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HANDBOOK

ON

AMMUNITION.

1905.

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AMMUNITION HANDBOOK.

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CHAPTER I.

GUNPOWDER.

Gunpowder for many centuries was the only explosive in general use, but in recent times many other explosives have been invented. It is an intimate mechanical mixture of saltpetre, sulphur, and charcoal. Composition.

For black powder the ingredients are mixed in the following proportions, viz. :— Black powder.

Saltpetre	75 parts.
Charcoal	15 „
Sulphur	10 „
	100

For brown powder:— Brown powder.

Saltpetre	79 parts.
Charcoal	18 „
Sulphur	3 „
	100

Saltpetre (Nitrate of Potash (KNO_3)) occurs as a natural product on, or near, the surface of the earth in China and India. The saltpetre used at Waltham Abbey is that brought from India. It 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. Saltpetre.

Charcoal is the charred woody fibre which remains after the liquid and more volatile parts have been driven off by destructive distillation. The object of charring wood or vegetable fibre is the removal of moisture, and, which is of great importance, the expulsion of those constituents which become volatile before they are burned, and which would consequently absorb a large amount of heat. Charcoal.

Wood may be charred in pits, but the usual method of preparing charcoal for gunpowder is by distillation in large iron cylinders or retorts. Most of the charcoal used for gunpowder is prepared from light spongy wood, such as dogwood, alder, and willow ; but for brown powder it is made from carefully selected straw.

Charcoal contains carbon, oxygen, and hydrogen; it acts as fuel in gunpowder, combining with the oxygen from the saltpetre.

Sulphur.

Sulphur is an elementary substance existing in various forms of combination, and occurring abundantly in nature in the uncombined state, chiefly in volcanic districts. It burns at a low temperature (about 500° F.), and gives out great heat. This is useful in enabling the other ingredients 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.

Explosiveness.

Explosiveness. — Powders made from exactly the same materials, mixed in the same proportions, differ greatly in "explosiveness," which has been defined as the *rate* at which the powder burns, or is converted into gas. This quality will depend chiefly upon the following physical properties :—

(*a*) The density of the powder.
(*b*) Its hardness.
(*c*) The size of the grains or pieces.
(*d*) The shape of the grains.
(*e*) The amount of glaze imparted to the powder.

Density.

Density.—The density has a most important effect upon the explosiveness, or rate of combustion. By density is meant the quantity of matter actually present in a certain bulk of the powder. Thus, if different quantities of meal powder, containing the same amount of moisture, be compressed into cylinders of equal size, that which contains the most *meal* will be the densest.

Hardness.

Hardness.—Hardness has not necessarily a relation to density, for a substance can be hard and yet possess little density. Increase of hardness can be given by pressing the meal in a moister condition.

Other things being equal, *increasing* the density of a powder *decreases* the pressure in the bore of a gun, but at the same time lessens the muzzle velocity.

Also with small arms, the denser the powder the less fouling there is.

A dense hard powder will keep and bear transport better than a more porous or more friable grain.

Size of grain.

Size of grain.—The size of the grains is one of the most important questions to be considered with reference to its explosiveness. Although a charge of powder appears to explode instantaneously, yet both ignition and combustion are gradual; the flame is communicated from one grain to the other, each burning in concentric layers, until all is consumed, so that the combustion of the grains is not simultaneous. Mealed powder ignites very readily, but a much longer time is required for its complete combustion than when the powder is granulated.

It has been found by experience that greater uniformity of action is secured by having the grains of the same size, and all charges are made with powder of uniform size and shape.

Shape of grain.

Shape of grain.—The same quantity of powder meal made into two grains of equal density, but different shapes, will take different times to burn, and the larger the surface exposed the quicker will be the combustion of the grain. A rounded form of grain is very favourable for the transmission of the flame, and theoretically this would be the best shape for the grains; but experience has shown that this shape does not answer for the cartridges for the heavy B.L. guns, which are of great length and must be fairly rigid.

For heavy B.L. charges it has been found best to build up the charge of hexagonal prisms of comparatively small size, each prism fitting closely to its neighbour, each prism having a hole running through its centre.

Glazing.

Glazing.—Glazing affects both the explosiveness and the keeping qualities of a powder. As regards the former, it modifies the violence of the combustion; and as regards the latter, the course of treatment rubs off the corners and edges, and hardens the surface.

Moisture.

Effect of Moisture.—Moisture reduces the explosiveness of a powder by using up a portion of the heat generated by the combustion to get rid of the water. All powders will take up moisture, the amount of which will depend upon their density, and upon the description of charcoal from which they are made.

So far as practicable, all gunpowder should be stored in air-tight cases.

For the purpose of describing the manufacture, gunpowder may be divided into three classes:—

A.—Granulated.
B.—Cut.
C.—Moulded.

Manufacture of Class A. Powders.

Manufacture of granulated powders.

In this class are included every description of gunpowder which is *granulated* in machines, and which, consequently, is composed of irregularly shaped grains of different sizes. All these powders are black, and the different classes into which they are divided have names generally indicating the size of the grain.

The following are the successive processes of the manufacture of granulated powders:—

1. Weighing and mixing the ingredients.
2. Incorporating, or milling.

3. Breaking down the mill cake.
4. Pressing.
5. Granulating.
6. Dusting (fine grain powders only).
7. Glazing.
8. Stoving, or drying.
9. Finishing.
10. Blending.

The first three of the above processes are precisely similar for all the classes of powder.

1. *Mixing the Ingredients.*

Weighing.—The ingredients, being brought into the mixing house, are very accurately weighed out in their proper proportions.

Mixing.—The charge is then placed in the mixing machine, and mixed for about five minutes, the machine then empties itself into a box, and the composition is passed through an eight-mesh copper wire hand sieve, it is then run into a bag, and tied up ready for the incorporating mill. In this state it is called a "green charge."

2. *Incorporating, or Milling.*

The green charge is brought in its bag and put on the bed of the incorporating mill, it is moistened with distilled water and is worked from four to eight hours, according to the nature of the powder required, under iron runners.

The action of the runners is a combination of rolling and twisting, and has somewhat the effect of a pestle and mortar, crushing, rubbing, and mixing, thus giving the charge a most intimate union.

When taken from the incorporating machine the powder is known as "mill cake," and is placed in wooden barrels and removed to small magazines.

3. *Breaking down the Mill Cake.*

The object of this process is to reduce the mill cake to meal, in order that it may be in a convenient form for loading into the press box.

4. *Pressing.*

The powder is then placed in a specially constructed box and pressed by a hydraulic ram; to get powder of uniform density, it is necessary to compress equal quantities of meal containing equal quantities of moisture, at the same rate, into

the same space. The powder when taken from the press box is known as "press cake," and is in layers of about half-inch thickness.

5. *Granulating.*

The press cake is next placed in the granulating machine, which consists of gun-metal rollers and sieves, and granulated, after passing through this process it is known as "foul grain."

6. *Dusting.*

The finer natures of powders, made from *dogwood* charcoal, require now to be passed through a dusting machine.

7. *Glazing.*

The powder is next placed in the glazing machine and glazed by the friction and in some cases by a small quantity of graphite being added.

8. *Stoving, or Drying.*

All kinds of gunpowder are stoved in the same manner. A drying room, heated by steam pipes, is fitted with open framework shelves one above another, and on these the powder is dried. The length of time and temperature vary according to the nature of the powder and the amount of moisture that it contains.

9. *Finishing.*

The drying process produces a small portion of dust, which has to be removed by the finishing process.

10. *Blending.*

Is carried out to obtain more uniform results at proof. It consists of mixing together, during the different processes of manufacture, different lots of powder, thus before stoving four glazings are blended together, it is again further blended after stoving, and again blended after samples from each batch have been proved.

Class B. or Cut Powders.

This class includes those natures of powder, viz., P. or pebble, S.P. or selected pebble, and Q.F. 1 powder, in which the press cake is cut with knife edges, either in a machine or by hand, first into strips and then into pieces of an approximately cubical shape.

The first three processes, viz., mixing, incorporating, and breaking down, are conducted in precisely the same manner as for the granulated powder.

Pressing.

The meal is pressed between metal plates which are built up horizontally on the ram of the hydraulic press.

A wooden frame 1¼ inches high is placed on each plate and the meal filled into this and scraped off level with the top by a wooden straight edge; the wooden frame is then removed. There are 27 plates for each pressing, forming 26 slabs.

Cutting.

The "press cake" is next cut into cubes of the required size by the cutting machine, or by hand, and is placed in barrels and conveyed to the glazing house.

Glazing.

The cubes are next placed in the glazing machine, which is of the same pattern as that for the class A. powders; this process rubs off the sharp corners and edges and produces a hardening of the surface which tends to retard ignition and also prevents the formation of dust.

Stoving.

"Cut" powders are "stoved" similarly to "granulated" powders, but a much longer time is required—about 36 hours at 130° F.

Finishing.

After stoving, the powder is "finished" by being run in a barrel-shaped skeleton reel with wooden ribs for about 40 minutes; pure graphite in muslin bags is then introduced and the reel run for another 20 minutes.

Blending.

The cut powders are blended in much the same way as the granulated.

Class C. or Moulded Powders.

Manufacture of moulded powders.

This class comprises gunpowder, each prism of which is moulded and pressed separately in a metal mould.

The following moulded powders are now in the Service :—

Prism Black.
Prism Brown.
S.B.C. (slow burning cocoa).

The processes of manufacture, up to and including granulating before moulding, are carried out in precisely the same manner as in making granulated powder.

Prism brown and S.B.C. powders differ in the following particulars : —

(1) The employment of special charcoal.
(2) The ingredients being in different proportions, viz., for prism brown and S.B.C. 79 saltpetre, 18 charcoal, and 3 sulphur.

Moulding, or Pressing the Prisms.

The operation of moulding or pressing the grains into prisms is performed either in the " hydraulic " or the " cam " machine.

The " hydraulic " machine produces 64 finished prisms at one operation.

The " cam " machine works automatically and presses six prisms at a time.

Stoving.

Prismatic powder is placed upon the stove cases and carefully dried at two different temperatures. First, for 24 hours at 90° F., and secondly, for 36 hours at 140° F.

Blending.

The finished prisms are carefully blended by hand in batches of 100 boxes of 100 lbs. each.

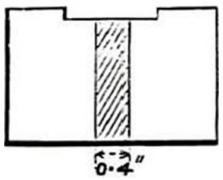
Colour and Distinguishing Marks.

Distinguishing marks of prism powders.

All the prismatic powders are made the same size, viz.:— height, ·98-inch, diameter over sides 1·38-inches, and diameter of hole in centre ·4-inch.

In order to distinguish S.B.C. from prism black and prism brown the top of each prism is grooved as shown in the diagram :—

S.B.C.



The colour of S.B.C. is similar to that of prism brown.

Distinguishing Marks and Use.

Service powder.

The term *Service* is applied to powders fit for firing projectiles.

Granulated, or Grain Powders.

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

M.G.[1]—Size 7 to 14 mesh, minimum density 1·75.

Use.—Primers for shrapnel shell.

R.F.G.[2] (*Rifle Fine Grain*[2]).—Size 12 to 20 mesh, density 1·72 to 1·75.

Use.—·45-inch aiming rifles and machine guns, primers and igniters for cordite charges, and for filling shrapnel shell having the bursting charges in the base, also 1-inch aiming cartridge.

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

Use.—Webley pistol ammunition.

Cubical, or Cut Powders.

P. (*Pebble*).—The grains are approximately cubical in form with rounded edges, and average about 80 to the pound. Minimum density 1·75.

Use.—Filling common and A.P. shell, in conjunction with F.G.

Q.F.[1]—The grains are cubical in shape, and average about 270 to the pound. The minimum density is 1·75.

Use.—Filling A.P. and common shell 6 inches and below.

Moulded Powders.

Prism-Black.—Density not less than 1·76.

Use.—Primers for prism brown, and S.B.C. cartridges.

Prism-Brown.—Minimum density 1·8.

Use.—12-inch B.L. (early marks).

S.B.C.—Minimum density 1·85.

Use.—16·25 B.L. guns.

Note.—All of the guns (except the 16·25-inch B.L.) shown above as firing a powder charge now fire cordite, either as an alternative or as a substitute.

Blank Powders.

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

Shell Powders.

Shell powders are manufactured or selected for shell filling.

P. Mixture.—Consists of P. and F.G. It is used for filling all common and armour-piercing shell for rifled ordnance except those noted below.

Q.F. Shell F.G. is used for the bursting charges of 3-pr. and 6-pr. Q.F. shells.

Shell Q.F. is Q.F.[1] selected for shell filling, it is mixed with F.G. and used for the 12-pr. Q.F. common shell, and may be used for A.P. and common for 6-inch and below. Service powders or shell powders specially manufactured are used for filling shrapnel shell.

Shell Q.F. is often now used in place of shell P.

Examination of Powder.

Powder, after being manufactured, is subjected to the following tests :—

(1) To see if the powder has a proper *colour*, a proper amount of *glaze*, sufficient *hardness* and *crispness*, and that it is free from *dust*.

These points are judged by hand and eye alone.

(2) *If it be properly incorporated.*

This is tested by "flashing," that is, burning a small quantity on a glass or copper plate.

(3) *Size, shape and proportion of the grain.*—The "cut" and "moulded" powders are tested by measurement, and moulded powder is also tested for size by means of a metal frame, into which a certain number of prisms must fit accurately.

A "granulated" powder is tested by being passed through two-sized sieves.

(4) *Density.*—Is ascertained with the assistance of a densimeter.

(5) *Moisture.*—The sample powder is crushed and carefully weighed, then dried to evaporate all the moisture, and re-weighed.

(6) *Hygrometric test.*—To ascertain its power of absorbing moisture.

(7) *Firing proof.*—(*a*) *Muzzle velocity.*—Each description of powder is fired from the pattern of gun it is intended to be used for, under certain fixed conditions as to charge, projectile, and gravimetric density.

(*b*) *Pressure in bore.*—To ascertain that it gives pressures not exceeding certain limits.

(8) *Proportion and purity of Ingredients.*—These are determined by analysis in the Chemical Department at Woolwich.

The following table shows the guns in which the various descriptions of gunpowder are used :—

Description of Powder.	Symbol	Guns supplied to.
Prismatic	S.B.C.	16·25 inch B.L.
	Prism brown	12-inch B.L. in some ships of Colossus class.
	Prism black	Primers for prism brown and S.B.C. charges.
Pebble	P.	Bursters for uncapped A.P. and common shell, except 12-pr. and 6 and 3-pr. Q.F.
Grained	L.G.	Blank and saluting charges, bursters for shrapnel, if in the head, and bursters for capped A.P. shell.
	R.F.G.	Bursters for A.P. and common shell.
	R.F.G.[2]	Bursters for shrapnel, if in the base; also for primers and igniters, cordite charges and lyddite shell, and for 1-inch electric aiming. (7-dram primers.)
	Pistol	Bursters for shrapnel, if in the base.
	M.G.[1]	Primers for shrapnel shell.
	Q.F.	Bursters for 12-pr. common, and may be used for bursters of shell in the place of pebble up to 6-inch.

NOTE.—Blank F.G. new is also used for Primers and Igniters for cordite charges.

CLASSIFICATION OF POWDERS.

Class I.—Service powders, for firing projectiles.
„ II.—Blank or saluting.
„ III.—Shell powders, either reduced or new.
„ IV.—Doubtful powders awaiting examination.
„ V.—Unserviceable for sale, condemned for Service.
„ VI.—To be destroyed, or may be used for the extraction of saltpetre.

CHAPTER II.

Cordite and Lyddite.

Cordite.

The introduction of Q.F. guns led to many attempts to produce a smokeless powder, and after numerous experiments cordite was the smokeless explosive adopted for the English service.

Its advantages over powder are :— Advantages of cordite.

