 20(*a*)	VI	8947, 9233	„ „ „ „	„ „ „ „
„ 21 ..	I	6547, 7078, 8947, 9233	.. ..	R.M.L., 9-inch, 25-lb., P.
„ 21(*a*)	II	8947, 9233	.. ..	„ „ „ „
„ 22 ..	I	5326, 7078, 8947, 9233	B.L., 9·2-inch, one 26¾-lb. cordite, or one 21-lb.	B.L., 8-inch, two 22½-lb., E.X.E., or B.L., 6-inch, four 12-lb., E.X.E., or two 22½-lb. Prism[1] black.
„ 22 ..	I	6513, 7078, 8947, 9233	„ „ „ „	„ „ „ „
„ 22(*a*)	III	8947, 9233	„ „ „ „	„ „ „ „
„ 23 ..	II	5305, 7078, 8947, 9233	.. ..	R.M.L., 8-inch, 35-lb., P.
„ 23(*a*)	III	8947, 9233	.. ..	„ „ „ „
„ 24 ..	I	8947, 9233	.. ..	R.M.L., 8-inch, 21-lb., P.
„ 24(*a*)	II	8947, 9233	.. ..	R.M.L., 8 inch, 21-lb., P.

TABLE No. 11—*continued.*

CYLINDERS, ZINC, FOR CARTRIDGES—*continued.*

Description of Cylinder.	Numeral.	§ Changes in War Stores.	Cartridges packed in each.	
			Cordite.	Powder.
Cylinder cartridge. No. 25 ..	III	4195 7078 8947 9233	.. .. ..	R.M.L., 7-inch, 30-lb., P., or two 17-lb., P.
„ 25 ..	IV	4709 7078 8947 9233	.. ..	„ „ „ „
„ 25 ..	V	6776 7078 8947 9233	.. ..	„ „ „ „
„ 25(*a*)	VI	8947 9233	.. ..	„ „ „ „
„ 26 ..	I	5177 7078 9233	.. .. ..	B.L., 9·2-inch, one 82-lb., Prism[1] brown, or two 41-lb., Prism[1] brown, or two 35-lb., Prism[1] brown.
„ 27(*a*)	I	9233	B.L., 10-inch, one 38-lb., cordite, or two 19-lb., or B.L. 9·2-inch, nine 15-lb. 12-oz. cordite.	.. ..
„ 28 ..	I	9233	R.M.L., 11-inch, one 25-lb. 4-oz., cordite, or R.M.L., 10-inch, one 20-lb. 6-oz. cordite.	.. ..
„ 29 ..	I	4773 7078 9233	.. .. ..	B.L., 12-inch, one 73¾-lb., Prism[1] brown.
„ 30 ..	I	5345 9233	.. .. ..	B.L., 6-inch, four 12-lb., E.X.E., without wood disc.
„ 31 ..	II	4195 7078 9233	.. ..	R.M.L., 11-inch, 85-lb., P.
„ 31 ..	III	4709 7078 9233	.. ..	„ „ „ „
„ 32 ..	IV	4195 9233	.. .. ..	R.M.L. 9-inch, one 33-lb., P.
„ 32 ..	V	4709 9233	.. ..	„ „ „ „
„ 33(*a*)	I	9473 9852	B.L., 12-inch, one 83-lb. 12-oz. cordite or two 41-lb. 14-oz. cordite or one 87-lb. or two 43-lb. 8-oz. cordite.	.. ..
„ 34(*a*)	I	9389 9852	B.L., 6-inch, Marks VII and VII guns, two ½ charges. B.L., 6-inch, Marks IX and X guns, one full charge.	.. ..
„ 35(*a*)	I	—	.. ..	.. ..
„ 36(*a*)	—	9507 9852	B.L., 9·2 inch, one 51-lb. 8-oz. cordite, or two 25-lb. 12-oz. cordite, or one 50-lb. or two 25-lb. cordite.	.. ..
„ 37(*a*)	I	9951	.. .. ..	R.M.L., 10-inch, one 48-lb., S.P.

(*a*) These cylinders have a ring of zinc ·019-inch thick, soldered round the inside of the mouth.

TABLE No. 11A.

INTERNAL DIMENSIONS OF CARTRIDGE, CYLINDERS, ZINC.

No.	Mark.	Service.	Diameter, inches.	Length, inches.	Remarks.
1	I and II	N	21·025	10·5	
2	I and II	C	17·9	16·0	
3	{I, II, III, IV and V}	C	15·9	14·75	
4	II and III	C	15·9	11·5	
5A	II	C	14·4	12·5	
5	III and IV	C	14·15	12·5	
6A	I and II	C	12·15	21·5	
6	III and IV	C	12·4	21·55	
7	I and II	C	11·9	18·75	
8	II, III, IV and V	L	11·65	28·5	
9	II, III and IV	C	11·65	22·5	
10	II, III and IV	C	11·65	15·25	
11	IV and V	C	10·9	26·0	
12	II, III and IV	C	10·65	19·35	
13	I and II	C	10·4	16·75	
14	I and II	L	10·15	27·45	
15A	III and IV and IV*	C	9·65	26·0	
15	V and VI	C	9·9	26·0	
16	I	L	9·9	23·25	
17	I and II	N	9·9	16·85	
18	I and II	C	9·9	16·5	
19	III, IV and V	C	9·65	17·3	
20A	III and IV and IV*	C	8·65	23·35	
20	V and VI	C	8·9	24·0	
21	I and II	L	8·65	12·25	
22	I, II and III	C	7·9	27·15	
23	II and III	C	7·65	22·0	
24	I and II	C	7·65	15·7	
25A	III and IV	C	6·65	30·0	
25	V and VI	C	6·9	30·0	
26	I	C	11·65	19·5	
27	I	N	8·65	27·37	
28	I	L	8·9	27·75	
29	I	C	14·15	11·5	
30	I	C	7·9	24·75	
31	II and III	C	10·65	27·25	
32	IV and V	C	8·65	18·0	
33	I	N	9·9	33·5	
34	I	C	6·5	24·0	
35	I	—	—	—	
36	I	C	8·9	33·5	
37	I	—	10·15	19·0	Converted from No. 14.

TABLE No. 12.

CASES, CARTRIDGE.

Description of case.	Numeral.	§ Changes in war stores.	Cartridges that may be carried in each.		Remarks.
			Cordite.	Powder.	
Case, cartridge.					
No. 1	II (L)	§§ 977, 1316, 3811	... ...	13-inch L.S. mortar, 10-inch S.B. gun, howitzer or mortar.	
No. 2	II (L)	§§ 1021, 3672, 3811	... ...	R.B.L. 7-inch, S.B. 68-pr., and 42-pr., and R.M.L. 8-inch howitzer.	
No. 3	I (C)	§ 3811	... ...	S.B. 8-inch gun.	
No. 4	II (C)	§§ 1021, 3672, 3811	... ...	R.M.L. 80-pr., 64-pr., 25-pr., and 6·6-inch guns, and 6·3 howitzers, R.B.L. 40-pr., S.B. 32-pr. from 56 cwt. to 63 cwt.	
No. 5	I (C)	§ 3811	... ...	R.B.L. 20-pr., S.B. 32-pr., 50 cwt. to 29 cwt. and 24-pr., 50 cwt. or 48 cwt.	
No. 6	I (C)	§ 3811	... ...	R.M.L. 9-pr. and 7-pr., R.B.L. 12-pr. and 9-pr., S.B. 32-pr. of 32 cwt. or 25 cwt., 24-pr. 20 cwt., 24 and 12-pr. howitzers, all carronades and smaller natures of guns.	
No. 7	I (C)	§ 3811	... ...	S.B. 100-pr.	
No. 8	I (N)	§§ 2076, 2575, 3811	... ...	R.M.L. 7-inch.	
No. 9	I (N)	§§ 2076, 2575, 3811	... ...	R.M.L. 8-inch.	
No. 10	I (N)	§§ 2076, 2575, 3811	... ...	R.M.L. 9-inch.	
No. 11	I (N)	§§ 2076, 2575, 3811	... ...	R.M.L. 10-inch.	
No. 12	I (N)	§§ 2816, 3811 ...	... ...	R.M.L. 11 inch.	
No. 13	I (N)	§§ 1794, 2076, 3811	... ...	R.M.L. 12-inch, 85-lb.	
No. 14	I (N)	§§ 2645, 3811 ..	... ...	R.M.L. 12-inch, 110-lb.	
No. 15	I (N)	§§ 3039, 3811 ...	... ...	R.M.L. 12·5-inch, Mark I.	
No. 16	II (N)	§§ 3658, 3811, 5945	... ...	R.M.L. 12·5-inch two 52½-lb., and B.L. 10-inch two 63-lb. cartridges.	
No. 17c	I (N)	§§ 5785, 6270 ...	... ...	B.L. 6-inch four 12-lb. cartridges.	
No. 18	I (N)	§§ 5785, 6270 ...	... ...	R.M.L. 12·5-inch 210-lb. prism or 200-lb. E.X.E. in four quarter charges.	
No. 19	I (N)	§ 4553	... ...	B.L. 4 inch.	
No. 22	I (N)	§ 4553	... ...	B.L. 5-inch.	
No. 23	I (N)	§ 4553	... ...	B.L. 8-inch.	
No. 24	II (N)	§§ 4553, 5946 ...	... ...	B.L. 9·2 inch, Marks I to V guns.	
No. 25	I (L)	§ 6271	... ...	B.L. 4-inch and 5-inch.	
No. 26	I (N)	§ 7224	... ...	B.L. 12-inch.	
No. 27	I (N)	§ 7224	... ...	B L. 13·5-inch.	
No. 28	I (N)	§ 8574	... ...	B.L. 16·25-inch.	
No. 29	I (N)	§ 8674	B.L. 9·2 inch, Mark VIII gun.		
No. 30	I (N)	§ 10118	B.L. 6 inch, Mark VII.		
No. 31	I (N)	§ 10119	B.L. 6-inch, Mark VII.		
No. 32	I (N)	§ 10251	B.L. 12-inch, Mark VIII and IX guns.		
No. 33	I (N)	§ 10340	B.L. 12-inch, Marks III to V.		
No. 34	I (N)	§ 10340	B.L. 10-inch.		
No. 35	I (N)	§ 10340	B.L. 8-inch, Marks III to VI.		
No. 36	I (N)	§ 10340	B.L. 9·2-inch, Mark X.		
No. 37	I (N)	§ 10912	B.L. C. 5-inch.		

Cases, cartridge, Nos. 17A, 20, and 21 are obsolete.
Cases, cartridge, Nos. 1 to 7, and 25 are made of leather.
Cases, cartridge, Nos. 8 to 36, except No. 30, are made of Clarkson's material.
Cases, cartridge, Nos. 30 and 37, are made of K.A. canvas.

Table No. 13.

Detonators, Electric Tubes and Fuzes, and Primers, Electric, Large.

Number, nature, and Mark.	§ Changes in War Stores.	Bridge.	Firing current in Ampères.	Priming.	Resistance in Ohms. Between.	Colour.	Service.	Remarks.
No. 8, Detonator, Mark II* ...	6542 8352	...	...	...	...	Tube red, socket coated with shellac varnish	L.S. ...	For instructional purposes.
,, ,, ,, III...	6548	...	...	...	...	Red all over	,, ...	Marks I and II are obsolete.
No. 9, Detonator, Mark III...	5644	Platinum silver wire	1	Guncotton dust and mealed powder.	1·5 and 1·8	Head and shoulder yellow, tube red.	N.S. ...	Marks I and II are obsolete.
,, ,, ,, IV...	5242	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	,, ,, ,,	,, ...	Wires and poles coated with tin, and bridge attached with pure tin instead of soft solder.
No. 10, Tube, Mark II ...	3446	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	Shellac varnished ...	C. ...	Three quills cemented together. Diagonal bridge. No ebonite head. Mark I is obsolete.
,, ,, ,, III ...	3661	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	,, ,, ...	,, ...	Priming more closely packed. Guncotton wad over mealed powder in the tube.
,, ,, ,, IV ...	5242	,, ,, ,,	1	,, ,,	1·5 ,, 1·8	,, ,, ...	,, ...	*See* No. 9, Mark IV.
No. 10A, Mark I ...	10897	,, ,, ,,	...	,, ,,	...	,, ,, ...	L.S. ...	Quill, for time guns.
No. 11, Tube, Drill, Mark I...	2832	,, ,, ,,	1	,, ,, ,,	1·5 and 1·8	Black	N.S. ...	... ...
,, ,, ,, ,, II	3446	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	Head lacquered, pin black.	,, ...	Differs in colour only.
,, ,, ,, ,, III	3547	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	,, ,, ,,	,, ...	Fresh priming can be introduced by unscrewing pin from head.
,, ,, ,, ,, IV	5242	,, ,, ,,	1	,, ,, ,,	1·5 ,, 1·8	,, ,, ,,	,, ...	*See* No. 9, Mark IV.
No. 12, Detonator, Mark I ...	3446	Iridio-platinum wire	·8 to 1 ampere in 4 seconds	Guncotton yarn	·95 ,, 1·1	Head white, shoulder blue, tube red	Submarine mining.	Made to meet urgent demands. To be used up for observation mines.
,, ,, ,, II...	3446	,, ,, ,,	,,	Guncotton dust and mealed powder.	·95 ,, 1·1	,, ,, ,,	,,	Less sensitive. Different priming.
,, ,, ,, III	5242	,, ,, ,,	,,	,, ,, ,,	·95 ,, 1·1	,, ,, ,,	,,	*See* No. 9, Mark IV.
,, ,, ,, IV	7097	,, ,, ,,	,,	,, ,, ,,	·95 ,, 1·1	,, ,,	,,	Similar to No. 9 in construction. Fulminate of mercury, 25 grains.
No. 13, Detonator, Mark I ...	3446	,, ,, ,,	2	Guncotton yarn... ...	·95 ,, 1·1	Head and shoulder white, tube red	L.S. ...	... ...
,, ,, ,, II...	5242	,, ,, ,,	2	,, ,, ...	·95 ,, 1·1	,, ,, ,,	,, ...	*See* No. 9, Mark IV.

TABLE No. 13—*continued.*

DETONATORS, ELECTRIC TUBES AND FUZES, AND PRIMERS, ELECTRIC, LARGE—*continued.*

Number, Nature, and Mark.	§ Changes in War Stores.	Bridge.	Firing Current in Ampères.	Priming.	Resistance in Ohms. Between	Colour.	Service.	Remarks.
No. 14, Fuze, Mark I	3446	Iridio-platinum wire	2	Guncotton yarn	·95 and 1·1	White	L.S.	Also used for instructional purposes.
,, ,, ,, II	5242	,, ,, ,,	2	,, ,, ...	·95 ,, 1·1	,, ...	,, ...	*See* No. 9, Mark IV.
No. 15, Detonator, Mark II... ...	4557	... ...	...	... ...	...	Red all over	N.S.	Mark I is obsolete.
No. 16, Fuze, Disconnecting, Mark I.	3446	Iridio-platinum wire	6 to 1 ampere in 4 seconds	Guncotton dust and mealed powder.	·95 and 1·1	Head white, shoulder blue	Submarine mining.	
No. 16, Fuze, Disconnecting, Mark II.	5242	,, ,, ,,	6 to 1 ampere in 4 seconds	,, ,, ,,	·95 ,, 1·1	,, ,, ,,	,,	*See* No. 9, Mark. IV
No. 18, Detonator, Drill, Mark I ...	3856	,, ,, ,,	·8 to 1 ampere in 4 seconds	,, ,, ,,	·95 ,, 1·1	Head white, shoulder blue, tube white.	For instructional purposes.	Same dimensions and external appearance as No. 12.
,, ,, ,, ,, II...	4412	,, ,, ,,	,,	,, ,, ,,	·95 ,, 1·1	,, ,, ,,	,, ,,	
,, ,, ,, ,, III	5242	,, ,, ,,	,,	,, ,, ,,	·95 ,, 1·1	,, ,, ,,	,, ,,	*See* No. 9, Mark IV.
,, ,, ,, ,, IV	9448	,, ,, ,,	,,	,, ,, ,,	·95 ,, 1·1	,, ,, ,,	,, ,,	
No. 19, Fuze, Disconnecting, Mark I.	4945	Platinum silver wire	...	,, ,, ,,	1·5 ,, 1·8	Head black, body lacquered	N.S. ...	Also used for exercising and drill purposes.
No. 19, Fuze, Disconnecting, Mark II.	5242	,, ,, ,,	...	,, ,, ,,	1·5 ,, 1·8	,, ,, ,,	,, ...	*See* No. 9, Mark IV.
No. 19, Fuze, Disconnecting, Mark III.	5388	,, ,, ,,	...	,, ,, ,,	1·5 ,, 1·8	,, ,, ,,	,, ...	Conducting wires, three stranded, and poles with double flange.
No. 20, Detonator, Drill, Mark I ...	5407	Iridio-platinum wire	2	,, ,, ,,	·95 ,, 1·1	White all over ...	L.S.	Drill purposes ... ...
Primer, Electric, Large, Mark I ...	5957, 6708, 7232, 8970	Double bridge of platinum silver wire	...	Guncotton dust and mealed powder. Tuft of guncotton yarn under the bridge.	·6 ,, ·9	Lacquered	Common ...	
,, ,, ,, ,, I* ...	8874, 8970	,, ,, ,,	...	Mealed powder	·6 ,, ·9	,, ...	,, ...	
,, ,, ,, ,, I**	8970, 9813	Single bridge of platinum silver wire	...	Guncotton dust and mealed powder. Tuft of guncotton yarn round the bridge.	1·5 ,, 1·8	,, ...	,, ...	
,, ,, ,, ,, I***	10542	Single bridge of iridio-platinum	...	Guncotton dust and mealed powder. Tuft of guncotton.	·75 ,, ·95	,, ...	,, ...	

TABLE No. 13—*continued.*

DETONATORS, ELECTRIC TUBES AND FUZES, AND PRIMERS, ELECTRIC, LARGE—*continued.*

Number, nature, and Mark.	§ Changes in War Stores.	Bridge.	Firing current in Ampères.	Priming.	Resistance in Ohms. Between.	Colour.	Service.	Remarks.
Primer, Electric, Large, Mark II ...	7454, 7765, 8841, 8970	Double bridge of platinum silver wire	...	Mealed powder	·6 and ·9	Lacquered	Common	Those made before January 1895, had a priming composition of guncotton dust and mealed powder.
,, ,, ,, ,, II*...	8970, 9813	Single bridge of platinum silver wire	...	Guncotton dust and Mealed powder. Tuft of guncotton yarn round the bridge.	1·5 ,, 1·8	,, ...	,, ...	Converted.
,, ,, ,, ,, II**	10356	Single bridge of platinum silver wire	...	,, ,, ,,	1·5 ,, 1·8	,, ...	,, ...	Ebonite washer and screwed collar fitted in.
,, ,, ,, ,, II*.*	10542	Single bridge of iridio platinum	...	,, ,, ,,	·75 ,, ·95	,, ...	,, ...	
,, ,, ,, ,, III...	8561, 8841, 8970	Double bridge of platinum silver wire	...	Mealed powder. Tuft of guncotton yarn under the bridge.	·6 ,, ·9	,, ...	,,	Those made before April, 1897, except those of E.O.C. manufacture, were without the guncotton yarn under the bridges.
,, ,, ,, ,, III*	8970, 9813	Single bridge of platinum silver wire	...	Guncotton dust and mealed powder. Tuft of guncotton yarn round the bridge.	1·5 ,, 1·8	,, ...	,, ...	Converted.
,, ,, ,, ,, III**	10356	,, ,, ,,	...	,, ,, ,,	1·5 ,, 1·8	,, ...	,,	Ebonite washer and screwed collar fitted in.
,, ,, ,, ,, III*.*	10542	Single bridge of iridio platinum	...	,, ,,	·75 ,, ·95	,, ...	,, ...	
,, ,, ,, ,, IV...	8970, 9055	Double bridge of platinum silver wire		Mealed powder. Tuft of guncotton yarn under the bridge.	·6 ,, ·9	,, ...	,, ...	
,, ,, ,, ,, IV*	8970, 9625	Single bridge of platinum silver wire	...	Guncotton dust and mealed powder. Tuft of guncotton yarn round the bridge.	1·5 ,, 1·8	,, ...	,, ...	
,, ,, ,, ,, IV**	10542	Single bridge of iridio platinum	...	,, ,, ,,	·75 ,, ·95	,, ...	,, ...	
,, ,, ,, ,, V...	10542	Single bridge of iridio platinum	...	,, ,, ,,	·75 ,, ·95	,, ...	,, ...	

TABLE No. 14.

TUBES, VENT-SEALING.

Tubes.	Changes in War Stores.	Priming.	Where used.	Remarks.
SERVICE.				
Tube, V.S., Percussion, Mark II ...	5892	... ...	Guns with percussion locks	Solid drawn brass tube, and brass striker. A few were made of brass bored out. Mark I is obsolete.
,, ,, ,, ,, III ...	6102	... ...	,, ,, ,, ,, ...	Sulphur pellet and brass ball, three fire-holes through anvil.
,, ,, ,, ,, IV ...	8655	... ...	,, ,, ,, ,, ...	End closed with cork and paper disc.
,, ,, ,, ,, V ...	10091	... ...	,, ,, ,, ,, ...	Pointed striker with shearing wire and small detonator.
,, ,, ,, ,, VI ..	10406	... ...	,, ,, ,, ,, ...	Shorter striker with copper gas-check attached.
,, ,, Electric, P, ,, I ...	4622	Guncotton dust and mealed powder	Guns with locks (except wireless locks) and steel cone vents.	Solid drawn brass tube, loose powder.
,, ,, ,, II ...	5352	,, ,, ,, ,,	,, ,, ,, ,, ,,	Wires and poles coated with tin, and bridge attached to the poles with pure tin.
,, ,, ,, ,, III ...	6071	,, ,, ,, ,,	,, ,, ,, ,, ,,	Length of wires increased from 18 inches to 21 inches.
,, ,, ,, ,, IV ...	6071	,, ,, ,, ,,	,, ,, ,, ,, ,,	Sulphur pellet and brass ball, wires 22 inches long.
,, ,, ,, ,, V ...	7204	,, ,, ,, ,,	,, ,, ,, ,, ,,	Internal arrangements altered.
,, ,, ,, ,, VI ...	8655	,, ,, ,, ,,	,, ,, ,, ,, ,,	End closed with cork and paper disc.
,, ,, ,, ,, VII ...	8685 / 9768	,, ,, ,, ,,	,, ,, ,, ,, ,,	Wires led out through V-shaped groove in the head.
,, ,, Electric, Wireless, P. Mark I.	8182 / 9676 / 9768	,, ,, ,, ,,	Guns with wireless locks	Wireless, end closed with cork and paper discs. Double bridge.
,, ,, Electric, Wireless, P. Mark II.	9768	,, ,, ,, ,,	,, ,, ,, ,, ...	Wireless, end closed with cork and paper discs. Single bridge and contact disc of pure tin.
,, ,, Friction, V, Mark IV ..	4604	... ...	Guns with tube holders	Brass, loose powder, cork disc. Marks I, II and III are obsolete.
,, ,, ,, V, ,, V ...	6524	... ...	,, ,, ,, ,, ...	Sulphur pellet and brass ball.
,, ,, ,, V, ,, VI ...	8655	... ...	,, ,, ,, ,, ...	End closed with cork and paper discs.
,, ,, ,, V, ,, VII ..	8914	... ...	,, ,, ,, ,, ...	Draw wire and friction bar made in one piece.
,, ,, Electric, V, ,, III ...	4604	Guncotton dust and mealed powder.	,, ,, ,, ,, ...	Brass, loose powder, cork disc. Marks I and II are obsolete.
,, ,, ,, V, ,, IV ...	5352	,, ,, ,, ,,	,, ,, ,, ,, ...	Wires and poles coated with tin, and bridge attached to the poles with pure tin.
,, ,, ,, V, ,, V ...	6072	,, ,, ,, ,,	,, ,, ,, ,, ...	Length of wires increased from 18·2 inches to 21·2 inches.
,, ,, ,, V, ,, VI ...	6524	,, ,, ,, ,,	,, ,, ,, ,, ...	Sulphur pellet and brass ball.

The bridges of electric, P, V, and M. tubes are made of platinum silver wire, ·25-inch long, resistance 1·5 to 1·8 ohms, except the wireless P tube, Mark I, which had a double bridge, resistance ·6 to ·9 ohms. The electric T tube has a platinum silver wire bridge ·2-inch long, resistance 1·0 to 1·3 ohms.

TABLE No. 14—*continued.*

TUBES, VENT-SEALING—*continued.*

Tubes.	§ Changes in War Stores.	Priming.	Where used.	Remarks.
SERVICE.				
Tube, V.S., Electric, V, Mark VII ...	8655 9768	Guncotton dust and mealed powder	Guns with tube holders	End closed with cork and paper discs; and ebonite "stop" in head.
,, ,, Friction, M, ,, III ...	4829	... ...	Guns with vent-masking slides ...	Like V, Mark III, but head strengthened with steel disc. Marks I and II are obsolete.
,, ,, ,, M, ,, IV ...	6405	... ...	,, ,, ,, ,, ...	Thicker and stronger friction bar.
,, ,, Electric, M, ,, III ...	4829	Guncotton dust and mealed powder.	,, ,, ,, ,, ...	Like V, Mark III, but head strengthened with steel disc. Marks I and II are obsolete.
,, ,, ,, M, ,, IV ...	5352	,, ,, ,, ,,	,, ,, ,, ,, ...	Wires and poles coated with tin, and bridge attached to the poles with pure tin.
,, ,, ,, M, ,, V ..	6072	,, ,, ,, ,,	,, ,, ,, ,, ...	Length of wires increased from 18·5 inches to 21·5 inches.
,, ,, ,, M, ,, VI ..	8913 9768	,, ,, ,, ,,	,, ,, ,, ,, ...	Ebonite "stop" in the head.
,, Friction, T, Mark I	7867	... .	Guns with T-vents	Recess in top of head.
,, ,, T, ,, I*	9573 9768	... ...	,, ,, ,, ...	Recess in top of head and shearing wire.
,, ,, T, ,, II	8560	... ...	,, ,, ,, ...	Recess in side of head.
,, ,, T, ,, II*	9520 9768	... ...	,, ,, ,, ...	Recess in side of head and shearing wire. Loop of friction wire enlarged, and the opening in the head altered.
,, ,, T, ,, III	9054	... ...	,, ,, ,, ...	Recess in side of head and shearing wire.
,, ,, T, ,, IV	9768 10025	... ...	,, ,, ,, ...	Recess in side of head and shearing wire. Loop of friction wire enlarged, and the opening in the head altered.
,, V.S., Electric, T, double wired, Mark I.	8839 9768	Mealed powder	,, ,, ,, ...	

The bridges of electric, P, V, and M, tubes are made of platinum silver wire, ·26-inch long, resistance 1·5 to 1·8 ohms, except the wireless P tube, Mark I, which had a double bridge, resistance ·6 to ·9 ohms. The electric T tube has a platinum silver wire bridge ·2-inch long, resistance 1·0 to 1·3 ohms.

Table No. 15.

Tubes, Vent-Sealing (Drill).

Tubes.	§ Changes in War Stores.	Priming.	Where used.	Remarks.
Drill.				
Tube, V.S., Percussion, Drill, Mark I	4780	... ...	Guns with percussion locks	Gun-metal.
,, ,, Electric, P, ,, ,, I	4780	Guncotton dust and mealed powder	Guns with locks (except wireless locks) and steel cone vents.	,,
,, ,, ,, P, ,, ,, II	5869	,, ,, ,,	,, ,, ,, ,, ...	Wires protected and whipped at side of head.
,, ,, ,, P, ,, ,, III	6072, 6143, 9675	,, ,, ,,	,, ,, ,, ,,	Length of wires increased from 18 inches to 22 inches. To become obsolete when used up.
,, ,, ,, P, ,, Naval, Mark IV ...	7601	,, ,, ,,	,, ,, ,, ,, ...	Same length as service tube, double bridge.
,, ,, ,, P, ,, ,, ,, V ...	8112	,, ,, ,,	,, ,, ,, ,, ...	5 inches of oiled silk insulation on leads near the head, double bridge.
,, ,, ,, P, ,, ,, ,, VI ...	10234, 10312	,, ,, ,,	,, ,, ,, ,, ..	Single bridge, with no guncotton yarn round.
,, ,, ,, P, Wireless, P, Drill, Mark I (N).	10256	,, ,, ,,	Guns with wireless locks	Double bridge.
,, ,, ,, P, Wireless, P, Drill, Mark II (N).	10256, 10312	,, ,, ,,	,, ,, ,, ,, ...	Single bridge, and contact disc of pure tin.
,, ,, Friction, V, Drill, Mark I	4762	... ...	Guns with tube holders	Gun-metal. Mark I is obsolete.
,, ,, Electric, V, ,, ,, I	4762	Guncotton dust and mealed powder	,, ,, ,, ,, ...	Gun-metal.
,, ,, ,, V, ,, ,, II	6072	,, ,, ,, ,,	,, ,, ,, ,, ...	Length of wires increased from 18·5 inches to 21·5 inches.
,, ,, ,, V, ,, ,, III	9356	,, ,, ,, ,,	,, ,, ,, ,, ...	Same length as Service Tube, double bridge.
,, ,, ,, V, ,, ,, IV	10234, 10312	,, ,, ,, ,,	,, ,, ,, ,, ...	Single bridge.
,, ,, Friction, M, ,, ,, I	4762	... ...	Guns with vent-masking slides ...	Gun-metal.
,, ,, Electric, M, ,, ,, I	4762	Guncotton dust and mealed powder	,, ,, ,, ,, ...	Gun-metal.
,, Friction, T, Drill, Mark I	7867	... ...	Guns with T-vents	Hardened steel.

TABLE No. 16.

FUZES FOR LAND SERVICE.

List of Guns showing Fuzes used with them.

The following fuzes (shown in *italics* in the table) will become obsolete as expended:—
R.L. percussion. Direct-action Marks I.*, and I.**. Direct-action delay, Marks I. and II. Pettman, G.S., percussion. 15-seconds M.L. 15-seconds with detonator. Middle sensitive time, except for star shell.‡‡ Short T. and P., Marks II., II.*, and III. Middle T. and P., Marks I.* and II.

Ordnance.	PERCUSSION FUZE. 1. For present use.	PERCUSSION FUZE. 2. For future use.	Ordnance.	TIME FUZE. 1. For present use.	TIME FUZE. 2. For future use.
R.M.L. — 17·72-inch	Direct-action, with plug, No. 3.		R.M.L. — 17·72-inch	... ...	... ...
R.M.L. — 16-inch ...	Direct-action, with plug, No. 3.		R.M.L. — 16-inch ...	... ...	... ...
R.M.L. — 12·5-inch...	Direct-action, with plug, No. 3. Base, large, No. 11.		R.M.L. — 12·5-inch...	*15-seconds M.L., No. 41.*	
R.M.L. — 12-inch (35 ton / 25 ton)	*Pettman, G.S., No. 5,†* or Direct-action, with plug, No. 3.	††Direct-action, with cap, No. 1, or with plug, No. 3.	R.M.L. — 12-inch (35 ton / 25 ton)	*15-seconds M.L., No. 41.*	
R.M.L. — 11-inch ...	*Pettman, G.S., No. 5,†* or Direct-action, with plug, No. 3.	Base, large, No. 11, for common pointed and armour-piercing shells, 9-inch and upwards, fired with full charges §	R.M.L. — 11-inch ...	*15-seconds M.L., No. 41.*	
R.M.L. — 10-inch ...	Base, large, No. 11.		R.M.L. — 10-inch ...	*15-seconds with detonator, No. 43.*	
R.M.L. — 9-inch ...			R.M.L. — 9-inch ...	*15-seconds with detonator, No. 43.*	
R.M.L. — 10-inch, Mark III.	Direct-action impact, No. 13, Mark II.	Direct-action impact, No. 13, Mark II., for 10-inch lyddite shells in guns on H.A. mountings.	R.M.L. — 7-inch ...	*15-seconds M.L., No. 41.*	Middle time and percussion, No. 54.
R.M.L. — 7-inch ...	*Pettman, G.S., No. 5.†* Direct-action, with cap, No. 1, or with plug, No. 3.		R.M.L. — 6·6-inch ...	*15-seconds with detonator, No. 43.*	
R.M.L. — 6·6-inch ...	Direct-action, with cap, No. 1.		R.M.L. — 80-pr. ...	*15-seconds M.L., No. 41.* *15-seconds with detonator, No. 43.*	
R.M.L. — 80-pr. ...	Direct-action, with cap, No. 1.		R.M.L. — 64-pr. ...	*15-seconds M.L., No. 41.*	
R.M.L. — 64-pr. ...	Direct-action, with cap, No. 1.		R.M.L. — 40-pr. ...	*15-seconds with detonator, No. 43.*	
R.M.L. — 40-pr. ...	Direct-action, with cap, No. 1.		R.M.L. — 25-pr. ...	*15-seconds M.L., No. 41.*	
R.M.L. — 25-pr. ...	*R.L., No. 7.‡*		R.M.L. — 16-pr. ...	*15-seconds M.L., No. 41.*	
R.M.L. — 16-pr. ...	*R.L., No. 7.‡*		R.M.L. — 13-pr. ...	*15-seconds with detonator, No. 43,* and time and percussion, No. 56.	
R.M.L. — 13-pr. ...	*R.L., No. 7.*		R.M.L. — 9-pr. ...	*15-seconds M.L., No. 41.*	Time and percussion, No. 56.
R.M.L. — 9-pr. ...	*R.L., No. 7.*	Small, No. 8, Mark IV.	R.M.L. — 7-pr.‖ ...	*15-seconds M.L., No. 41.*	
R.M.L. — 7-pr. ...	Direct-action, with cap, No. 1, *and small percussion for double.*		R.M.L. — 2·5-inch ...	*Short time and percussion, No. 55.*	
R.M.L. — 2·5-inch ...	*Small, No. 8, Mark III.**		B.L. howitzers — 8-inch ...	Middle time and percussion, No. 54.	Middle time and percussion, No. 54, and *middle sensitive, No. 24, for star shell.‡‡*
B.L. howitzers — 8-inch ...	Direct-action, with cap, No. 1.	Direct-action, with cap, No. 1.	B.L. howitzers — 6-inch (25 cwt. / 30 cwt.)	Middle time and percussion, No. 54. *Middle sensitive, No. 24, for star shell.‡‡*	
B.L. howitzers — 6-inch (25 cwt. / 30 cwt.)	Direct-action, with cap, No. 1. delay, No. 10, Marks I., II., and III.	Direct-action, with cap, No. 1. delay, No. 10, Mark III.	B.L. howitzers — 5·4-inch ...		
B.L. howitzers — 5·4-inch ...	Direct-action, with cap, No. 1.	Direct-action, with cap, No. 1.	B.L. howitzers — 5-inch ...		
B.L. howitzers — 5-inch ...	Direct-action, with cap, No. 1.				

† This fuze only acts with full charges.
§ Base, percussion, large, Mark 1., are not to be used with guns on H.A. mountings.
†† For L.S., No. 1 is to be used on land fronts, No. 3 on sea fronts.
‡‡ The introduction of a suitable fuze for use with star shell will be considered when the present stock of middle sensitive time fuzes is nearly expended.
N.B.—For practice purposes with lyddite shell, *Fuze, Percussion, D.A. Impact, No. 13, Mark II.*, will be used instead of *Grain* No. 4.
‡ Primer fuze, percussion, R.L., No. 7, to be used with these fuzes in projectiles above 16 pr.
‖ 15-seconds wood time, No. 42, with special priming, supplied for use with star shells and 7-pr. double shell.

TABLE No. 16—*continued.*

FUZES FOR LAND SERVICE—*continued.*

Ordnance.	PERCUSSION FUZE. 1. For present use.	PERCUSSION FUZE. 2. For future use.
R.M.L. howitzers: 8-inch (70 cwt. / 46 cwt.), 6·6-inch, 6·3-inch	Direct-action, with cap, No. 1. ,, delay, No. 10, Marks *I.*, *II.*, and III.	††Direct-action, with cap, No. 1, or with plug, No. 3, and a proportion of delay-action, Mark III., for high-angle fire.
R.B.L. 7-inch	Direct-action, with cap, No. 1, or with plug, No. 3. *R.L., No. 7.*‡	††Direct-action, with cap, No. 1, or with plug, No. 3. Small, No. 8, Marks III.* and IV.
R.B.L. 40-pr., 20-pr., 12-pr., 9-pr.	B.L., plain, No. 2.	As in 1.
B.L. 13·5-inch, 12-inch, 10-inch	Direct-action, with plug, No. 3.	Direct-action, impact, No. 13, Mark III., for lyddite shells, 10-inch to 5-inch. Base, large, No. 11, for 12-inch to 6-inch. ††Direct-action, No. 1 or No. 3. Base, medium, No. 12, Mark I., for 5-inch and 4-inch.
B.L. 9·2-inch, 8-inch	Direct-action, with plug, No. 3. ,, impact, No. 13, *Mark I.**	
B.L. 6-inch, 5-inch	††Direct-action, with cap, No. 1, or with plug, No. 3. ††Direct-action, impact, No. 13, Mark I.	
B.L. 4-inch, 30-pr.	Small, No. 8, Mark III.* or IV.	
Q.F. 6-inch, 4·7-inch, 12-pr., 6-pr., 3-pr., 2·95-inch	Base, large, No. 11. Base, medium, No. 12. Base, medium, No. 12. Hotchkiss, *Marks II., II.*, III.,* and IV.	Base, large, No. 11. Base, medium, No. 12. Base, medium, No. 12. Mark IV. Base, medium, No. 12.

Ordnance.	TIME FUZE. 1. For present use.	TIME FUZE. 2. For future use.
R.M.L. howitzers: 8-inch (70 cwt. / 46 cwt.), 6·6-inch, 6·3-inch	*Middle sensitive, No. 24.*	Middle time and percussion, No. 54.
R.B.L. 7-inch	*15-seconds with detonator, No. 43.* / *Middle sensitive, No. 24.*	
R.B.L. 40-pr.	*15-seconds with detonator, No. 43.*	
R.B.L. 20-pr., 12-pr., 9-pr.	Armstrong E., No. 22. *15-seconds with detonator, No. 43.*¶ Armstrong E., No. 22.	As in 1.
B.L. 13·5-inch, 12-inch, 10-inch, 9·2-inch, 8-inch, 6-inch	*Middle sensitive, No. 24.*	Middle time and percussion, No. 54.
B.L. 5-inch	Middle time and percussion, No. 54.	
B.L. 4-inch, 30-pr.	*Short time and percussion, No. 55.*	
B.L. 15-pr., 12-pr. (6 cwt. / 7 cwt.)	Time and percussion, No. 56. *Short time and percussion, No. 55.*	Time and percussion, No. 56.
Q.F. 6-inch, 4·7-inch, 12-pr.	Middle time and percussion, No. 54. *Short time and percussion, No. 55.*	Middle time and percussion, No. 54.
Q.F. 2·95-inch	... ...	Time and percussion, No. 56.

‡ Primer fuze, percussion, R.L., No. 7, to be used with these fuzes in projectiles above 16-pr.
‖ 15-seconds wood time, No. 42, with special priming, supplied for use with star shells and 7-pr. double shell.
†† For L.S., No. 1 is to be used on land fronts, No. 3 on sea fronts.
¶ Shrapnel only. Segment take E time.

TABLE No. 16(A).

FUZES USED WITH CERTAIN GUNS.

Nature of fuze.	Distinguishing No.	Paragraph in List of Changes in War Stores.	Material.	Nature of Ordnance with which used.
		PERCUSSION.		
Direct-action, with cap.§	1	I.* 5572 6740 II. 5216 9906 10087 10172 10173 I.** 10297	Metal	R.M.L. 64-pr. and upwards, except 9-inch H.A. guns. All rifled howitzers. B.L. 5-inch and upwards. R.B.L. 7-inch. *See* § 6740, *List of Changes.*
B.L., plain	2	IV. 2620	,,	R.B.L. 20, 12, and 9-prs.
Direct-action, with plug.§	3	III. 5593 5788 6274 6740 7635 9906 10172	,,	R.M.L. 64-pr. and upwards. B.L. 5-inch and upwards. R.B.L. 7-inch. *See* § 6740, *List of Changes.*
Pettman's G.S.... ...	5	II. 3200	,,	R.M.L. 12 (of 25 and 35 tons), 11, 10, 9, and 7-inch, when firing full charges. To become obsolete as expended.
R.L.	7	II. 2621 II.* 5270 III. 5270 III.* 7175 IV. 7175 7635 8807	,,	R.M.L. 7-pr. to 40-pr. R.B.L. 40-pr. *See* § 5270, *List of Changes.* To be replaced, so soon as existing stock has become exhausted, by small percussion. For 25-pr. and 40-pr. M.L. and 40-pr. R.B.L. common shell, the primer, R.L. percussion, Mark I, to be used.
Small	8	III.* 7230 IV. 7230 7635 8807 10172	,,	R.M.L. 25-pr. and under. R.B.L. 40-pr. B.L. 30-pr. and 4-inch. This fuze will take the place of the R.L. percussion fuze when the stock of the latter is exhausted.
Direct-action, delay ..	10	I. 6038 II. 7229 7635 III. 8871	,,	Rifled howitzers, except 5-inch and 5·4-inch.
Base, large†	11	I. 8099 8315 II. 8552 9674	,,	R.M.L. 9 inch and upwards, including 9-inch H.A. B.L. and Q.F. guns of 6-inch calibre and upwards, for use in common pointed and armour-piercing shells.
Base, medium	12	I. 8100 8315 8653 9674	,,	B.L. and Q.F. guns, 12-pr. to 5-inch calibre, for use in common pointed and armour-piercing shells, and 2·95-inch for use in double shell.
Direct-action, impact‡	13	II. 8630 9620 9673 9721 I. 9854 10172 I.* 10321 III. 10321	,,	B.L. 5-inch to 10-inch, and 10-inch H.A. lyddite shells.
Base, Hotchkiss ...	...	II. 5944 7009 II.* 8229 III. 7490 8229 IV. 9451 9814	,,	3-pr. and 6-pr. Q.F. shell.

† Mark I. is not suitable for use with reduced charges. *See* § 8652, *List of Changes.*
‡ Mark I. for lyddite shells, for direct fire. *See* § 9854, *List of Changes.* Mark II. for lyddite shells of 10-inch H.A. guns. *See* § 8630, *List of Changes.*
§ No. 1 is to be used on land fronts and No. 3 on sea fronts.

TABLE No. 16(A)—*continued.*

FUZES USED WITH CERTAIN GUNS—*continued.*

Nature of fuze.	Distinguishing No.	Paragraph in List of Changes in War Stores.	Material	Nature of Ordnance with which used.
TIME.				
Armstrong, E	22	2496	Metal	R.B.L. 20-pr. to 9-pr. (segment).
Sensitive, middle ...	24	5638 5982 7046 7201 7305 8417	,,	R.M.L. 12·5-inch to 25-pr. R.L. 12-inch to 5-inch. R.B.L. 7-inch. All howitzers. All star shell. To be replaced, when existing stock has become exhausted, by middle time and percussion fuze, No. 54, except for star shells.
30-seconds M.L. ...	40	3458	Wood	All ordnance with which 15-seconds M.L. is used, except 7-pr. shrapnel.
15-seconds M.L. ...	41	4045 4684 4685 9621 10268	,,	R.M.L. 12·5-inch to 11-inch, 7-inch, 80-pr. and 64-pr., 25-pr. to 7-pr. (except 13-pr.). Until stock is expended.
15-seconds M.L., special priming.	42	4686 4824 5061 9621	,,	All R.M.L. star shell, and 7-pr. double shell.
15-seconds, with detonator, Marks II. and III.	43	4045 III. 4496 4685 9621 10268	,,	R.M.L. 10 and 6·6-inch, 40 and 13-pr. 80-pr., and 9-inch studless, also studded with gascheck. R.B.L. 7-inch, 40, 12, and 9-pr. shrapnel.
15-seconds, with detonator, Mark II.*	43	10353	,,	R.M.L. 12·5 to 10-inch, 7-inch, 64, 25, and 7-pr.; also 80-pr. and 9-inch, studded. R.B.L. 7-inch, 40, 12, and 9-pr.
TIME AND PERCUSSION.				
Middle	54	I.* 8417 II. 8417 III. 8912 9809 9856	Metal.	B.L. howitzers, 5-inch, 5·4-inch, and 6-inch, and for guns with which the middle sensitive time fuze is at present used, when existing stock of the latter has been expended.
Short	55	II. 5574 5982 III. 7176 7305	,,	R.M.L. 2·5-inch. B.L. 4-inch and 30-pr., Q.F. 12-pr., until stock is expended. To be replaced by No. 56, Mark IV.
Mark IV.	56	7716 9088 9194 9809 9856	,,	B.L. 12-pr. to 4-inch Q.F. 12-pr. and 2·95-inch. R.M.L. 2·5-inch to 16-pr.
22-seconds	57	10174	,,	Has been issued for special service.

TABLE No. 17.

FUZES FOR NAVAL SERVICE.

ORDNANCE.		PERCUSSION FUZE.	ORDNANCE.		TIME FUZE.
R.M.L.	16-inch	**For use with nose-fuzed common shell and shrapnel shell.** One direct-action, to each common and shrapnel shell, and 7-inch double shell.	R.M.L.	16 inch	One 15-seconds M.L. wood fuze to each shrapnel shell, with 20 per cent. spare.
	12·5-inch ...			12·5-inch ...	
	12-inch			12-inch	
	11-inch	NOTE.—*Except for guns loaded by hydraulic machinery, for which direct-action Mark III, and Pettman, G.S., will be supplied. The latter will be used during peace, but if it fails, the former will be substituted in war.*		11-inch	NOTE (1).—*15-seconds wood fuzes with detonators may be considered equally available for these guns, except when loaded by hydraulic machinery.*
	10-inch			10-inch	
	9-inch	**For use with pointed-headed common shell.** Base percussion, large, No. 11.		9-inch	NOTE (2).—*In 9-inch R.M.L., when projectiles are fitted with gas-checks, wood fuzes with detonators, Mark III, must be used.*
	8-inch			8-inch	
	7-inch	NOTE.—*A ¼-inch hole must be bored in the gas-check to allow the pressure of the powder gas to act on the fuze.*		7-inch	
	64-pr.			64-pr.	NOTE (3).—*The middle sensitive time fuze can be used, when supplied, for 64-pr. to 16-inch.*
	9-pr.	One R.L. for each common shell. One direct-action, for each 7-pr. double shell.		9-pr.	
	7-pr.	NOTE 1.—*The R.L. fuze can be used with shrapnel shell, 9-pr. and 7-pr.* NOTE 2.—*The manufacture of R.L. fuzes has been discontinued; its place will be taken by the direct-action fuze.*		7-pr.	
R.B.L.	20-pr.	One direct-action, to each common—one B.L. plain to each segment shell.	R.B.L.	20-pr.	One E time to each segment shell.
	12-pr.	One B.L. plain to each segment shell.		12-pr.	
	9-pr.			9-pr.	

Table No. 17.

Fuzes for Naval Service—*continued.*

Ordnance.		Percussion Fuse.	Ordnance.		Time Fuse.
B.L.	16·25-inch ...	For use with nose-fuzed common shell and shrapnel shell. One direct-action, to each common and shrapnel shell.	B.L.	16·25-inch ...	One middle sensitive to each shrapnel shell, and 20 per cent. spare.
	13·5-inch ...			13·5-inch ...	
	12-inch			12-inch	
	10-inch			10-inch	
	9·2-inch... ...			9·2-inch... ...	
	8-inch			8-inch	
	6-inch			6-inch	
Q.F.	6-inch	For use with pointed-headed common shell and A.P. shell. Base percussion, large, No. 11.		5-inch	
B.L.	5-inch	For nose-fuzed common shell and shrapnel shell. One direct-action.	Q.F.	6-inch	
	4-inch	For use with pointed-headed common shell, and armour-piercing shell. Base percussion, medium, No. 12.		4·7-inch... ...	One middle sensitive to each shrapnel shell.
Q.F.	4·7-inch... ...	Note.—*4·7-inch armour-piercing shell, Marks I, I*, II, and III, and common shell, Marks I, II, and III, take the Armstrong base fuze, Mark III.* *12-pr. Q.F. common, Mark I, takes the Hotchkiss base percussion Mark III fuze.*		4-inch	
	4-inch			12-pr.	Time and percussion, No. 56, Mark IV, to each shrapnel shell.
	12-pr.				
	6-pr.	Hotchkiss base percussion, Mark IV.			
	3-pr.				

NOTE.—For use with high explosive shell.
Fuze, percussion, direct-action, impact, No. 13.

Note.—The manufacture of middle sensitive fuzes has been discontinued; their place will be taken by fuze, time and percussion, middle, No. 54, which should only be used with full charges.

TABLE No. 18.

PROJECTILES TAKING GAS-CHECKS.

Calibre.	§ Changes in War Stores.	Palliser shot.	Palliser shell.	Common shell.	Shrapnel shell.	Weight of gas-check.		Weight of plug.			Weight of nut.	Remarks.
						At-tached.	Auto-matic.	Common.	Palliser.	Shrap-nel		
						lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
17·72-inch, A I ‡	4374	Yes.	—	Yes.	Yes.	—	24 0	—	—	—	—	
16-inch, A I	4115	Yes.	Yes.	Yes.	Yes.	—	21 4	—	—	—	—	
12·5-inch, II	3863	Yes.	—	Yes.	Yes.	12 12	—	3 6½	3 6½	3 6½	1 1	
12·5-inch, A I	4116	Yes.	Yes.	Yes.	Yes.	—	15 10½	—	—	—	—	
12·5-inch, A II	5062	Yes.	Yes.	Yes.	Yes.	—	15 14	—	—	—	—	
12-inch, 35 tons, II. ..	3863	Yes.	—	Yes.	No.	11 14	—	3 2	3 4½	—	1 1	
12-inch, 35 tons, A I ..	4141	Yes.	—	Yes.	Yes.	—	14 6	—	—	—	—	
12-inch, 35 tons, A II ..	5062	Yes	—	Yes.	Yes.	—	13 14	—	—	—	—	
12-inch, 25 tons, II. ..	3863	Yes.	—	Yes.	No.	11 14	—	3 2	3 0	—	1 1	
12-inch, 25 tons, A I ..	4141	Yes.	—	Yes.	Yes.	—	14 6	—	—	—	—	
12-inch, 25 tons, A II ..	5062	Yes.	Yes.	Yes.	Yes.	—	13 14	—	—	—	—	
11-inch, II	3863	Yes.	—	Yes.	No.	10 8	—	2 15½	3 2	—	1 1	
11-inch, A I.	4141	Yes.	Yes.	Yes.	Yes.	—	12 5	—	—	—	—	
11-inch, A II	5062	Yes.	Yes.	Yes.	Yes.	—	12 4	—	—	—	—	
10-inch, II	3862	Yes.	—	Yes.	No.	9 4	—	2 10	2 13½	—	1 1	
10-inch, A I	4141	Yes.	Yes.	Yes.	Yes.	—	11 0	—	—	—	—	
10-inch, A II	5062	Yes.	Yes.	Yes.	Yes.	—	10 10	—	—	—	—	
10-inch, polygroove, A I ..	8691	—	—	Yes.	—	—	10 10	—	—	—	—	For lyddite shell.
9-inch, II	3799	Yes.*	—	Yes.†	No.	7 0	—	2 10	2 7	—	1 1	
9-inch, A I	4141	Yes.	Yes.	Yes.	Yes.	—	9 0	—	—	—	—	
9-inch, A II	5062	Yes.	Yes.	Yes.	Yes.	—	9 0	—	—	—	—	

* Not Marks I or II. † Not Marks I to V. ‡ The letter "A" throughout this table denotes automatic.

TABLE No. 18—*continued.*

PROJECTILES TAKING GAS-CHECKS—*continued.*

Calibre.	§ Changes in War Stores.	Palliser shot.	Palliser shell.	Common shell.	Shrapnel shell.	Weight of gas-check.		Weight of plug.			Weight of nut.	Remarks.
						At-tached.	Auto-matic.	Common.	Palliser.	Shrap-nel.		
						lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
9-inch, polygroove, A I ..	5862	Yes.	—	Yes.	Yes.	—	9 3	—	—	—	—	For Mark VI gun.
9-inch, polygroove, A II ..	8733	—	—	Yes.	—	—	9 3	—	—	—	—	For H. A. fire.†
8-inch A I	9063	—	—	Yes.	—	—	7 12	—	—	—	—	
8-inch howitzer, 70 cwt., A I	4031, 6060	No.	—	Yes.	Yes.	—	6 4	—	—	—	—	
8-inch howitzer, 70 cwt., A II	5062, 5948	No.	—	Yes.	Yes.	—	6 2	—	—	—	—	
8-inch howitzer, 46 cwt., I..	3380	No.	—	Yes.	No.	4 8	—	1 0½	—	—	—	Special.
8-inch howitzer, 46 cwt., A I	5389	No.	—	Yes.	Yes.	—	7 6	—	—	—	—	
6·6-inch gun and howitzer, A I	4030	Yes.*	—	Yes.	Yes.	—	3 1	—	—	—	—	
6·6-inch gun and howitzer, A II	5062	Yes.*	—	Yes.	Yes.	—	3 0	—	—	—	—	
6·3-inch howitzer, I ..	3285	No.	—	Yes.	Yes.	1 14¾	—	1 0¼	—	1 0¼	—	Special.
80-pr. gun, A I	4723	Yes.	—	Yes.	Yes.	—	3 8½	—	—	—	—	
40-pr. gun, I	3382	No.	—	Yes.	Yes.	0 15	—	0 5½	—	0 4½	—	Special.
13-pr. gun, A I	4060	No.	—	Yes.	Yes.	—	0 6¼	—	—	—	—	
2·5-inch gun, A I	3800	No.	—	Yes.	Yes.	—	0 4¼	—	—	—	—	
2·5-inch gun, A II	4807	No.	—	Yes.	Yes.	—	0 6	—	—	—	—	

* Gun only. † Has a hole in centre.

N.B.—Gas-check plugs are interchangeable for the projectiles for which they are made, but not in all cases for different projectiles. The reason is that the lengths slightly differ.

Table No. 19.

Bursting Charges of Common, Double, Armour-piercing, and Ring Shells.

N.B.—The following are the proportions of P. and F.G. powders, to be inserted at one time into the undermentioned shells:—

Natures.	Proportions.
13·5-inch and above	about 8-lb. P. then 20-oz. F.G.
12·5-inch to 11-inch	„ 5·lb. P. „ 12-oz. F.G.
10-inch to 8-inch	„ 4-lb. P. „ 10-oz. F.G.
7-inch to 4-inch	„ 2-lb. P. „ 5-oz. F.G.
Under 4-inch, with bag	„ 1-lb. P. „ 2½-oz. F.G.
All without bag	Fill with P. or Q.F. and then fill up the interstices with F.G.