(*a*) Smokeless.
(*b*) Gives better ballistic results.
(*c*) The weight of the charge necessary to obtain the same M.V. is much less.
(*d*) The reduction in the diameter of the chamber, owing to the greatly diminished charge, allows of a much lighter breech screw.
(*e*) Being very slow burning, the recoil of the gun is less violent.
(*f*) It fouls the gun less than powder.
(*g*) It is not damaged by exposure to a moist atmosphere.

Cordite Mark I. is an intimate mechanical mixture of nitro-glycerine, gun-cotton, and vaseline in the following proportions :- Composition of cordite.

Nitro-glycerine - - -	58 parts
Gun-cotton - - - - -	37 „
Vaseline - - - -	5 „
	100

Modified cordite (M.D.) = { N.G. 30, G.C. 65, Vas. 5 } = 100.

M.D. cordite is much harder than Mark I. cordite, and knotty in appearance ; the advantages claimed are less erosion in the gun, same ballistics with slightly larger charge.

Nitro-glycerine is prepared by the action of nitric acid on glycerine. A full description of the Waltham Abbey method of preparation is given in "Treatise on Service Explosives, 1895." Nitro-glycerine.

Pure nitro-glycerine is a clear, heavy, oily liquid ; specific gravity 1 · 6, neutral to test papers, almost colourless and without

smell at the ordinary temperatures; it has an intensely sweet taste, and is an active poison.

It is difficult to ignite by contact with a flame; but it is very sensitive to friction or percussion, by either of which it can be easily detonated.

Gun-cotton.

Gun-cotton is prepared by the action of nitric acid on cellulose, or cotton. A full description of the method of preparation is given in "Treatise on Service Explosives, 1895."

Gun-cotton is without smell or taste, and is neutral to test papers. It inflames at a temperature of about 390° F., and burns off very rapidly with a bright yellowish flame, and almost without smoke or residue. It is very sensitive to percussion or friction, especially when warm, and may easily be detonated by either of these means.

Gun-cotton placed in about its own volume of acetone swells up at first and becomes transparent and gelatinous, and finally dissolves to a clear viscous liquid.

Acetone.

Acetone, used as a solvent in the manufacture of cordite, is one of the products of the destructive distillation of wood, or it may be obtained by distilling certain mineral acetates, such as those of lime, barium, or strontium.

Vaseline.

Vaseline, or mineral jelly, is a material obtained by the fractional distillation of crude petroleum oil at a temperature of 392° F. The variety used in the manufacture of cordite must have a flash point not below 400° F., a specific gravity not below ·87 at 100° F., and a melting point not below 86° F. Its use is to act as a deadener, to facilitate the shaping, to prevent brittleness, and to counteract metallic fouling.

Processes of manufacture of cordite.

The various processes in the manufacture of cordite are as follows :—

A.—Drying the gun-cotton.
B.—Weighing out and mixing the gun-cotton and nitro-glycerine.
C.—Incorporating.
D.—Pressing and reeling, or cutting.
E.—Drying.
F.—Blending and packing.

A.—*Drying the Gun-cotton.*

Drying gun-cotton.

The gun-cotton as it comes from the wet gun-cotton store contains from 40 to 45 per cent. of moisture. In this state it is laid out on trays with copper wire gauze bottoms arranged in racks in the drying stoves. The drying is effected by means of warm air blown into the stove by a circular fan running at a fairly high speed, the air being warmed by passing it through a series of pipes surrounded by steam and contained in a cylindrical chamber, or "heater." The temperature of the air-

blast, as it enters the stove, is not allowed to exceed 140° F. until the amount of moisture in the gun-cotton has been reduced to about 10 per cent.; after this, until the gun-cotton is dry, the temperature of the air-blast is reduced to 120° F. The actual temperature in the stove is never allowed to exceed 100° F. The gun-cotton is dried down to about 1 per cent. of moisture, the operation taking from 90 to 100 hours. The stove is then allowed to cool down, and when cool the gun-cotton is taken off the trays and placed loosely in wooden boxes, in which it is conveyed to the weighing room.

B.—*Weighing out and mixing the Gun-cotton and Nitro-glycerine.*

Weighing and mixing.

In the gun-cotton weighing room, the gun-cotton is weighed out into brass-lined wooden boxes, 27¾ lbs. to each box, and sent over in these boxes to the nitro-glycerine weighing and preliminary mixing houses. Each charge of nitro-glycerine, as soon as it arrives in this house from the washing house, is weighed off into gutta-percha jugs. The quantity of nitro-glycerine for a 27¾ lbs. charge of gun-cotton is 43½ lbs., and this amount is poured on to the gun-cotton in the brass-lined boxes. The contents of each box are mixed or rubbed up by hand so as to break up the gun-cotton and make it absorb the nitro-glycerine. This operation takes about half an hour, and in this condition the mixture is not nearly so sensitive or dangerous to handle or transport as either the dry gun-cotton or the liquid nitro-glycerine alone. The mixture is in this state known as "cordite paste."

C.—*Incorporating.*

Incorporating.

The cordite paste is next taken to the incorporating house. The incorporating machine is an iron box, on suitable supports, open at the top, and with a bottom shaped to form two semi-circular troughs, in each of which a spindle, with screw-shaped blades, revolves. The spindles turn in opposite directions, one moving at twice the rate of the other. They are driven by cog-wheels on a third spindle running underneath the machine, and so arranged that the spindles with the screw blades can be made to revolve inwards or outwards as desired. At the back of the machine there is an arrangement for tilting it so as to facilitate the removal of the contents. An iron jacket surrounds the lower portion of the machine, and cold water is circulated between it and the machine to keep down the temperature during incorporation.

The details of the process are shortly as follows:—

A portion of the charge of acetone is poured into the machine, and the blades are started to revolve inwards; the cordite paste is then ladled in with a wooden scoop, the remainder of the

acetone being added at the same time; the top of the machine is then closed to prevent the loss of acetone by evaporation, and the machine allowed to run for 3½ hours. The weighed quantity of mineral jelly is then added, and the machine set to work for another 3½ hours. For the last quarter of an hour the motion of the blades is reversed, which has the effect of breaking up the "cordite dough," as it is now termed, in which condition it is more easily filled into the press cylinders.

At the end of seven hours the gelatinisation of the gun-cotton, and its mixture with the nitro-glycerine by the aid of the solvent acetone, is complete, and the mineral jelly is also uniformly distributed throughout the mass. The cordite dough is then removed from the machine and placed in brass-lined boxes for conveyance to the press house.

In the incorporation of M.D. cordite the machines run for 3 hours before adding the mineral jelly and 3 hours after.

Smaller natures. For cordite for small-arm ammunition clarified jelly is used instead of the ordinary mineral jelly.

D.—*Pressing and Reeling, or Cutting.*

Pressing, &c. There are three natures of presses in use at Waltham Abbey for pressing the cordite, viz., the screw, the screw and hydraulic combined, and the hydraulic. The screw presses are used for the manufacture of small-arm cordite, and are combined with an automatic reeling arrangement for winding the cordite on to reels as it issues from the die. The screw and hydraulic combined and the hydraulic presses are for producing the larger natures of cordite, and they are provided with cutting gear for cutting the cordite to the required lengths as it passes from the press. In all these presses the cordite dough is forced through orifices of various diameter, according to the size of the cordite required, in passing through which the mixture hardens and comes out as long cords; it is then reeled up, either by hand or machinery, for the smaller natures, *i.e.*, up to size 10, and cut into lengths for the larger natures, *i.e.*, sizes 15 and above.

Size of cordite. Cordite varies in diameter and is made in sizes from ·03-inch upwards to ·7-inch; the various sizes are known as "3," "3½," "5," &c., these figures representing the number or hundredths of an inch in the diameter of the orifices through which the cordite is pressed, and therefore also approximately its diameter.

Tubular M.D. cordite. Cordite M.D. is now being manufactured in the form of a tube; the process of manufacture is the same as M.D. cordite up to the pressing, then it is pressed through a die which has a pin in the centre, so that the cordite comes out of the die in the shape of a tube, it is termed M.D.T., and when the size is stated it should give the external diameter and internal diameter, together with the length of the sticks, thus—

$$\frac{50-17}{26} = \begin{cases} \text{external diameter} = \cdot 5 \text{ inch.} \\ \text{internal diameter} = \cdot 17 \text{ inch.} \\ \text{length of stick, 26 inches.} \end{cases}$$

E.—*Drying.*

Drying. All cordite after pressing is dried in stoves to remove the acetone and any moisture. The stoves are heated by means of steam pipes to a temperature not exceeding 100° F. Small-arm cordite takes about three days, the larger sizes about six days, and the largest nearly three weeks to dry.

F.—*Blending.*

Blending. After drying the cordite is blended—that is, portions of a number of separate lots are mixed together; this is done to obtain greater uniformity of results when fired.

Cordite for Small Arm Blank and Webley Pistol Ammunition.

Small cordite. Cordite for blank ammunition is prepared from size 20, which as it is pressed is wound on to large reels, and after drying is cut into very fine slices by being passed through a machine much resembling a chaff cutter, 40 strands being fed into the machine at one time. The flakes should vary in thickness from ·008-inch to ·003-inch. After cutting it is twice sieved to remove large pieces and dust, and is then blended. It is designated $\frac{20}{\text{S.C.}}$

Cordite for the Webley pistol ammunition, Mark I., is prepared by slicing rifle cordite (size $3\frac{3}{4}$), and it is designated $\frac{3\frac{3}{4}}{\text{S.C.}}$, and for Marks II. and III., size 1, chopped $\frac{1}{\text{S.C.}}$

Appearance and Properties.

Colour. The consistency and appearance of cordite is somewhat that of a cord of brown india-rubber; in the smaller sizes made with clarified jelly the colour is lighter.

Smokeless. Cordite is practically smokeless; on explosion a very thin vapour is produced which is dissipated rapidly.

Slow burning. Compared with powder, cordite is very slow burning, the rate of burning varying according to the size of the cords, a charge made up of large size cords burning more slowly than one made up of small cords.

Igniter necessary. Cordite is difficult to ignite, and an *igniter* has always to be used to ignite the charge; after several experiments rifle fine-grain powder was found to give the best results as the igniting material. Igniters are dealt with on page 42.

Susceptibility to concussion. Cordite of small diameter and in short lengths is very susceptible to explosion by concussion; this susceptibility diminishes as the diameter and length increase; under all circumstances it

is more susceptible than gunpowder. This susceptibility is not such, however, as to necessitate any special regulations, other than those already in force for gunpowder, for its handling and stowage.

4·7-inch and 6-pr. cartridges filled with cordite have been fired at from the ·303 rifle at short range. In no case did any explosion occur, in the majority of cases the material ignited and burnt quietly away, in some instances it was not ignited.

Effects of fire on cordite ammunition.

The effect of bursting a shell filled with powder amongst cordite cartridges stowed in limber boxes was less than would occur with powder cartridges; the cordite did not explode, and some of the cartridges were not even ignited.

When ignited in the open, cordite burns quietly away; 5,000 lbs. of size 20 cordite were so burnt under circumstances similar to those experienced in a drying-room, and no explosion occurred.

Stability.

Exhaustive experiments, carried out to test its stability and constancy of composition, have shown that it keeps well in all climates.

Sweating.

When stored in open, or extensively perforated, boxes at high temperatures (110° to 140° F.), there is a perceptible loss of nitro-glycerine by evaporation. If, however, the cases containing the cordite be closed (not necessarily hermetically, but with screwed-down lids), no appreciable loss of nitro-glycerine will take place. It has been stored for long periods at 100° F. without injury.

If by any accident cordite should be wetted by fresh water, it may on an emergency be fired at once; but if it is desired to re-store it, it should be first thoroughly dried in a properly ventilated building. Cordite which has been immersed in salt water should be washed in fresh and then dried.

Effect of heat.

Though exposure to heat does not affect cordite in respect to its constancy of composition, it does affect its constancy of ballistics if the charge is fired when in the heated condition. Any trials for constancy of ballistics have clearly shown that variations in temperature which do not affect the velocity and pressure given by a powder charge do materially affect those given by one of cordite.

Examination and Proof.

After the cordite has been through all the above processes of manufacture it is subjected to the following tests, which may be divided into chemical, mechanical, and ballistic.

The *chemical* tests are :—

(1) *Analysis :* to ascertain that the percentage composition is correct.

(2) *Moisture test :* to ascertain that it does not contain more than a certain percentage of volatile matter.

(3) *Heat test :* to determine its freedom from uncombined acid. (*See* page 23.)

The *mechanical* tests are :—

(1) *Inspection :* to see that the cordite is dry, homogeneous, and free from air-holes; and in the case of $\frac{20}{\text{S.C.}}$ that it is free from dust.

(2) *Measurement :* to see that the sticks are within the limits laid down in the specifications for diameter and length.

The *ballistic* test is a firing proof for—

(*a*) Muzzle velocity,
(*b*) Pressure in bore,

which must come within limits laid down by specification.

Cordite when fired for proof is heated to 80° F. and fired hot.

Storage.

Cordite for transport and storage is classed as Group I., Class I. It is laid down that it should not be stored in magazines the temperature of which habitually exceeds 100° F., nor should the temperature be less than 45° F. The magazine should be dry, and under the same hygrometric and other precautions as a powder magazine.

Size.

As stated previously, cordite is made in various sizes from ·01 upwards.

When cut in specified lengths it is distinguished 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 lengths of the sticks in inches.

M.D.T. cordite, as previously stated, has both the external and internal diameters, also the length of stick.

The following table gives the sizes which have been adopted for use in the various guns in the Service:—

Cordite Mark I.

Size.	Nature of Gun supplied to.
50	12-inch B.L., Marks VIII., IX.
44	13·5-inch B.L., Marks I. to IV., and 9·2-inch Marks VIII. and X.
40	9·2-inch B.L., Mark VIII.
30	12-inch B.L., Marks III. to VII., 10-inch B.L., Marks II. to IV., 9·2-inch B.L., Marks III., and V. to VII., 6-inch Q.F. and Q.F.C.
20	6-inch B.L., Marks VII. and VIII. 4·7-inch Q.F., Marks I. to IV. Primers for B.L. guns above 6-inch, when using powder charges, and sliced for ·303-inch blank ammunition.
15	4-inch Q.F., Marks I. to III. and 12-pr. 12-cwt. Q.F.
10	12-pr. 8 cwt. Q.F. (and for the 12-cwt. gun when no size 15 is available) and reduced charges 6-inch Q.F. for gunnery ships.
7½	Reduced charges for 4·7-inch Q.F. guns for gunnery ships.
5	4-inch Q.F. reduced charges and 3-pr. and 6-pr. Q.F.
3½	·303-inch ammunition and for composite charges.
3½ S.C.	Mark I. Webley pistol ammunition.
3	·45-inch machine gun ball.
1	Marks II. and III. Webley pistol ammunition.

Modified Cordite.

Size.	Nature of Gun supplied to.
45	12-inch B.L., Marks VIII. and IX.
37	9·2-inch B.L. Mark X.
26	7·5-inch and 6-inch B.L. Marks VII. and XI. } except 6-inch guns on twin mountings.
16	10-inch Mark II. to IV. - - - } except 6-inch guns on twin mountings.
	6-inch B.L. Mark VII. - - - } except 6-inch guns on twin mountings.
11	12-pr. 12-cwt. and 18-cwt. Q.F.
8	Full charges for 3-pr. Vickers semi-automatic. Mark I. and reduced charges for 12 pr. 18-cwt.
4½	Reduced charge for 3-pr. Q.F. Vickers semi-automatic.

Picric Acid and Lyddite.

Picric acid.

Picric acid is a true nitro-substitution compound obtained by the action of nitric acid on phenol or carbolic acid, a constituent of coal-tar oils. It is a bright yellow crystalline body with an intensely bitter taste. It is almost insoluble in cold, and only

slightly soluble in hot, water, but dissolves readily in alcohol or ether. It melts at 252·5° F. to a yellow liquid.