Nature of Shell.		Approximate bursting charges.	
		lb.	oz.
B.L., 16·25-inch	cast steel, Mark III	179	4
	forged steel, Mark II	187	8
	pointed, cast steel, Mark I	182	0
B.L., 13·5-inch	cast steel, Mark I and II..	85	9
	pointed, cast steel, Marks I, II, III, and IV ..	84	8
	A.P., Mark I	62	8
B.L., 12-inch	iron, light, Mark II	31	8
	forged steel, light, Mark III	95	0
	cast steel, light, Mark IV	79	0
	„ „ Mark V	79	0
	pointed, cast steel, light, Mark I	77	4
	„ „ „ Marks III, IV ..	76	13
	A.P. light, Mark I	35	0
	pointed, cast steel, heavy, Marks I and III ..	80	4½
	„ „ „ Marks IV and V ..	83	4
	A.P. heavy, Mark I	42	8
B.L., 10-inch	cast steel, Mark I	37	12
	pointed, cast steel, Marks I, III, and IV ..	37	5
	A.P., Mark I	25	0
B.L., 9·2-inch	iron, Mark VII	18	8
	forged steel, Mark III	33	0
	cast steel, Mark IV	31	14
	„ Mark V..	31	14
	pointed, cast steel, Marks I, II, III, IV, and V	30	0
	A.P., Marks I and II	18	0
B.L., 8-inch	iron, Mark II	13	8
	forged steel, Mark III	29	0
	cast steel, Mark IV	18	8
	pointed, cast steel, Marks I, II, III, IV, and V	18	5
	A.P., Mark I	10	8
	C.S. special for Marks VII and VIIA, guns Mark II and III.	15	13½
	pointed C.S. special for Marks VII and VIIA guns Mark I.	15	6½
	A.P., Mark I	9	0
B.L., Q.F., or Q.F.C., 6-inch	iron, Mark III	7	6
	cast steel, Mark V..	9	1
	„ Marks VI and VIII	9	13
	pointed, cast steel, Marks I, II, and III ..	9	4
	„ „ Marks IV and V	8	14
	steel A.P., Mark I..	4	4
	„ „ „ II and III	5	8
	howitzer, cast steel, Mark I	14	7
B.L., 5·4-inch	„ „ „	5	12½

TABLE No. 19—*continued.*

BURSTING CHARGES OF COMMON, DOUBLE, ARMOUR-PIERCING, AND RING SHELLS—*continued.*

Nature of Shell.		Approximate bursting charges.	
		lb.	oz.
B.L. 5-inch..	iron, Mark III	4	13½
	forged steel, Mark IV	7	12
	„ Marks V and VII	6	15
	pointed, cast steel, Marks I and II	5	3
Q.F. 4·7-inch	forged steel, A.P., Mark III	1	15
	„ Marks IV and V	1	12
	iron, Mark II	2	15½
	cast steel, Mark III	4	4
	„ Marks IV and VI	4	3½
B.L. 30-pr., cast steel, Mark I		3	0
B.L., Q.F., or Q.F.C., 4-inch	iron, Mark III	1	6
	forged steel, Mark IV	2	9½
	„ Marks V, VI, VII	3	3
	pointed, cast steel, Marks I, II, and III ..	2	0
Q.F. or Q.F.C., 4-inch, forged steel, A.P., Marks II and III ..		0	13½
Q.F. 12-pr.	cast steel, Mark I..	1	8
	„ Marks II, III, and IV	1	3
R.M.L.			
17·72-inch iron, Mark I		106	0
C.S., Mark II		194	0½
16-inch iron, Mark II		75	6
C.S., pointed, Mark III		112	8
12·5-inch	studded, iron, Mark I	35	4
	studless, iron, Mark I	37	8
	C.S., Mark II	95	8
	C.S., Mark III	88	1
	pointed, Mark I..	75	4
12-inch	35-ton: studded, iron, Mark III	49	12
	35-ton: studless, iron, Mark I	34	10
	25-ton: studded, Mark I and II	47	0
	25-ton: studless, iron, Mark I	28	2
	25-ton: C.S., Mark II..	63	6½
	25-ton: pointed, Mark I	61	11
11-inch	studded, iron, Mark I	37	9
	studless, iron, Mark I	27	0
	„ C.S., Mark II..	65	8
	„ „ Mark III	61	10
	pointed, Mark I..	52	8
10-inch	studded, Mark II	27	0
	„ Mark III	26	15
	studless, iron, Mark I	23	8
	„ C.S., Mark II..	48	0
	„ „ Mark III	46	0
	pointed, Mark I..	42	12
	H.A. iron, Mark I	23	14
9-inch ..	studded, iron, Mark VI	16	15
	studless, iron, Mark I	17	0
	„ cast steel, Mark II	27	12
	„ „ pointed, heavy, Mark I	24	8
	pointed, Mark I..	27	8

TABLE No. 19—*continued.*

BURSTING CHARGES OF COMMON, DOUBLE, ARMOUR-PIERCING AND RING SHELLS—*continued.*

Nature of Shell.	Approximate bursting charges.	
	lb.	oz.
8-inch .. gun, studded iron, Mark III	17	12
8-inch .. gun, pointed, Mark I	18	8
8-inch .. gun, studded, iron, Mark III	17	12
8-inch .. howitzer, 46 cwt. studded iron, Mark II	19	2
8-inch .. howitzer, iron, studless, Mark II	18	0
8-inch .. howitzer, cast steel, studless, Mark III	26	8
7-inch .. common, studded, iron, Mark VI	11	1
7-inch .. double, studded, iron, Mark IV	15	11
6·6-inch gun or howitzer, studless, iron, Mark II	6	9
6·3-inch howitzer, studless, iron, Mark II	8	8
80-pr. .. studded, iron, Mark III	11	11
80-pr. .. studless, iron, Mark II..	9	2
64-pr., studded, iron, Mark VII	8	8
40-pr., „ „ Mark II	3	0
40-pr., „ „ Mark III	3	6
25-pr., „ „ Mark II	1	13½
16-pr., studded, iron, Mark III	1	2
13-pr., „ iron, Mark I	0	11
9-pr., studded, iron, Mark V	0	8¾
7-pr. .. common, iron, Mark IV	0	7¼
7-pr. .. double, iron, Mark V	0	14¼
2·5-inch, ring shell, Mark I*	0	4
R.B.L.		
7-inch .. iron, 98 lb.	10	5
7-inch .. iron, 83 lb., Mark I and II	8	4
40-pr. .. iron, Mark E.O.C.	2	4
40-pr. .. iron, Mark II	2	6
20-pr., iron, N.S., Mark III	1	5

* R.L.G.² and R.F.G. powders.

Table No. 20.

Shot, B.L., Palliser.

Calibre.	Mark.	§ Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls. Minimum.	Thickness of Metal. Base.	Total Weight ± ·75 per cent.	Remarks.
				inches			inches	inches	inches	inches	inches	lb. oz.	
16·25-inch	I	5738	Vavasseur	4·355	5	43·57	16·05	16·19	16·5	5·025	4·65	1800 0	Lacquered internally, and has gun-metal screw plug.
13·5-inch	I	5837	,,	3·657	5	41·65	13·3	13·45	13·65	5·525	2·5	1250 0	Solid plug and bush.
12-inch	I*	4475 / 4510	,,	1·5	4	32·3	11·8	11·95	12·11	3·15	3·3	714 0	Formerly shell.
12 ,, ...	II	4968	,,	3·275	4	31·05	11·8	11·95	12·13	4·775	2·5	714 0	Solid plug only.
10 ,, ...	I	5092	,,	2·815	3	30·56	9·8	9·95	10·145	3·775	2·5	500 0	Solid plug and bush.
10 ,, ...	II	10568	,,	2·815	2	30·56	9·8	9·95	10·6	3·775	2·5	500 0	Solid plug and bush. New form of D.B.
9·2-inch	I & II*	4474	,,	1·15	3	28·5	9·0	9·15	9·305	2·5	2·5	380 0	Formerly shell. Mark I differs from Mark II in having no eyebolt hole.
9·2 ,, ...	III	4968	,,	2·565	3	27·8	9·0	9·15	9·32	3·375	2·5	380 0	Solid plug only.
9·2 ,, ...	IV	5582	,,	2·565	3	27·8	9·0	9·15	9·32	3·28	...	380 0	Solid plug and bush.
9·2 ,, ...	V	10508	,,	2·565	2	27·8	9·0	9·15	9·7	3·28	...	380 0	Solid plug and bush. New form of D.B.
8-inch	I*	4573	,,	1·0	3	21·5	7·85	7·95	8·11	2·1	2·15	210 0	Formerly shell, no eyebolt hole.
8 ,, ...	II	4968	,,	2·265	3	20·7	7·85	7·95	8·12	3·25	2·9	210 0	Solid plug only.
8 ,, special for Mark VII and VIIa guns.	II†	6464	,,	2·265	3	18·32	7·85	7·95	8·1	...	...	180 0	Solid plug and bush.
8 ,, ,, ,, ,, ,, ,,	III	8696	Vavasseur with gas-check	...	3	18·545	...	7·965	8·41	...	...	180 0	
6 ,, or Q.F.	II	4226	Segmental	0·74	2	17·9	5·96	...	6·12	1·6	2·0	100 0	Formerly shell.
6 ,, ,, ...	III*	4438	Vavasseur	0·74	2	17·9	5·96	...	6·12	1·6	2·0	100 0	Formerly shell.
6 ,, ,, ...	IV	4968	,,	1·754	2	17·0	5·96	...	6·115	2·305	2·0	100 0	Solid plug only.
6 ,, ,, ...	V	5838	,,	1·754	2	16·9	5·96	...	6·125	2·28	...	100 0	Solid soft iron core.
6 ,, ,, ...	VIII	9273	Vavasseur with gas-check	...	2	17·11	5·97	...	6·33	2·28	...	100 0	
5 ,, ...	I	5062	Vavasseur	1·494	2	12·8	4·96	...	5·11	1·98	1·5	50 0	Solid plug only.
5 ,, ...	II	6919	,,	1·494	2	12·65	4·96	...	5·11	...	...	50 0	Solid soft iron core.
4 ,, or Q.F.	I	5032	,,	1·244	2	9·95	3·96	...	4·11	1·48	1·5	25 0	Solid plug only.
4 ,, ...	II	6919	,,	1·244	2	9·9	3·96	...	4·11	...	...	25 0	Solid soft-iron core.

* Narrow Vavasseur driving band.

† The previous pattern (Mark I) not published in List of Changes were issued with the guns. No more will be made.

Table No. 21.

Shells, B.L., Q.F., or Q.F.C., Common and Common Pointed.

Calibre.	Mark.	Parn. changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls, Minimum.	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug, or Plug and Adapter.	Weight of Lead Disc or Ring.	Weight of Fuze.	Total Weight filled ± 1·5 per cent.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	oz.	oz.	lb. oz.	
16·25-inch	I	5738	Vavr.	4·355	5	55·0	16·19	...	16·5	2·47	3·12	1607 0	193 0	...	...	6	1800 0	Forged steel, solid base.
,, ...	IIA	5902	,,	4·355	5	55·0	16·19	...	16·5	2·47	3·12	1607 0	187 8	8 4	9	6	1800 0	Forged steel, large adapter in base.
,, ...	III	6065	,,	4·355	5	54·925	16·05	16·19	16·5	2·4	3·5	1619 4	179 4	8 4	9	6	1800 0	Cast steel, large adapter.
,, pointed ...	I	9963	,,	4·355	5	57·35	16·19	16·205	16·505	2·4	3·5	1615 8	182 0	2 8	...	40	1800 0	For large base fuze. Steel bush, no adapter.
13·5-inch	I	5349	,,	3·657	4	48·5	13·3	13·45	13·65	2·45	3·25	1155 10	85 9	8 8	9	6	1250 0	Cast steel, large solid base plug.
,, ...	II	5581	,,	3·657	4	48·5	13·3	13·45	13·65	2·45	3·25	1155 10	85 9	8 8	9	6	1250 0	Cast steel, large adapter.
,, ...	III	...	,,	3·275	1	48·41	13·25	13·45	14·0	2·303	3·075	1164 9½	...	...	...	6	1250 0	New form of G.C.D.B.
,, pointed ...	I	8105	,,	3·457	4	50·34	13·3	13·45	13·66	2·45	3·4	1143 4	84 8	8 0	9	40	1250 0	For large base fuze.
,, ,, ...		9957	,,	3·457	4	50·34	13·3	13·45	13·65	2·45	3·4	1163 0	84 8	2 8	...	40	1250 0	Steel bush, no adapter.
,, ,, ...	III	9963	,,	3·457	4	50·96	...	13·465	13·655	2·45	3·4	1163 0	84 8	2 8	...	40	1250 0	,, ,, ,,
,, ,, ...	IV	10252	,,	3·457	1	50·96	13·28	13·465	14·0	2·45	3·4	1163 0	84 8	2 8	...	40	1250 0	,, ,, ,, ,, Gas-check D.B.
12-inch, light	I	4475 / 4540	,,	1·5	...	36·1	11·8	11·95	12·11	2·95	3·3	686 14	24 12	2 1	5	...	714 0	Cast iron. Narrow Vav. D. band.
,, light	II	4895	,,	3·275	4	35·56	11·8	11·95	12·13	2·95	3·3	679 6	31 8	2 1	5	15	714 0	Cast iron.
,, light	IIIA	5011	,,	3·275	4	43·8	11·95	...	12·13	1·5	2·5	618 8	95 0	...	...	8	714 0	Forged steel.
,, light	IV	5349	,,	3·275	4	41·75	11·8	11·95	12·13	1·625	2·5	634 1	79 0	6 13½	9	6	714 0	Cast steel, large solid base plug.
light	V	5581	,,	3·275	4	41·75	11·8	11·95	12·13	1·625	2·5	634 1	79 0	6 13½	9	6	714 0	Cast steel, large adapter.
,, light	VI	...	,,	3·275	2	41·55	11·76	11·95	12·66	1·528	2·35	634 9¼	...	...	...	6	714 0	New G.C.D.B.
,, light	VII		No more to be made, see § 1 0519.															
,, pointed, light ..	I	8105	,,	3·275	4	42·6	11·75	11·95	12·13	1·65	2·5	617 11	77 4	6 2	9	40	714 0	For large base fuze. Fitted gas-check.
,, ,, ,, ...	III	9963	,,	3·275	3	42·93	11·75	11·965	12·71	1·65	2·5	634 11	76 13	2 8	...	40	714 0	Steel bush, no adapter, and gas-check D.B.

(A) Obsolete for future manufacture.

TABLE No. 21—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., COMMON AND COMMON POINTED—*continued.*

Calibre.	Mark.	Para. Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls, Minimum.	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug, or Plug and Adapter.	Weight of Lead Disc or Ring.	Weight of Fuze.	Total Weight Filled ± 1·5 per cent.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	oz.	oz.	lb. oz.	
12-inch, pointed, light ...	IV	10177	Vavr.	3·275	2	42·93	11·75	11·965	12·71	1·65	2·5	634 11	76 13	2 8	...	40	714 0	Steel bush, no adapter, and gas-check D.B. for a different design.
,, ,, heavy	I	{9278 / 10039}	,,	3·94	3	48·6	...	11·965	12·5	1·8	2·75	766 10½	86 4½	2 8	...	40	855 7	
,, ,, ,,	III	9963	,,	3·94	3	48·6	...	11·965	12·5	...	...	766 10½	86 4½	2 8	...	40	855 7	Steel bush, no adapter.
,, ,, ,,	IV	9963	,,	3·94	3	48·0	...	11·965	12·71	1·74	2·35	764 4	83 4	2 8	...	40	850 0	,, ,, ,,
,, ,, ,,	V	10187	,,	3·94	1	48·0	11·75	11·965	12·71	1·8	2·75	764 4	83 4	2 8	...	40	850 0	,, ,, ,, and gas-check D.B." of a different design.
10-inch	I	6171	,,	2·815	3	36·5	9·8	9·95	10·145	1·74	2·25	461 5	37 12	4 8¼	6·75	6	500 0	Cast steel, small adapter.
,, pointed	I	8105	,,	2·815	2	37·85	9·95	9·95	10·145	1·74	2·35	469 3	37 5	2 8	...	40	500 0	Driving band with gas-check.
,, ,, ...	III	9963	,,	2·815	2	37·85	9·95	9·95	10·6	...	...	460 3	37 5	2 8	...	40	500 0	Steel bush, no adapter.
,, ,, ...	IV	10508	,,	2·815	2	38·32	9·75	9·965	10·61	1·79	2·45	460 3	37 5	2 8	...	40	500 0	,, ,, ,,
9·2-inch	I	4474	,,	1·15	...	32·9	9·0	9·15	9·305	2·25	2·5	362 10½	15 8	1 8½	5	...	380 0	Cast iron. Narrow band.
,, ...	II	4895	,,	2·565	3	32·3	9·0	9·15	9·32	2·25	2·5	359 3½	18 8	1 8½	5	15	380 0	Cast iron.
,, ...	III	5011	,,	2·565	3	33·5	9·15	...	9·32	1·575	2·0	346 8	33 0	...	...	8	380 0	Forged steel.
,, ...	IV	5556	,,	2·565	2	33·58	9·04	...	9·32	1·525	2·25	338 12¾	31 14	4 8	6·75	6	380 0	Cast steel, solid base plug.
,, ...	V	5556	,,	2·565	3	33·58	9·04	...	9·32	1·525	2·25	338 12¾	31 14	4 8	6·75	6	380 0	Cast steel, small adapter.
,, ...	VII	9957	,,	2·565	3	32·3	9·0	9·15	9·32	1·525	2·25	359 3½	18 8	1 8½	5	...	380 0	Cast iron. D.B. groove undercut.
,, pointed	I	8105	,,	2·565	3	34·98	8·96	9·15	9·32	1·525	2·35	337 14½	30 0	4 0	6¼	40	380 0	For large base fuze.
,, ,, ...	II	8695	,,	2·565	3	35·41	8·96	9·165	9·71	1·575	2·35	317 8	30 0	2 8	...	40	380 0	Steel bush, no adapter.
,, ,, ...	IV	9963	,,	2·565	2	35·40	8·96	9·165	9·71	1·525	2·35	347 8	30 0	2 8	...	40	380 0	,, ,, ,,
,, ,, ...	V	10508	,,	2·565	2	35·40	8·97	9·165	9·7	1·525	2·35	347 8	30 0	2 8	...	40	380 0	,, ,, ,, New D.B.

TABLE No. 21—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., COMMON AND COMMON POINTED—*continued.*

Calibre.	Mark.	Para. Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug, or Plug and Adapter.	Weight of Lead Disc or Ring.	Weight of Fuze.	Total Weight filled ± 1·5 per cent.	Material and Remarks.
							ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	oz.	oz.	lb. oz.	
8-inch	I	4523	Vavr.	1·0	...	25·9	7·85	7·95	8·11	1·6	2·15	197 8¾	11 8	0 11½	3½	...	210 0	Cast iron. Narrow band, no eyebolt hole.
,, ...	II	4895	,,	2·265	3	25·1	7·85	7·95	8·12	1·6	2·15	194 7¾	13 8	0 11½	3½	15	210 0	Cast iron.
,, ...	III	5011	,,	2·265	3	29·0	7·95	...	8·12	0·975	1·6	180 8	29 0	...	...	8	210 0	Forged steel.
,, ...	IV	6066	,,	2·265	3	25·65	7·85	7·95	8·12	1·25	1·75	190 9	18 8	1 11½	...	6	210 0	Cast steel, plug only. No eyebolt hole.
,, pointed	I	9279	,,	2·265	2	27·33	7·81	7·965	8·41	1·25	1·8	189 3	18 5	2 8	...	40	210 0	For large base fuze.
,, ,, ...	III	9963	,,	2·265	2	27·33	7·81	7·965	8·41	...	...	189 3	18 5	2 8	...	40	210 0	Steel bush, no adapter.
,, ,, ...	IV	9963	,,	2·265	2	27·13	7·81	7·965	8·41	1·25	1·8	189 8	18 0	2 8	...	40	210 0	,, ,, ,,
,, ,, ...	V	10720	,,	2·265	2	27·13	7·81	7·965	8·4	1·25	1·8	189 8	18 0	2 8	...	40	210 0	Gas-check D.B.
8-inch, special for Mark VII gun.	II	6464	,,	2·265	3	22·45	7·85	7·95	8·1	...	...	161 8	15 13¼	1 11½	...	15	180 0	Cast steel.
8-inch, special for Mark VII gun.	IIIA	8696	,,	2·265	2	22·59	7·85	7·965	8·41	1·2	1·75	163 12½	15 13¼	1 11½	...	6½	180 0	,, ,,
8-inch, special for Mark VII and VIIA guns, pointed	I	9963 / 10239	,,	2·265	2	23·84	7·85	7·965	8·1	1·2	1·75	162 1½	15 6¼	2 8	...	40	180 0	Cast steel. Obsolete for future manufacture.
6-inch	I	4226	Segtl.	0·74	...	21·55	5·85	5·96	6·12	1·32	2·0	94 9¼	4 8	0 11	3¾	...	100 0	Cast iron.
,, ,, ...	II	4226 / 4139	,, / Vavr.	0·74 / 0·74	...	21·55	5·96	...	6·12	1·1	2·1	92 11¼	6 6	0 11	3¾	...	100 0	Cast iron. Those made before 5·83 have the segmental driving band.
,, ,, ...	III	4895	,,	1·754	2	21·05	5·96	...	6·115	1·1	2·0	90 14½	7 6	0 11	3¾	15	100 0	Cast iron.
,, ,, ...	IV	5011	,,	1·754	2	21·9	5·96	...	6·115	0·9	1·4	88 8¾	9 5	0 14½	5	15	100 0	Cast steel.
,, ,, ...	V	5083	,,	1·754	2	21·9	5·96	...	6·115	0·9	1·55	88 10½	9 1	1 3½	5	15	100 0	,, ,,
,, ,, ...	VI	5581 / 5951	,,	1·754	2	21·63	5·96	...	6·115	0·92	1·55	88 10½	9 13	1 8½	...	6	100 0	,, ,, plug only.

4. Obsolete for future manufacture.

TABLE No. 21—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., COMMON, AND COMMON POINTED—*continued.*

Calibre.	Mark.	Pars. Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug.	Weight of Lead Disc, Ring, or Washer.	Weight of Fuze.	Total Weight filled ± 1·5 per cent.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
6-inch	VII	8891	Vavr.	1·754	1	21·225	5·97	...	6·36	1·1 / 1·155	2	90 4	6 9¼	2 5¾	...	0 6½	99 10	Cast iron for practice and gas-check D.B.
,, ...	VII*	8891	,,	1·754	2	21·225	5·97	...	6·115	...	...	90 4	6 9¾	2 5¾	...	0 6½	99 10	Cast iron for practice and ordinary D.B.
,, ...	IX	9957	,,	1·754	1	21·225	5·97	...	6·115	1·1 / 1·155	2	90 4	6 9¾	2 5¾	...	0 6½	99 10	Cast iron for practice and ordinary D.B.
,, light	I	4226	Segtl.	1·14	1	17·8	5·96	...	6·12	0·82	1·5	62 14¾	6 6	0 7½	3¾	...	70 0	Cast iron. To be used for practice with reduced charges.
,, pointed	I	8142	Vavr.	1·754	2	22·50	5·96	...	6·115	0·928	1·55	88 0	9 4	2 8	...	2 8	100 0	Cast steel.
,, ,, ...	II	9272	,,	1·754	1	22·78	5·97	...	6·33	0·930	1·65	88 4	9 4	2 8	...	2 8	100 0	Cast steel and gas-check D.B.
,, ,, ...	III	9957		1·754	1	22·78	5·97	...	6·33	0·930	1·65	88 4	9 4	2 8	...	2 8	100 0	Cast steel and gas-check D.B.
,, ,, ...	IV	9958	,,	1·754	1	22·53	5·97	...	6·33	0·930	1·55	88 10	8 14	2 8	...	2 8	100 0	Cast steel and gas-check D.B.
,, howitzer, 30-cwt.	IA	12/9.94	,,	1·754	2	27·0	5·96	...	1·115	0·8	1·1	103 8	14 7	...	...	0 9	118 8	Cast steel.
,, ,, practice	I	9006	,,	1·754	2	27·225	5·97	...	6·12	0·97	1·4	106 2½	10 11	1 6½	...	0 9	118 13	Cast iron.
,, ,, ,,	II	9346	,,	1·754	2	27·225	5·97	...	6·12	1·07	1·4	112 12	9 4	...	...	0 9	122 9	,, ,, solid base.
,, ,, ,,	III	9957	,,	1·754	2	27·225	5·97	...	6·12	1·07	1·4	112 12	9 4	...	...	0 9	122 9	,, ,, ,, ,, D.B. groove undercut.
5·4-inch ,, ...	I	4/2/96	,,	1·594	2	16·2	5·36	...	5·51	0·81	1·0	53 10½	5 12	...	...	0 9	60 0	Cast steel.
,, ,, ...	IIA	12/4/99	,,	1·594	2	16·2	5·36	...	5·51	0·81	1·0	53 10½	5 12	...	...	0 9	60 0	,, ,, D.B. groove undercut.
,, ,, ...	I	4/2/96	,,	1·594	2	16·2	5·36	...	5·51	0·94	1·45	55 0	4 7	...	...	0 9	60 0	Cast iron.

A. Obsolete for future manufacture

TABLE No. 21—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., COMMON, AND COMMON POINTED—*continued.*

Calibre.	Mark.	Para. Charges in War Stored.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug.	Weight of Lead Disc, Ring, or Washer.	Weight of Fuze.	Total Weight filled ± 1·5 per cent.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	oz.	lb. oz.	lb. oz.	
5·4-inch, howitzer ...	II	12·4 99	Vavr.	1·594	2	16·2	5·36	...	5·51	0·94	1·45	55 0	4 7	...	...	0 9	60 0	Cast iron D.B. groove undercut.
5-inch	I	4375	Segtl.	0·7	...	16·5	4·96	...	5·12	5·12	0·8	45 5½	3 15	0 7½	3½	...	50 0	Cast iron. To be used for practice with reduced charges.
,, ...	II	4375	Vavr.	0·7	...	16·0	4·96	...	5·12	5·12	0·82	45 9½	3 5	0 7½	3½	0 6½	50 0	Cast iron.
,, ...	III	4826	,,	1·494	2	16·0	4·96	...	5·11	5·11	0·82	46 5½	4 4	...	...	0 6½	51 8	Cast iron.
,, ...	IV	5011	,,	1·494	2	18·25	4·96	...	5·11	0·5	0·9	41 8	7 12	...	...	0 8	50 0	Forged steel.
,, ...	VA	5812	,,	1·494	2	18·25	4·96	...	5·11	0·51	0·75	41 13½	6 15	...	...	0 6½	50 0	Forged steel; walls thicker and bush lengthened.
,, ...	VI	9957	,,	1·494	2	16·0	4·96	...	5·11	0·51	0·75	46 5½	4 4	...	...	0 9	60 0	Cast iron, D.B. groove undercut.
,, pointed	I	8142	,,	1·494	2	17·33	4·96	...	5·11	0·65	1·25	43 7½	5 3	...	...	1 5	50 0	Cast steel.
,, ,, ...	II	9957	,,	1·494	2	17·33	4·96	...	5·11	0·65	1·25	43 7½	5 3	...	...	1 5	50 0	,, ,, D.B. groove undercut.
,, howitzer	I	8319	,,	1·494	2	15·0	4·96	...	5·11	0·98	1·1	46 4	3 3	...	...	0 9	50 0	Cast iron.
,, ,, ...	II	9957	,,	1·494	2	15·0	4·96	...	5·11	0·98	1·1	46 4	3 3	...	...	0 9	50 0	,, ,, D.B. groove undercut.
4·7-inch, pointed ..	III	7315	,,	...	2	17·15	4·694	...	4·809	...	...	39 7½	4 4	1 5	...	1 4½	45 0	Cast steel. For Armstrong base fuze.
,, ,, ...	IV	8104	,,	...	2	17·15	4·694	...	4·814	...	...	39 7	4 3¾	1 5	...	1 5	45 0	Cast steel. For Medium base fuze.
,, ,, ...	VI	9957	,,	1·264 / 1·224	2	17·15	4·694	...	4·814	0·635	1·25	39 7	4 3¾	1 5	...	1 5	45 0	Cast steel. D.B. groove undercut.

A. Obsolete for future manufacture.

TABLE No. 21—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., COMMON, AND COMMON POINTED—*continued.*

Calibre.	Mark.	Para. Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. No. of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Weight empty.	Approximate Bursting Charge of Powder.	Weight of Base Plug.	Weight of Lead Disc, Ring, or Washer.	Weight of Fuze.	Total Weight filled ± 1·5 per cent.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.	lb. oz.	lb. oz.	lb. oz.	oz.	lb. oz.	lb. oz.	
30-pr.	I	10 7 95	Vavr.	1·244	2	14·45	3·96	...	4·11	0·55 / 0·58	0·7	26 9¾	3 0	...	...	0 6¼	30 0	Cast steel, no countersink for wad.
,, ...	II	12 4 99	,,	1·244	2	14·45	3·96	...	4·11	0·55 / 0·58	0·7	26 9¾	3 0	...	...	0 6¼	30 0	Cast steel, no countersink for wad, D.B. groove undercut.
4-inch	I	4265	R.L.	1·5	3	12·05	3·96	...	4·115	0·75	1·0	23 10	1 6	...	...	...	25 0	Cast iron.
,, ...	II	4336	Vavr.	0·5	...	11·85	3·96	...	4·105	0·75	1·0	23 11	1 5	...	...	...	25 0	,, ,,
,, ...	III	4965	,,	1·244	2	11·37	3·96	...	4·11	0·75	1·0	22 14	1 6	...	...	0 6	25 0	,, ,,
,, ...	IV	5011 / 5369	,,	1·244	2	12·7	3·96	...	4·11	0·5	0·75	21 12	2 9½	...	...	0 8	25 0	Forged steel.
,, ...	V	5836	,,	1·244	2	13·20	3·96	...	4·11	0·46	0·7	21 7	2 14½	...	...	0 6	25 0	Forged steel; bush longer.
,, ...	VI[A]	6254	,,	1·244	2	13·20	3·96	...	4·11	0·46	0·7	21 7	3 3	...	...	0 6	25 0	Driving band 0·94 inch from base instead of 0·44 inch.
,, pointed	I	8142	,,	1·244	2	13·48	3·96	...	4·11	0·55	1·25	21 10¾	2 0	1 5	...	1 5	25 0	Cast steel.
,, ,, ...	II	9957	,,	1·244	2	13·48	3·96	...	4·11	0·55	1·25	21 10¾	2 0	1 5	...	1 5	25 0	,, ,,
,, ring	I	25 10 92	,,	1·244	2	10·7	3·96	...	4·11	0·98	1·0	23 1¼	0 15½	1 5	...	0 5·8	25 0	Cast iron.
12-pr., pointed	I	7726	,,	1·0	2	12·55	2·97	...	3·085	0·375	1·25	10 9¾	1 8	1 5	...	0 2¼	12 8	Cast steel. Hotchkiss base fuze.
,, ,, ...	II	8106	,,	1·0	2	12·0	2·97	...	3·085	0·275	1·25	9 15¾	1 3	1 5	...	1 5	12 8	Cast steel. Medium base fuze.
,, ,, ...	III	9957	,,	1·0	2	12·0	2·97	...	3·085	0·375	1·25	9 15¾	1 3	1 5	...	1 5	12 8	Cast steel. Medium base fuze, D.B. groove undercut.
,, ,, ...	IV	10301	Plain	1·0	...	12·0	2·97	...	3·095	0·375	1·25	9 15¾	1 3	1 5	...	1 5	12 8	Cast steel.

A. Obsolete for future manufacture.

TABLE No. 22.

SHELLS, B.L., Q.F., OR Q.F.C., COMMON, POINTED, PRACTICE (CAST IRON).

Calibre.	Mark.	Service.	§ Changes in War Stores.	Length in inches.	Diameter in inches over.		Thickness of Metal.		Weight of shell, empty, including Driving Band.	Weight of Salt in lieu of Bursting Charge.	Weight of Plug.	Total Weight.	Remarks.
					Bands.	Driving Bands.	Walls.	Base.					
							ins.	ins.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
16·25-inch, practice	I	N	10237	50·12	16·205	16·505	4·05	4·5	1746 7	51 1	2 8	1800 0	
13·5-inch ,, ...	I	N	10237	48·81	13·465	14·00	3·55	3·9	1213 13	33 11	2 8	1250 0	
12-inch, heavy ,, ...	I	N	10237	42·16	11·965	12·5	3·0	3·25	814 10	32 14	2 8	850 0	Bursting charge of powder.
,, ,, ,, ...	I*	N	10341	42·16	11·965	12·76	3·0	3·25	814 10	32 14	2 8	850 0	Fitted with a new design of gas-check D.B.
,, ,, ,, ...	II	N	10237	42·25	11·965	12·76	3·05	3·3	823 6	24 2	2 8	850 0	
,, light ,, ...	I	C	10237	37·05	11·965	12·66	2·9	3·3	689 3	22 5	2 8	714 0	
10-inch, practice	I	C	10237	35·69	9·965	10·61	2·65	2·8	484 4	13 4	2 8	500 0	
,, ,, ...	II	C	10508	35·69	9·965	10·61	2·65	2·8	484 4	13 4	2 8	500 0	Fitted with new design of driving band.
9·2-inch, ,, ...	I	L	9725 / 10100	32·35	9·165	9·71	2·3	2·5	363 2	12 4	2 8	377 14	Bursting charge of powder.
,, ,, ...	II	C	10508	32·16	9·165	9·71	2·35	2·6	367 3	10 5	2 8	380 0	
8-inch, ,, ...	I	N	10237	24·45	7·965	8·41	1·95	2·5	201 3	6 5	2 8	210 0	
,, ,, ...	II	N	10720	24·45	7·965	8·4	1·95	2·5	201 3	6 5	2 8	210 0	Gas-check D.B.
6-inch, ,, ...	I	N	9697	22·376	5·97	6·33	1·155	2·0	90 8	7 0	2 8	100 0	Bursting charge of powder.
,, ,, ...	II	N	10157 / 10253	21·06	5·97	6·33	1·33	2·1	93 6	4 2	2 8	100 0	
5-inch gun, ,, ...	I	C	10237	16·03	4·97	5·115	1·0	1·5	46 4½	2 6½	1 5	50 0	
4·7-inch ,, ...	I	C	5966	16·45	4·694	4·809	...	...	40 9	3 3	1 4	45 0	Bursting charge of powder.
,, ,, ...	II	C	5966	16·45	4·694	4·809	...	...	40 9	3 3	1 4	45 0	,, ,, ,, ,,
,, ,, ...	V	N	8715	16·96	4·7	4·819	0·972	1·75	41 0	2 11	1 5	45 0	,, ,, ,, ,,
,, ,, ...	VII	N	10157 / 10253	15·49	4·7	4·819	1·0	1·75	41 13¾	1 13¾	1 5	45 0	
4-inch ,, ...	I	N	10157 / 10253	12·403	3·97	4·115	0·78	1·3	22 9¼	1 1¾	1 5	25 0	
12-pr., ,, ...	I	N	8481	9·515	2·98	3·09	0·75	...	11 0	8	1 5	12 8	Bursting charge of powder, and Mark II has the groove for D.B. undercut.
,, ,, ...	II	C	9957 / 10028	9·515	2·98	3·09	0·75	...	11 0	8	1 5	12 8	
,, ,, ...	III	C	10301	9·515	2·98	3·095	0·75	...	11 0	8	1 5	12 8	New form of driving band.

TABLE No. 23.

SHELLS, B.L., Q.F., OR Q.F.C., AND R.M.L. LYDDITE, COMMON.

Calibre.	Mark.	Service.	§ Changes in War Stores.	Length in inches.	Diameter in inches over Bands.	Diameter in inches over Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Weight of Shell empty including Driving Band.	Weight of Bursting Charge of Lyddite.	Weight of Exploder.	Weight of Plug.	Total Weight.	Remarks.
							ins.	ins.	lb. oz.	lb. oz.		oz.	lb. oz.	
10-inch, B.L.	I	L	10510	36·55	9·965	10·61	1·7	2·0	453 6	*46 0	4½-oz. with primer†	10	500 0	
9·2-inch, ,, ...	I	L	9036	33·58	9·165	9·71	1·5	2·0	339 6	40 0	,, ,, ,, †	10	380 0	A 4-oz. exploder was first issued.
,, ,, ...	II	L	10508	33·58	9·165	9·71	1·5	2·0	339 6	40 0	,, ,, ,, †	10	380 0	Differs from I in shape of driving band.
8-inch, special for Marks VII and VIIA, B.L. guns.	I	L	10509	22·3	7·965	8·105	1·15	1·6	158 5	21 1	,, ,, ,, †	10	180 0	
8-inch, B.L. howitzer	I	L	16/2/99	36·25	7·95	8·12	1·0	1·25	229 6	46 8	,, ,, ,, †	10	276 8	
6-inch, B.L., Q.F. or Q.F.C. gun	I	C	8479	21·81	5·97	6·33	0·87	1·25	87 14	13 12	3½-oz. (N)†	10	102 4	A 4-oz. exploder was first issued to N.S., and a 5½-oz. exploder with primer for both naval and land service.
											5-oz. with primer†	10		
,, ,, ,, ,, ,,		C	9057	21·81	5·97	6·33	0·87	1·25	87 14	13 12	,, ,, ,, †	10	102 4	A 5¼-oz. exploder with primer was first issued. The groove for driving band is undercut.
,, ,, ,, ,, ,,	III	C	9960	20·57	5·97	6·33	0·98	1·25	90 2	10 6	4½-oz. ,, ,, †	10	101 2	A 5½-oz. exploder with primer was first issued.
,, ,, howitzer	I	L	9007	27·2	5·97	6·12	0·8	1·1	103 1	18 14	4-oz.	10	122 9	
,, ,, ,, ...	II	L	9957	27·2	5·97	6·12	0·8	1·1	103 1	18 14	4½-oz. with primer†	10	122 9	
5·4-inch, ,, ...	I	L	15/5/00	19·44	5·36	5·11	0·45	0·8	46 12	12 10	,, ,, ,, †	10	60 0	A 4-oz. exploder was first issued. Groove for D.B. undercut.

* The weight given for bursting charges of lyddite includes the weight of exploder.
† Enclosed in waterproofed paper cylinders.

TABLE No. 23—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., AND R.M.L. LYDDITE, COMMON—*continued.*

Calibre.	Mark.	Service.	§ Changes in War Stores.	Length in inches.	Diameter in inches over Bands.	Diameter in inches over Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Weight of Shell empty including Driving Band.	Weight of Bursting Charge of Lyddite.	Weight of Exploder.	Weight of Plug.	Total Weight.	Remarks.
							ins.	ins.	lb. oz.	lb. oz.		oz.	lb. oz.	
5 inch, B.L. or B.L.C. gun ...	VII	L	10148	16·18	4·97	5·115	0·56	0·8	42 2	7 4	4½-oz.	10	50 0	This shell can be fired from the 5-inch howitzer and may be filled with powder instead of lyddite.
,, ,, howitzer	I	L	8231 8463	15·00	4·96	5·11	0·8	1·0	45 4¼	4 14	4-oz.	10	50 10	
,, ,, ,, ...	II	L	9347	18·225	4·97	5·115	0·44	0·75	39 7	9 15	4½-oz.*	10	50 0	A 4-oz. exploder was first issued.
,, ,, ,, ...	III	L	9957	18·225	4·97	5·115	0·44	0·75	39 7	9 15	,, *	10	50 0	,, ,, ,, ,, ,, Groove for D.B. in shell undercut.
4·7-inch, Q F.	I	C	8479	17·06	4·7	4·819	0·525	0·75	38 10	7 5	4-oz.*	10	46 9	A 4½-oz. exploder was first issued.
,, ,, ...	II	C	9957	17·06	4·7	4·819	0·525	0·75	38 10	7 5	,, *	10	46 9	,, ,, ,, ,, ,, Groove for D.B. in shell undercut.
30-pr., B.L.	I	L	14 5 00	14·22	3·96	4·11	0·5	0·7	25 7½	3 14½	3½-oz.*	10	30 0	
4-inch, B.L., Q.F., or Q.F.C. ...	I	N	8784	12·3	3·97	4·115	0·5	0·7	21 2½	3 3½	3½-oz.	10	25 0	
,, ,, ,, ,, ...	II	C	9957 10148	12·3	3·97	4·115	0·5	0·7	21 2½	3 3½	3-oz.*	10	25 0	This shell can be filled with powder instead of lyddite. A 3½-oz. exploder was formerly issued. Groove for D.B. undercut.
,, ,, ,, ,, ...	III	N	...	12·3	3·97	4·105	0·5	0·7	21 2¾	3 3½	3-oz.	10	25 0	Plain driving band.
10-inch. R.M.L. on H.A. mounting.	I	L	8165	31·58	9·94	...	1·6	2·0	351 10	46 12	4½-oz. with primer	10†	410 0	A 4-oz. exploder was first issued.
6·3-inch, R.M.L., howitzer ...	I	L	...	17·47	6·25	6·47 (gas-check)	·45 to ·55	1·35 to 1·65	54 15½	13 9	3½-oz.	10	72 0	Gas-check and plug, 2-lb. 13¼-oz.

Existing shells with 4-oz. exploders not in paper cylinders will be replaced by the 3½-oz. in paper cylinder; the 3½-oz. by the 3-oz.; the 4½-oz. by the 4¼-oz.; the 5½-oz. by the 5-oz.; the 5½-oz. by the 4¼-oz. The primers are still retained with exploders so fitted.

* Enclosed in waterproofed paper cylinders.

† Gas-check weighs 11 lb.

TABLE No. 24.

SHELLS, B.L., Q.F., AND Q.F.C., ARMOUR PIERCING.

Calibre.	Mark.	§ Changes in War Stores.	Driving Band. Description.	Driving Band. Width.	Driving Band. Cannelures.	Length.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls. Minimum.	Thickness of Metal. Base. Minimum.	Weights. Empty.	Weights. Bursting Charge..	Weights. Fuze.	Weights. Total.	Remarks.
				inches.		inches	inches	inches	inches	inches	lb. oz.	lb. oz.	oz.	lb. oz.	
13·5-inch	I	10307	Vavasseur with G.C.	3·315	1	Left to Manufacturer	13·465	14·0	2·2	2·75	1195 0	62 8	40	1250 0	
12-inch, heavy	I	10307	,,	3·315	1		11·965	12·76	1·8	2·5	805 0	42 8	40	850 0	
12-inch, light	I	10307	,,	3·315	2		11·965	12·66	1·65	2·5	676 8	35 0	40	714 0	
10-inch	I	10508	,,	2·815	2		9·965	10·61	1·74	2·5	472 8	25 0	40	500 0	
9·2-inch	I	10307	,,	2·505	2		9·165	9·71	1·4	2·25	359 8	18 0	40	380 0	
9·2-inch	II	10508	,,	2·565	2		9·165	9·71	1·4	2·25	359 8	18 0	40	380 0	New D.B.
8-inch	I	10720	,,	2·305	2		7·965	8·41	1·25	2·1	197 0	10 8	40	210 0	
Special for Marks VII and VIIA guns.	I	10509	Vavasseur	2·305	3		7·965	8·105	1·18	2·1	168 8	9 0	40	180 0	
6 inch	I	9529	Vavasseur with G.C.	1·754	2		5·97	6·33	1·1	2·0	93 4	4 4	40	100 0	
6-inch	II	10027	,,	1·794	2		5·97	6·33	·93	2·0	92 0	5 8	40	100 0	
4·7-inch	I	5966	Vavasseur	1·244	2		4·694	4·808	·797	...	41 6	1 15	23	45 0	
	I*	5966	,,	1·244	2		4·694	4·808	·797	...	41 6	1 15	23	45 0	
	II	5966	,,	1·244	2		4·694	4·808	·797	...	41 6	1 15	23	45 0	
	III	5966	,,	1·244	2		4·694	4·808	·797	...	41 6	1 15	23	45 0	
	IV	8460	,,	1·274	2		4·69	4·814	·8	1·25	41 14¼	1 12	21	45 0	
	V	9957	,,	1·274	2		4·53	4·819	·8	1·25	41 14¼	1 12	21	45 0	Groove for D.B. undercut.
4-inch	I	8480	,,	1·244	2		3·96	4·11	·63	1·25	22 13½	0 13½	21	25 0	
	II	9957	,,	1·244	2		3·96	4·11	·63	1·25	22 13½	0 13½	21	25 0	Groove for D.B. undercut.

TABLE No. 25

SHELLS, B.L., Q.F., or Q.F.C., SHRAPNEL.

Calibre.	Mark.	Parts. in L. of Charges.	Driving Band. Description.	Driving Band. Width.	Driving Band. Number of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Nature and Number of Balls.	Weight empty.	Weight of Bursting Charge.	Fuze.	Total Weight filled.	Percentage of Useful Weight.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.		lb. oz.	lb. oz.	oz.	lb. oz.		
16·25-inch ...	I	5738	Vavr.	4·355	5	55·6	16·19	...	16·5	1·15 / 1·4 / 1·75	2·75	2330 4-oz. sand shot.	1792 0	8 0	21	1800 0	32·3	Forged steel.
,, ,, ...	II	9957	,,	4·355	5	55·0	16·19	...	16·5	1·15 / 1·4 / 1·75	2·75	2330 ,, ,,	1792 0	8 0	21	1800 0	32·3	,, ,, groove for D.B. undercut.
13·5-inch ...	I	5394 / 5620	,,	3·657	5	49·0	13·3	13·45	13·65	1·85	2·3	1348 ,, ,,	1243 15	5 4	21	1250 0	27·0	Cast steel.
,, ,, ...	II	10252	,,	3·657	5	49·0	13·3	13·45	13·65	1·85	2·2	1348 ,, ,,	1243 15	5 4	21	1250 0	...	,, ,, groove for D.B. undercut.
12-inch light...	I	4475	,,	1·5	...	34·75	11·8	11·95	12·11	2·9	3·0	340 ,, ,,	711 5	1 14	21	714 0	11·9	Cast iron, narrow Vav. D.B.
,, ,, ...	II	4895	,,	3·275	4	34·1	11·8	11·95	12·13	2·9	3·0	328 ,, ,,	711 5	1 14	21	714 0	11·4	Cast iron, narrow Vav. D.B.
,, ,, ...	III	5011	,,	3·275	4	42·0	11·95	...	12·13	0·7 / 1·15	1·8	1120 ,, ,,	710 4	2 0	21	714 0	39·2	Forged steel.
,, ,, ...	IV	6401	,,	3·275	4	40·5	11·97	...	12·13	0·7 / 0·85 / 1·15	1·8	1000 ,, ,,	709 11	3 0	21	714 0	35·0	Cast steel.
,, ,, ...	V	8694	,,	3·275	2	40·837	11·965	...	12·71	1·15	1·8	1000 ,, ,,	709 11	3 0	21	714 0	...	Gas-check, D.B.
,, ,, ...	VI	10177	,,	3·275	2	40·837	11·965	...	12·66	0·8	1·8	1000 ,, ,,	709 11	3 0	21	714 0	...	New D.B.
10-inch ...	I	6171	,,	2·805	3	35·3	9·8	9·95	10·145	1·35	2·0	458 ,, ,,	497 10	1 9	21	500 0	22·9	Cast steel.
,, ,, ...	II	9271	,,	2·815	2	36·59	...	9·965	10·61	1·35	2·0	466 ,, ,,	497 2	1 9	21	500 0	...	Cast steel D.B. with gas-check.
,, ,, ...	III	10508	,,	2·855	2	36·59	9·75	9·965	10·61	1·35	2·0	466 ,, ,,	497 2	1 9	21	500 0	...	New form of D.B.
9·2-inch ...	I	4474	,,	1·15	...	31·5	9·0	9·15	9·305	2·0	2·3	420 2-oz. ,,	384 11	1 6	21	386 14	13·6	Cast iron, narrow D.B.
,, ...	II	4895	,,	2·565	3	30·65	9·0	9·15	9·32	2·0	2·3	416 ,, ,,	377 13	1 6	21	380 0	13·7	Cast iron, narrow D.B.
,, ...	III	5011	,,	2·565	3	33·5	9·15	...	9·32	0·825 / 1·075	1·75	900 ,, ,,	377 6	1 8	21	380 0	29·6	Forged steel.
,, ...	IV	5442 / 5620	,,	2·565	3	33·7	9·0	9·15	9·32	1·25	1·85	640 ,, ,,	377 0	2 3	21	380 0	21·0	Cast steel.
,, ...	V	8695	,,	2·565	3	32·7	8·96	9·15	9·7	1·25	1·85	638 ,, ,,	377 13	2 3	21	380 0	24·1	Cast steel, driving band with gas-check.
,, ...	VI	9957	,,	2·605	2	32·97	8·96	9·15	9·7	1·25	1·85	638 ,, ,,	377 0	2 3	21	380 0	...	Groove for D.B. undercut.
,, ...	VII	10508	,,	2·565	2	32·97	8·96	9·165	9·7	1·25	1·85	638 ,, ,,	377 0	2 3	21	380 0	...	New form of D.B.

TABLE No. 25—*continued.*

SHELLS, B.L., Q.F., OR Q.F.C., SHRAPNEL.

Calibre.	Mark.	Para. in L. of Changes.	Driving Band. Description.	Driving Band. Width.	Driving Band. Number of Cannelures.	Length in inches.	Diameter. Body.	Diameter. Bands.	Diameter. Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Nature and Number of Balls.	Weight empty.	Weight of Bursting Charge.	Fuze.	Total Weight filled.	Percentage of Useful Weight.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.	ins.		lb. oz.	lb. oz.	oz.	lb. oz.		
8-inch*	I	4523	Vavr.	1·0	...	23·83	7·85	7·95	8·11	1·5	2·0	260 2-oz. sand shot.	208 3½	0 15½	13	210 0	15·5	Cast iron.
,, ...	III	4895	,,	2·265	3	23·63	7·85	7·95	8·12	1·5	2·0	332 ,, ,,	208 3½	0 15½	13	210 0	19·8	,, ,,
,, ...	IV	5011	,,	2·265	3	28·0	7·95	7·95	8·12	{0·55 / 0·75}	1·3	528 ,, ,,	207 12	1 2	18	210 0	31·4	Forged steel.
,, ...	V	5889	,,	2·265	3	24·55	7·85	7·95	8·12	1·0	1·35	412 ,, ,,	208 4	0 15	21	210 8	24 5	Cast steel.
,, ...	VI	9279	,,	2·265	2	24·55	7·85	7·95	8·4	1·0	1·35	412 ,, ,,	208 4	0 15	21	210 8	24·5	,, ,, Gas-check driving band.
,, ...	VII	9957	,,	2·265	2	24·55	7·85	7·95	8·4	1·0	1·35	412 ,, ,,	208 4	0 15	21	210 8	...	Groove for D.B. undercut.
,, ...	VIII	10720	,,	2·265	2	24·55	7·85	7·95	8·4	1·0	1·35	412 ,, ,,	208 4	0 15	21	210 8	...	Gas-check D.B.
8 inch special for Marks VII and VIIa guns.	II	6464	,,	2·265	3	21·7	7·85	7·95	8·1	1·0	1·35	320 ,, ,,	177 12	0 15	21	180 0	...	Cast steel.
,, ,, ,,	III	8696	,,	...	...	22·0	...	7·965	8·41	1·0	1·35	320 ,, ,,	177 12	0 15	21	180 0	...	Gas-check D.B.
,, ,, ,,	IV	9957	,,	...	...	22·0	...	7·965	8·41	1·0	1·35	320 ,, ,,	177 12	0 15	21	180 0	...	Groove for D.B. undercut. Obsolete for future manufacture.
Or Q.F. 6-inch‡ ...	I	{4226 / 4139}	,,	0·74	...	18·35	5·96	...	6·12	1·1	1·5	259 {mixed metal 14 to a lb.}	98 12	0 7	13	100 0	18·5	Cast iron.
,, ,, ...	II	4895	,,	1·754	2	18·2	5·96	...	6·115	1·1	1·5	255 ,,	98 12	0 7	13	100 0	18·2	,,
,, ,, ...	III	5011	,,	1·754	2	19·65	5·96	...	6·115	{0·4 / 0·5}	0·9	700 16 to a lb.	98 6	0 8	18	100 0	43·7	Forged steel.

* A few 8-inch Shrapnel II (not published in L. of C.) have been issued, differing from Mark I in having the hole for eyebolt.
† Mark I, issued with the guns, did not appear in "Changes."
‡ Those made before 5/83 have the segmental driving ring, and those made since have the "Vavasseur" driving band.

TABLE NO. 25—*continued.*

SHELLS, SHRAPNEL, B.L., Q.F., OR Q.F.C.—*continued.*

Calibre.	Mark.	Para. in List of Changes.	Driving Band. Description.	Driving Band. Width.	Driving Band. Number of Cannelures.	Length in inches.	Diameter. Body.	Diameter. Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Nature and Number of Balls.	Weight empty.	Weight of Bursting Charge.	Fuze.	Total Weight filled.	Percentage of Useful Weight.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins		lb. oz.	lb. oz.	oz.	lb. oz.		
6-inch	IV	5621	Vavr.	1·754	2	18·925	5·96	6·115	0·5	1·5	536 14 to a lb.	98 8½	0 10½	21	100 8	38·3	Forged steel; walls thicker.
,, ...	V	6465	,,	1·754	2	18·925	5·96	6·115	0·55	1·5	518 14 ,,	98 9½	0 10½	21	100 8½	38·0	Cast steel
,, ...	VI	9272	,,	1·754	1	18·925	5·96	6·33	0·55	1·5	518 14 ,,	98 9	0 10½	21	100 8½	38·0	,, Gas-check D.B.
,, ...	VII	9957	,,	1·754	1	18·925	5·97	6·33	0·55	1·5	518 14 ,,	98 9	0 10½	21	100 8½	38·0	,, Groove for D.B. undercut.
,, ...	VIII	10097	,,	...	1	18·582	5·97	6·33	0·65	1·213	453 14 ,,	98 9	0 10½	21	100 8½	35·8	
,, ...	IX	...	,,	1·794	1	18·582	5·97	6·33	0·65	1·213	453 14 ,,	98 9	0 10½	21	100 8½	35·8	
5·4-inch howitzer	I	27/1/96	,,	1·594	2	13·5	5·36	5·51	0·45	0·9	350 16 ,,	58 6	0 6	20	60 0	36·5	Cast steel.
,, ,,	II	...	,,	1·594	2	13·6	5·36	5·51	0·42	0·9	397 16 ,,	58 6	0 6	20	60 0	...	Forged steel.
,, ,,	III	...	,,	1·594	2	13·61	5·26	5·51	0·42	0·9	397 16 ,,	58 6	0 6	20	60 0	...	,, Groove for D.B. undercut.
5-inch gun... ...	I	4712	...	Obsolete; to be broken up.													
,, ,, ...	II	4712	...	Obsolete; the existing store to be used up for practice on Gunnery Ships.													
,, ,, ...	III	4712	Vavr.	1·494	2	14·1	4·96	5·11	0·45	0·9	236 14 to a lb.	49 9	0 4½	...	50 0	33·7	Forged steel.
,, ,, ...	IV	9957	,,	1·494	2	14·1	4·96	5·11	0·45	0·9	236 14 ,,	49 9	0 4½	...	50 0	33·7	,, Groove for D.B. undercut.
5-inch howitzer ...	I	8231	,,	1·494	2	13·1	4·96	5·11	0·35 / 0·4	0·9	84 50 ,, / 288 16 ,,	48 15	0 4	13	50 0	38·0	Gunmetal head.
,, ,, ...	II	8812	,,	1·494	2	13·1	4·96	5·11	0·35 / 0·4	0·9	84 50 ,, / 288 16 ,,	48 15	0 4	13	50 0	38·0	Mild steel head.
4·7-inch	I	6575	,,	1·274	2	13·0	4·694	4·809	0·4	0·85	242 14 ,,	43 14	0 5	13	45 0	...	Forged steel.
,, ...	II	9957	,,	1·274	2	13·71	4·69	4·819	0·4	0·85	225 14 ,,	43 14	0 5	13	45 0	...	,, Groove for D.B. undercut.
,, ...	III	...	,,	1·244	2	13·6	4·69	4·814	0·45	0·85	205 14 ,,	43 14	0 5	13	45 0	...	Forged steel. Field service type.
30-pr.	I	21/11/95	,,	1·244	2	12·45	3·96	4·11	0·28	0·65	313 27 ,,	29 0	0 3	13	30 0	38·5	Forged steel. Bullets contained in wire cage.
,, ...	II	...	,,	1·244	2	12·45	3·96	4·11	0·28 / 0·32	0·65	313 27 ,,	29 0	0 3	13	30 0	38·5	Forged steel. Bullets contained in tin cage.
,, ...	III	...	,,	...	...	...	...	...	...	...	...	...	...	...	...	...	
4-inch	I	4265	R.L.	1·5	3	11·0	3·95	4·115	0·5	0·65	40 34 ,, / 105 20 ,,	24 13	0 3	...	25 0	25·7	Cast iron.

TABLE No. 25—*continued.*

SHELLS, SHRAPNEL, B.L., Q.F., OR Q.F.C.—*continued.*

Calibre.	Mark.	Para. in List of Changes.	Driving Band. Description.	Driving Band. Width.	Driving Band. Number of Cannelures.	Length in Inches.	Diameter. Body.	Diameter. Driving Bands.	Thickness of Metal. Walls.	Thickness of Metal. Base.	Nature and Number of Balls.	Weight empty.	Weight of Bursting Charge.	Fuze.	Total Weight filled.	Percentage of Useful Weight.	Material and Remarks.
				ins.			ins.	ins.	ins.	ins.		lb. oz.	lb. oz.	oz.	lb. oz.		
4-inch	II	4394	Vavr.	0·5	...	11·2	3·96	4·105	0·5 to 0·54	0·65	40 34 to a lb. 105 20 ,,	24 13	0 3	...	25 0	25·7	Narrow band.
,, ...	III	4965	,,	1·244	...	10·85	3·96	4·1	0·5 to 0·54	0·65	40 34 ,, 94 20 ,,	24 0	0 3	13	25 0	24·7	,,
,, ...	IV	5011 5705	,,	1·5	2	10·3	3·96	4·11	0·26	0·65	238 22½ ,,	22 12½	0 1½	18	25 0	42·3	Forged steel, B.C. in shalloon bag.
,, ...	V	5515	,,	1·244	2	10·3	3·96	4·11	0·26	0·65	230 22½ ,,	24 1½	0 1½	13	25 0	40·8	Forged steel, B.C. loose in tin cup.
,, ...	VI	9957	,,	1·244	2	10·3	3·96	4·11	0·26	0·65	230 22½ ,,	24 1½	0 1½	13	25 0	40·8	Forged steel. Groove for D.B. undercut.
,, ...	VII	10543	,,	1·244	2	10·64	3·96	4·11	0·375	0·67	169 22½ ,,	24 0	0 3	13	25 0	...	F.S. base burster.
15-pr. ...	I	8143	,,	1·0	2	9·8	2·97	3·085	0·17	0·45	210 35 ,,	13 14½	0 1½	13	14 8	41·0	Forged steel. Bullets in wire cage.
	I*	9058	,,	1·0	2	9·075	2·98	3·09	0·17	0·45	200 35 ,,	13 1½	0 1½	13	14 0		
,, ...	II	8232	,,	1·0	2	9·0	2·97	3·085	0·25	0·45	200 35 ,,	13 1½	0 1½	13	14 0	40·2	Forged steel. Bullets in wire cage.
,, ...	III	8502	,,	1·0	2	9·0	2·97	3·085	0·25	0·45	192 35 ,,	13 1½	0 1½	13	14 0	40·0	Forged steel. Bullets in tin cage.
,, ...	IV	9957	,,	1·0	2	9·0	2·97	3·085	0·25	0·45	192 35 ,,	13 1½	0 1½	13	14 0	40·0	Forged steel. Groove for D.B. undercut.
,, ...	V	10301	Plain	1·0	...	9·0	2·97	3·095	0·17 to 0·25	0·45	192 35 ,,	13 1½	0 1½	13	14 0	40·0	
,, practice ...	I	8562	Vavr.	1·0	2	9·0	2·97	3·085	0·375	0·55	110 35 ,, 68 84 ,,	13 1½	0 1½	13	14 0	28·1	
12-pr., service ...	I	5146	,,	1·0	2	8·25	2·97	3·085	0·2	0·45	177 34 ,,	11 10½	0 0¾	13	12 8	41·6	
,, 6 cwt.	I	8143	,,	...	2	8·5	2·97	3·085	0·2	0·45	162 35 ,,	11 9½	0 1½	13	12 8	37·0	Bullets in wire cage.
	I*	9058	,,	1·0	2	8·349	2·98	3·09	0·2	0·45	158 35 ,,	11 9½	0 1½	13	12 8		
12-pr., 12, 8, or 6 cwt.	II	8233	,,	1·0	2	8·28	2·97	3·085	0·23	0·45	156 35 ,,	11 9½	0 1½	13	12 8	36·2	,, ,, ,,
12-pr., 12, 8, or 6 cwt.	III	8502	,,	1·0	2	8·28	2·97	3·085	0·23	0·45	156 35 ,,	11 9½	0 1½	13	12 8	36·2	Tin cage.
12-pr., 12, 8, or 6 cwt.	IV	9957	,,	1·0	2	8·28	2·97	3·085	0·23	0·45	156 35 ,,	11 9½	0 1½	13	12 8	36·2	Groove for D.B. undercut.
12-pr., 12, 8, or 6 cwt.	V	10301	Plain	1·0	...	8·28	2·97	3·095	0·2 to 0·23	0·45	156 35 ,,	11 9½	0 1½	13	12 8	...	
12-pr., practice ...	I	5146	Vavr.	1·0	2	8·6	2·97	3·085	0·45	0·6	72 34 ,,	11 0½	0 0¾	13	12 8	16·9	To become obsolete when used up.
10-pr., B.L. ...	I	11011	Plain	0·4	...	7·85	2·72	2·85	...	...	163 48 ,,	9 1¼	0 1 1/16	13	10 0		

TABLE No. 26.