Heated briskly to 572° F. in the open it burns rapidly; if confined, it explodes. It can be readily detonated by fulminate of mercury.

Lyddite, which is used as the bursting charge of shell, is simply picric acid brought into a dense state by fusion. Lyddite.

Picric powder D.M. is composed of 57 per cent. dried saltpetre and 43 per cent. dried picrate of ammonia. Both ingredients are passed through a 36-mesh sieve, ground under runners so that the crystals cannot be seen by the naked eye, mixed by being placed in drums containing lignum vitæ balls of equal weight to the charge, viz., 100 lbs. The drum revolves about eight times per minute, the powder is then placed in waterproof bags and then in barrels with 1-inch blue band on outside. It is light yellow in colour. Unconfined and on contact of flame it only burns locally, and requires strong confinement in order to develop its explosive power. It is used for exploders of lyddite shell. Picric powder.

Heat Test for Cordite.

Twice during the year, viz., 31st March and the 30th September, samples of the cordite stowed in magazines of H.M. ships are to be sent to the nearest ordnance depôts for heat test; the quantity sent being one unopened package from each magazine, the package to have a label pasted on containing the name of ship, the nature of magazine taken from, date, and ordnance depôt it is being sent to; also the words "For heat test." The Forms S. 1429, Report of Inspection of Cordite, and S. 1147, Magazine Record, are to accompany the samples sent in. Form S. 1429 should contain the nature of magazine from which the cordite is taken, highest and lowest temperatures recorded, also the temperature of the open air at same time, number of days over 100° F., and the number of consecutive days over 100° F., the nature of cartridges stowed in the magazine, date of receipt on board, whence received, number of cartridges in the magazine, pattern of cases in which packed, size of cordite, number of lot, actual number of cartridges landed for inspection, where made up and date, and the date of last inspection. This information should be inserted in columns 1 to 14 and 19, the remainder being filled in by the Inspecting Officer. This form is to be sent in duplicate. Form 1147 should contain the different numbers of cartridges of each lot stowed in the magazine. Samples of these forms are inserted in this book.

When cordite is supplied to ships the Ordnance Officer will supply a list of the lot numbers, and a record should be kept on board of the lots from which Forms S. 1147 and S. 1429 can easily be compiled, care being taken when carrying out the quarterly practices that the record of lot numbers is corrected.

The samples to be sent in should be taken from that which has been longest on board the ship.

The Test.

The inspecting officer, on receipt of the samples sent in, will take the cordite to be tested from the interior of the charge—not less than three sticks from size 30 and above, and more as necessary from the smaller sizes. Ends of the sticks are also cut off and are not used for the heat test. The sticks to be tested are cut in halves, one half being set aside for sending to Woolwich, should the sample be found to be unserviceable, together with about 1 lb. of the remains of the original cartridge, for special examination.

The half-sticks to be tested are cut in small pieces and are then passed through a small mill which grinds them up. The ground material falls on to a nest of two sieves: that which falls through the first sieve and remains in the second is taken for the test, that which goes through the second sieve being merely dust and no good for testing. The first portion which comes through the mill is also discarded, on account of the possible presence of some foreign matter.

In composite cartridges no test is taken of the size $3\frac{3}{4}$ cordite, provided the larger size stands the test; if, however, the larger size is unsatisfactory, then samples of the $3\frac{3}{4}$ are taken.

The ground and sifted material prepared for the test must be kept in a dark place, freely exposed to the air, for 24 hours before testing.

The quantity used is 25 grains, which is accurately weighed and placed in a glass tube (Fig. 2), and collected in the bottom by gently tapping; the glass tube has an india-rubber stopper through which passes a glass rod, at the end of which is a platinum silver hook. Before inserting the stopper and rod a piece of test paper is placed on the hook; this test paper is prepared by treating filter paper with a mixture of starch and potassium iodide in solution; the dimensions of the paper are ·4 in. by ·8 in., and it is kept in coloured glass-stoppered bottles. This paper is liable to deterioration, and should occasionally be tested by dilute acetic acid; on any discoloration taking place the test paper is to be rejected.

It is most important that the test paper should not be touched by the hand during the operation, and forceps are supplied for placing it on the P.S. hook, a small hole being made in the paper near the upper edge with a pin, then the upper edge of the paper is moistened with a mixture of glycerine and water, applied by the solid rod of the stopper in glycerine bottle; this operation requires great care, as only sufficient mixture is required just to moisten the upper half of the paper, if too much is applied the glycerine will creep down as the paper is hanging on the hook and will cover the whole of the paper.

The stopper with rod and test paper are then put in the test tube and adjusted so that the paper is about half-way down the tube.

The test tube is then inserted in a water bath, filled with water to within ¼ inch of top, which has been heated to a temperature of 160° F.

The water bath, *see* Fig. 1, has a lamp or gas jet under it to keep the water at the proper temperature. The bath consists of a spherical copper vessel, which stands on a tripod; the tripod is surrounded by a thin screen of copper, the lamp or gas jet being placed immediately under the bath. There is a cover (Fig. 3) which fits on the top of bath, which has six holes for test tubes and one for the thermometer, there being small brass springs (Fig. 4) soldered to the cover to keep the tubes in position.

The test is completed when the faint brown line which after a time makes its appearance at the margin between the wet and dry portions of the test paper equals in depth of tint the brown line on the standard test paper supplied.

Should the line not equal the standard paper after the test tube has been immerged for six minutes the cordite is considered serviceable, should it make its appearance under six, but over four, minutes, is sentenced doubtful; but before doing this three tests should be taken, and the mean of the three considered as the true test, in which case, should that fail, further tests are taken from the same magazine, of the same lot, and should that fail, of the next longest on board, until cordite is found which stands the test, all the lots of cordite which do not stand the test being landed. The cordite sentenced as doubtful, viz., over four minutes but not six, together with all that is in the same magazine with the same manufacturer's initials and number, *i.e.*, of the same lot, is to be landed and not to be issued, except in case of emergency, until the final sentence of the Chief Inspector at Woolwich.

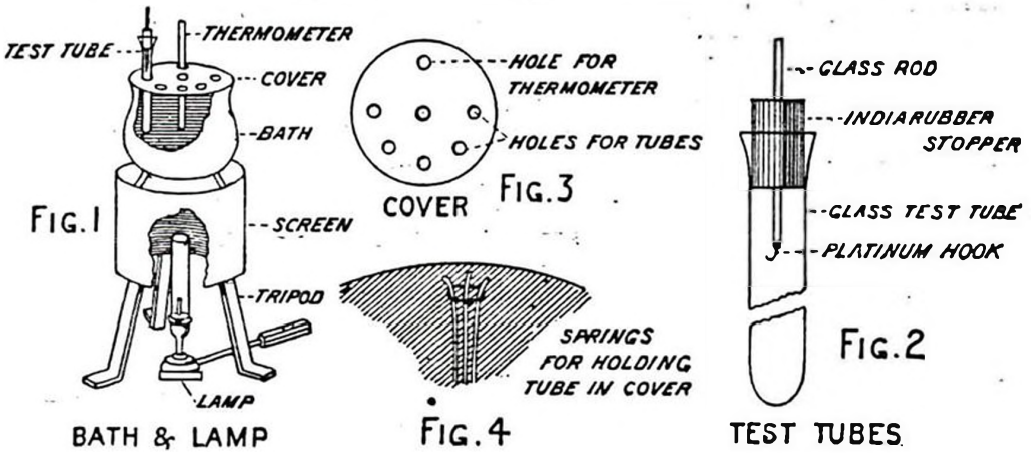
The cordite which does not stand the test for four minutes is sentenced unserviceable, and will be destroyed, together with all that of the same lot in the same magazine.

In the case of a lot of cordite being condemned, the Commander-in-Chief or the Senior Naval Officer will inform the Admiralty by telegraph. The Admiralty will inform all other Ordnance Depôts.

Precautions in Testing.

The heat test is a very delicate one for the presence of free acid, and the presence of the slightest trace of acid from any extraneous source will render the test useless and misleading. The greatest care must therefore be taken that there are not traces of acid on any of the articles used or on the operator's hands, and that the laboratory is free from acid fumes, and it is better to carry out this test in a separate room where no

chemical testing is done. The handling of the cordite should be avoided as much as possible. No direct sunlight should be allowed to reach the cordite before or during the test.



Modified Heat Test.

Where there is no testing apparatus supplied, another test may be used, known as the modified heat test. It consists of 1 oz. of cordite to be tested cut up moderately fine, and placed in a small clean and dry flask or bottle, together with a piece of iodised starch paper and a piece of ordinary white filtering paper of the same size, both dry, the flask or bottle being closed with a stopper or clean cork. The flask should then be put in a cool and dark place and left for 24 hours.

After the expiration of that time the test paper should be examined for discoloration. If the cordite is in good condition no discoloration of the test paper will take place.

Cordite sometimes has the surface moist, which is called sweating. This may be due to the exudation of nitro-glycerine, which is liable to take place when the cordite has been subjected to temperature below 45° F. and again warmed. Below 45° F. the nitro-glycerine freezes and crystallises on the surface, and the melting of the crystals forms the sweating. The sweating has sometimes an oily appearance only, but at other times extends to drops on the surface of the sticks; it does not injuriously affect the cordite, and if it occurs in made-up cartridges no action need be taken, but if it appears on cordite in bulk, the cordite should not be handled until it recovers its normal state, which it will do (if its temperature be kept above 45° F.) by the re-absorption of the nitro-glycerine; when this is done the cordite will be considered serviceable.

An oily appearance is also sometimes seen on cordite which has been subjected to temperatures approaching or exceeding 100° F.; this is due to exudation of mineral jelly and has no injurious effect on the cordite.

To distinguish the exudation of nitro-glycerine from that of mineral jelly, wipe a stick of the sweating cordite with a strip of clean thin blotting paper about $\frac{1}{4}$ inch wide, so that the stain from the exudation shall appear about the centre of the strip. Then, in some comparatively dark place, hold the strip in a horizontal position and light it at one end. If the exudation is nitro-glycerine the flame will travel faster and become distinctly green on reaching the stain.

CHAPTER III.

Cartridges for B.L. Guns.

B.L. Guns.

Cartridge.

For safety, convenience, and rapidity in loading, the powder, or cordite, for charges of guns is placed in a bag, and is then called a "cartridge."

The material of which the cartridge bag is made should possess the following qualifications :—

Requirements of the bag.

(1) Strong enough to bear reasonable knocking about when filled, and to stand the wear and tear of travelling.

(2) Sufficiently close in texture to prevent any powder dust working through it.

(3) Easy for the flash from the tube to penetrate.

(4) Lastly, and this is of the greatest importance, the material should be entirely consumed in the gun when fired, or at least should not leave any smouldering fragments or sparks in the bore.

Silk cloth fulfils the above conditions more perfectly than any other material, and is therefore used for all B.L. cartridges.

Classes of silk cloth.

Silk cloth is made of the refuse silk from the outside of the cocoons. For making cartridge bags it is divided into three classes, according to its texture and strength, as follows :—

Class No. 1 is used for all powder cartridges below 14 lbs. in weight.

Class No. 2 is used for all powder cartridges from 14 lbs. to 85 lbs. inclusive, and for all cordite charges from 6-inch to the 12-inch Mark VII.

Class No. 3 is used for powder cartridges above 85 lbs., all prismatic charges, and cordite charges for the 12-inch Mark VIII. and IX., and 13·5-inch B.L.

Heavy prismatic charges.

For the powder charges for the 12-inch B.L. and larger B.L. guns, the cartridges are made with two containing bags, the inner one being of No. 2 class, and the outer one of No. 3 class, silk cloth.

Test for silk cloth.

Each class of silk cloth is required to possess a minimum strength, and 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 stress is gradually applied, and the different classes should stand a stress both warp and weft as follows:—

No. 1 class	- - - - -	150 lbs.
„ 2 „	- - - - -	200 „
„ 3 „	- - - - -	300 „

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. 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 fit for use:—

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

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

Cartridge bags for the other charges, of granulated powders, B.L., are made of two pieces, one nearly rectangular, to form the body, and one circular, to form the bottom.

Marking of cartridge bags.

After being cut out they are marked in printers' ink, with the nature of the gun in which they are to be used, the weight and description of the powder they are to contain, and also for the positions of the hoops and the choke, *see* woodcut, page 32.

Paint must not be used for marking the cartridge, as it holds fire.

After marking, the bag is sewn together, either by hand or by machine, with silk thread or twist.

Red shalloon disc.

Cartridge bags for prism powder have a hole cut in the top and bottom; over this hole a piece of silk twist netting is securely fastened; and, after filling, a disc of red shalloon with a braid loop is secured over the netting by shellac.

Beckets.

Cartridge bags to contain 30 lb. charges or over, and all cartridge bags for prismatic powder, are fitted with silk braid beckets for convenience in handling.

Silk braid for beckets is made in two sizes, 1 inch and 1½ inch, and should support a weight of 160 and 250 lbs. respectively for test.

Silk braid for hooping is made in two sizes, ·35 and ·65 inch should support 28 and 85 lbs. respectively.

Shalloon.

Shalloon was originally introduced on account of its being a thinner material for the flash from tube to penetrate than silk cloth;

it is now used for 7 and 8 drm. primers, discs in fuzes, &c., and for that part of burster bags nearest the fuze hole, and saluting charges for 3-pr. and 6-pr. Q.F. guns.

Charges.

B.L. Guns.

Charges are known as "Full," "Reduced," "Practice," "Blank," and "Saluting."

Powder charges.

The "Full" charges for the 12-inch Marks III. to V., using prismatic powder, are made up in *quarters*, and for the 16·25-inch B.L., in *eighths*.

Reduced and practice.

The "Reduced" and "Practice" charges of all guns using prismatic powder are *three-quarters* and a *half* respectively of the full charge.

Blank.

6-inch B.L. and below have special charges of L.G. powder for use as blank only.

Cordite charges.

Cordite charges for the 12-inch B.L. Marks III. to Vw. and IX., are supplied in quarters; those for the 12-inch B.L. Mark VIII., and for the 13·5-inch, 10-inch, 9·2-inch, and 7·5-inch B.L. in halves and quarters; the earlier charges for the 6-inch B.L. Marks VII. and VIII. were made up in halves; later charges for these guns and for the 6-inch Mark XI. are made up in one third and two thirds laced together.

Blank firing.

Cordite charges are unsuitable for blank firing, and are not to be used for that purpose in any gun.

Making up Cartridges.

Cartridges filled with Grain or Cubical Powders.

Charges of granulated powder are made up as follows:—

(1) Care is taken to see that the cartridge bags are thoroughly dry before being filled.

(2) The proper charge is carefully weighed out and inserted into the cartridge bag by means of a copper funnel.

(3) The cartridge is then choked by drawing together the mouth of the cartridge into several pleats with a 4-inch phosphor-bronze needle, threaded with two strands of silk twist. After drawing the mouth of the cartridge together, three turns are taken round the pleats, and the choke thus formed is further secured by passing the needle three times through it.

Charges with beckets have the choke first formed and temporarily secured by two turns, the becket is then drawn tightly in on both sides, three turns taken round the choke, and the needle passed through choke and becket five times, the becket forming a loop 3½ inches in length over the choke.

(4) The cartridge is then made up to its proper length and diameter by hooping, the braid forming the hoops being drawn tight so as to make a firm cartridge.

(5) The cartridge then has the ends of the choke cut to a convenient length, which should in all cases be less than half the diameter of the cartridge, and the superfluous ends of the hoops are also cut off.

Cartridges filled with Prismatic Powder.

Cartridges for guns using prism powders are made up as follows :—

The prisms are built up by hand in a zinc envelope, or "former," open at both ends and having as many sides, and being of the same length as the finished cartridge; it is fitted with a wooden bottom secured by three brass screws.