SHOT, B.L. CASE.

Calibre.	Mark.	§ Changes in War Stores.	Diameter. Body.	Diameter. Studs or Rings.	Length over Handles.	Contents. Balls. No.	Contents. Balls. Nature.	Contents. No. of Segments.	No. of Handles.	No. of Mixed Metal Studs at Base.	Approximate Weight of Balls.	Approximate Weight of Case, Linings, Sand, and Clay.	Weight.	±	Remarks.
			inches	inches	inches						lb. oz.	lb. oz.	lb. oz.	lb. oz.	
13·5-inch	I	...	13·38	13·65	48·2*	1415	8 oz. sand shot ...	8	2	8	702 8	547 8	1250 0	37 8	Staybolt up the centre, and fitted with hole for eyebolt.
12-inch, light ...	I	4574	11·88	12·11	35·2	828	8 oz. ditto ...	6	2	6	414 0	300 0	714 0	21 0	
10-inch	I	7980	9·93	10·15	34·5	528	8 oz. ditto ...	6	2	6	254 8	245 8	500 0	15 0	
9·2 ,, ...	I	4654	9·08	9·305	33·15	414	8 oz. ditto ...	6	2	6	207 0	173 0	380 0	11 0	
8-inch ...	I	4523	7·89	8·11	23·5	468	4 oz. ditto ...	6	2	6	117 0	93 0	210 0	6 0	No hole for eyebolt.
	II	4792	7·89	8·12											Fitted with hole for eye-bolt.
6 ,, ...	I	4226	5·94	6·1	20·1	207	4 oz. ditto ...	6	1	3	51 9	48 7	100 0	3 0	
5·4 ,, howitzer ...	I	5/9/98	...	...	...	245	2 oz. ditto ...	...	1	...	30 10	29 6	60 0	...	Copper ring at base.
5-inch	I	4376	4·95	5·1	12·3	450	Mixed metal balls, 14 per lb.	4	1	6	32 3½	17 12½	50 0	1 8	
5 ,, howitzer ...	I	8234	4·95	5·1	13·91	433	Ditto, 14 per lb....	4	1	...	30 15	19 1	50 0	1 8	Copper ring at base.
5 ,, ,, ...	II	9515	4·97	5·115	14·9	185	2 oz. sand shot	3	...	...	23 2	26 14	50 0	...	,, ,,
30-pr.	I	...	3·95	4·1	11·45	300	Mixed metal balls, 14 per lb.	3	1	6	18 9	11 7	30 0	3 p.c.	,, ,,
4-inch	I	4265	3·95	4·1	9·45	245	Ditto, 16½ per lb.	3	1	6	15 5	9 11	25 0	0 12	,, ,,
12-pr.	I	5146 / 8108	2·96	3·085	8·5	314	Ditto, 34 ,, ...	3	1	3	9 4	3 11	12 15	0 6	,, ,, fitted with handle becomes Mark I*.
12-pr.	II	7570	2·96	3·085	8·5	314	Ditto, ,, ...	3	1	3	9 4	3 11	12 15	0 6	Copper ring at base, fitted with handle.
15-pr. or 12-pr. ...	III	8235	2·9	3·08	8·9	300	Ditto, ,, ...	3	1	...	8 13	3 11	12 8	0 6	Corrugated in three places. For use with cordite.
,, ,, ...	IV	8736	2·97	3·09	9	290	Ditto ,, ...	2	1	...	...	...	12 14	...	Base screwed to body.
,, ,, ...	IV*	10283	This is Mark IV with two partial perforations					in base	for	N.S.					
,, ,, ...	V	9456 / 9815	2·96	3·085	8·9	290	Ditto 34 per lb....	2	1	—	8 9	4 11	13 4	...	Base pressed into recess in body.

Table No. 27.

Common and Double Shell (Studded) R.M.L. Heavy Guns.

TABLE

COMMON AND DOUBLE SHELL

Calibre and Mark.	§ Changes in War Stores.	Length, ± ½ inch per foot.	Diameters.		Thickness of Metal.			Approximate weight empty, without Nut, Gas-check, Plugs, &c.
					Walls.			
			Body.	Studs.	Top.	Bottom.	Base.	
		inches.	inches. ± ·01	inches. ± ·05	inches.	inches.	inches.	lb. oz.
12·5-inch, Mark I	3375 3635	36·93	12·3	12·85	2·96	3·1	3·4	780 8
12-inch, 35-ton, Mark I ...	2419	34·45	11·92	12·35	2·2	2·4	3·0	575 0
,, ,, II ...	2557 2655	34·45	11·92	12·35	2·2	2·4	3·0	575 3
,, ,, III ...	3378	34·45	11·92	12·35	2·2	2·4	3·0	573 0
12-inch, 25-ton, ,, I ...	1766 2655	30·0	11·92	12·35	1·96	1·96	3·0	459 6
,, ,, II ..	3497	30·0	11·92	12·35	1·96	1·96	3·0	457 6
11-inch, Mark I	2378 2655	34·2	10·92	11·35	2·15	2·4	2·75	506 4
10-inch, ,, I	...	...	...	...	...	To be broken up.		
,, ,, II	2524 2655	30·55	9·92	10·35	1·95	2·15	2·15	377 12
,, ,, III	3497	30·55	9·92	10·35	1·95	2·15	2·15	376 5
9-inch, Mark I								
,, ,, II								
,, ,, III	...	...	...	...	...	To be broken up.		
,, ,, IV								
,, ,, V								
,, ,, VI	3799	24·5	8·8	9·31	1·65	2·0	2·3	238 0
8-inch, ,, I	1338 and 2356	24·0	7·92	8·31	1·335	1·335	2·0	167 0
,, ,, II	1518 and 2356	24·0	7·92	8·31	1·335	1·335	2·0	167 0
,, ,, III	1765 and 2655	24·17	7·92	8·31	1·335	1·335	2·0	166 0
7-inch, ,, I	1188 and 2356	20·05	6·92	7·31	1·15	1·15	1·75	106 12
,, ,, II	1240 and 2356	20·05	6·92	7·31	1·15	1·15	1·75	106 12
,, ,, III	1341 and 2356	20·05	6·92	7·31	1·15	1·15	1·75	106 12
,, ,, IV	1518 and 2356	20·1	6·92	7·31	1·15	1·15	1·75	106 12
,, ,, V	1765 and 2655	20·4	6·92	7·31	1·15	1·15	1·75	106 14
,, ,, VI	5370	20·4	6·92	7·31	1·15	1·15	1·75	106 12
,, Double, Mark I ...	1339 and 2356	27·2	6·92	7·31	1·0	1·0	2·0	146 12
,, ,, ,, II ...	1518 and 2356	27·2	6·92	7·31	1·0	1·0	2·0	146 12
,, ,, ,, III ...	1765 and 2655	27·2	6·92	7·31	1·0	1·0	2·0	145 6
,, ,, ,, IV ...	5370	27·2	6·92	7·31	1·0	1·0	2·0	146 12

N.B.—× indicates that the studs are formed to correspond to the curve of the groove instead of being concentric with the projectiles as in previous patterns, and in all but 7-inch projectiles previous to 8/3/72; it also indicates that they are of hard alloy, viz.: 7 of copper to 1 of tin. Soft alloy, viz.: 10 of copper to 1 of tin was approved for all natures on the above date. Soft studs are indicated by the date marked on them being subsequent to the above date.

On 20/12/72 it was ordered that all common shell for the Woolwich guns should be marked on the base with the day and month of casting, and calibre; the 12-inch being followed with "25 ton," or "35 ton," the date when finished being marked on the stud as usual.

No. 27.

(Studded) R.M.L. Heavy Guns.

Approximate Bursting Charge, Shell Powder, L.G.	Approximate weight of Filled Shell. Limits of Error ± 1·5 per cent.	Studs screwed in or swedged into undercut Holes.	Base rounded off.	Marks on One Rear Stud are the Date of Manufacture.	Remarks.
lb. oz.	lb. oz.				
35 4*	809 12	Swedged	Yes	Date and × ...	Three rings of studs. Has bands front and rear. Diameter over bands 12·425 inches. Is fitted for gas-check.
38 4	613 4	,,	,,	Date and × ... ("35 ton" on every alternate stud.)	Two rings of studs. Since converted to II.
38 4	613 7	,,	,,	Date and × ... ("35 ton" on every alternate stud.)	Three rings of studs. Altered to take gas-check.
49 12*	614 0	,,	,,	Date and × ... ("35 ton" on every alternate stud.)	Three rings of studs. Fitted for gas-check with hole through base.
47 0*	497 2	,,	,,	Date and × ...	Altered to take gas-check.
47 0*	496 0	,,	,,	Date and × ...	Fitted for gas-check with hole through base.
37 9*	536 6	,,	,,	Date and × ..	Altered to take gas-check.
W.O. Appl., 24/5/81.					
27 0*	398 0	,,	,,	Date and × ...	Thicker walls. Altered to take gas-check.
26 15*	397 5	,,	,,	Date and × ...	Fitted for gas-check with hole through base.
W.O. Appl., 24/5/81.					
16 15*	251 12	,,	,,	Date and × ...	Has bands, front and rear. Diameter over bands, 8·925 inches. Is fitted for gas-check.
14 9	181 9	Screwed	No	Nil	
14 9	181 9	Swedged	,,	Date and × ...	Studs placed at a constant distance apart.
17 12*	181 2	,,	Yes	Date and × ...	Unloading hole.
9 4	116 2	Screwed	No	Nil	Three extractor holes. This shell has the Moorsom bush, and requires a G.S. adapter. For practice only.
9 4	116 0	,,	,,	Nil	Three extractor holes, countersink ·1 inch, and G.S. bush.
9 4	116 0	,,	,,	Nil	Two extractor holes and countersink ·2 inch.
9 4	116 0	Swedged	,,	Date and × ...	Studs placed at constant distance apart.
9 4	116 2	,,	Yes	Date and × ...	Unloading hole.
11 1*	116 2	,,	,,	Date and × ...	Gun-metal bush extended over nose, no unloading hole.
13 3	159 15	Screwed	No	Nil	
13 3	159 15	Swedged	,,	Date and × ...	Studs placed at constant distance apart.
12 12	158 12	,,	Yes	Date and × ...	Unloading hole.
15 11*	159 8	,,	,,	Date and × ...	Gun-metal bush extended over nose, no unloading hole.

Unloading holes discontinued 27 1/73 § 2426, without a change of pattern.

Some Mark II 7-inch double shell were made with rounded base, and advance numeral stamped on a front stud. § 1776.

Each shell is marked on one front stud with its numeral: thus $\frac{\text{III.}}{\text{R. † L.}}$

The weights of filled shell do not include gas-checks, plugs, nuts, bags, or fuze-hole plugs, &c.

Shells *altered* to take gas-checks have a star in addition to original numeral: thus II*.

* P. mixture.

TABLE No. 28.

SHRAPNEL SHELL (STUDDED), R.M.L. HEAVY GUNS.

Calibre and Mark.	§ Changes in War Stores.	Length without Gas-check, Plug, or Nut ± ½ inch per foot.	Diameters.		Thickness of Metal.			Number and Nature of Balls.	Percentage of useful Weight.	Approximate Weight of Shell, empty.	Charge. Bursting Pistol or R.F.G., R.F.G. Powder.	Bottom, rounded at Edge, with a Radius of	Remarks.
					Walls.								
			Body.	Studs.	Top.	Bottom.	Base.						
		ins.	ins. ± ·01	ins. ± ·005	ins.	ins.	ins.			lb. oz. ± 1·5 per cent.	lb. oz.	ins.	
12·5-inch, Mark I	3377	35·65	12·3	12·85	...	...	...	284 4-oz. sand shot	8·8	803 6	2 7	1	Has bands front and rear. Diameter over band 12·425 inches. Fitted for gas-check.
12-inch, 35 ton, Mark I ...	2522	33·55	11·92	12·35	2·2	2·4	2·25	368 4-oz. or 453 3½-oz. sand shot.	15·0	610 6	1 15	3·96	
12-inch, 25 ton, Mark I ...	1873	30·75	11·92	12·35	...	...	...	530 4-oz. sand shot	28·7	495 0	1 2	3·96	
,, ,, ,, II ...	2381	29·75	11·92	12·35	2·04	2·24	2·25	276 ,, ,, ...	13·9	495 0	1 15	3·96	Thicker sides, gun-metal socket, larger centre tube, thicker diaphragm, and diaphragm and tin cup coned.
,, ,, ,, III ...	2523	29·05	11·92	12·35	2·04	2·24	2·25	276 4-oz., or 339 3½-oz. sand shot.	13·9	494 13	1 15	3·96	Flush socket.
11-inch, Mark I	2780	3·18	10·92	11·35	1·78	2·24	2·25	378 4-oz., or 465 3½-oz. ,,	17·9	529 10	1 12	3·5	
10-inch, ,, II*	2366	31·88	9·92	10·35	1·59	1·84	1·88	306 4-oz. sand shot	18·9	403 0	1 9	3·96	Same improvements as 12-in. 25 ton. II.
,, ,, III	2523	31·13	9·92	10·35	1·59	1·84	1·88	306 4-oz., or 376 3½-oz. sand shot.	18·9	403 0	1 9	3·96	,, ,, III.
9-inch, ,, I	1609	26·25	8·92	9·31	...	...	...	564 2-oz. sand shot	28·1	250 0	0 12	3	
,, ,, II	2366	26·25	8·92	9·31	1·34	1·52	1·7	374 ,, ,, ...	18·2	254 0	1 5	3	,, ,, II.
,, ,, III	2491	25·35	8·92	9·31	1·34	1·52	1·7	374 ,, ,, ...	18·2	254 0	1 5	3	,, ,, III.
8-inch, ,, I	1609	23·25	7·92	8·31	...	...	...	376 ,, ,, ...	26·9	174 0	0 10	2·65	
,, ,, II	2366	23·23	7·92	8·31	1·11	1·27	1·5	300 ,, ,, ...	20·7	180 0	1 0	2·65	,, ,, II.
,, ,, III	2491	22·55	7·92	8·31	1·11	1·27	1·5	300 ,, ,, ...	20·7	179 8	1 0	2·65	,, ,, III.
7 inch, ,, II†	1609	19·72	6·92	7·31	...	...	...	227 ,, ,, ...	25·2	112 0	0 8	2	
,, ,, III	2366	19·72	6·92	7·31	0·9	1·04	1·25	192 ,, ,, ...	20·3	117 4	0 12	1	,, ,, II.
,, ,, IV	2491	19·0	6·92	7·31	0·9	1·04	1·25	192 ,, ,, ...	20·6	115 10	0 12	1	,, ,, III.

* 10-inch, Mark I, is obsolete.

† 7-inch, Mark I, with cast-iron diaphragm and no tin cup, is declared unserviceable, and is broken up on return to Woolwich.

N.B.—The marks on the rear stud and the marks in front of one front stud of Shrapnel are the same, and have the same signification as those in the common shell.

Table No. 29.

Palliser Shot (formerly Shell) (Studded), R.M.L., Heavy Guns.

Calibre and Mark.	§ Changes in War Stores.	Length in Inches ± $\frac{1}{10}$ inch per foot, without Gas-check, Plug, or Nut.	Diameters.		Thickness of Metal.		Weight empty, without Gas-checks, Plugs, or Nuts.	Approximate Bursting Charge, Shell Powder, L.G.	Weight of Filled Shell, without Gas-checks, Plugs, or Nuts.	Studs, hard or soft.	Edge of Bottom rounded.	Bands round Shoulder and Base.	Bodies cast in sand.	Mark on a Rear Stud. The Date referring to the Manufacture of each individual Shell.	Remarks.
			Body.	Studs.	Walls (minimum).	Base.									
		ins.	ins. ± ·01	ins. ± ·005	ins.	ins. ± ·05	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.						
12·5-inch, I	2877	33·0	12·425	12·85	3·25	3·4	790 8	11 12	802 4	Soft	Yes	No	Yes	Date, × and I ...	Three rings of studs. Altered to take gas-check. A few only made.
,, II	3376	33·0	12·425	12·85	3·19	3·4	790 8	11 12	802 4	,,	Yes	No	Yes	Date, × and II ...	Three rings of studs. Stronger bush. Fitted for gas-check. A few only made.
,, III	3376 and 3899	33·0	12·3	12·85	3·19	3·4	788 4	11 14	800 14	,,	Yes	Yes	Yes	Date, × and III ...	Three rings of studs. Diameter over band 12·425 inches.
12-inch, 35-ton, I ...	2380 2459	31·3	11·925 ± ·015	12·35	3·16	3·25	691 2	9 14	701 0	,,	Yes	No	Yes	Date, × and I ... "35-ton," on every alternate stud	Two rings of studs.
,, ,, II ...	2460 2655	31·3	11·925	12·35	3·16	3·25	688 5	9 14	698 3	,,	Yes	No	Yes	Date, × and II ... "35-ton," on every alternate stud	Three rings of studs.
,, ,, III ...	3379	31·3	11·925	12·35	3·16	3·25	688 5	9 14	698 3	,,	Yes	No	Yes	Date, × and III ... "35-ton," on every alternate stud	Stronger bush. Fitted for gas-check.
,, ,, IV ...	3560 3899	31·3	11·8	12·35	3·16	3·25	686 3	10 4	696 7	,,	Yes	Yes	Yes	Date, × and IV ... "35-ton," on every alternate stud	Three rings of studs. Diameter over bands 11·925 inches.
12-inch, 25-ton, I ...	To be broken up.			W.O. Ap pl., 24/5/81.											
,, ,, II ...	1872 2655	29·2	11·92	12·35	2·85	2·85	586 4	14 0	600 0	,,	Yes	No	Yes	Date, × and II ...	

TABLE No. 29—*continued.*

PALLISER SHOT (FORMERLY SHELL) (STUDDED), R.M.L., HEAVY GUNS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length in inches ± ·1 inch per foot, without Gas-check, Plug, or Nut.	Diameters. Body.	Diameters. Studs.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Weight, empty, without Gas-checks, Plugs, or Nuts.	Approximate Bursting Charge, Shell Powder, L.G.	Weight of Filled Shell, without Gas-checks, Plugs, or Nuts.	Studs, hard or soft.	Edge of Bottom, rounded.	Bands round Shoulder and Base.	Bodies cast in Sand.	Mark on a Rear Stud. The Date referring to the Manufacture of each individual Shell.	Remarks.
		ins.	ins. ± ·01 to ·015	ins. ± ·005	ins.	ins. ± ·05	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.						
12-inch, 25-ton, III ...	3379	29·2	11·92	12·35	2·85	2·85	584 5	15 8	599 13	Soft	Yes	No	Yes	Date, × and III ...	Stronger bush. Fitted for gas-checks.
,, ,, IV ...	3560	29·2	11·8	12·35	2·85	2·85	584 5	15 8	599 13	,,	Yes	Yes	Yes	Date, × and IV ...	Diameter over bands 11·925 inches.
11-inch, II	2106 2429 2655	28·3	10·925	11·35	2·9	3·0	529 8	6 7	535 15	,,	Yes	No	Yes	Date, × and II ...	11-inch, Mark I, was not finally approved, a number issued, capacity 9 lb. 4 oz. By § 2429 it was decided that only one description of Palliser projectile should be issued for the 11-inch gun, viz., that described in § 2106 as Shot, Palliser, 11-inch, Mark I, which was then ordered to be called Shell, Palliser, 11-inch, Mark II.
,, III	3479	28·3	10·925	11·35	2·9	3·0	529 8	6 7	535 15	,,	Yes	No	Yes	Date, × and III ...	Stronger bush. Fitted for gas-checks.
,, IV	3560 3899	28·3	10·8	11·35	2·9	3·0	527 8	6 12	534 4	,,	Yes	Yes	Yes	Date, × and IV ...	Diameter over bands 10·925 inches.
10-inch, I	To be	broken	up. W.	O. Appl.	24/5/	81.									
,, II	1872 2655	26·3	9·92	10·35	2·8	2·5	393 8	6 14	400 6	Hard	Yes	No	Yes	Date, × and II ...	
,, III	3379	26·3	9·92	10·35	2·8	2·5	393 8	6 14	400 6	Soft	Yes	No	Yes	Date, × and III ...	Stronger bush. Fitted for gas-check.
,, IV	3560 3899	26·3	9·8	10·35	2·8	2·5	391 15	7 4	398 11	,,	Yes	Yes	Yes	Date, × and IV ...	Diameter over bands 9·925 inches.
9-inch, I	To	be broke	n up.	W.O. 24	/5/81.										

TABLE No. 29—*continued.*

PALLISER SHOT (FORMERLY SHELL) (STUDDED), R.M.L., HEAVY GUNS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length in Inches ± ¼ inch per foot, without Gas-check, Plug, or Nut.	Diameters. Body.	Diameters. Studs.	Thickness of Metal. Walls (minimum).	Thickness of Metal. Base.	Approximate Weight, empty, without Gas-checks, Plugs, or Nuts.	Approximate Bursting Charge, Powder, L.G.	Approximate Weight of Filled Shell, without Gas-checks, Plugs, or Nuts.	Studs.	Edge of Bottom, rounded.	Bands round Shoulder and base.	Bodies cast in Sand.	Mark on a Rear Stud. The Date referring to the Manufacture of each individual Shell.	Remarks.
		ins.	ins. ± ·01 to ·015	ins. ± ·005	ins.	ins. ± ·05	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.						
9-inch, II	To be broken up.		W.O. Appl. 24/5.81.												
,, III	1765	21·45	8·92	9·31	...	...	244 2	5 14	250 0	Hard	Yes	Yes	No	Date, × and III.	
,, IV	1872 2655	21·45	8·92	9·31	2·15	2·0	244 3	5 8	249 11	,,	Yes	No	Yes	Date, × and IV.	
,, V	3379	21·45	8·92	9·31	2·15	2·0	244 8	5 8	250 0	Soft	Yes	No	Yes	Date, × and V ...	Stronger bush. Fitted for gas-checks.
,, VI	3560	21·45	8·8	9·31	2·15	2·0	240 15	6 0	246 15	,,	Yes	Yes	Yes	Date, × and VI ...	Diameter over bands 8·925 inches.
8-inch, I*	1387	18·4	7·92 ± ·015	8·31	2·36	1·8	178 0	2 0	180 0	,,	No	No	No	Nil	Small capacity shell.
,, II	-/11/67	19·4	7·92	8·31	...	...	175 10	4 6	180 0	Hard	No	Yes	No	Date and ×.	
,, III	1765	19·6	7·92	8·31	...	...	175 9½	4 6½	180 0	,,	Yes	Yes	No	Date and ×.	
,, IV	1872 2655	19·25	7·92	8·31	1·92	2·0	174 12	4 8	179 4	,,	Yes	No	Yes	Date, × and IV.	
,, V	3560	19·25	7·85	8·31	1·92	2·0	174 12	4 8	179 4	Soft	Yes	Yes	Yes	Date, × and V ...	Diameter over bands 7·925 inches.
7-inch, I	-/11/67	16·4	...	...	...	...	112 8	2 8	115 0	,,	No	Yes	No	Date and ×.	
,, II	1765	16·5	6·92	7·31	...	...	112 8	2 8	115 0	,,	Yes	Yes	No	Date and ×.	
,, III	1872 2655	16·5	6·92	7·31	1·685	1·6	112 1	2 8	114 9	,,	Yes	No	Yes	Date, × and III.	
,, IV	3560	16·5	6·85	7·31	1·685	1·6	112 1	2 10	114 11	,,	Yes	Yes	Yes	Date, × and IV ...	Diameter over bands 6·925 inches.

* Many 9-inch and 8-inch shells of large capacity were made as Mark I, these may be recognised from Mark I small capacity shells by being 1·3 inch and 1·0 inch longer respectively. To facilitate identification Palliser shell with sand cast bodies have their distinguishing numeral stamped on a rear stud in addition to being cast on the base. § 1872. "E" on a rear stud denotes that the base has been tested for porous places; this Mark was discontinued 1/8/72. × and the date on a rear stud has the same signification as in common shell, table, p. 520. On the base of Palliser shell manufactured since 1872, will be found the mark Palr. shell, followed by the calibre, R.L., date, numeral indicating pattern, and letters indicating the nature of iron used. Thus a 10-inch Palliser shell cast on the 1st January would be marked: Palr. shell, 10-inch, R.L., ¼ R.C. 11. The letters R.C. standing for Ridsdale and Cwmbran.

Table No. 30.

Shell, R.M.L., Palliser, Studless.

Calibre.	Mark.	Date of Approval.	§ Changes in War Stores.	Length in inches.	Diameters.		Thickness of Metal.		Bursting Charge. P. and F.G.	Total Weight.	Remarks.
					Body.	Bands.	Walls (minimum).	Base.			
					inches.	inches.	inches.	inches.	lb oz.	lb. oz.	
16-inch	III	1/1/95	8438	43·45	15·88	15·955	3·948	4·0	21 8	1,700 0	For base fuze.
12·5-inch	IV	1/1/95	...	34·45	12·3	12·44	3·2	3·0	10 6	818 0	,, ,,
12-inch, 35-ton											
12-inch, 25-ton	IV	1/1/95	...	29·0	11·8	11·94	3·1	3·0	7 3	614 0	,, ,,
11-inch	IV	1/1/95	8438	30·0	10·88	10·955	2·8	2·85	7 11	548 0	,, ,,
10-inch	IV	1/1/95	8438	27·06	9·88	9·955	2·7	2·7	4 11	410 0	,, ,,
9-inch	IV	1/1/95	8438	21·65	8·87	8·955	2·115	2·5	3 3	256 0	,, ,,

Table No. 31.

Palliser Shot (Studless), R.M.L. Guns.

Calibre and Mark.	§ Changes in War Stores.	Length in Inches, ± 1/5 inch per foot.	Diameters.		Thickness of Metal.		Weight, empty.	Approximate Bursting Charge.	Weight of Gas-check.	Weight of Filled Shell.	Remarks.
			Body.	Bands.	Walls (minimum).	Base.					
		inches.	inches. ± ·03	inches. ± ·01	inches.	inches.	lb. oz. ± 1·5 per cent.	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.	
17·72-inch, Mark I	4374	48·6	17·52	17·66	4·585	4·5	1943 8	32 0	24 0	2000 0	Formerly shell.
16-inch, Mark I	4115	43·7	15·8	15·94	4·14	4·5	1662 12	16 0	21 4	1700 0	Formerly shell.
,, ,, II	5082	43·7	15·8	15·94	4·14	4·5	1662 12	16 0	21 4	1700 0	Formerly shell. Hole in base-plug for eye-bolt.
12·5-inch, Mark I	4116	34·5	12·3	12·44	3·2	3·4	793 11½	8 10	15 10½	818 0	Formerly shell.
,, ,, II	4266	...	12·3	12·44	3·2	2·9	794 2	8 3	15 10½	818 0	Formerly shell; detached base disc.
,, ,, III	5750	33·15	12·3	12·44	...	...	...	...	15 10½	818 0	New pattern shot.
12-inch, 35-ton, Mark I	4141	32·9	11·8	11·94	3·2	3·8	692 6	7 4	14 6	714 0	Formerly shell.
,, ,, ,, II	4266	...	11·8	11·94	3·15	2·75	692 6	7 4	14 6	714 0	Formerly shell; detached base disc.
,, 25-ton, ,, I	4141	29·15	11·8	11·94	3·0	2·75	594 0	5 10	14 6	614 0	Formerly shell.
,, ,, ,, II	4266	...	11·8	11·94	3·0	3·8	594 6	5 4	14 6	614 0	Formerly shell; detached base disc.
,, ,, ,, III	5903	28·0	11·8	11·94	...	...	...	...	14 6	614 0	New pattern shot.
11-inch, Mark I	4141	20·9	10·8	10·94	2·9	3·0	530 13	4 14	12 5	548 0	Formerly shell.
,, ,, II	4266	...	10·8	10·94	2·9	2·6	530 9	5 2	12 5	548 0	Formerly shell; detached base disc.

TABLE No. 31—*continued.*

PALLISER SHOT (STUDLESS), R.M.L. GUNS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length in Inches, ± 1/10-inch per foot.	Diameters.		Thickness of Metal.		Weight, empty.	Approximate Bursting Charge, Shell Powder, L.G.	Weight of Gas-check.	Weight of Filled Shell.	Remarks.
			Body.	Bands.	Walls (minimum).	Base.					
		inches.	inches. ± ·03	inches. ± ·01	inches.	inches.	lb. oz. ± 1·5 per cent.	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.	
11-inch, Mark III	5350	28·85	10·8	10·94	...	...	...	...	12 4	548 0	New pattern shot.
10-inch, Mark I	4141	27·2	9·8	9·94	2·8	3·5	395 0	4 0	11 0	410 0	Formerly shell.
,, ,, II	4266	...	9·8	9·94	2·8	2·5	395 9	3 7	11 0	410 0	Formerly shell; detached base disc.
,, ,, III	6014	26·3	9·8	9·94	...	...	...	...	11 0	410 0	New pattern shot.
9-inch, Mark I	4141	21·35	8·8	8·94	2·1	2·25	243 15	2 11	9 6	256 0	Formerly shell.
,, ,, II	4266	...	8·8	8·94	2·1	2·0	244 3	2 7	9 6	256 0	Formerly shell; detached base disc.
,, ,, III	5750	20·9	8·8	8·94	...	...	...	...	9 6	256 0	New pattern shot. For 9-inch R.M.L. guns, except when on high-angle mountings.
,, heavy, Mark I	5750 6046 6174	27·33	8·8	8·94	...	...	...	...	9 6	360 0	New pattern shot. For guns on high-angle mountings.
6·6-inch, Mark I	4030 4285 5030	16·425	6·55	...	1·5	2·0	94 11½	2 1	3 1	100 0	Lacquered inside.
80-pr., Mark I	4723	15·1	6·25	...	5·475	1·0	86 7½	...	3 8½	90 0	Detached base disc.

Table No. 32.

Palliser Shot (Studded), R.M.L. Heavy Guns.

TABLE

PALLISER SHOT (STUDDED),

Calibre and Mark.	§ Changes in War Stores.	Length, ± 1/6-inch per foot.	Diameters.		Thickness of Metal.		Approximate weight, without Plug, empty, Gas-check, or Nut.	Approximate Capacity for Bursting Charge, Shell Powder, L.G.
			Body.	Studs.	Walls (minimum).	Base.		
		ins.	ins. ± ·01 to ·015	ins. ± ·005	ins.	ins.	lb. oz. ± 1·5 per cent.	lb. oz.
12-inch, 25-ton, Mark I*	1707	26·0	11·92	12·35	4·935	2·3	600 0	...
,, ,, ,, II	1872	26·2	11·92	12·35	4·935	2·3	600 0	...
,, ,, ,, III	2038	28·15	11·925	12·35	3·0	2·85	600 9	...
,, ,, ,, IV	2263	28·15	11·925	12·35	3·0	2·85	596 4	7 12
,, ,, ,, V	3379	28·15	...	12·35	...	...	596 4	7 12
10 inch, Mark I*	1678	24·5	9·92	10·35	3·935	2·3	400 0	...
,, ,, II...	1872	24·5	9·92	10·35	3·935	2·3	400 0	...
,, ,, III...	2039	25 8	9·925	10·35	2·8	2·5	400 0	...
,, ,, IV...	2107	25·8	9·925	10·35	2·8	2·5	400 8	4 0
,, ,, V...	3379	25·8	9·925	10·35	...	...	400 8	4 0
9-inch, Mark I*...	1518	18·8	8·92	9·31	...	...	250 0	...
,, ,, II*...	1765	19·0	8·92	9·31	...	...	250 0	...
,, ,, III†	1872	19·1	8·92	9·31	...	...	250 0	...
,, ,, IV†	...	...	8·92	9·31	...	...	250 0	...
,, ,, V	2222	20·85	8·925	9·31	2·15	2·0	244 8	3 12
,, ,, VI	3379	20·85	8·925	9·31	...	...	244 8	3 12
-inch, Mark I	1518	17·15	7·92	8·31	...	...	180 0	...
,, ,, II	1765	17·39	7 92	8·31	...	...	180 0	...
,, ,, III	1872	17·4	7·92	8·31	...	...	180 0	...
,, ,, IV	2222	18·8	7·925	8·31	1·92	2·0	176 0	2 10
7-inch, Mark I	...	...	...	...	...	Experimental, only		
,, ,, II	1340	14·0	6·92	7·31	...	...	115 0	...
,, ,, III	1518	14·55	6·92	7·31	...	...	115 0	...
,, ,, IV	1765	14·7	6·92	7·31	...	...	115 0	...
,, ,, V	1872	14·7	6·92	7·31	...	...	115 0	...
,, ,, VI	2222	16·1	6·925	7·31	1·685	1·6	112 0	1 10

By § 3560. Palliser shot 12-inch Mark VI, 10-inch Mark VI, 9-inch Mark VII, 8-inch Mark V, 7-inch Mark VII are introduced.

* To be broken up, W.O. Appl. 24/5/81. Those in R.A. charge to be kept as a reserve. W.O. 73/3/4867.

† Take special wrought-iron gas-check plug.

No. 32

R.M.L. Heavy Guns.

Radius of Head.	Studs.	Base rounded off.	Band round Shoulder and Base.	Bodies cast in Sand.	Mark on a Rear Stud, the Date referring to the Manufacture of each individual Shot.	Remarks.
diameter.						
1½	Hard	Yes	Yes	No	Date and × ...	Base closed with a wrought-iron plug swedged into an undercut; requires strengthening plug. § 2040.
1½	,,	,,	No	Yes	Date, ×, and II ...	Base closed with a bush and screw plug of wrought iron. No key-hole in plug.
1½	Soft	,,	,,	,,	Date, ×, and III ...	Do., and enlarged core.
1½	,,	,,	,,	,,	Date, ×, and IV ...	Do., do., and gun-metal plug with keyhole. Red lacquer.
1½	,,	,,	,,	,,	Date, ×, and V ...	Stronger bush in base.
1½	Hard	,,	Yes	No	Date and × ...	Base closed, same as 12-inch, I.
1½	,,	,,	No	Yes	Date, ×, and II ...	,, ,, II.
1½	Soft	,,	,,	,,	Date, ×, and III ...	,, ,, III.
1½	,,	,,	,,	,,	Date, ×, and IV ...	,, ,, IV.
1½	,,	,,	,,	,,	Date, ×, and V ...	,, ,, stronger bush in base.
1¼	Hard	No	Yes	No	Date and ×... ...	Base closed, same as 12-inch, I.
1¼	,,	Yes	,,	,,	Date and ×... ...	
1¼	,,	,,	No	Yes	Date, ×, and III ...	,, ,, II.
1½	...	,,	,,	,,	... ...	,, ,, II.
1½	Soft	,,	,,	,,	Date, ×, and V ...	,, ,, IV.
1½	,,	,,	,,	,,	Date, ×, and VI ...	,, ,, stronger bush in base.
1¼	Hard	No	Yes	No	Date and ×... ...	
1¼	,,	Yes	,,	,,	Date and ×... ...	Base closed, same as 12-inch, I.
1¼	,,	,,	No	Yes	Date, ×, and III ...	,, ,, II.
1½	Soft	,,	,,	,,	Date, ×, and IV ...	,, ,, IV.
a few issues.						
1	Soft	No	No	No	Nil	Solid shot, practice only.
1¼	,,	,,	Yes	,,	Date and ×... ...	Base closed, same as 12 inch, I.
1¼	,,	Yes	,,	,,	Date and ×... ...	,, ,, I.
1¼	,,	,,	No	Yes	Date, ×, and V ...	,, ,, II.
1½	,,	,,	,,	,,	Date, ×, and VI ...	,, ,, IV.

N.B.—The marks on the rear stud are similar to those on the Palliser shell, table p. 523 *et seq.*, and have the same meaning. On the base of Palliser shot manufactured since 1872 will be found the mark, Palliser shot, followed by the calibre, R.L., date, numeral indicating pattern, and letter indicating the nature of iron used. Thus a 10-inch Palliser shot cast on the 1st January would be marked: Palr. shot, 10-in., R.L. ¼. R.C. IV. The letters R.C. standing for Ridsdale and Cwmbran.

Table No. 33.

Shot, R.M.L., Case, 7-inch and Upwards.

Calibre.	Mark.	Para. Changes in War Stores.	Length.	Diameter.	No. of Handles.	Number and Nature of Balls.	Weight of Balls.	Weight of Case, Lining, &c.	Total Weight.	Marks on Top of Case.	Remarks.
			inches	inches			lb. oz.	lb. oz.	lb. oz.		
17·72-inch	I	4377	40·5	17·6	2	1915 8 oz. sand shot 195 4 oz. ,,	1005 11	994 5	2000 0 ±30 lb.	I, † 17·72 inch M.L.	
12·5 inch	I		35·0	12·35	2	828 ,, ,,	414 0	391 0	805 0 ±14 lb.	I, R † L 12·5-inch, M.L.	Top of wrought iron, gas-check on base.
,, ...	II	4049	35·0	12·35	2	828 ,, ,,	414 0	391 0	805 0 ±14 lb.	II ,, ,, ,,	Top of cast iron, two rows of gun-metal studs, two in a row, at base.
,, iron...	III		35·0	12·35	2	828 ,, ,,	414 0	391 0	805 0 ±14 lb.	III ,, ,, ,, iron.	Three gun-metal stops at base.
,, special	IV	8425	38·4	12·38	2	100 chilled iron shot, 3 lb. 9½ oz.	359 6	458 10	818 0 ±3 per cent.	I, R † L, filled chilled iron shot, M.L. 12·5-inch.	White band round body.
12 inch, 25-ton...	I	1777	11·35	11·88	2	255 4 oz. sand shot	127 8	102 8	230 0 ± 5 lb.	I. R † L 12-inch, M.L. ...	Balls packed in coal-dust.
,, 25 or 35-ton	II	2264 2382	11·35	11·88	2	258 ,, ,,	129 0	117 0	246 0 ± 5 lb.	II ,, ,, ,, ...	
,, ,, iron	III	4083	11·35	11·88	2	258 ,, ,,	129 0	117 0	246 0 ± 5 lb.	III ,, ,, ,, iron.	Strengthened method of attaching handles to top.
11-inch	I	2265	10·9	10·88	2	210 ,, ,,	105 0	95 0	200 0 ± 6 lb.	I, R † L, 11-inch, M.L.	
,, ...	II	4083	10·9	10·88	2	210 ,, ,,	105 0	95 0	200 0 ± 6 lb.	II ,, ,. ...	Strengthened method of attaching handles on top.

TABLE No. 33—*continued.*

SHOT, R.M.L., CASE, 7-INCH AND UPWARDS—*continued.*

Calibre.	Mark.	Para. Changes in War Stores.	Length.	Diameter.	No. of handles.	Number and Nature of Balls.	Weight of Balls.	Weight of Case, Linings, &c.	Total Weight.	Marks on Top of Case.	Remarks.
			inches	inches			lb. oz.	lb. oz.	lb. oz.		
11-inch, iron	III	5952	12·1	10·88	2	210 4 oz. sand shot	105 0	95 0	200 0 ± 6 lb.	III, R † L, 11-inch, M.L., iron.	Iron ring instead of disc; loose wrought-iron disc fitting inside segments.
,, special	IV	8425	33·1	10·88	2	72 chilled iron shot, 3 lb. 9½ oz.	257 8	290 8	548 0 ± 3 per cent.	I, R † L, filled chilled iron shot M.L., 11-inch	White band round body.
10-inch	I	1705	9·6	9·88	2	136 ,, ,,	68 0	62 0	130 0 ± 4 lb.	I, R † L 10-inch, M.L....	Balls packed in coal dust.
,, ...	II	2188	9·6	9·88	2	139 ,, ,,	69 8	73 8	143 0 ± 4 lb.	II ,, ,, ...	
,, iron	III	4083	9·6	9·88	2	139 ,, ,,	69 8	73 8	143 0 ± 4 lb.	III, R † L, 10-inch, M.L., iron.	Strengthened method of attaching handles to top.
,, special	IV	8425	30·2	9·88	2	50 chilled iron shot, 3 lb. 9½ oz.	179 11	230 5	410 0 ± 3 per cent.	I, R † L, filled chilled iron shot, M.L., 10-inch	White band round body.
9-inch	I	1241	24·7	8·88	2	87 2 lb. sand shot ...	174 0	16 0	190 0 ±2·85 lb.	I, W † D, 9-inch, M.L.	Balls packed in wood discs.
,, ...	II	1611	9·1	8·88	2	168 8 oz. ,, 50 musket balls 58 pistol balls	68 0	32 0	100 0 ± 3 lb.	II ,, ,,	Balls packed in coal-dust.
,, ...	III	1311	9·1	8·88	2	113 8 oz. sand shot	56 8	43 8	100 0 ± 3 lb.	III, W † D, 9-inch, M.L.	Balls packed in coal-dust.
,, ...	IV	2115	9·1	8·88	2	113 ,, ,,	56 8	50 8	107 0 ± 3 lb.	IV, R † L, 9 inch, M.L.	
,, iron	V	4083	9·1	8·88	2	113 ,, ,,	56 8	50 8	107 0 ± 3 lb.	V, R † L, 9 inch, M.L., iron.	Strengthened method of attaching handles to top.

TABLE No. 33—*continued.*

SHOT, R.M.L., CASE, 7-INCH AND UPWARDS—*continued.*

Calibre.	Mark.	Para. Changes in War Store.	Length.	Diameter.	No. of handles.	Number and Nature of Balls.	Weight of Balls.	Weight of Case, Lining, &c.	Total Weight.	Marks on Top of Case.	Remarks.
			inches	inches			lb. oz.	lb. oz.	lb. oz.		
9-inch, special	VI	8425	23·78	8·885	2	40 chilled iron shot, 3 lb. 9½ oz.	143 14	112 2	256 0 ± 3 per cent.	I, R † L, filled chilled iron shot, M.L., 9-inch	White band round body.
8-inch	I	1611	8·4	7·885	1	75 8 oz. sand shot...	37 8	30 8	68 0 ± 2 lb.	I, W † D, 8-inch, M.L....	Balls packed in coal-dust.
8-inch (gun or howitzer)	II	2188 2742	8·4	7·885	1	75 ,, ,, ...	37 8	36 8	74 0 ±2½ lb.	II, R † L, 8-inch, M.L.	
,, ,, ...	III	4083	8·4	7·885	1	75 ,, ,, ...	37 8	36 8	74 0 ±2½ lb.	III, R † L, 8-inch, M.L. iron.	Strengthened method of attaching handles to top.
7-inch, M.L. or B.L.	I	1241	22·0	6·89	1	87 1 lb. ,, ...	87 0	15 0	102 0 ±1·53lb.	I, W † D, 7-inch, M.L. or B.L.	Balls packed in wood discs.
,, ,, ...	II	1611	10·25	6·89	1	112 6 oz. ,, 23 musket balls 22 pistol balls	42 0	22 14	67 0 ± 2 lb.	II, W † D, 7-inch, M.L.	Balls packed in coal-dust.
,, ,, ...	III	1611	10·25	6·89	1	74 8 oz. sand shot ...	37 0	30 0	67 0 ± 2 lb.	III, W † D, 7-inch, M.L.	Balls packed in coal-dust.
,, ,, ...	IV	2188	10·25	6·89	1	70 ,, ,, ..	35 0	34 0	69 0 ±2½ lb.	IV, R † L, 7-inch, M.L.	
,, ,, ...	V	2924	10·25	6·89	1	71 ,, ,, ...	35 8	32 10½	68 2½ ±2½ lb.	V, R † L, 7-inch, M.L....	Case of tin in three pieces, ring at bottom.
,, ,, ...	VI	4083	10·25	6·89	1	71 ,, ,, ..	35 8	32 10½	68 2½ ±2½ lb.	VI, R † L, 7-inch, M.L., iron.	Strengthened method of attaching handles to top.

TABLE No. 34.

COMMON SHELL, STUDLESS, R.M.L., HEAVY GUNS.

Calibre and Mark.	§ Changes in War Stores.	Length over Gas-check ± ⅛ inch per foot.	Diameters.		Thickness of Metal.			Weight, empty.		Approximate Bursting Charge, Shell Powder, P. Mixture.		Weight of Gas-check.		Weight of filled Shell, Limits of Error ± 1·5 per cent.		Remarks.
			Body.	Bands.	Walls. Body.	Walls. Bottom.	Base.									
		inches.	inches. ± 0·3	inches. ± 0·015	inches.	inches.	inches.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	
17·72-inch, iron, Mark I ...	4374	48·6	17·52	17·66	3·63	4·16	4·5	1897	8	106	0	24	0	2000	0	
,, cast steel, Mark II ...	7979	52·55	...	17·66	2·66	2·66	3·5	1781	9	194	0½	24	0	2000	0	
16-inch, iron, Mark I	4115	48·55	15·8	15·94	3·766	4·0	4·5	1618	12	75	6	21	4	1700	0	
,, ,, ,, II	5082	48·55	15·8	15·94	3·766	4·0	4·5	1618	12	75	6	21	4	1700	0	Hole in base-plug for eye-bolt.
,, pointed, Mark I... ...	10360	50·826	15·75	15·955	3·0	3·0	3·5	1563	8	112	12	21	4	1700	0	Cast steel for large base fuze.
12·6-inch, iron, Mark I	4116	39·7	12·3	12·44	2·75	3·2	3·4	769	5½	37	8	15	10½	818	0	
,, cast steel, Mark II ...	7287	44·95	12·3	12·44	1·73	1·73	2·5	706	4	95	8	15	14	818	0	
,, ,, ,, III ...	8563	43·65	12·3	12·44	1·83	1·83	2·5	716	11	88	1	15	14	818	0	
,, pointed, Mark I ...	8576	42·95	12·3	12·44	1·8	2·25	3·0	716	8	75	4	15	14	818	0	Cast steel. Large adapter.
,, ,, ,, II ...	10360	41·41	12·25	12·455	1·9	2·45	3·5	736	9	63	1	15	14	818	0	For large base fuze.
12-inch, 35-ton, iron, Mark I ...	4141	37·15	11·8	11·94	2·6	3·1	3·25	672	6	34	10	14	6	714	0	
,, 25-ton, iron, Mark I ...	4141	32·65	11·8	11·94	2·59	3·0	3·25	576	4	28	2	14	6	614	0	
,, ,, cast steel, Mark II.	7520	35·95	11·8	11·94	1·69	1·72	2·5	535	13	63	6½	14	6	614	0	
,, pointed, Mark I ...	10360	36·85	11·75	11·955	1·69	1·75	2·65	539	3	57	15	14	6	614	0	Cast steel for large base fuze.
11-inch, iron, Mark I	4141	33·95	10·8	10·94	2·35	2·75	3·0	513	11	27	0	12	5	548	0	
,, cast steel, Mark II ...	7287	38·65	10·8	10·94	1·475	1·475	2·5	469	8	65	8	12	10	548	0	
,, ,, ,, III ...	8563	37·77	10·8	10·94	1·575	1·575	2·5	473	12	61	10	12	10	548	0	
,, pointed, Mark I ...	10360	35·8	10·75	10·955	1·545	1·85	2·75	492	7	40	7	12	10	548	0	Cast steel for large base fuze.

TABLE No. 34—*continued.*

COMMON SHELL, STUDLESS, R.M.L., HEAVY GUNS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length over Gas-check ± 1/8 inch per foot.	Diameters.		Thickness of Metal.			Weight, empty.	Approximate Bursting Charge, Shell Powder, P. Mixture.	Weight of Gas-check.	Weight of filled Shell, Limits of Error ± 1·5 per cent.	Remarks.
			Body.	Bands.	Walls. Body.	Walls. Bottom.	Base.					
		inches.	inches. ± 0·3	inches. ± 0·015	inches.	inches.	inches.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
10-inch, iron, Mark I	4141	32·0	9·8	9·94	2·0	2·5	2·8	379 7	23 8	11 0	410 0	
,, cast steel, Mark II ...	7287	34·95	9·8	9·94	1·35	1·35	2·25	350 10	48 0	11 0	410 0	
,, ,, ,, III ...	8563	34·33	9·8	9·94	1·45	1·45	2·25	352 10	46 0	11 0	410 0	
,, pointed, Mark I ...	10360	32·905	9·75	9·955	1·42	1·5	2·4	365 6	31 2	11 0	410 0	For large base fuze.
,, iron, Mark I	9726	31·84	9·75	9·955	1·5	1·6	2·0	374 11½	19 14	11 0	406 0	Practice guns on H.A. mountings.
9-inch, iron, Mark I	4141 / 7287	25·95	8·8	8·94	1·65	2·0	2·25	232 2	17 0	9 6	256 0	
,, cast steel, Mark II ...	5537	27·0	8·8	8·94	1·2	1·2	1·8	216 0	27 12	9 6	256 0	
,, heavy, pointed, Mark I	7426	33·2	8·8	8·94	1·475	1·475	2·25	321 0½	24 8	9 3	360 0	Cast steel.
,, light, pointed, Mark I ...	10360	27·64	8·76	8·955	1·2	1·3	2·25	220 10	23 14	9 0	256 0	For large base fuze.
8-inch, pointed, Mark I	8576	24·85	7·81	7·95	1·05	1·1	2·0	149 2½	18 8	7 6	180 0	Cast steel. Small adapter.

Table No. 35.

Shell, R.M.L., Shrapnel, Studless, 9-inch and Upwards.

Calibre and Mark.	§ Changes in War Stores.	Length. ± ¹⁄₁₀ inch per foot.	Diameters.		Thickness of Metal.			Number and Nature of Balls.	Percentage of useful Weight.	Weight of Shell, empty.	Weight of Bursting Charge, Pistol F.G., R.F.G. Powder.	Weight of Gas check.	Total Weight, filled.	Remarks.
			Body.	Bands.	Walls. Top.	Walls. Bottom.	Base.							
		ins.	ins. ±·03	ins. ±·015	ins.	ins.	ins.			lb. oz. ± 1·5 per cent.	lb. oz.	lb. oz.	lb. oz.	
17·72-inch, Mark I	4374	45·0	17·52	17·66	4·01	4·26	4·5	920 4 oz. sand shot	11·5	1971 0	5 0	24 0	2000 0	To become obsolete when used up. § 7730.
16-inch, Mark I	4115	47·5	15·8	15·94	3·745	3·962	4·5	860 ,, ,,	12·6	1674 9	4 3	21 4	1700 0	To become obsolete for L.S. § 7730.
,, ,, II	5082	47·5	15·8	15·94	3·745	3·962	4·5	860 ,, ,,	12·6	1674 9	4 3	21 4	1700 0	Hole in base-plug for eye-bolt.
12·5-inch, iron, Mark I	4116	37·5	12·3	12·44	3·227	3·275	3·4	296 ,, ,,	9·0	799 14½	2 7	15 10½	818 0	
,, cast steel, Mark II	7287	39·0	12·3	12·44	1·7	1·7	2·5	775 ,, ,,	23·5	526 12	4 0	15 14	818 0	
12-inch, 35-ton, iron, Mark I	4338	35·5	11·8	11·94	2·86	2·9	3·3	322 ,, ,,	11·3	697 9½	2 0½	14 6	714 0	
12-inch, 25-ton, iron, Mark I	4338	32·45	11·8	11·94	2·68	2·72	3·3	288 ,, ,,	11·7	597 10	2 0	14 6	614 0	
,, ,, cast steel, Mark II	7287	32·6	11·8	11·94	1·55	1·55	2·1	608 ,, ,,	24·4	595 14	2 8	14 6	614 0	
11-inch, iron, Mark I	4267	32·45	10·8	10·94	2·6	2·65	3·0	244 ,, ,,	11·1	533 10½	2 0½	12 5	548 0	
,, cast steel, Mark II	7287	33·0	10·8	10·94	1·475	1·475	2·0	508 ,, ,,	23·1	531 15	2 10	12 10	548 0	
10-inch, iron, Mark I	4267	30·55	9·8	9·94	2·129	2·2	2·5	210 ,, ,,	12·8	397 6	1 10	11 0	410 0	
,, cast steel, Mark II	7287	30·7	9·8	9·94	1·325	1·325	1·75	390 ,, ,,	23·7	396 3	2 0	11 0	410 0	
9-inch, iron, Mark I	7287	24·45	8·8	8·94	1·8	1·8	2·25	292 2 oz. ,,	11·1	245 5	1 5	9 6	256 0	
,, cast steel, Mark II	5537	24·95	8·8	8·94	1·05	1·05	1·4	532 ,, ,,	25·9	234 0	1 5	9 6	256 0	

TABLE No. 35—*continued.*

SHELL, R.M.L., COMMON, MEDIUM, AND SIEGE GUNS, AND HOWITZERS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length without Gas-check ± 1·5 inch per foot.	Diameter, over.			Thickness of Metal.			Weight, empty, without Gas-check, &c.	Approximate Bursting Charge, Shell L.G.	Total Weight of Filled Shell.	No. of Studs in a Ring or Projections on Gas-check.	No. of Serrations or Grooves on Base for Gas-check.	Remarks.
			Body.	Studs or Projections on Gas checks.	Bands.	Walls. Top.	Walls. Bottom.	Base.						
		ins.	ins.	ins.	ins.	ins.	ins.	ins.	lb. oz. ± 1·5 per cent.	lb. oz.	lb. oz. ± 1·5 per cent.			
8-inch howitzer, studless, Mark I ...	4031	24·15	7·85	8·05	7·95	1·295	1·395	2·15	159 14	13 10	173 8	24	37	Head struck to radius of 1½ diameters. Hole through base closed by gun-metal plug.
8-inch howitzer, studless, Mark II ...	5395	24·25	7·85	8·05	7·95	1·295	1·395	2·15	159 14	*20 2	180 0	24	37	Gun-metal bush extended over nose.
8-inch howitzer, studless, Mark III ...	5465	26·8	7·85	8·05	7·95	·875	·875	1·8	145 7	*26 8	180 0	...	...	Cast steel.
8-inch howitzer of 46 cwt., studded, Mark I.	2539	24·17	7·92	8·31	...	1·335	1·335	2·0	166 0	14 8	180 8	4	...	Converted to take gas-check. Hole in base 1·65 inches deep.
8-inch howitzer of 46 cwt., studded, Mark II.	3380	24·17	7·92	8·31	...	1·335	1·335	2·0	165 3½	15 2	180 5½	4	...	Fitted for gas-check. Hole through base.
6·6-inch gun and howitzer, Mark I ...	4030	17·90	6·45	6·65	6·55	1·15	1·3	2·0	91 1½	5 9	96 10½	20	32	Hole through base closed by gun-metal plug.
6·6-inch gun and howitzer, Mark II ...	5370	17·90	6·45	6·65	6·55	1·15	1·3	2·0	91 2	*6 9	98 11½	20	32	Gun-metal bush extended over nose.
6·3-inch howitzer, Mark I	3285	16·0	6·25	6·46	...	·775	·775	1·1	59 7	7 2	66 9	20	8	
,, ,, ,, II	5370	16·0	6·25	6·46	...	·775	·775	1·1	60 7½	*8 8	69 11½	20	8	Gun-metal bush extended over nose.
80-pr., studded, Mark I...	2278	19·0	6·22	6·53	...	·75	·9	1·5	71 1	8 10	79 11	3	...	
,, ,, ,, II...	3366	19·0	6·22	6·53	...	·75	·9	1·5	71 1	8 10	79 11	3	...	Mark II cast to gauge.
,, ,, ,, III...	5370	19·0	6·22	6·53	...	·75	·9	1·5	71 1	*11 11	82 12	3	...	Mark III cast to gauge. Gun-metal bush extended over nose.

* P. and F.G. mixture.