The "former" is placed on a pedestal less in diameter than itself and filled with the required number of prisms, the prisms being arranged in regular layers with the same number in each layer, except the top layer, which is sometimes incomplete, to adjust the weight.

The cartridge bag is then drawn down over the "former," the screws holding the wooden bottom withdrawn, and the "former" drawn down from between the prisms and the cartridge bag; the cartridge is then hooped, commencing from the bottom, and the ends of the hoops cut off. The cartridge is then reversed, the wooden bottom removed, and the cartridge weighed, the necessary prisms being added, or removed, from the top layer to bring it up to the correct weight.

The top of the cartridge bag is then sewn on. The top and bottom of the cartridge have a hole in the centre fitted with network, which is covered over with a shalloon patch to prevent powder dust falling into the package; this patch is always to be torn off the rear end of the charge before entering it in the gun.

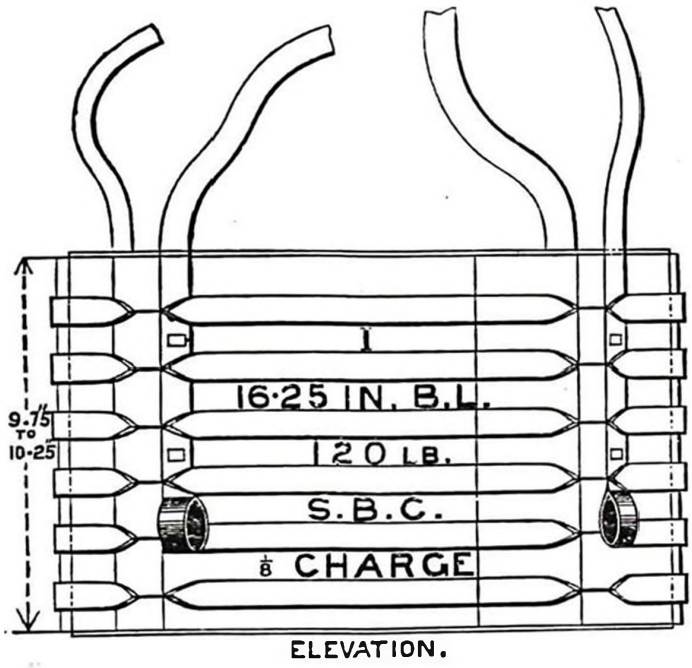
Priming.

Those cartridges which are made of prism brown and S.B.C. have the centre prisms in the top and bottom layers of black powder, these act as a primer and prevent hang-fires; the number of prisms forming the primer vary according to the size of the charge.

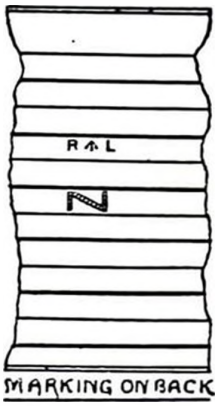
Charges for 16·25-inch B.L. gun.

There is a special feature with regard to the $\frac{1}{8}$th charges for the 16·25-inch B.L. gun. These cartridges are very short in comparison with their diameter, and are very liable to fall over when loading; to overcome this, four braids are fastened longitudinally on the outside of the cartridge, as shown in figure below, the lower ends being made into loops, into which the ends of the braids of the next cartridge below it are fastened.

Scale $\frac{1}{6}$.



ELEVATION.



MARKING ON BACK

Cordite Mark I. Cartridges for B.L. Guns.

The following B.L. guns have cordite charges as below :—

Nature of Gun.	Weight of Full Charge.	Size Cordite.	Weight of Primer, R.F.G.	How made up.	Marks of Cartridges.	Shape.	Remarks.
			Pdr. oz.				
6-in. B.L. Marks VII. and VIII.	20 lb.	20	2	Halves	Mark I.	Cylindrical.	
9·2 in. B.L. Marks III., and V. to VII.	53 lb. 8 oz.	30	8	Half and quarter.	„	Conical.	
9·2-in. B.L. Mark VIII.	63 lb.	40	8	„	Marks I., II.	„	
„ „ „	63 lb. and 3 lb.	44 3¾	6	„	Mark III.	½ charge cylindrical. ½ charge conical.	
9·2-in. B.L. Mark X.	99 lb. and 4 lb. of size 3¾.	44	8	„	Marks I., II.	Conical.	
10-in. B.L. Marks II. to IV.	76 lb.	30	8	„	Marks I., II., III.	„	
12-in. B.L. Marks III. to Vw.	88 lb. 8 oz.	30	8	Quarter	Marks I., II.	„	
12-in. B.L. Mark VIII.	167 lb. 8 oz. or 166½ lb. and 7½ lb. of size 3¾.	50	8	Half and quarter.	Mark I. Mark I.	Cylindrical.	
			12	„	Marks I., II.		
12-in. B.L. Mark IX.	201 lb. 8 oz. and 9½ lb. of size 3¾.	50	12	Quarter	Marks I., II.	„	
13·5-in. Marks I. to IV.	177½ lb. and 10 lb. of size 3¾.	44	8	Half and quarter.	Mark I.	„	
			12	„	Mark II.	„	

M.D. Cordite Cartridges for B.L. Guns.

Nature of Gun.	Weight of Charge.	Size Cordite.	Weight of Primer.	How made up.	Mark of Cartridge.	Shape.	Remarks.
			Pdr. oz.				
6-in. B.L. Mark VII. -	23	16	2	Halves	I.	Cylindrical.	
" " " " -	29	26	2	$\frac{2}{3}$ and $\frac{1}{3}$	"	"	
" " " XI. -	$32\frac{10}{16}$	26	2	"	"	"	
7·5-in. " " I. -	$62\frac{3}{4}$	26	6	Halves and quarters.	"	"	
9·2-in. " " X. -	120	37	8				
10-in. " " IL to IV.	80	16	8	"	"	"	
12-in. " " VIII. -	200	45	8	"	"	"	
" " " IX. -	254	45	12	Quarters	"	"	

6-inch B.L. Marks VII. and VIII.

There are three descriptions of charges for these guns. They differ in their weight and the nature of the cordite used, the latest charges being of M.D. cordite.

The latest charge is 29 lbs. of size 26 M.D. cordite, made up in $\frac{1}{3}$rds and $\frac{2}{3}$rds, and similar in construction to the charge for the Mark XI. (*see* Plate II.). The $\frac{2}{3}$rds charge is used as a practice charge.

The 23-lb. charge is made up in halves, each of $11\frac{1}{2}$ lbs. of size 16 M.D. cordite.

The body of the cartridge is made of No. 2 silk cloth. The top consists of two layers of shalloon and a ring of two thicknesses of silk cloth stitched together ; the two layers of shalloon are stitched across the middle and enclose a primer of fine grain powder.

Four hollow cylindrical felt wads are stitched to the silk cloth ring of the top, the purpose of which is to prevent the primer from coming in contact with the heated breech-block.

The lower end of the body is strengthened by a band of broad braid, and the lower hoop is passed in and out of the cartridge and strengthening bands, thus forming a jackstay for a lacing of braid by which the bottoms of the half-charges are laced together, the ends of this lacing being secured together by a slip-knot.

The above charges are not suitable for guns mounted on the twin mountings of the Monmouth type, owing to their being too long for the hoists.

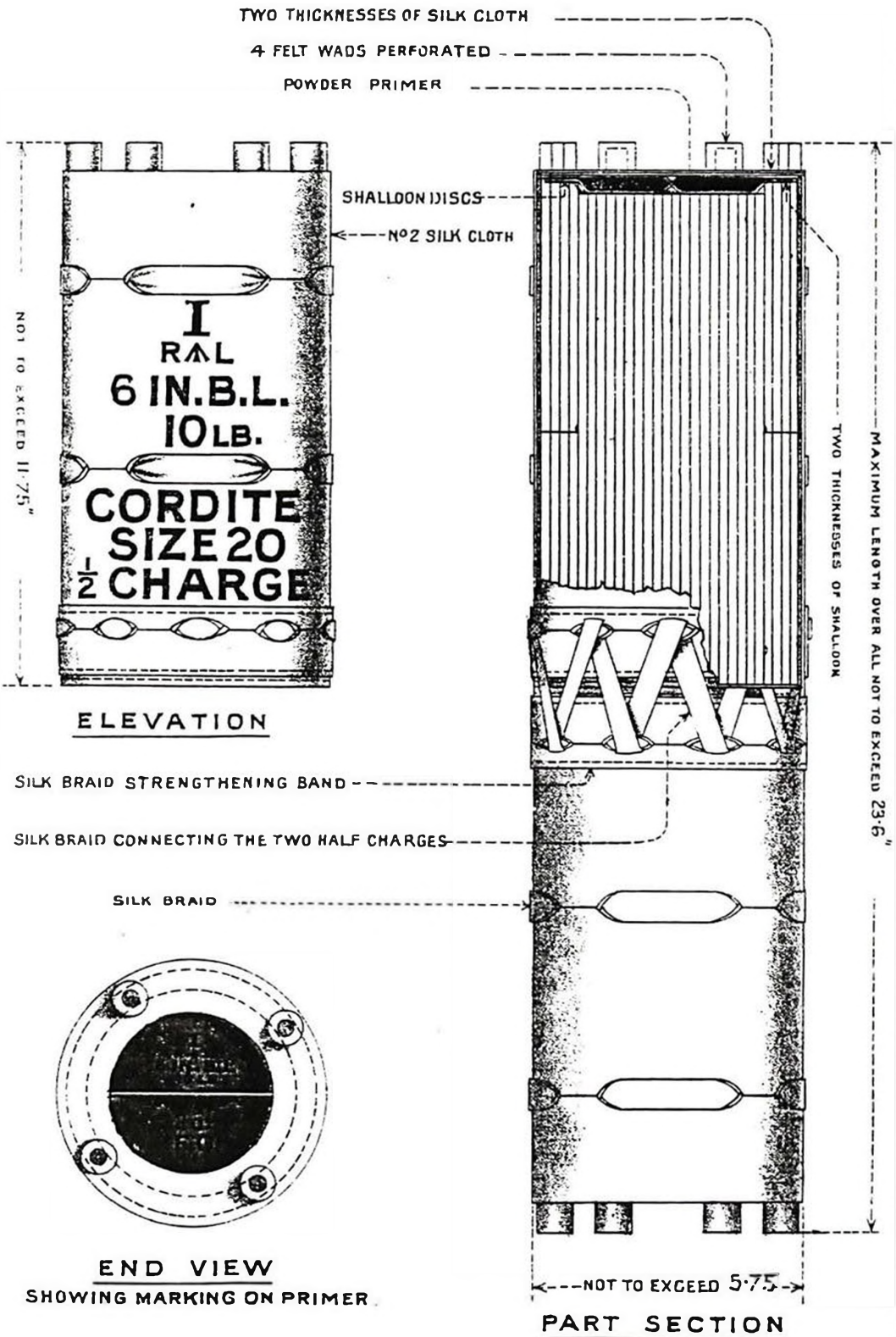
The 20-lb. charge of size 20 cordite Mark I. is similar in construction to the modified cordite charge, except that the outer layers of cordite are made up of two short sticks, *see* Plate I.

CARTRIDGE B.L.6" 10LB. CORDITE SIZE 20 (MARK I) | C

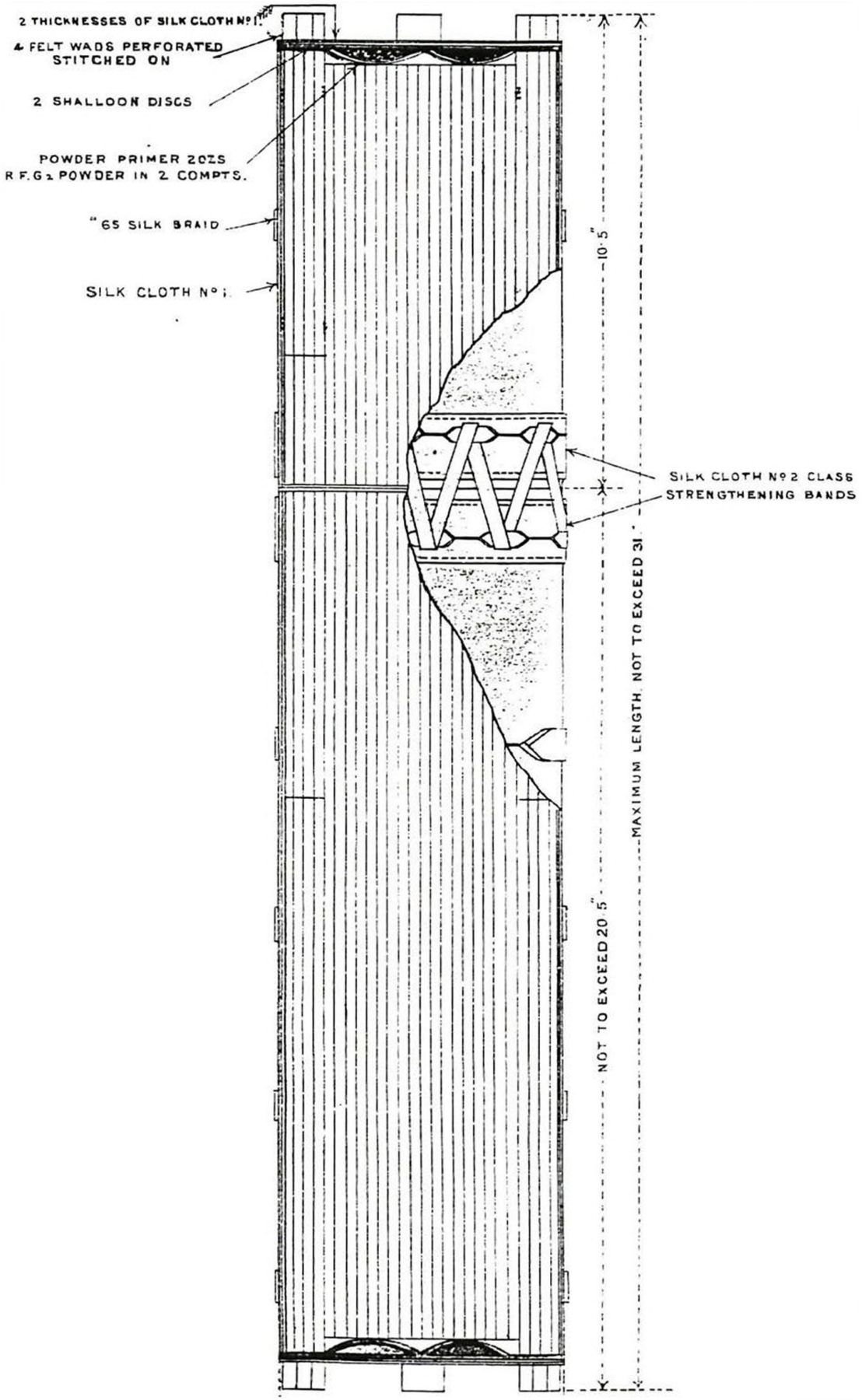
SILK CLOTH. HALF CHARGE MARK VII TO VIII GUNS.

TWO CARTRIDGES TIED TOGETHER AS SHOWN ARE ISSUED FOR SERVICE WHEN REQUIRED

SCALE 1/4.



CARTRIDGE B.L. 6 INCH 21 LBS. 12 OZS. AND 10 LBS. 14 OZS. CORDITE SIZE 26.
SILK CLOTH. 2/3 & 1/3 CHARGES FOR MK. XI GUNS. TOTAL 32 LBS 10. OZS



The charge for the B.L. gun Mark XI. is made up in $\frac{1}{3}$rds and $\frac{2}{3}$rds; each of these charges being laced together.

The charge consists of 32 lbs. 10 oz. of M.D. cordite, size 26.

In other respects the charge is similar to the earlier 6-inch charges.

The charges for the heavy B.L. guns, with the exception of the 10-inch and 9·2 B.L. earlier charges, are made up cylindrical; those for the 10-inch and early 9·2-inch have the end which carries the igniter of larger diameter than the other.

These charges are usually made up of full-length sticks of cordite—in some cases the sticks are 26 inches long; a core of these sticks is first formed, then some rings of shorter sticks are placed round the end of the core and the charge made up with full-length sticks outside. These are hooped round with silk twist, thus bending the outer sticks.

In the latest charges several modifications in the building up of the charge have been made.

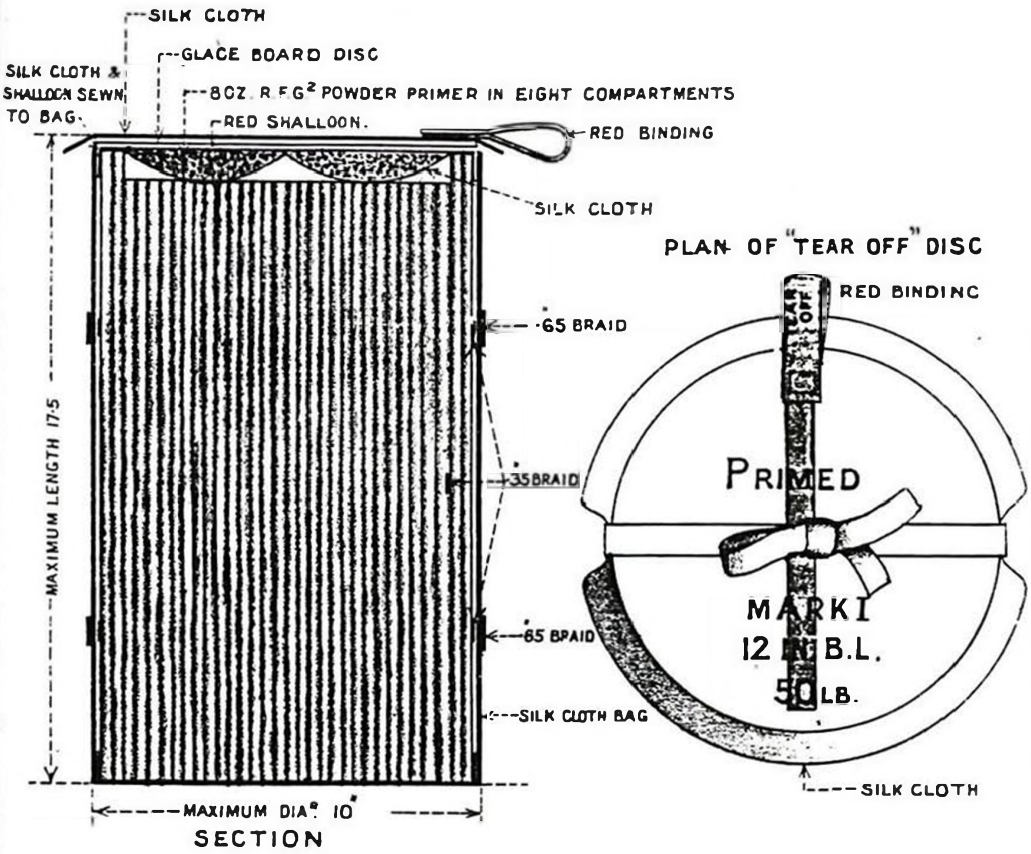
The silk cord passing through the centre of the core, together with the lifting bands on the base of the charge, and in the heavier charges, those on the body also, have been omitted. In place of the lifting bands the following has been substituted: Two loops of silk braid are sewn on the cartridge bag near the primer end, and another piece of silk braid is rove through the loops and is tied in the form of a bow (which can be easily slipped) on top of the "tear-off" disc, it can then be used for lifting purposes; but before placing the charge in the gun, the band should be slipped and unrove from the beckets, and thrown on one side. After that the "tear off" disc is torn off, and proceed as with the old pattern charges.

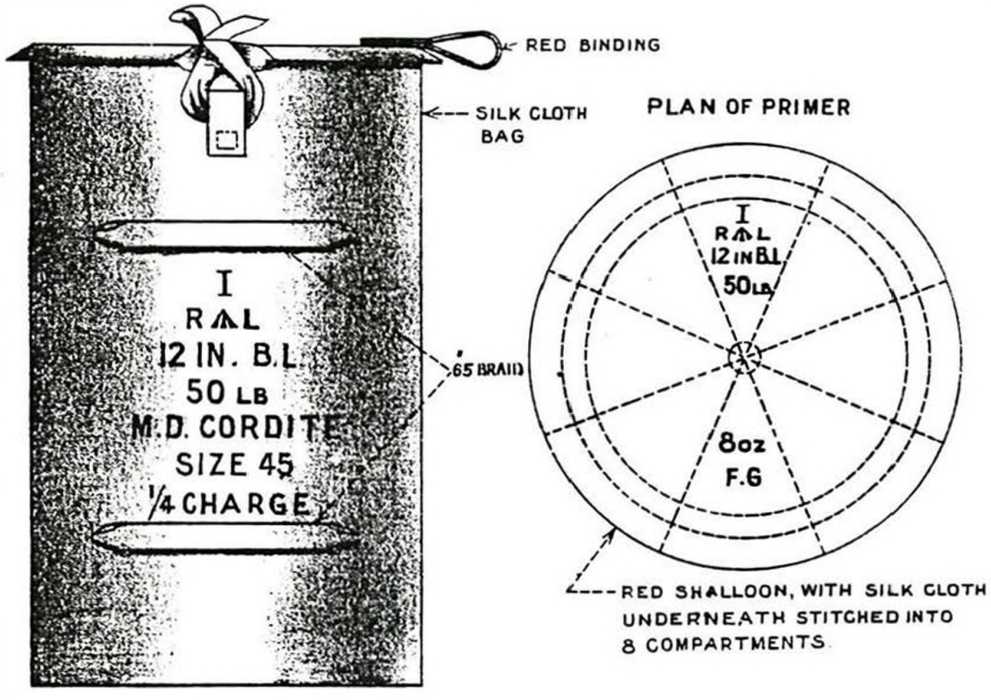
The 200-lb. M.D. charge for the 12-inch Mark VIII. guns, as shown in Plate IV., is only for use in certain ships where the hoisting cages are large enough to take this charge, other ships carrying these guns will still use the 174-lb. composite charge. But the method of building up of the M.D. charge of 200 lbs. for the 12-inch Mark VIII. is typical of the guns mentioned in the previous paragraph.

The cylindrical charges are plain bundles of sticks, but where, as in the 12-inch Mark VIII. charges, the sticks are not long enough to complete the half-charges, the charge is built up in layers. Thus, in the composite half-charge for the Mark VIII. gun, the core is composed of two bundles of cordite, each stick being about 17 inches long. The bundles are placed end on, and succeeding layers of full-length sticks are placed round so as to break the joint, the ends of these layers being made up with short sticks. The outside layers are, like the core, made up of full-length sticks.

CARTRIDGE B.L. 12 INCH 50 LB. M.D. CORDITE SIZE 45.

QUARTER CHARGE, FOR MARK VIII GUNS IN CERTAIN SHIPS.





ELEVATION.

Recess for powder primer.

In all cases except the latest charges the cordite is built up round a cord of silk twist. Also an annular recess is formed at one end for the primer to lie in. This can be seen in Plate III.

Putting on the bag.

The becket in the centre of the base of the bag having been attached to the silk twist core mentioned above, is drawn tight into the charge by it, and the bag is then drawn up over the charge.

The bag is of No. 2 silk cloth.

The primer is then placed in the space left in the top of the cordite for it, and the outer edge of the shalloon disc of the primer drawn over the charge and the bag sewn to it.

The charge is closed by a disc of glazeboard covered with silk cloth, which is sewn to the bag in four places, the silk twist cord having previously been rove through a hole in its centre. This disc is fitted with a loop and marked in red with a cross and the words *primed* and *tear off* in black.

Primers.

There are two different patterns of primer, the latest consisting of a circular disc of red shalloon and one of silk cloth to go next the cordite.

The two discs are sewn together near the centre and round the edge, and radially, forming compartments, to prevent the contents all falling to the lowest part and leaving none at the highest where it is most required, being in line with the vent. The bag thus formed is filled with grained powder in each compartment. The silk cloth disc being made to bag somewhat, the primer sits down in the annular recess in the cordite as before, and the shalloon disc lies flat over the top of the cartridge. The shalloon disc is of greater diameter than the cartridge, and the outer edge being fitted with a draw-string, the edge is turned down over the cordite and the string pulled tight and secured. The edge of the bag is then sewn to the shalloon all round.

The primer which will be found in the earlier charges is known as the "lifebuoy pattern."

It consists of a bag of shalloon made in the form of a ring divided radially into four compartments, and is placed into the recess left in the top of the cordite, and the outer edge of the shalloon stitched to the edge of the bag. Silk netting is then placed over the primer, and is also sewn to the bag, and the charge is closed by the "tear-off" disc.

Putting on the bag.

The primer for the 9·2-inch and above is 8 oz. of grained powder, except the 12-inch Mark IX., which is 12 oz.

Composite charges.

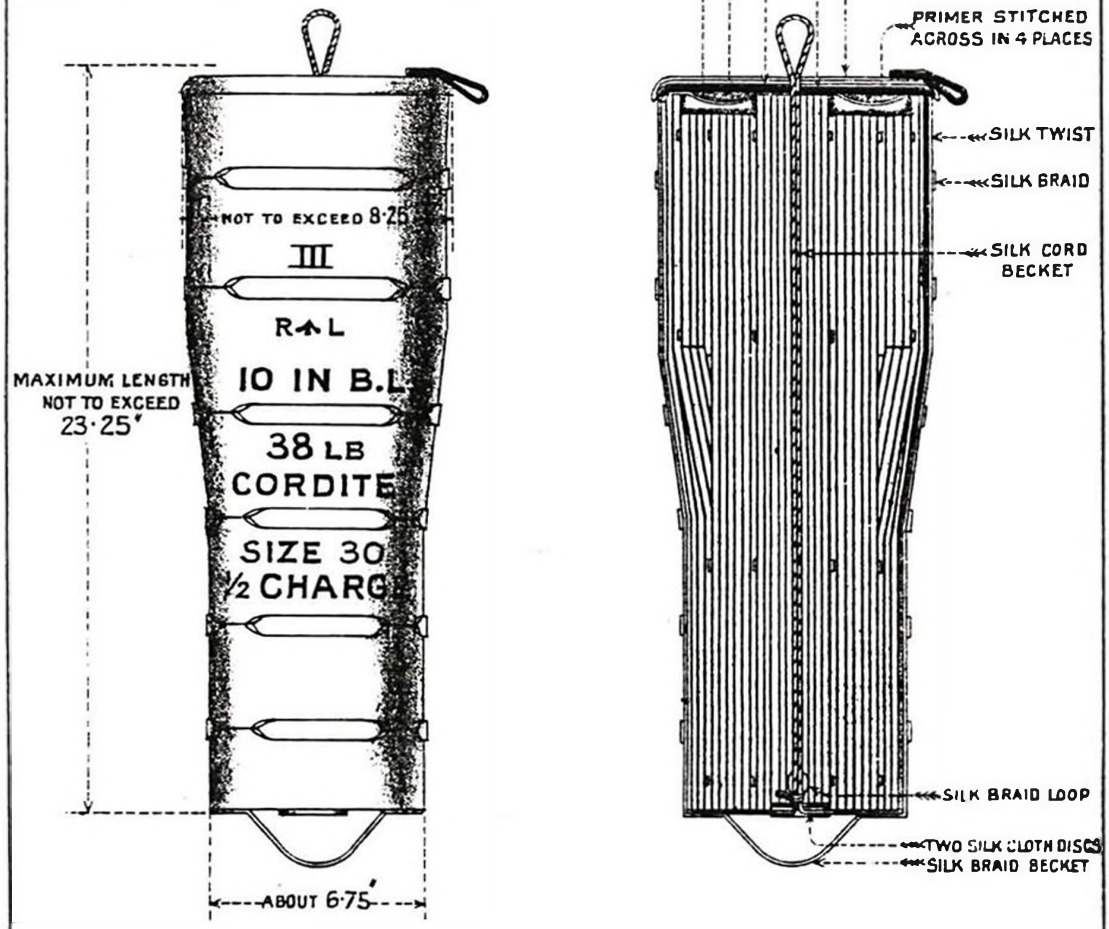
Major Holden's method of making up heavy cordite cartridges is to introduce a quantity of smaller-sized cordite. This has the effect that the pressure in a gun rises much sooner on firing than with the older charges, although the maximum pressure is

CARTRIDGE B.L. 10 INCH 38 LB. CORDITE

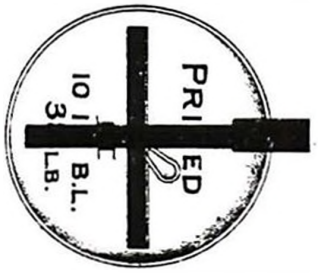
SIZE 30 MARK III.

SILK CLOTH HALF CHARGE

SCALE = ONE SEVENTH



THE 8 INCH, 9·2 INCH MARK VII AND BELOW 10 INCH B.L. AND 12" UP TO THE MARK III ARE MADE UP AS ABOVE, EXCEPT AS REGARDING WEIGHTS AND SIZE OF CORDITE.



not increased. The cordite used is size $3\frac{3}{4}$, in strands of 120 threads, wound spirally round a core formed of the larger cordite and secured with silk twist; the remainder of the charge, which is of the larger sized cordite, is placed outside it and hooped with silk twist.

Plate VII. shows a section of a quarter-charge for the 12-inch Mark VIII. made up in this way.

The following guns have composite charges:—13·5-inch, 12-inch Marks VIII. and IX., and 9·2-inch Marks VIII. and X.

The half-charges for the 12-inch Mark VIII. and 9·2-inch Mark X. are very long, and the sticks of cordite are arranged to break joint as shown on Plate V.

Modified cordite charges are never made up composite. The half-charge of modified cordite for the 9·2-inch Mark X. is shown on Plate VI.

Most cartridges are fitted with beckets of silk cloth as required for handling them.

The "tear-off" disc must be removed from each cartridge before entering the charge in the gun.

In the case of hydraulic loaded guns of the "Majestic" and "Royal Sovereign" classes this should be done in the handing room, in other ships at the gun.

NOTE.—In the 9·2-inch Mark V. mounting the tear-off disc is not to be torn off until the charge reaches the gunhouse; the reason being that the clip holding the cartridge in the bucket is steel, and it is necessary to prevent contact with primer.

Cordite cartridges are marked with black printers' ink, with the numeral of the cartridge, the manufacturers' initials or trade mark, nature of gun, weight and size of cordite, and, after filling, with the lot number of the cordite, initials or trade mark of the manufacturer of the cordite, date of filling and monogram of the station where filled.