TABLE No. 35—*continued.*

SHELL, R.M.L., COMMON, MEDIUM, AND SIEGE GUNS, AND HOWITZERS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length without Gas-check ± 1/10 inch per foot.	Diameter, over			Thickness of Metal.			Weight, empty, without Gas-check, &c.	Approximate Bursting Charge, Shell, L.G.	Total weight of Filled Shell.	No. of Studs in a Ring, or Projections on Gas-check.	No. of Serrations or Grooves on Base for Gas-check.	Remarks.
			Body.	Studs or Projections on Gas-checks.	Bands.	Walls. Top.	Walls. Bottom.	Base.						
		ins.	ins.	ins.	ins.	ins.	ins.	ins.	lb. oz. ±1·5 per cent.	lb. oz.	lb. oz. ±1·5 per cent			
80-pr., studless, Mark I	4761	19·75	6·25	6·53	...	1·0	1·0	1·5	77 2½	9 5	86 7½	3	32	
,, ,, ,, II	5644	19·4	6·25	6·53	...	1·0	1·0	1·5	77 5½	*9 2	86 10½	3	32	
64-pr., Mark I	1042	14·71	6·22	6·47	...	·76	·76	1·3	59 8	4 8	64 0	3	...	Moorsom gauge. Black lacquer. Issued for practice only. Requires adapter.
,, ,, II	1393	16·0	6·22	6·47	...	·76	·76	1·3	57 9	7 0	64 9	3	...	Moorsom gauge. Three rings of studs instead of five. Requires adapter.
,, ,, III	1394	16·0	6·22	6·47	...	·76	·76	1·3	57 9	7 0	64 9	3	...	G.S. bush, countersunk ·2-inch.
,, ,, IV	1768	16·0	6·22	6·47	...	·76	·76	1·3	56 14	7 2	64 0	3	...	Unloading hole, afterwards discontinued.
,, ,, V	3172	16·0	6·22	6·47	...	·76	·76	1·3	57 6	7 2	64 8	3	...	Cast to gauge.
,, ,, VI	5370	16·0	6·22	6·47	...	·76	·76	1·3	57 6	*8 8	67 2	3	...	Gun-metal bush extended over nose.
,, ,, VII	9348	16·0	6·25	6·5	...	·76	·76	1·3	58 2	8 8	67 8	3	...	Gun-metal bush extended over nose.
40-pr. ,, I	2603	13·53	4·69	4·93	...	·80	·80	1·2	35 9½	2 8	38 1½	3	...	Bushed, but bush not countersunk. Altered to take gas-check
,, ,, II	3382	13·53	4·69	4·93	...	·80	·80	1·2	35 12	*3 0	38 4	3	...	Bushed, but bush not countersunk. Cast to gauge. Fitted to take a gas-check.
,, ,, III	5370	13·53	4·69	4·93	...	·80	·80	1·2	35 12	*3 6	39 2½	3	...	Gun-metal bush extended over nose, and countersunk.
25-pr. ,, I	2725	12·85	3·94	4·18	...	·69	·69	·95	23 3½	1 12	24 15½	3	...	Unbushed.
,, ,, II	3366	12·85	3·94	4·18	...	·69	·69	·95	23 3½	*1 13½	24 15½	3	...	Unbushed. Cast to gauge.

* P. and F.G. mixtures.

TABLE No. 36.

SHELL, R.M.L., SHRAPNEL, MEDIUM GUNS AND HOWITZERS.

Calibre and Mark.	§ Charges in War Stores.	Length ± 1/10 inch per foot.	Diameters.		Thickness of Metal.			Number and Nature of Balls, 4 parts lead, 1 part antimony.	Percentage of useful Weight.	Weight of Shell, empty.	Weight of Bursting Charge, Pistol, R.F.G., or F.G. Powder.	Number of Rings of Studs.	Total Weight.	Remarks.
			Body.	Studs.	Walls. Top.	Walls. Bottom.	Base.							
		ins.	ins. ± ·01	ins. ± ·005	ins.	ins.	ins.			lb. oz.	lb. oz.		lb. oz.	
80-pr., studded, Mark I ...	2379	15·8	6·22	6·53	·8	·9	1·0	288, 14 per lb.	26·2	77 7	0 9	2	78 0	
,, ,, ,, II ...	2491	15·13	6·22	6·53	·8	·9	1·0	,, ,, ,,	26·2	77 6	0 9	2	78 0	Flush socket.
,, ,, ,, III ...	2878	15·13	6·22	6·53	·8	·9	1·0	,, ,, ,,	26·2	77 6	0 9	2	78 0	Improved form of head.
,, ,, ,, IV ...	3366	15·5	6·22	6·53	·8	·9	1·0	,, ,, ,,	25·9	78 10	0 9	2	79 3	Cast to gauge, grooves in base only.
,, studless ,, I ...	4761	16·7	6·25	6·53	·885	·9	1·4	304 ,, ,,	26·2	89 6	0 10	nil	90 0	
6·6-inch gun, Mark I ...	4339	17·035	6·45	6·55	1·005	1·05	1·6	318 ,, ,,	22·71	96 3½	0 11½	nil	100 0	
64-pr, Mark II	1609	14·02	6·22	6·47	·76	·81	·9	234 ,, ,,	25·8	64 3	0 5	3	64 8	
,, ,, III	2209	14·02	6·22	6·47	·76	·81	·9	,, ,, ,,	25·8	64 7	0 9	3	65 0	Metal socket, larger tube diaphragm and cup coned.
,, ,, IV	2491	13·55	6·22	6·47	·76	·81	·9	,, ,, ,,	25·8	65 10	0 9	3	66 3	Flush socket.
,, ,, V	2852	13·72	6·22	6·47	·76	·81	·9	,, ,, ,,	25·1	66 0	0 9	3	66 9	Improved form of head.
,, ,, VI	3172	13·72	6·22	6·47	·76	·86	·9	,, ,, ,,	25·1	66 0	0 9	3	66 9	Cast to gauge.
,, ,, VII	3717	13·72	6·22	6·47	·76	·86	·9	,, ,, ,,	25·1	66 0	0 9	3	66 9	Grooves in base only.
,, ,, VIII	9348	13·834	6·26	6·505	...	·85	·9	,, ,, ,,	25·1	66 14	0 9	3	67 7	
40-pr., ,, II	3172	13·03	4·69	4·93	·69	·69	·9	180 at 18 per lb.... ...	43·1	41 9	0 4½	2	41 13½	Cast to gauge, no internal grooves, gun-metal tube, and composite socket.
,, ,, III	3383	13·03	4·69	4·93	·69	·69	·9	,, ,, ,, ...	24·0	41 8	0 4½	2	41 12½	Fitted for gas-check.
25-pr., ,, I	2526	11·4	3·94	4·18	·50	·50	·65	45 at 34, and 113 at 20 per lb.	27·6	25 0	0 3	2	25 3	Flush socket.
,, ,, II	3172	11·4	3·94	4·18	·50	·50	·65	,, ,, ,, ...	27·6	25 0	0 3	2	25 3	Cast to gauge, no internal grooves.
Howitzers.				Bands										
8-inch, Mark I	5389	20·15	7·85	7·95	1·0	1·0	1·65	540, 14 per lb.	21·39	170 0	2 0	...	180 0	Cast steel large powder chamber lacquered, base plug.
6·6-inch, Mark I	5413	16·7	6·45	...	·775 / ·875	1·6	1·35	238 ,, ...	17·0	94 6½	1 5½	...	100 0	
6·3-inch, ,, I	5413	13·0	6·25	...	·75 / ·85	1·5	1·3	140 ,, ...	14·28	65 13¾	0 15½	...	70 0	

TABLE No. 37.

SHOT, R.M.L., CASE, MEDIUM GUNS AND HOWITZER.

Calibre and Mark.	§Changes in War Stores.	Length in inches.	Diameter, inches.	Number and Nature of Balls.	Approximate Weight of Balls.	Approximate Weight of Case, Linings, Clay, and Sand, &c.	Total Weight.	Remarks.
					lb. oz.	lb. oz.	lb. oz.	
8-inch howitzer	Same as that for 8-inch gun, *see* p. 534.							
6·6-inch gun or howitzer ...	4287	17·4	6·5	224 4-oz. sand shot	56 0	44 0	100 0 ± 3 lb.	
6·3-inch howitzer	Same as 64 or 80-pr. Mark V, which *see* below.							
64-pr., Mark I	1611	9·6 ± ·1	6·2 ± ·03	56 8-oz. ,, ...	27 6	20 10	48 0 ± 1½ lb.	Balls packed in coal-dust.
64-pr. or 80-pr., Mark II ...	2188 2266	9·6 ± ·1	6·2 ± ·03	49 ,, ,, ...	24 8	26 8	51 0 ± 2 lb.	
,, ,, ,, III ...	2716	9·55 ± ·1	6·2 ± ·03	51 ,, ,, ...	25 8	25 0½	50 8½ ± 1½ lb.	Outer case of tin in three segments soldered together.
,, ,, ,, IV ...	2925	9·6 ± ·1	6·2 ± ·03	50 ,, ,, ...	25 0	24 14½	49 14½ ± 2 lb.	Outer case of tin in three segments soldered together. Inside lining of six segments.*
64-pr., 80-pr., or 6·3-inch howitzer V.	4083	9·6 ± ·1	6·2 ± ·03	50 ,, ,, ...	25 0	24 14½	49 14½ ± 2 lb.	Stronger method of attaching handles.
40-pr. Mark I	2479	9·75	4·69 ± ·025	405 mixed metal balls, 16½ per lb.†	24 8	13 14	38 6 ± 1 lb.	
,, ,, I	4083	9·75	4·69 ± ·025	,, ,, ,,	24 8	13 14	38 6 ± 1 lb.	Stronger method of attaching handles.
25-pr. Mark I	2675	9·75	3·94 ± ·02	245 mixed metal balls, 16½ per lb.†	14 14	9 6	24 4 ± 12 oz.	
,, ,, II	4083	9·75	3·94 ± ·02	,, ,, ,,	14 14	9 6	24 4 ± 12 oz.	Stronger method of attaching handles.

In future the high gauge for the diameter of case shot will be the same as that for common and shrapnel shells, while the limit between the high and low gauges will be as follows: 8-inch, ·08-inch, 80-pr. ·06-inch, 64-pr. ·06 inch, 40-pr. ·04-inch, 25-pr. ·03-inch, § 2971.

* Tin plate is now used instead of tinned iron. No change in pattern. † 4 of lead to 1 of antimony. For future manufacture 16 per lb.

Each shot has stamped on the top of the case its numeral and the ordnance for which it is intended.

TABLE No. 38.

SHELL, R.M.L., COMMON, DOUBLE, AND RING; FIELD AND MOUNTAIN GUNS, AND HOWITZERS.

Calibre and Mark.	§ Changes in War Stores.	Length ± 1/16 inch per foot.	Diameters.		Thickness of Metal.		Weight empty, ± 1·5 per cent.	Approximate Bursting Charge, Shell, Powder, L.G.	Weight of Filled Shell.	Remarks.
			Body.	Studs.	Walls.	Base.				
			ins. ± ·01	ins. ± ·005	ins.	ins. ± ·05	lb. oz.	lb. oz.	lb. oz. ± 1·5 per cent.	
16-pr., Mark I	2190	10·0	3·54	3·8	0·6	0·86	15 1	1 0	16 1	
16-pr., ,, II	2853	10·0	3·54	3·8	0·6	0·86	14 15½	1 0	15 15½	Cast to gauge.
16-pr., ,, III	3420	10·0	3·54	3·8	0·6	0·86	14 15½	1 2†	16 1½	
13-pr., ,, I	4060	10·57	2·97	2·97*	0·6	1·25	12 0	0 11†	12 10	Gas-checks 6 oz.
9-pr., ,, I	1921	7·93	2·94	3·2	0·55	0·6	8 8	0 8	9 0	
9-pr., ,, II	2104	7·93	2·94	3·2	0·55	0·6	8 9½	0 8	9 1½	
9-pr., ,, III	2744	7·93	2·94	3·2	0·55	0·6	8 9½	0 7½	9 1	Copper studs.
9-pr., ,, IV	2853	7·93	2·94	3·2	0·55	0·6	8 7½	0 7½	8 14½	
9-pr., ,, V	3172	7·93	2·94	3·2	0·55	0·6	8 7½	0 8½†	8 14½	Cast to gauge.
7-pr., ,, I	1153	6·75	2·94	3·17	0·5	0·5	6 14	0 7	7 5	Fuze-hole ordered to be altered to G.S. gauge, § 2097.
7-pr., ,, II	2097	6·75	2·94	3·17	0·5	0·5	6 15½	0 7	7 6½	Copper studs.
7-pr., ,, III	2744	6·75	2·94	3·17	0·5	0·5	6 14½	0 6½	7 4½	Cast to gauge.
7-pr., ,, IV	3366	6·75	2·94	3·17	0·5	0·5	6 14	0 7½†	7 4½	
7-pr., double, Mark II	1779	11·25	2·94	3·17	0·5	0·5	11 0	0 15	11 15	Fuze-hole ordered to be altered to G.S. gauge, § 2097.
7-pr., ,, ,, III	2097	11·25	2·94	3·17	0·5	0·5	11 2½	0 15	12 1½	Copper studs.
7-pr., ,, ,, IV	2744	11·55	2·94	3·17	0·5	0·5	11 2½	0 15	12 1½	Cast to gauge.
7-pr., ,, ,, V	3366	11·25	2·94	3·17	0·5	0·5	11 4½	0 14½†	12 3½	
2·5-inch, Mark I	{3800 4649}	7·925	2·47	2·47*	0·55	0·75	6 7½	0 4	6 11½	To become obsolete.
2·5-inch, ,, II	5031	7·925	2·47	2·47	0·55	0·75	6 10	0 4	7 10	Mark II gas-checks 6-oz. Fuze 6 oz. Fuze-hole deeper. To become obsolete.
2·5-inch, Ring, I	6748	8·1	2·47	2·57	0·385	0·84	6 9½	0 4	7 10	

7-pr., double shell, Mark I, obsolete. * Over gas-check. † P. mixture.

Table No. 39.

Shell, R.M.L., Shrapnel, Field and Mountain Guns.

Calibre and Mark.	§ Changes in War Stores.	Length ± 1/10 inch per foot.	Thickness of Metal. Walls. Top.	Walls. Bottom.	Base.	No. and Nature of Balls, 4 lead to 1 antimony.	Percentage of Useful Weight.	Weight of Shell empty.	Weight of Bursting Charge, Pistol, F.G., or R.F.G.	Remarks.
		ins.	ins.	ins.	ins.			lb. oz. ± 1·5 p.c.	lb. oz.	
16-pr. Mark I	2189	10	·38	·4	·58	To be broken up, 10/11/73.				
16-pr. ,, II	2898	10	·45	·45	·58	72, lead and antimony, 18 per lb. ... / 56 ,, ,, 84 ,, ...	26·2	17 13	0 1½	No internal grooves.
16-pr. ,, III	2898	10	·45	·45	·58	72 ,, ,, 18 ,, ... / 56 ,, ,, 84 ,, ...	26·2	17 13	0 1½	Copper studs, no internal grooves, and cast to gauge.
13-pr. Mark I	4060	10·1	·36	·375	1·28	116 ,, ,, 34 ,, ...	33·4	12 9	0 0¾	
13-pr. ,, II	5050	10·17	·25	·25	·45	133 ,, ,, 34 ,, ...	22·12	12 6½	0 0¾	Forged steel.
9-pr. Mark I	1921	7·93	·345	·37	·45	To be broken up.				
9-pr. ,, II	2104	7·93	·345	·37	·45	To be broken up.				
9-pr. ,, III	2210	7·93	·345	·37	·45	28, lead and antimony, 18 per lb. ... / 35 ,, ,, 34 ,, ...	28·0	9 4	0 0¾	Junction of head and body stronger, and secured by screw rivets as well as by plain rivets.
9-pr. ,, IV	2525	7·93	·345	·37	·45	28 ,, ,, 18 ,, ... / 35 ,, ,, 34 ,, ...	28·0	9 4	0 0¾	Flush socket.
9-pr. ,, V	2625	7·93	·375	·375	·45	28 ,, ,, 18 ,, ... / 35 ,, ,, 34 ,, ...	26·6	9 12	0 0¾	Flush socket. No internal grooves (except in powder chamber).

N.B.—For diameters, *see* Table of Common Shell.

TABLE No. 39—*continued.*

SHELL, R.M.L., SHRAPNEL, FIELD AND MOUNTAIN GUNS—*continued.*

Calibre and Mark.	§ Changes in War Stores.	Length ± 1/10 inch per foot.	Thickness of Metal. Walls. Top.	Walls. Bottom.	Base.	No. and Nature of Balls.	Percentage of Useful Weight.	Weight of Shell empty.	Weight of Bursting Charge, Pistol F.G., or R.F.G.	Remarks.
		ins.	ins.	ins.	ins.			lb. oz. ± 1·5 p.c.	lb. oz.	
9-pr. Mark VI	2744	7·93	·375	·375	·45	28, lead and antimony, 18 per lb. ... ... 35 ,, ,, ,, 34 ,, ...	26·6	9 12	0 0½	Copper studs.
9-pr. ,, VII	2853	7·93	·375	·375	·45	,, ,, ,, ,, ,, ...	26·6	9 12	0 0½	Studs reduced in width.
9-pr. ,, VIII	3172	7·93	·375	·375	·45	,, ,, ,, ,, ,, ...	26·6	9 12	0 0½	Cast to gauge.
7-pr. ,, II	1600	6·5	·315	·37	·45	21 ,, ,, 18 ,, ... 21 ,, ,, 34 ,, ...	24·0	7 5	0 0½	
7-pr. ,, III	2097	6·5	·345	·37	·45	,, ,, ,, ,, ,, ...	24·0	7 5	0 0½	Fuze-hole, G.S. gauge.
7-pr. ,, IV	2210	6·5	·345	·37	·45	,, ,, ,, ,, ,, ...	24·0	7 5	0 0½	Junction of head and body stronger, and secured by screw rivets as well as by plain rivets, centre tube of gun-metal.
7-pr. ,, V	2577	6·5	·345	·37	·45	,, ,, ,, ,, ,, ...	23·7	7 8½	0 0½	Flush socket.
7-pr. ,, VI	2744	6·5	·345	·37	·45	,, ,, ,, ,, ,, ...	23·5	7 9½	0 0½	Copper studs.
7-pr. ,, VII	3366	6·5	·345	·37	·45	,, ,, ,, ,, ,, ...	23·4	7 10½	0 0½	Cast to gauge.
2·5-in. ,, I	4142	6·96	·1875	...	·5	21 ,, ,, 18 ,, ... 98 ,, ,, 35 ,, ..	41·2	6 15½	0 0½	Steel body. Bursting charge in cylindrical shalloon bag.
2·5-in. ,, I*	4142	A few supplied by contract.								
2·5-in. ,, II	4142	6·96	·1875	...	·5	100 ,, ,, 35 ,, ... 70 buckshot and 10 segments ...	45·4	6 15½	0 0½	
2·5-in. ,, III	5031	6·96	·1875	...	·5	100 mixed metal balls, 35 per lb. ... 11 buckshot, 220 per lb. ... ... 10 cast-iron segments	45·4	6 9½	0 0½	Mark II gas-check 6 oz., fuze 13¾ oz.
2·5-in. ,, IV	8972	6·96	·18	·18	·5	101 mixed metal, 35 per lb.	37·9	6 12½	0 0½	Total weight filled and fuzed, 7 lb. 10 oz.

A few Mark II 9-pr. and Mark III 7-pr. shell have been made and issued which have the junction of head and body stronger, and some with all the improvements; these are distinguished by one small star (*) or two small stars (**) on the studs. 7-pr., Mark I (§ 1392), is unserviceable, and is broken up on return to Woolwich.

TABLE No. 40.

SHOT, R.M.L., CASE, FIELD AND MOUNTAIN GUNS.

Calibre and Mark.	§ Changes in War Stores.	Length.	Diameter ⊥ ·03.	No. and Nature of Balls.	Approximate Weight of Balls.	Approximate Weight of Case Linings, Clay, and Sand, &c.	Total Weight.	Remarks.
		inches	inches		lb. oz.	lb. oz.	lb. oz.	
16-pr., Mark I	2279	7·1	3·54	176, lead and antimony, 16 per lb.	10 9	4 10	15 3 ± 8 oz.	
,, ,, II	7570	7·5	3·54	,, ,, ,,	10 9	4 10	15 3	Fitted with handle.
13-pr., ,, I	4060	9·0	2·96	340, lead and antimony, 34 per lb.	10 1½	3 6	13 7½ ± 6 oz.	
,, ,, II	7570	9·4	2·96	,, ,, ,,	10 1½	3 6	13 7½	Fitted with handle.
9-pr., ,, I	1921	7·4	2·94	110, lead and antimony, 16 per lb.	6 12	3 0	9 12 ± 4 oz.	Balls packed in equal parts of resin and sand.
,, ,, II	2060	7·4	2·94	108, lead and antimony, 16 per lb.	6 11	3 2½	9 13½ ± 6 oz.	Outer case in three parts, ring at bottom instead of a disc.
,, ,, III	2104	7·4	2·94	,, ,, ,,	6 11	3 2½	9 13½ ± 6 oz.	Knob removed.
,, ,, IV	2802	7·4	2·94	,, ,, ,,	6 9½	3 1	9 10½ ± 6 oz.	Iron ring, disc, and segments, instead of zinc.
,, ,, V	7570	7·8	2·94	,, ,, ,,	6 9½	3 1	9 10½	Fitted with handle.
7-pr., ,, I	1153	5·6	2·94	48, lead and antimony, 8 per lb.	6 0	1 8	7 8 ±2½ oz.	Balls loose.
,, ,, II	1468	5·2	2·94	36, 1½ oz. sand shot	3 6½	1 13½	5 4 ± 4 oz.	Balls packed in coal dust.
,, ,, III	1814	4·7	2·94	82, 1 oz. lead and antimony.	5 4	1 10	6 14 ± 4 oz.	,, ,, ,,
,, ,, IV	2280	4·7	2·94	70, lead and antimony, 16 per lb.	4 4	2 0	6 4 ± 4 oz.	Outer case in three parts. Ring at bottom.
,, ,, V	5990	4·7	2·94	,, ,, ,,	4 4	2 0	6 4 ± 4 oz.	Loose base disc fitting inside segments.
,, ,, VI	7570	5·1	2·94	,, ,, ,,	4 3½	2 2	6 5½	Fitted with handle.
2·5-inch, Mark I	3801 / 4649	6·6	2·46	159, lead and antimony, 34 per lb.	4 12½	1 15½	6 12 ± 4 oz.	
,, ,, II	7570	7·0	2·46	,, ,, ,,	4 12½	1 15½	6 12	Fitted with handle.

§ 8180. 16-pr. Mark I; 13-pr. Mark I; 9-pr Marks IV and V, and 2·5″ Mark I when fitted with a handle have a * added to the numeral.

Table No. 41.

Shell, R.B.L., Common.

Calibre and Mark.	§Changes in War Stores.	Length.	Weight, empty.	Approximate Bursting Charge, Shell Powder, L.G.	Gauge of Fuze-Hole.	Attachment of Lead Coat.	Remarks.
		inches	lb. oz.	lb. oz.			
7-inch (no Mark)	211	18·73	95 14 ± 2 lb.	7 10	Moorsom*	Tin	Black lacquer.
,, ,, ...	405	18·75	97 15 ± 2 lb.	7 10	,, ...	Undercut	,, ,,
,, ,, ...	541	18·53	98 2 ± 2 lb.	7 10	,, ...	Zinc	,, ,,
,, ,, ...	753	18·53	98 0 ± 2 lb.	†10 5	,, ...	,, ...	
,, Mark I	1119	15·8	83 0 ± 1½ lb.	†8 4	,, ...	,, ...	Black lacquer.
,, ,, II	1421	15·8	83 0 ± 1½ lb.	†8 4	General Service	,, ...	Red ,,
40-pr. (no Mark)	209	13·87	37 10 ± 1 lb.	†2 4	Moorsom	Tin	Black ,,
,, ,, ...	405	13·87	38 7½ ± 1 lb.	†2 4	,, ...	Undercut	,, ,,
,, Mark I	541	13·52	37 14 ± 1 lb.	2 4	,, ...	Zinc	,, ,,
,, ,, II	1425	13·52	38 5 ± 1 lb.	†2 6	General Service	,, ...	Red ,,
20-pr. (no Mark)	477	11·28	20 5 ±9 oz.	1 0	Moorsom	Undercut	Black ,,
,, Mark I	477	10·91	20 9 ±9 oz.	1 2	,, ...	Zinc	,, ,,
,, ,, II	1342	10·875	20 8 ±4 oz.	1 2	Field Service	,, ...	Red ,,
,, ,, III	1426 / 4335	10·5	20 12½ ±4 oz.	†1 5	General Service	,, ...	,, ,,
12-pr., Mark III	2061	8·35	10 12 ±4 oz.	0 8	Field Service	,, ...	,, ,,
9-pr. ,, III	2061	6·30	8 2½ ±2½ oz.	0 6	,, ,, ...	,, ...	,, ,,

N.B.—Marks I and II 12-pr. Mark I and Mark II 9-pr. may be regarded as unserviceable.

* Existing shell with Moorsom gauge to have G.S. adapters screwed in, § 1238. For diameters of base, *see* Table of Segment Shell.

† P. Mixture.

TABLE No. 42.

SHELL, R.B.L., SEGMENT.

Calibre and Mark.	§Changes in War Stores.	Length, inches.	Diameter at Base.	Number and Nature of Segments.	Weight, mean, empty.	Approximate Bursting Charge.	Gauge of Fuze-hole.	Attachment of Lead Coat.	Remarks.
			Inches.		lb. oz.	Shell L.G. powder. lb. oz.			
7-inch (no Mark)	211	14·23	7·0875	112, 3·36 oz. each ...	97 15	3 2	Moorsom	Tin	Black lacquer.
,, ,, ...	405	13·75	7·0875	,, ,, ...	97 13$\frac{3}{4}$	3 2	,,	Undercut	,, ,,
,, Mark I	405	14·48	7·0875	,, ,, ...	98 9$\frac{1}{2}$	3 2	,,	Zinc	Red ,,
40-pr. (no Mark)	211	10·68	4·835	72, 2·47 oz. each ...	39 9	0 13	,,	Tin	Black ,,
,, Mark I	405	10·62	4·835	,, ,, ...	38 9$\frac{1}{4}$	0 13	,,	Zinc	Red ,,
,, (no Mark)	405	10·58	4·835	,, ,, ...	38 15	0 13	,,	Undercut	Black ,,
						Shell F.G.	Armstrong		
20-pr. ,, ...	405	8·16	3·841	56, 1·7 oz. each, and 14, 1·06 oz. each	19 10$\frac{1}{2}$	700 grs.	Fd. Service	,, ...	
,, Mark I	754	8·1	3·841	,, ,,	19 10	,,	,,	Zinc	
12-pr. (no Mark)	90	6·82	3·0705	42, 1·32 oz. each ..	10 9	550 grs.	,,	Tin	Practice only.
,, ,, ...	210	6·82	3·0705	42, 1·32 oz. each, and 6, ·86 oz. each	10 8	,,	,,	Tin, probably ...	
,, ,, ...	405	6·72	3·0705	,, ,,	10 6$\frac{1}{2}$	,,	,,	Undercut	
,, ,, ...	754	6·75	3·0705	,, ,,	10 8	,,	,,	Zinc	
,, Mark I	1001	6·75	3·0705	,, ,,	10 8$\frac{1}{2}$	,,	,,	,, ...	
9-pr. (no Mark)	..	5·4	3·0705	35, 1·5 oz. each, and 7, 1·2 oz. each	8 3$\frac{1}{2}$	300 grs.	,,	Undercut	For practice only.
,, ,, ...	542	5·35	3·0705	,, ,,	8 3$\frac{1}{4}$	,,	,,	,, ...	
,, ,, ...	754	5·4	3·0705	,, ,,	8 3$\frac{1}{2}$	,,	,,	Zinc	
,, Mark I	1001	5·4	3·0705	,, ,,	8 3$\frac{1}{2}$	,,	,,	,, ...	

By § 602 the following ± limits are allowed in the manufacture of segment shell, 7-inch 2 lb., 40-pr. 1¼ lb., 20-pr. 9 oz., 12-pr. 4 oz., 9-pr. 2½ oz.
§ 1238 directs that existing shell with Moorsom gauge fuze-hole are to be fitted with G.S. adapters permanently screwed in. New shell to have the G.S. bush.

Table No. 43.

Shell, R.B.L., Shrapnel.

Calibre and Mark.	§ Changes in War Stores.	Length, inches.	Number and Nature of Balls contained.	Percentage of useful Weight.	Weight of Shell empty, ± 1·5 per cent.	Weighed Bursting Charge, Pistol R.F.G. or F.G. Powder.	Total Weight of Shell.	Gauge of Fuze-hole.	Remarks.
					lb. oz.	lb. oz.	lb. oz.		
7-inch Mark II ..	1,609	15·98	305 { lead and antimony } 14 per lb.	22·3	97 0	0 8	97 8	General Service	
40-pr. Mark I ..	1,807	12·4	162, „ „ 16 „	25·8	39 0	0 3	39 3	„	
12-pr. Mark I† ..	1,978	8·415	56, „ „ { 42, 18 „ / 14, 34 „ }	25·1	10 11	0 0¾	10 11¾	„	
„ „ II ..	2,210	8·415	56, „ „ „ „ „	25·1	10 11	0 0¾	10 11¾	„	Junction of head and body stronger and secured by screw as well as by plain rivets, centre tube of gun-metal.
9-pr. Mark I† ..	1,979	7·15	42, „ „ { 21, 18 „ / 21, 34 „ }	20·1	8 11	0 0¾	8 11¾	„	
„ „ II ..	2,210	7·15	42,* „ „ „ „ „	20·1	8 11	0 0¾	8 11¾	„	Same remarks as to 12-pr. II.

Mark I, 7-in. (§ 1422) with cast-iron diaphragm, and without tin cup, is ordered to be broken up.

† Shells with stronger sockets, sealed to govern future manufacture, without a change of pattern, marked "P.S." (plain socket) on the lead coat, § 2062.

A few Mark I shells have been made and issued which have the junction of head and body stronger (*vide* remarks), and some with all the improvements, strengthened head and gun-metal tube; the former are distinguished by one small (*), and the latter, those with all the improvements, by two small stars, viz. (**), on the lead coat, § 2210.

Diameters at base, same as segment and common shell. All shrapnel have the zinc attachment.

TABLE No. 44.

SHOT, R.B.L., CASE.

Calibre and Mark.	§ Changes in War Stores.	Length, inches.	Diameters, inches. Over Body.	Diameters, inches. Over Studs.	Number and Nature of Balls.	Approximate Weight of Balls.	Approximate Weight of Case, Linings, Clay and Sand.	Total Weight.	Number of Solder Studs at Base.	Remarks.
						lb. oz.	lb. oz.	lb. oz.		
7-inch, Mark III	1611 & 2444	10·25 ± ·1	6·89 ± ·03	7·097 + ·03 − ·02	74 8-oz. sand shot... ...	36 5	30 11	67 0 ±2 lb.	3	Balls packed in coal dust, surplus stores to be returned to Woolwich for alteration to IV.
,, ,, IV	2188	10·25 ± ·1	6·89 ± ·03	7·097 + ·03 − ·02	70 ,, ...	35 0	34 0	69 0 ±2½ lb.	3	
,, ,, V	2924	10·25 ± ·1	6·89 ± ·03	7·11 ± ·005	71 ,, ...	35 8	32 10½	68 2½ ±2½ lb.	3	Ditto. Case in 3 pieces, ring at bottom instead of a disc.
,, ,, VI	4083	10·25 ± ·1	6·89 ± ·03	7·11 ± ·005	71 ,, ...	35 8	32 10½	68 2½ ±2½ lb.	3	Strengthened method of attaching handles to top.
40-pr., ,, I	1611	10·15 ± ·1	4·715 ± ·015	4·885 ± ·015	37 ,, ...	18 8	11 8	30 0 ±1 lb.	24	Balls packed in coal dust.
,, ,, II	2264	10·15 ± ·1	4·715 ± ·015	4·885 ± ·015	35 ,, ...	17 8	14 0	31 8 ±1 lb.	3	Tin case in 3 pieces.
20-pr. ,, I	1299	8·4 ± ·05	3·705 ± ·015	...	55 lead and antimony, 4 oz.	13 12	1 2	14 14	...	Reeves' pattern.
,, ,, II	1611	9·3 ± ·1	3·705 ± ·015	3·841 ± ·015	41 4-oz. sand shot... ...	9 12½	5 3½	15 0 ±12 oz.	Divided ring	Balls packed in coal dust.
,, ,, III	2841	9·3 ± ·1	3·705 ± ·015	3·841 ± ·005	239 lead and antimony bullets, 16½ per lb.	14 10½	5 11	20 5½ ±8 oz.	3 studs	Case in pieces, ring at bottom instead of a disc.
,, ,, IV	5219	9·3 ± ·1	3·705 ± ·015	3·841 ± ·005	239, 16 per lb.	14 10½	5 11	20 5½ ±8 oz.	3 studs	Iron discs smaller, to fit inside the longitudinal segments, to make the shot break up readily.
12 or 9-pr., Mark I	1242 1900	10·5	2·97	3·074	77 lead and antimony, 7 per lb.	11 0	1 8½	12 8½	12 ,,	Reeves' pattern.
12-pr., Mark II	1467 1900	6½	...	...	70 lead and antimony, 1½ oz. each.	6 9	2 7	9 0	12 ,,	Balls packed in coal dust.
,, ,, III	1611 2058	8·5 ± ·1	2·95 ± ·015	3·12 ± ·015	48 2-oz. sand shot	6 0	3 0	9 0 ±8 oz.	Divided ring	Ditto.
,, ,, IV	2058	8·5 ± ·1	2·96 ± ·01	3·117 ± ·002	132 lead and antimony bullets, 16½ per lb.	8 1½	3 6½	11 8 ±6 oz.	3 studs	Case in 3 pieces, a ring at the bottom instead of a disc.
9-pr., ,, II	1867 2058	6·85 ± ·1	2·95 ± ·01	3·07 + ·004 − ·003	35 2-oz. sand shot	4 6	2 3½	6 9½	Divided ring	Balls packed in coal dust.
,, ,, III	2059	6·85 ± ·1	2·87 ± ·08	3·117 ± ·02	101 lead and antimony bullets, 16½ per lb.	6 3	2 13	9 0 ±6 oz.	3 studs	Case in 3 pieces, ring at the bottom instead of a disc.

7-inch, Marks I and II, are by § 2444 ordered to be returned to Woolwich to be broken up.
Each shot is stamped on the top with its numeral and the nature of ordnance for which it is intended.

Table No. 45.

Packages of Cartridges, Aiming Rifle, S.A., and M.G. (Ball).

Nature.	Charge.	Bullet.	Bundle.		Box.			Remarks.
			No.	Weight.	No.	Mark.	Gross Weight.	
	grs.	oz. grs.		lb. oz.			lb. oz.	
1-inch, aiming rifle	400 or 465	9 408	12	10 10½	96	XI, XII, XIV	97 10	
Machine gun, Nordenfeldt, 1-inch	625 M.G.[1]	3170	12	8 11½	96	,, ,,	81 8	
Gardner, Gatling, Mark IV	85 R.F.G.[2]	480	10	1 3½	680	,, ,,	94 8	
,, ,, ,, I (cordite)	38 size 3	480	10	1 2½	680	,, ,,	90 8	
Machine gun, M.H. chamber, Mark I (cordite)	48 size 3½	480	10	1 3½	580	,, ,,	81 10	
					1000	*XIII*	*134 10*	
Rifle or machine gun, M.H. chamber, Mark II (powder	85 R.F.G.[2]	480	10	1 4½	580	XI, XII, XIV	85 4	
					1000	*XIII*	*149 0*	
·303-inch, Mark II (powder)	71½ R.F.G.[2]	215	10	0 10½	1100	XI, XII, XIV	84 4	
					500	Half naval	38 2	
,, cordite, Marks II to V	31½ size 3½	215	10	0 9½	1100	XI	79 14	
					1100	XIV	77 14	
					500	Half naval	37 8	
					750	750 rounds ·303-inch	56 6	
,, short range, Mark II	12 cordite tape	188	10	0 8½	400	A.S.A. pistol, Enfield, 600 rounds.	28 10	
Rifle, M.H., rolled case, Mark III	85 R.F.G.[2]	480	10	1 1½	600	XI, XII, XIV	79 4	
					1000	*XIII*	*125 14*	
					700	½ barrel	86 0	
					1540	Half metal, lined case	202 0	
					660	Quarter metal, lined case	91 11	
Carbine, M.H., rolled case, Mark III	70 R.F.G.[2]	410	10	1 0	630	XI, XII, XIV	75 4	
					1000	*XIII*	*117 6*	
					700	½ barrel	77 12	
					1620	Half metal, lined case	192 6	
					660	Quarter metal, lined case	84 0	
,, ,, solid case, Mark I	65 R.F.G.[2]	410	10	1 2½	600	XI. XII, XIV	81 4	
					1000	*XIII*	*199 12*	
Snider, rifle or carbine, Mark IX	70 R.F.G.	480	10	1 0½	560	XI, XII, XIV	70 4	
					900	XIII	108 0	
					700	½ barrel	81 4	
Aiming tube, S.A., Mark II	3½	37	100	1 0½	9100	Quarter metal, lined case	108 0	
					10000	Packing case	113 0	
Webley pistol, powder, Mark I	18	265				Box cartridge aiming tube	113 0	
			12	0 10½	768	Half naval	47 0	
					240	Enfield pistol, L.S.	16 0	
,, cordite, Mark II	7½	265	6	0 4½	864	Half naval	43 0	
			12	0 9½	276	Enfield pistol, L.S.	16 8	
,, ,, ,, III	7	218½	6	0 4½	828	Half naval	47 8	
			12	0 8½	300	A.S.A. pistol, Enfield, 240 rounds.	16 2	

TABLE No. 46.

PACKAGES OF CARTRIDGES, S.A., AND M.G. (BLANK).

Nature.	Charge.	Bundle.		Box.			Remarks.
		No.	Weight.	No.	Mark.	Gross Weight.	
	grs.		lb. oz.			lb. oz.	
1-inch Nordenfeldt	625 M.G.[1]	12	3 1½	108	XI, XII, XIV	12 4	
M.G., G.G., chamber powder, Mark I, solid case	65	10	0 8 3/16	1670	Half barrel	95 12	
				2000	Half-metal lined case ...	134 8	
M.G., M.H., chamber powder, Mark I, solid case	85	10	0 9 1/16	580	XI, XII, XIV	46 4	
·303-inch powder, Mark II, solid case...	71½	10	0 5½	3200	Half barrel	125 0	
				1900	Quarter barrel	75 0	
·303-inch cordite, Mark V, solid case...	10 Size 20 sliced	10	0 4½	1400	XI, XII, XIV	48 0	
				2500	*XIII*	*81 0*	
				500	Enfield, N.S.	18 12	
				3200	Half barrel	103 8	
				1900	Quarter barrel	59 6	
				7400	Whole M.L. case	257 0	
				3400	Half ,, ...	124 4	
				1450	Quarter ,, ...	58 4	
M.H., or Snider rifle or carbine, Mark IV	68 Blank F.G.	10	0 4	960	XI, XII, XIV	36 4	
				1500	*XIII*	*52 4*	
				2000	Half barrel	62 2	
				1300	Quarter barrel	40 4	
				2400	Half M.L. case	90 0	
				1020	Quarter ,, ...	43 8	
M.H., or Snider rifle or carbine (converted), Mark IV	68 Blank F.G.	10	0 5 3/16	960	XI, XII, XIV	44 8	
				1500	*XIII*	*69 6*	
				2000	Half barrel	79 5	
				1300	Quarter barrel	51 7	
				2400	Half M.L. case	110 10	
				1020	Quarter ,, ...	52 8	
M.H., rifle or carbine cordite, Mark I (rolled case)	10	10	0 6	2000	Half barrel	88 4	
Webley pistol	10			420	Enfield pistol	8 8	

Table No. 47.

Combustible Compositions for Laboratory Stores.

Carcass Composition :—	lb.	oz.
Saltpetre, ground	6	4
Sulphur, ground	2	8
Rosin, pounded	1	14
Antimony, Sulphide of ..	0	10
Tallow, Russian	0	10
Turpentine, Venice	0	10

Portfires.

Common Portfires :—	lb.	oz.
Saltpetre, ground	6	0
Sulphur, ground	2	0
Powder, mealed, cylinder ..	1	4

Light, Illuminating Wrecks, Mark IV :—	lb.	oz.
Saltpetre, ground	6	0
Sulphur, ground	1	12
Orpiment, red	0	9

Magnesium Light for ½ lb. Light Rocket :—	lb.	oz.
Magnesium powder	1	8
Chlorate of Potash	1	2
Nitrate of Baryta	1	9½
Oil, Linseed, boiled	0	3

Stars for all Star Shell :—	lb.	oz.
Nitrate of Baryta	1	11
Nitrate of Potash	1	2
Magnesium Powder coated with Paraffin*	1	8
Add 3 per cent. boiled Linseed Oil.		

Long, Short, and Coast Guard Lights, and Lights for Wrecks :—	lb.	oz.
Saltpetre, ground	17	8
Sulphur, ground	4	6
Orpiment, red	1	4

Fuze Composition.

15 Seconds :—	lb.	oz.
Saltpetre, ground	3	0
Sulphur	1	12½
Powder, mealed, R.F.G.[2] ..	2	3

30 Seconds :—	lb.	oz.
Saltpetre, ground	4	7
Sulphur	1	14½
Powder, mealed, R.F.G.[2] ..	2	2

Fuzes, Metal.

Nature.	Powder, Prism[1], Brown, Waltham Abbey, about.		Powder, R.F.G.[2], Mealed. about.	
	lb.	oz.	lb.	oz.
Time Sensitive Middle I	5	10	6	8
„ and Percussion, Middle I	6	0	4	6
„ „ Short II	4	5	3	3
„ „ „ III	4	11	3	3
„ „ No. 56 IV ..	4	11	3	3

* The Magnesium Powder is immersed in melted paraffin so as to coat each grain of the powder. The paraffin so taken up amounts to about ¼ of the weight of the unprepared powder. The weights given above are the weights of the *prepared* powder.

TABLE No. 47—*continued.*

COMBUSTIBLE COMPOSITIONS FOR LABORATORY STORES—*continued.*

ROCKETS.

War Rocket :—	24-PR. lb.	9-PR. lb.
Saltpetre, ground ..	64·75	8·75
Sulphur, ground ..	14·75	2·0
Charcoal, Alder, ground	20·5	2·5

Signal Rocket Composition :—	lb.	oz.
Saltpetre, ground	8	0
Sulphur, ground	2	0
Charcoal, Dogwood	3	0

For Quick Pellet for Rocket, Life-Saving :—	lb.	oz.
Saltpetre, ground	8	9½
Charcoal, Alder, ground ..	2	1
Sulphur, ground	1	13½

Rocket, Life-Saving :—	lb.	oz.
Saltpetre, ground	7	0
Charcoal, Alder, ground ..	3	4
Sulphur, ground	2	0

Rocket, Buoyant :—	lb.	oz.
Saltpetre, ground	7	12
Charcoal, Alder, ground ..	3	0
Sulphur, ground	2	0

Composition for Stars of Signal Rocket :—	lb.	oz.
Saltpetre, ground	8	0
Sulphur, ground	2	0
Antimony, Sulphide of ..	2	0
Isinglass	0	3½
Spirits, methylated	pint	1
Vinegar	qrt.	1
Powder, L.G., mealed for priming	lb. 1	oz. 0

Stars, Incendiary, for Shells :—	lb.	oz.
India-rubber solution ..	0	2
Powder, mealed	0	5
Saltpetre, ground	0	1
Paraffin wax	0	0½
Naphthalene	0	0½
Coal tar	0	1

MATCH.

Slow Match :—	
Hemp, Yarn, pure, Russian	lb. 100
Ashes, Wood.. ..	bushel 1
Water	gals. 50

Quick Match :—

	2 threads. lb.	oz.	3 threads. lb.	oz.	4 threads. lb.	oz.	6 threads. lb.	oz.	10 threads. lb.	oz.
Cotton Wick	2	0	3	0	1	10	2	2	2	7
Gum Arabic	0	10½	1	0	0	11	0	12	0	13
Powder, mealed, L.G.	18	0	26	0	20	0	20	0	24	0
Water, distilled ..	8 pints		12 pints		8 pints		9 pints		10 pints	

COLOURED FIRES.

Blue :—	
Chlorate of Potash	50 per cent.
Gum Shellac, prepared	10 per cent.
Basic Carbonate of Copper	8 per cent.
	4·6 per cent. copper.
Calomel	32 per cent.

Green :—	lb.	oz.	dr.
Chlorate of Baryta..	5	0	0
„ „ Potash..	3	0	0
Gum Shellac, prepared	1	0	0

Red :—			
Nitrate of Strontia, pulverised	2	8	0
Calomel	1	9	8
Dextrine	0	11	0
Gum Shellac, pale	0	9	0
Sulphide of Copper, fused	0	2	0
Chlorate of Potash, ground	2	7	6

TABLE No. 47—*continued.*

COMBUSTIBLE COMPOSITIONS FOR LABORATORY STORES—*continued.*

DETONATING COMPOSITIONS.

FUZES.

Detonating Composition for Boxer, 5, 9, and 15 seconds Time-Fuze, B.L.:—

	Parts.
Potash, Chlorate of	6
Antimony, Sulphide of ..	4
Mercury, Fulminate of ..	4

Damped with varnish, of spirits, methylated, 1 pint, shellac 645 grains, in the proportion of 24 minims to 100 grains of composition.

Composition for Percussion Caps for S.A., M.G., and aiming rifle powder cartridges, E Time, R.L. small, B.L. plain, Direct Action, D.A. Delay, and Base Percussion, and Time and Percussion Fuzes:—

	lb.	oz.
Mercury, Fulminate of ..	0	6
Potash, Chlorate of	0	6
Antimony, Sulphide of ..	0	4

Composition for Percussion Caps of 6 and 3-pr. Q.F.:—

	Parts.
Potash, Chlorate of	12
Antimony, Sulphide of ..	18
Mealed powder	1
Sulphur	1
Ground glass..	1

Detonating Composition for Pettman Percussion Fuzes:—

	Parts.
Potash, Chlorate of	12
Antimony, Sulphide of ..	12
Sulphur, ground	1
Powder, mealed, L.G. ..	1

Damped with varnish, of spirits, methylated, 1 pint, shellac 112 grains, in the proportion of 40 minims to 100 grains of composition.

TUBES.

Detonating Composition for Copper Friction Tube:—

	lb.	oz.
Potash, Chlorate of	0	6
Antimony, Sulphide of ..	0	6
Sulphur, ground	0	0½

Damped with spirits, methylated, 1 quart, shellac 448 grains, in the proportion of 200 minims to 1,000 grains of composition.

Detonating Composition for Quill and T, V., and M. Friction Tubes:—

	lb.	oz.
Potash, Chlorate of	0	6
Antimony, Sulphide of ..	0	6
Sulphur, ground	0	0½
Powder, mealed	0	0½
Glass, ground..	0	0½

Damped with spirits, methylated, 1 quart, shellac 448 grains, in the proportion of 200 minims to 1,000 grains of composition.

Composition for Percussion Caps for Cordite S.A., and M.G. Cartridges:—

	Parts.
Chlorate of Potash	14
Sulphide of Antimony ..	18
Fulminate of Mercury ..	8
Sulphur	1
Mealed powder	1

Composition for Caps and Detonator of Fuze, 1-pr. Q.F.:—

	Parts.
Potash, Chlorate of	18
Antimony, Sulphide of ..	12
Mealed powder	1
Sulphur	1
Ground Glass	1

TABLE No. 48.

PAINTS AND OTHER NON-COMBUSTIBLE COMPOSITIONS FOR LABORATORY STORES.

Paint for Projectiles :—

First Coat.	lb.	oz.
Magnetic oxide	7	0
Lead, red, dry	7	0
Litharge	2	0
Oil, linseed, boiled	qrts.	2½
Turpentine, spirits	„	1½

Second Coat.	lb.	oz.
Magnetic oxide	14	0
Litharge	2	0
Driers, patent	1	12
Oil, linseed, boiled	qrts.	2½
Turpentine, spirits	„	1½

Lead colour for 15-pr. B.L. Shrapnel Shells :—

	lb.	oz.
White lead, ground	14	0
Lamp black, dry	0	8
Driers, patent	1	8
Oil, linseed, raw	pints	2½
Turpentine	„	1½

White :—

	lb.	oz.
Lead, white, ground.. ..	16	12
Driers, patent	1	12
Oil, linseed, raw	qrt.	1
Turpentine, spirits	pint	½

Red for heads of Shrapnel :—

	lb.	oz.
Lead, red, dry	11	4
Driers, patent	1	12
Oil, linseed, raw	pints	1½
Turpentine, spirits	„	½

Red for Marking :—

	lb.	oz.
Vermilion	1	0
Red lead	1	0
Driers, patent	0	4
Oil, linseed, raw	pint	¼
Turpentine	„	¼

Yellow for Practice :—

	lb.	oz.
Lead, white	2	0
Driers, patent	0	4
Chrome, lemon	0	1
Oil, linseed, raw	pint	1
Turpentine	„	½

Yellow for Lyddite Shells :—

	lb.	oz.
Ochre, yellow stone	0	10
Varnish, copal	gills	1½
Turpentine	„	¼

Red for Lyddite Shells :—

	lb.	oz.
Vermilion	0	12
Varnish, gold size	0	3½
Turpentine	pint	½

Black for 6 and 3-pr. Q.F. Shells :—

	lb.	oz.
Vegetable Black	1	0
Varnish, copal	qrts.	2
„ gold size	„	1
Turpentine	pint	1

Stone, Colour for Brass Pentagon, Plain and Corrugated Rectangular Powder Cases, and Zinc Cylinders :—

	lb.	oz.
Lead, white	28	0
Copperas	0	12
Umber	0	8
Varnish, copal	qrts.	3
Gold size	„	2
Turpentine, spirits	„	2

Black for B.L. plain Percussion Fuze, Bodies of Quill, and Copper Friction Tubes :—

	lb.	oz.
Black, vegetable	0	8
Litharge	0	8
Varnish, copal	qrts.	3
Turpentine, spirits	„	2
Gold size	pints	1½

Thick Brown Varnish :—

	lb.	oz.
Shellac, gum	16	0
Spirits, methylated	gals.	2

Thin Brown Varnish :—

	lb.	oz.
Shellac, gum	8	0
Spirits, methylated	gals.	2

Shellac Putty :—

	lb.	oz.
Whiting	6	0
Shellac, gum	2	0
Spirits, methylated	qrt.	1

Paste :—

	lb.	oz.
Flour	2	0
Alum, pounded	0	1
Water..	gal.	1

TABLE No. 48—*continued.*

PAINTS AND OTHER NON-COMBUSTIBLE COMPOSITIONS FOR LABORATORY STORES—*continued.*

Flesh Colour for Common Portfire, &c.:—

	lb.	oz.
Lead, white, ground	20	0
,, red, dry	0	4
Shellac, gum	10	0
Spirits, methylated	gals.	3

Drab Colour for Long, Short, Signal, and Coast Guard Lights, and 1 lb. and ½ lb. Signal Coloured Rockets:—

	lb.	oz.
Lead, white, ground.. ..	20	0
Shellac, gum	10	0
Spirits, methylated	gals.	3

Black for Body of Wood Fuze:—

	lb.	oz.
Black, lamp	2	0
Shellac, gum	10	0
Spirits, methylated	gals.	3

Heads of Signal Coloured Rockets, 1 lb. and ½ lb.:—

		lb.	oz.
Red	Vermilion	3	0
	Shellac, gum ..	4	0
	Spirits, methylated	gal.	1
		lb.	oz.
Blue	Ultramarine ..	0	8
	Shellac, gum ..	1	4
	Spirits, methylated	qrt.	1
		lb.	oz.
Green	Green, Brunswick..	3	0
	Shellac, gum ..	5	0
	Spirits, methylated	gal.	1

List of Ingredients used for the Paint of M.L. and B.L. Wood Time Fuzes:—

Body of Fuze	Lead, white	lb.	10
	Shellac	,,	5
	Spirits, methylated ..	gals.	1½
Distinguishing Colour 5 secs. M.L. and B.L. — For body	Vermilion	lb.	3
	Shellac	,,	4
	Spirits, methylated	gal.	1
Distinguishing Colour 5 secs. M.L. and B.L. — For figures	Blue, ultramarine	oz.	4
	Oil, raw	pint	1
	Turpentine	gill	0½

Red for outside of Case of Hale's War, Boxer Life-Saving and Buoyant Rockets and Light-Illuminating Wrecks:—

	lb.	oz.
Lead, red	3	0
,, white	1	0
Litharge	0	4
Copperas	0	2
Oil, linseed, boiled	pint	1

Luting, Mark I:—

Tallow } Equal parts.
Beeswax }

Luting, Mark III:—

	Parts.
Whiting	80
Mineral jelly	20
Castor oil	1

Black Paint for Iron Burster:—

	lb.	oz.
Black, lamp	3	0
Litharge	1	0
Oil, linseed, boiled	pints	3
Turpentine, spirits	,,	3

The second coat is Brunswick black.

Thick Black Paint for Ring round Cap of Wood Fuze:—

	lb.	oz.
Shellac, gum	1	0
Black, lamp	0	8
Spirits, methylated	pints	1½

Varnish for the Gut and Silk over Detonating Ball of Pettman Fuzes:—

	lb.	oz.
Shellac, gum	0	8½
Spirits, methylated	qrt.	1

Transparent Lacquer for Brass Work:—

	lb.	oz.
Seed lac	5	0
Turmeric	2	8
Spirits, methylated	gals.	5

Thinned luting equal parts, Mark III, luting and mineral jelly.

TABLE No. 48—*continued.*

PAINTS AND OTHER NON-COMBUSTIBLE COMPOSITIONS FOR LABORATORY STORES—*continued.*

Fuze Grease :—

	lb.	oz.
Tallow, Russian	3	0
Beeswax	3	4
Oil, sweet	qrts.	2

Lacquer for inside of Shells for Rifled Guns :—

	lb.	oz.
Rosin	12	0
Brown, Spanish	2	0
Plaster of Paris	1	0
Turpentine, spirits	pint	0½

Varnish for inside of Lyddite Shell :—

	lb.	oz.
Shellac	3	0
Methylated spirits	qrts.	5
Turpentine	pints	1½

Lubricant for Lids, Q.F. cartridges and R.B.L. guns Lubricator :—

Tallow, Russian } equal parts.
Oil, Linseed, raw }

Waterproof Varnish for Percussion Caps :—

	lb.	oz.
Shellac, gum	2	2
Spirits, methylated	gal.	1

Kit Composition No. 1 (for use hot) :—

	lb.
Pitch, Swedish	30
Tallow, Russian	7¾
Beeswax	30
Resin	32¼

Anti-corrosive for inside of Boxer Life-Saving Rocket Case, and Lights Illuminating Wrecks :—

Copal varnish	pints 0½
Gold Size	„ 1
Turpentine, spirits	„ 1½
Lead, white, dry	lb. 7

White, for Case of Signal Rocket :—

	lb.	oz.
Lead, white, ground . ..	20	0
Ultramarine	0	4
Shellac, gum	10	0
Spirits, methylated	gals.	3

Composition for Lubricating Fuzes, Shell Plugs, &c. :—

Luting oil	17 parts.
Luting	100 „

Pettman cement for waterproofing purposes :—

	lb.	oz.
Shellac gum	7	8
Methylated spirits (1 gal.) ..	8	4
Tar Stockholm (½ gal.) ..	5	0
Red Venetian	20	12

Kit composition No. 2 (for use cold) :—

Tar, Stockholm	qrt. 1
Shellac	lb. 6
Spirits, methylated.. ..	gal. ½

PAINT FOR LYDDITE SHELLS.

	1st Coat.	2nd Coat.
White oxide of zinc (without lead)	3 lbs.	2 lbs.
Oil, linseed, boiled (special, without lead)	1¾ pints.	1¾ gills.
Terebine (without lead)	1¾ gills.	*Nil.*
Turpentine	1¾ gills.	1¾ gills.
Ochre, yellow	*Nil.*	1 lb.
Varnish, copal	*Nil.*	2¾ pints.

It is very important that the ingredients employed in paints for lyddite shell should be quite free from lead, and supplies obtained at Woolwich for this purpose are chemically analysed to guard against the presence of lead. Paint, or the ingredients for making up paint for lyddite shells, should, therefore, only be obtained from Woolwich.

TABLE No. 49.

ANALYSIS OF METALS.

No. 1. *Gunmetal.*

Used for bodies, &c., of fuzes :—

	Parts.
Copper	87
Tin	3·5
Zinc	6·0
Lead	3·5

No. 3. *Gunmetal.*

Used for fittings of Q.F. boxes :—

	Parts.
Copper not less than ..	84
Tin	9 ± 1
Zinc not more than	3
Lead	3

Drawn Gunmetal.

An alternative with No. 1 :—

	Parts.
Copper	90
Tin	7
Zinc	3

Iron and lead traces.

Forgeable Alloy.

Used for composition ring T and P fuzes :—

	Parts.
Copper	60
Zinc	40
Lead	2
Aluminium	0·25

Brass.

For tubes :—

	lb.
Copper	70
Zinc	30

Brass.

For parts of fuzes, *i.e.*, dome, &c. :—

	Parts.
Copper	65 to 70
Spelter	95 to 30

White Metal.

Lids, Q.F. cartridges :—

	Parts.
Tin	4
Zinc	1

Mixed Metal.

For shrapnel bullets :—

	Parts.
Lead	4
Antimony	1

12 and 15-pr., 7 parts lead, 4·7-inch Mark III, 9 parts.

INDEX.

* *This sign shows that the store in question is illustrated by a woodcut.*
† *This sign shows that the store in question is illustrated by a plate.*

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K.

L.

M.

N.

O.

P.

Q.

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S.

T.

U.

V.

W.

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