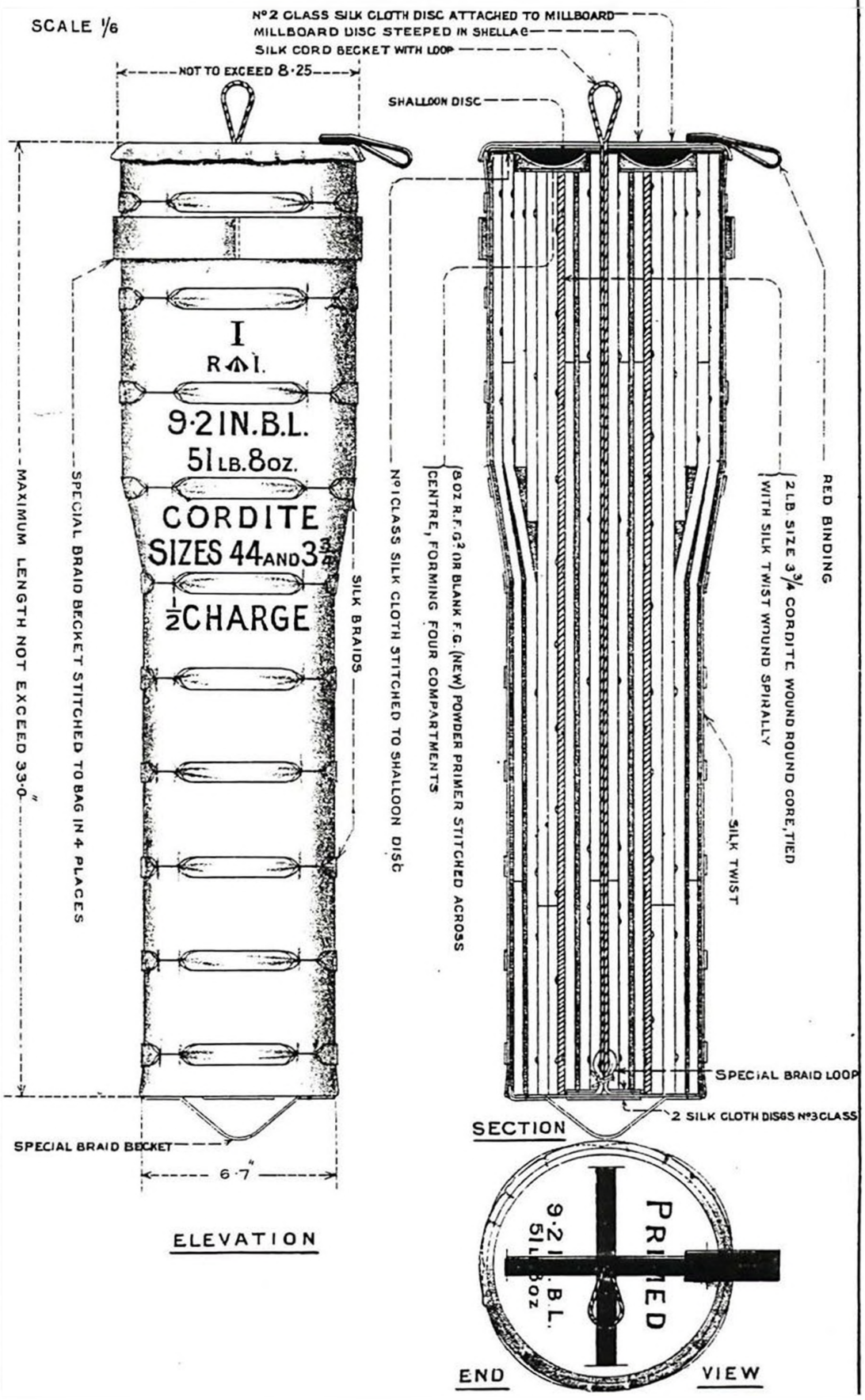
Also the letter N for Naval Service in red ink.

Whenever a powder charge is withdrawn from a B.L. gun, it is to be thrown overboard; but cordite charges are to be examined, and, if free from fouling, to be returned to the magazine.

Adjusted Charges.—With a view to eliminating one of the causes of error in shooting with heavy guns, due to the slight variation in the lots of cordite, it has been arranged that in making up the various charges, the actual weight of cordite used will, where this is possible without exceeding the authorised pressure, be so adjusted that so far as the charge is concerned, the gun will shoot to its normal velocity.

CARTRIDGE B.L. 9·2" 51 LB. 8 OZ. CORDITE SIZES 44 & 3¾ MARK I | C |

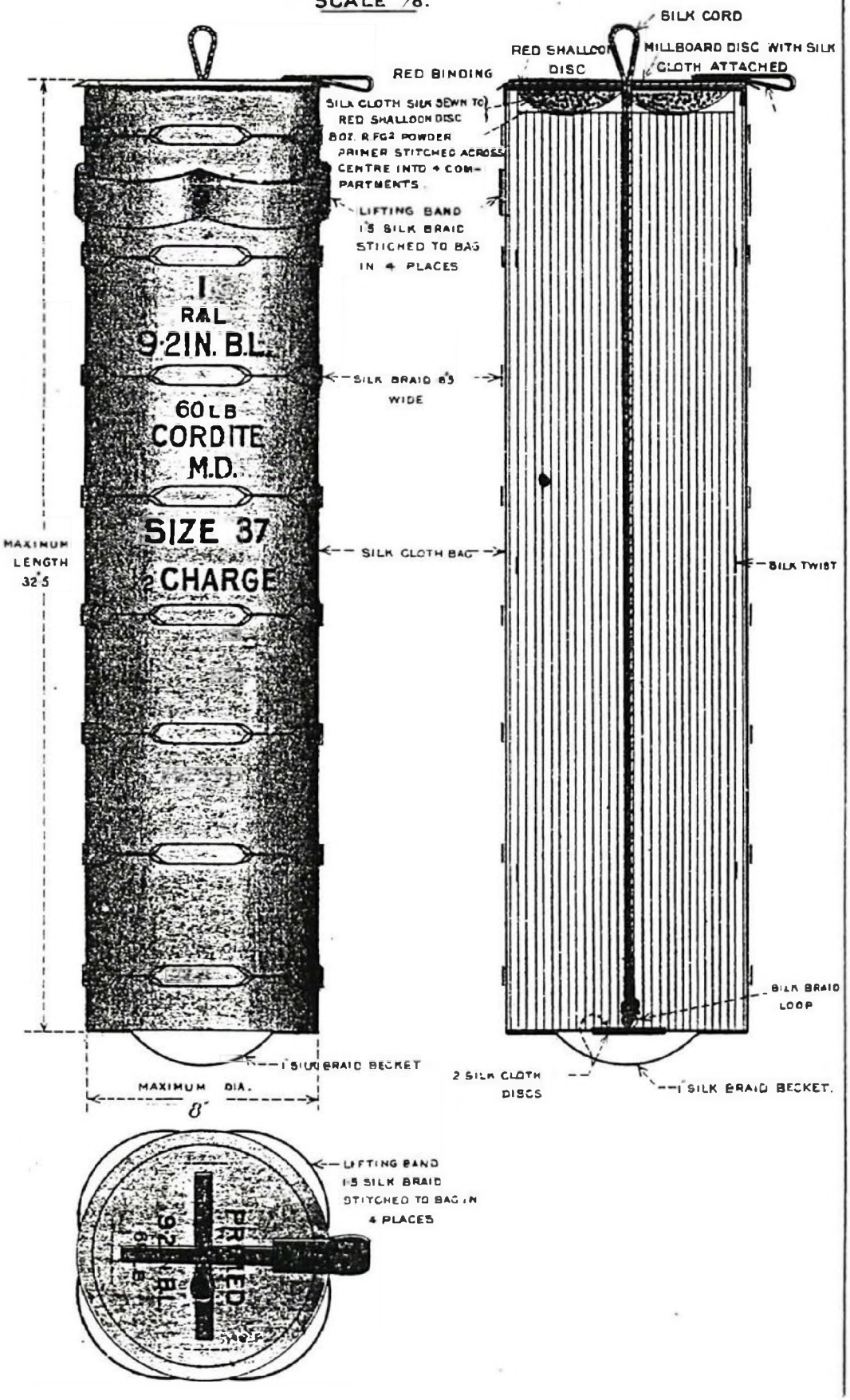
SILK CLOTH, 49 LB. 8 OZ. SIZE 44, & 2 LB. SIZE 3¾, ½ CHARGE, MARKS IX. & X. GUNS



CARTRIDGE B.L. 9·2 INCH 60 LBS. M.D. CORDITE SIZE 37 MARK I N

½ CHARGE FOR MARK X GUN.

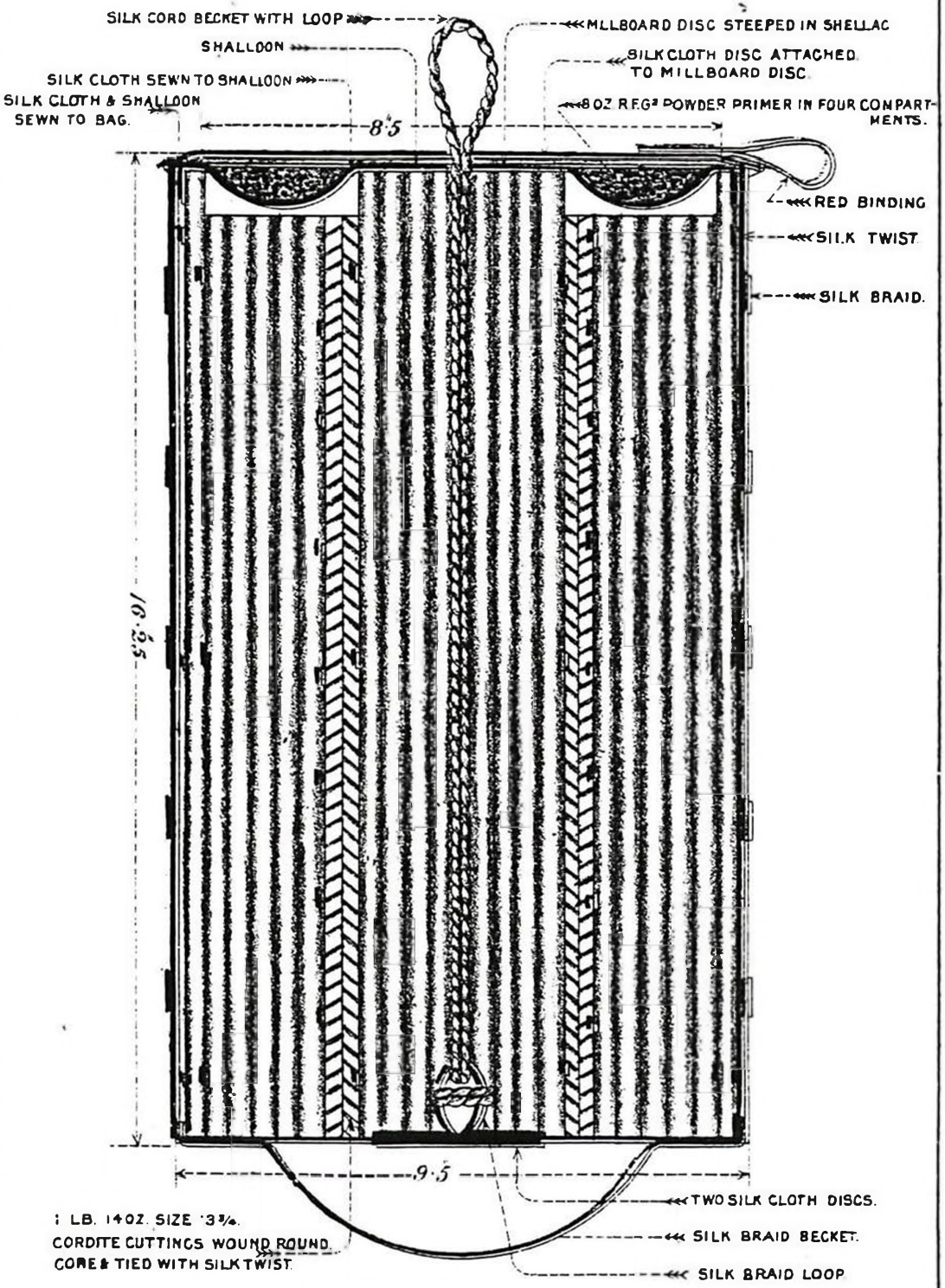
SCALE 1/6.



CARTRIDGE B.L.12 INCH 43 LB. 8 OZ. CORDITE.

(41 LB. 10 Z. SIZE 50. LB. 14 OZ. SIZE 3¾.)

QUARTER CHARGE FOR MARK VIII GUN.



The charges will continue to be designated by their nominal weight, and the amount of cordite (plus or minus) necessary for the adjustment will appear on the cartridge opposite the lot number of the cordite.

Drill Cartridges.

Drill cartridges are made to the same shape, weight, and dimensions as the Service cartridges they represent. They consist of wooden cylinders, usually containing an iron core to give the necessary weight, and covered with raw hide. For the older natures of guns loaded by hydraulic power the cartridge is covered with a layer of felt and two layers of canvas to prevent it from slipping out of the gun.

The latest type of drill cartridges are made of rope covered with canvas.

Rope handles.

The representatives ot all prism cartridges have rope handles at each end, so fitted that they do not project; the others have rope handles at one end only.

All drill cartridges aro marked like the Service cartridges they are intended to represent.

CHAPTER IV.

Cartridges for Heavy Q.F. Guns.

Cartridges for Q.F. guns are divided into two classes, viz. :—

(*a*) Those which have the projectile entirely separate from the cartridge.

(*b*) Those which have the projectile secured in the mouth of the cartridge, such as the 3 and 6 prs., and which are called "fixed."

Cordite Cartridges for Q.F. Guns.

Nature of Gun.	Weight of Charge.	Size of Cordite.	Weight of Igniter.	Marks of Cartridge.	Remarks.
6-inch Q.F. -	13¼ lbs.	30	1¼ ozs.	I. to VII.	
	5½ „	10	„	I.	Reduced.
4·7-inch Q.F.	5 7/16 lbs.	20	„	I. to V.	
	2 lb. 2½ oz.	7½	„	I.	Reduced.
4-inch Q.F. -	3 9/16 lbs.	15	„	I. and II.	
„ *Q.F.C.	1½ lb.	5	„	I.	Reduced.
12-pr. 18 cwt.	2 lbs. 12⅛ ozs.	11 M.D.	10 drs.	—	
„ „ -	1 lb. 11 14/16 ozs.	8 „	„	—	Reduced.
12-pr. 12 cwt.	2 lbs. 0 ozs.	11 „	„	—	
„ „	1 lb. 15 ozs.	15	1¼ ozs.	I. and II.	
	12½ ozs.	5	„	II.	Reduced.
12-pr. 8 cwt.	13¾ ozs.	10	„	„	
6-pr. Q.F. -	7¾ ozs.	5	1½ drs. G.C.	I. to VII.	
3-pr. Q.F. -	6⅜ ozs.	5	„	I. to VI.	
„ „ -	13 6/16 oz.	8 M.D.	—	—	Vickers' semi-automatic.
„ „ -	6 14/16	4¼ „	—	—	Reduced.

* 4-inch Q.F.C. is not allowed to fire full charges, but only the reduced charge of 1½ lbs. size 5.

Cartridge for Q.F. Guns (except 3 and 6 Prs.).

Brass cartridge case.

For all these Q.F. guns the charge, whether of cordite or powder, is placed in a brass cartridge case.

All these cartridges are fitted to fire by electricity through the "primer," but should this method fail the "primer" can be unscrewed, an "adapter" screwed in, a percussion tube inserted, and the gun fired by percussion.

In Q.F. cartridges fitted with the Mark IV. manganese bronze adapters, or adapters converted from electric primers, an electric tube is placed in the adapter before entering the cartridge into the gun.

The cartridge consists of the brass cartridge case, the primer or adapter, the igniter, the charge, the wads, and the lid.

The brass cartridge.

The brass cartridge is either built up or solid drawn, threaded in its base to receive the primer or adapter; the inside is lacquered with a thick dark-coloured lacquer when used for a powder charge, and when used with cordite the cartridge is lacquered with the ordinary brass lacquer; if a cartridge has been lacquered with the thick lacquer and is used for a cordite charge, a paper lining is inserted between the cartridge and the charge.

Lid.

The lid, which closes the mouth of the case, is made of two parts of white metal soldered together; the lower part forms a cup in which is placed a lubricant formed of equal parts of beeswax and tallow. The lid is secured by three tongues cut in the end of the cartridge cases, which are bent down over it, and the joint is made air-tight by cement. The lids are weakened by the tops being grooved by circular and radial grooves.

A paper label is shellaced on to the lid of the cartridge showing the size of cordite, the word "cordite," the weight of the charge, the lot number of the cordite, and the numeral of the filled cartridge. In the earlier issues this information was stencilled on the lid.

Electric primer.

The Electric Primer (Plates VIII., IX., and X.).—There are several marks of these primers, the latest being Mark V., of which the following is a description :—

The body.

The body is of manganese bronze, threaded on the exterior to fit the hole in the cartridge. The head is milled and has two slots to receive the key for screwing in or removing.

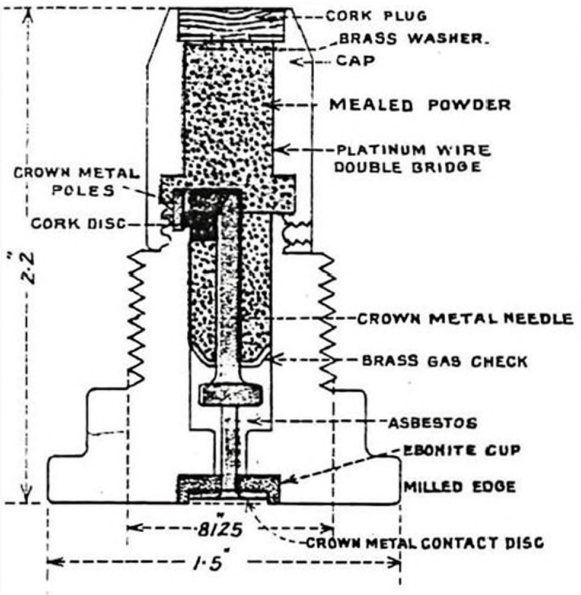
Insulator and contact piece.

An ebonite insulator is screwed into the head of the primer, and fitted with a contact disc of tin held in by an undercut groove in the insulator.

Cone.

The interior of the primer is bored out to receive a brass cone, which is insulated from the body with oiled silk.

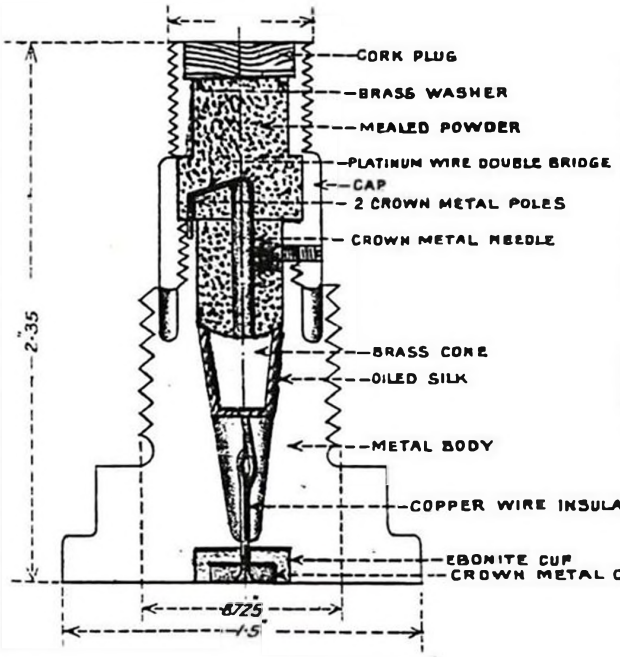
MARK I^{x}.



MARK I^{xx} HAS ONLY A SINGLE P.S. BRIDGE, AND IS FILLED WITH PRIMING COMPOSITION AND CLOSED WITH A GLAZEBOARD DISC. BROUGHT UP TO MARK IV* AS NEARLY AS POSSIBLE. EXCEPT THEY DID NOT HAVE EBONITE WASHER AND SCREW COLLAR.

MARK I^{xxx} DIFFERS FROM MARK I^{xx} IN HAVING THE BODY POLE BENT OVER TOWARDS THE CENTRE POLE AND HAS AN IRIDIO PLATINUM BRIDGE; BROUGHT UP AS NEARLY AS POSSIBLE TO MARK V PRIMER.

MARK II.

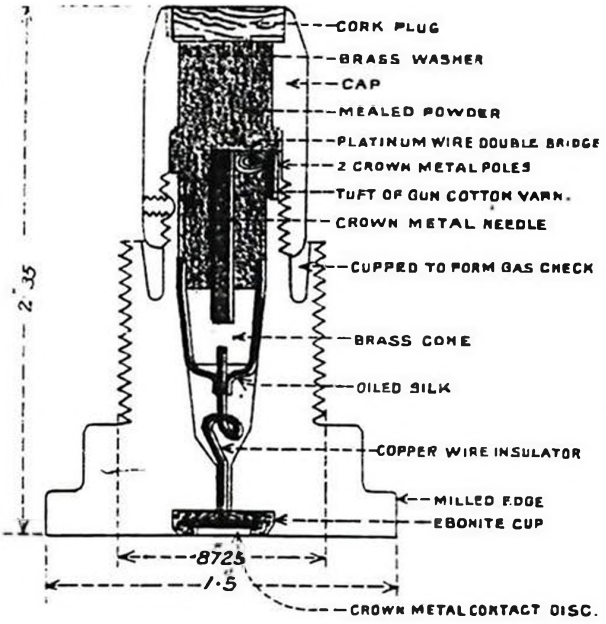


MARK II^{x} HAS A SINGLE BRIDGE OF P.S. WIRE, IS FILLED WITH PRIMING COMPOSITION AND CLOSED WITH A GLAZEBOARD DISC. BROUGHT UP TO MARK IV^{x}, BUT NO EBONITE WASHER AND SCREW COLLAR.

MARK II^{xx} DIFFERS FROM MARK II^{x} IN HAVING THE CONE SECURED BY A BRASS WASHER AN EBONITE WASHER BEING PLACED UNDER IT TO INSULATE THE CONE IDENTICAL TO IV*.

MARK II^{xxx} DIFFERS FROM MARK II^{xx} IN HAVING THE BODY POLE BENT OVER TOWARDS THE CENTRE POLE, AND HAS AN IRIDIO PLATINUM BRIDGE. BROUGHT UP TO MARK V.

MARK III

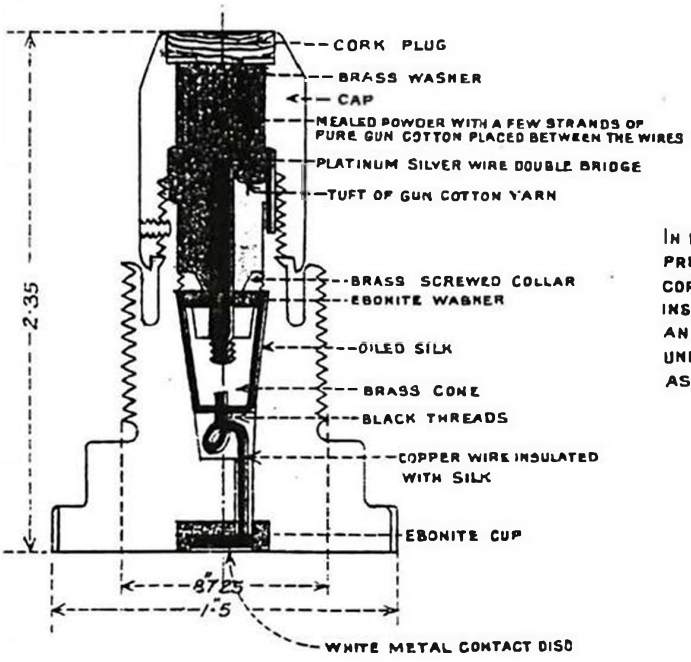


MARK III^{x} SINGLE P.S. BRIDGE. PRIMING COMPOSITION AND GLAZEBOARD DISC. BROUGHT UP TO MARK IV^{x} BUT NO EBONITE AND SCREW COLLAR.

MARK III^{xx} AS FOR MARK III^{x} BUT CONE IS SECURED BY BRASS AND EBONITE WASHER, INDENTICAL WITH MARK IV^{x}.

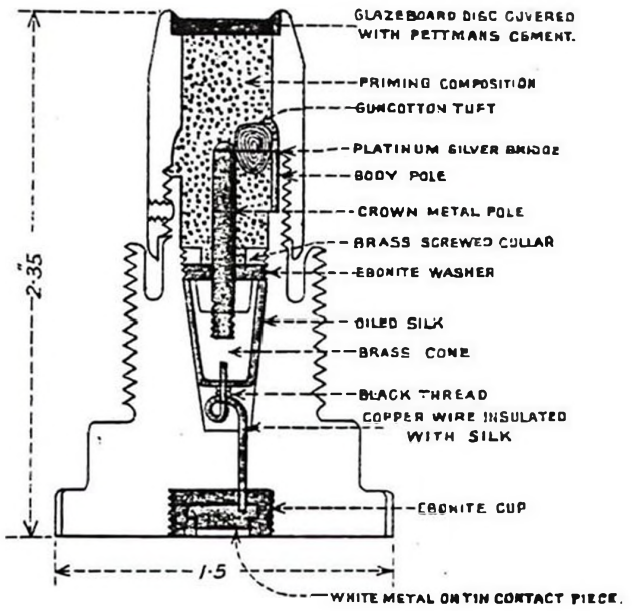
MARK III^{xxx} AS FOR MARK III^{xx} BUT BODY POLE IS BENT TOWARDS CENTRE POLE AND THE PRIMER HAS AN IRIDIO PLATINUM BRIDGE; IDENTICAL WITH MARK V

MARK IV



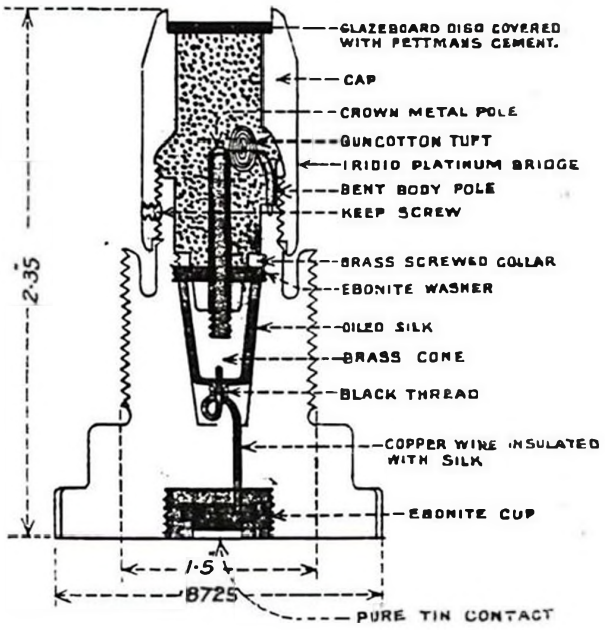
IN LATER MANUFACTURES OF MARK IV PRIMER, THE BRASS WASHER UNDER CORK PLUG WAS OMITTED. THE EBONITE INSULATOR IN BASE WAS SCREWED IN AND CONTACT DISC HELD BY AN UNDERCUT GROOVE IN INSULATOR SAME AS MARK IV*.

MARK IV.*



MARK IV** BODY POLE BENT TOWARDS CENTRE POLE AND IRIDIO PLATINUM BRIDGE BROUGHT UP TO MARK V.

MARK V.



The cone is cupped at the base, and is retained in position by a screwed brass collar, an ebonite collar being placed between the collar and the base of the cone to insulate the latter.

A piece of insulated copper wire connects the cone to the tin contact disc, passing through a hole in the head, a little on one side of the centre line.

Centre and body pole.

A white metal spindle is screwed in and soldered on the other end of the cone, this is connected to a white metal pin on the body by an iridio-platinum bridge, this pin or body pole being bent slightly towards the centre pole.

The bridge is embedded in a tuft of gun-cotton yarn.

Thimble and filling.

The body is lengthened by a thimble or cap screwed on to it, and is filled with priming composition. The end of the thimble being closed by a disc of glazeboard.

The closing disc and the screw threads between the body and thimble are coated with Pettman's cement, the thimble being prevented from unscrewing by a set screw.

A groove, $\frac{1}{4}$-inch deep, is formed on the body at the termination of the thread, this acts as a gas check, and prevents the gas passing between the primer and cartridge.

Earlier marks.

Earlier marks of primers will be returned to store and brought up to date, being made as nearly as possible the same as Mark V. These primers will then be termed the Marks I***., II***., III***., IV**., respectively.

Marks on primers.

Primers are marked on the base with the manufacturers' initials, the numeral of the primer, the number of thousand, date of manufacture with S. if made of stamp metal, and on all primers other than the Mark V. with the letter T. if fitted with a pure tin contact disc.

Supply primers.

Primers are supplied, one in each cartridge case and 70 spare for each Q.F. or Q.F.C. gun, packed in tin cylinders, 10 in a cylinder, for testing purposes.

Where the 12-pr. 12 cwt. gun is used for saluting purposes, there is an additional allowance of 720 to flagships, 360 to other ships, and 12 to each 12-pr. 12-cwt. and 8-cwt. gun, for use as blank, but not to be supplied to the 12-pr. 12 cwt. gun if the saluting proportion is allowed.

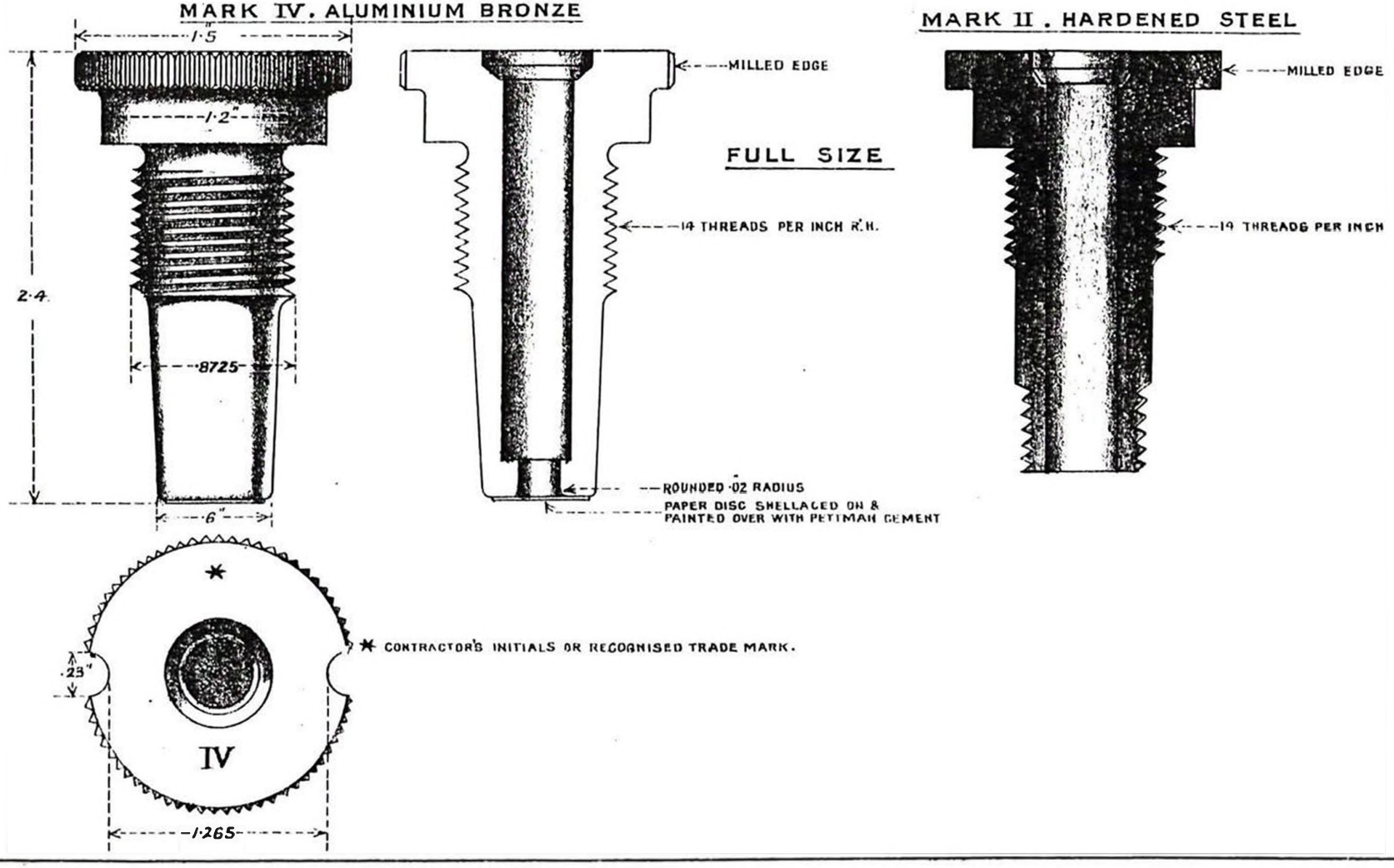
Packages containing primers fitted with pure tin contact discs are marked with the letter T., except Mark V., which are all of pure tin.

Adapters.

There are three marks of adapters, which may be found in the Naval Service, viz., I., II., and IV.

The Mark I. was similar to IV., as shown in Plate XI., but not coned quite so much; there was no paper disc, and it was made of hardened steel.

CARTRIDGE, Q.F. OR Q.F.C., ADAPTER.



To face page 41.

The Mark II. was similar to Mark I., but the front end was threaded to take the Mark I. igniter.

There was no issue of the Mark III. adapter to the Naval Service.

The Mark IV. is made of aluminium-bronze and bored out to take a tube, and threaded on the outside to screw into the base of the cartridge case; the front end is coned, and the end is closed by a paper disc, which is shellaced on and painted over with Pettman's cement to prevent the ingress of damp into the cartridge.

The Marks I. to IV. electric primers are now being converted to adapters by having a hole bored through the centre, and a paper disc shellaced on the end similar to the Mark IV. metal adapter; they are then known as Adapters, Converted, Mark I. Metal adapters are only to be used once; after firing they are to be returned to store for reforming.

The igniter.

The Mark III. igniter is in present use, the Marks I. and II. being obsolete.

The Mark III. igniter consists of a 1¼-oz. charge of R.F.G.[2] or Blank F.G. new powder, in a red shalloon bag, choked into the end of a cylinder of cordite, which forms part of the calculated weight of the charge. The cylinder is secured in the rear end of the charge, with its open end over the end of the primer or adapter. It is shown on Plate XII.

In the modified cordite charge for the 12-pr. 12 cwt. and 18 cwt. Q.F. the igniter of powder inside the M.D. cylinder is 10 drams only.

Cordite cylinders.

The thickness of the cordite cylinder in the Mark III. igniter varies, however, those for the 6-inch being ·2-inch thick, for the 4·7-inch, ·15-inch thick, for the 4-inch, ·10-inch thick, and for the 12-pr. ·05-inch thick.

Dome igniter.

An igniter which consits of 8½ drams of R.F.G.[2] or Blank F.G. new powder choked in the top of a perforated cardboard dome, having a flange at its base, is placed into the pocket of the bag containing the blank charge for all Q.F. guns, 12-pr. and above.

The charge.

The charge is formed of sticks of cordite of full lengths, around the lower end of which are placed short sticks forming an enlarged part which is enclosed in a shalloon bag, the front end of the charge being kept in shape by silk braid hoops.

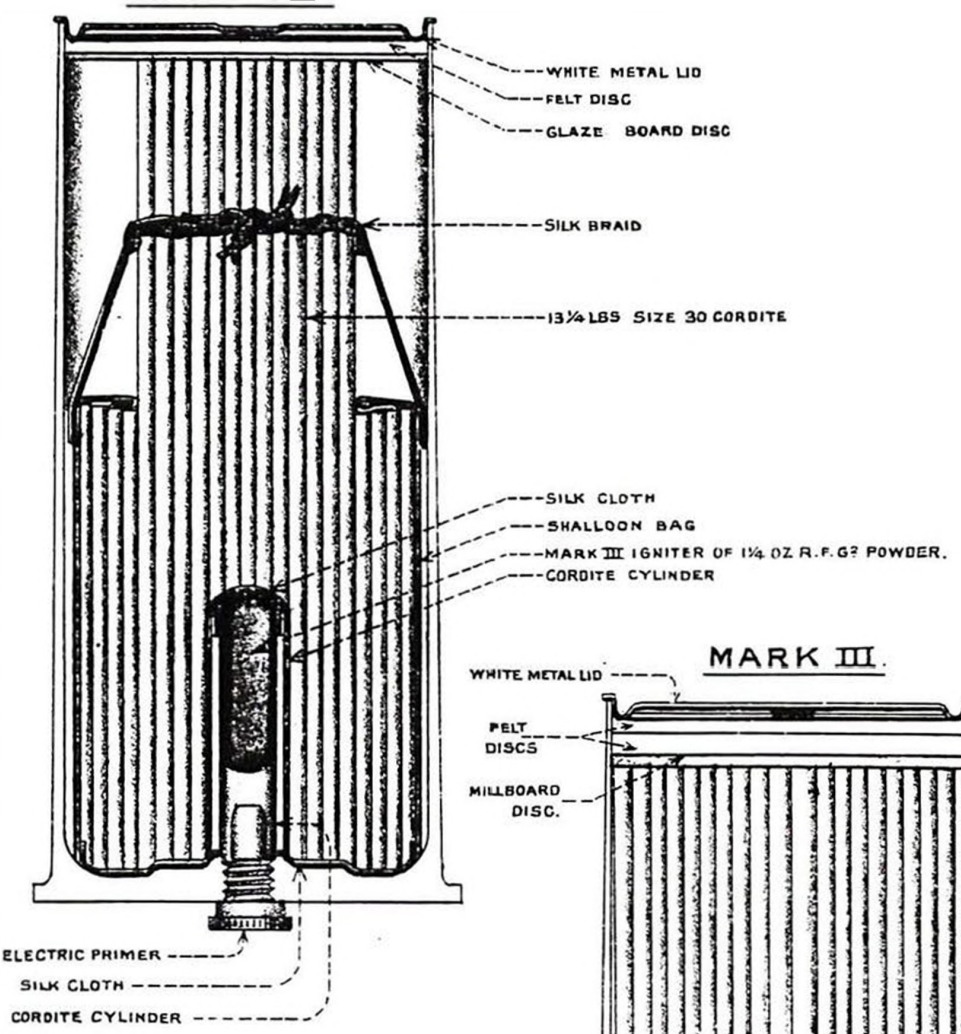
The bottom of the bag is fitted with a pocket, into which is placed the cordite cylinder containing the igniter; this is thrust up into the charge and forms the centre of the lower end.

CARTRIDGES 6 INCH Q.F. AND Q.F.C.

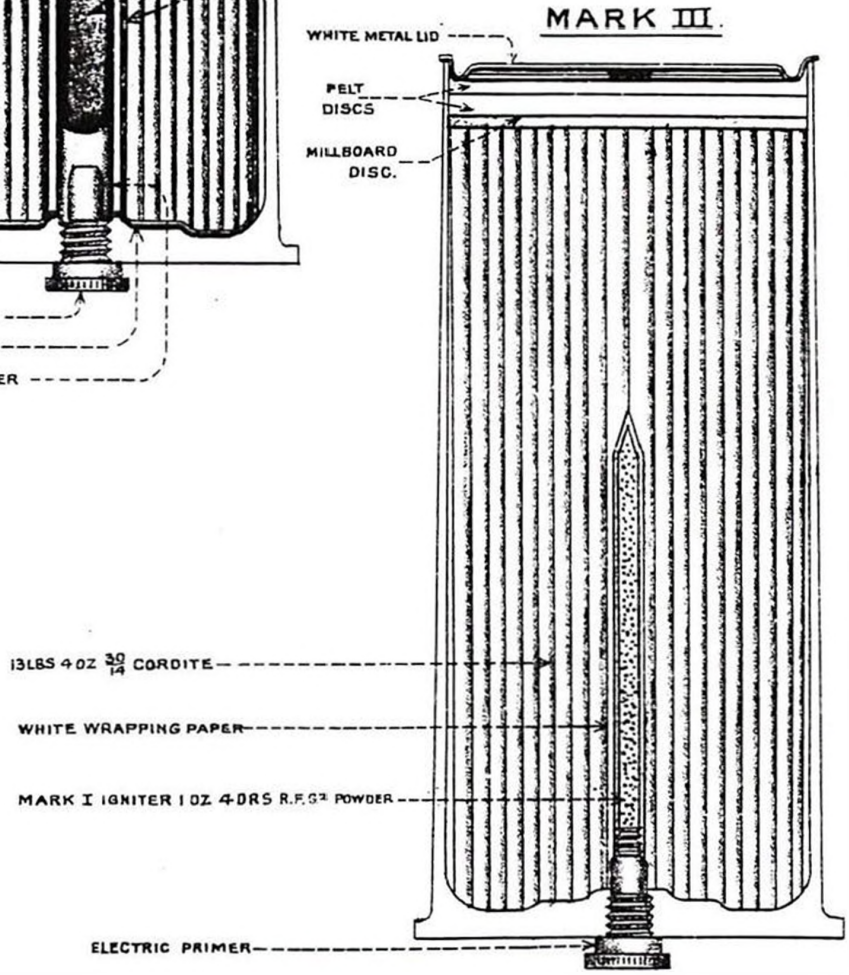
CHARGE CORDITE 13¼ LBS SIZE $\frac{30}{20}$

SCALE = ¼

MARK VII



MARK III.



Making up the Cartridge.

The charge is placed into the brass cartridge, a glazeboard and felt disc stitched together placed over the cordite, the glazeboard being next the cordite, and the lid put on and secured by tongues, the space between the edge of the lid and the cartridge being covered with Pettman's cement.

The foregoing is a general description of the latest cartridges for Q.F. guns, 12-pr. and above.

The following is a detailed description of the cartridges for each gun.

6-*inch Q.F. or Q.F.C.—Charge* 13¼ *lbs. Cordite, size* 30.

6-inch Q.F. cartridge.

The following marks are now in use in the Naval Service, Marks VI. and VII. They are made up exactly as described in the general description of Q.F. cartridges given on page 42, and differ from each other only in the bottom of the bag and pocket of the Mark VII. being made of silk cloth instead of shalloon.

6-*inch Q.F. or Q.F.C. Blank.—Charge* 7 *lbs. L.G. Powder.*

Blank.

The Mark III. cartridge is the only blank cartridge in use, and is issued filled in "outfit" boxes painted red. It is similar to the 4·7-inch blank charge, Mark III. (Plate XIII.)

The charge is made up in a silk cloth bag with a dome igniter choked into the rear end.

The charge is in a Service cartridge case. Over the charge is a cardboard cylinder, and the case is closed by the usual lid.

4·7-*inch.—Charge* 5 *lbs.* 7 *oz. Cordite, size* 20.

4·7-inch cartridge.

The Mark V. cartridge is made up as described above.

In the Mark IV. cartridge the full-length sticks of cordite were shorter, but at the same time the short sticks were longer than in the Mark V., necessitating a longer shalloon bag.

The space between the top of the cordite and the lid was filled up by a paper ring, to the under side of which was secured a disc of silk cloth ; on top of the ring was placed a felt wad.

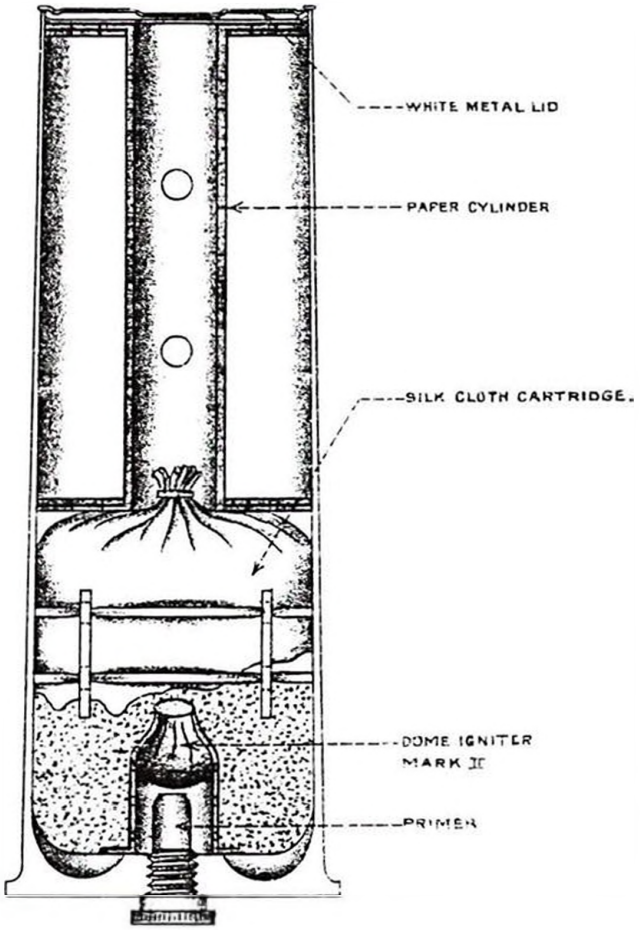
These cartridges are being altered to resemble Mark V. by removing the paper ring and felt wad and placing over the cordite a glazeboard and felt disc and felt wads as required.

The earlier marks are now obsolete.

CARTRIDGE Q.F. 4·7 INCH FILLED BLANK (3 LBS L.G.)

SCALE = 1/4

MARK III.



4·7-inch.—Blank.—Charge 3 lbs. L.G. Powder.

Blank.

Mark III. Cartridge.—Is much similar to the 6-inch Mark III. blank charge, and is the only type issued. *See* Plate XIII.

4-inch Q.F.—Charge 3 lbs. 9 oz. Cordite, size 15.

4-inch Q.F. cartridge.

Mark II. Cartridge.—Is made up in two diameters with the lower part of the charge in a shalloon bag. It has the Mark III. igniter choked in the base; on top of the cordite is a felt wad and the lid.

4-inch Q.F.C.—Charge 1 lb. 8 oz. Cordite, size 5.

4-inch Q.F.C. cartridge.

Mark I. Cartridge.—Is similar in construction to the Mark II. cartridge for the 4-inch Q.F., except that there is a paper cylinder to fill up the space.

4-inch.—Blank.—Charge 3 lbs. L.G. Powder, Mark II.

Blank.

The 4-inch blank charge is the same as that for 4·7 Q.F. Mark III.

12-pr. 18 cwt.—Charge 2 lbs. 12⅛ oz. Cordite M.D., size 11.

12-pr. 18-cwt. cartridge.

The method of making up this charge differs somewhat from the general description of Q.F. cartridges given on page 42.

The centre sticks of cordite are partly enveloped in a shalloon bag, to the bottom of which is sewn another shalloon bag, containing the igniter of 10 drams of F.G. powder; the outside sticks of cordite are then placed around the core, so that the igniter will be about 1¾ inches inside, and the shalloon bag is drawn down over the upper part of outside sticks and secured by seizings of silk twist, which is also stabbed through the charge to prevent the core from shifting; the lower ends of the outside sticks are then tied up in eight small bundles, and thus form a ring which fits around the primer or adapter when the charge is inserted in the cartridge case. On the top of the charge is placed the usual glazeboard and felt-wads, and the case is closed by a lid similar in construction to other Q.F. cartridges. *See* Plate XIV.

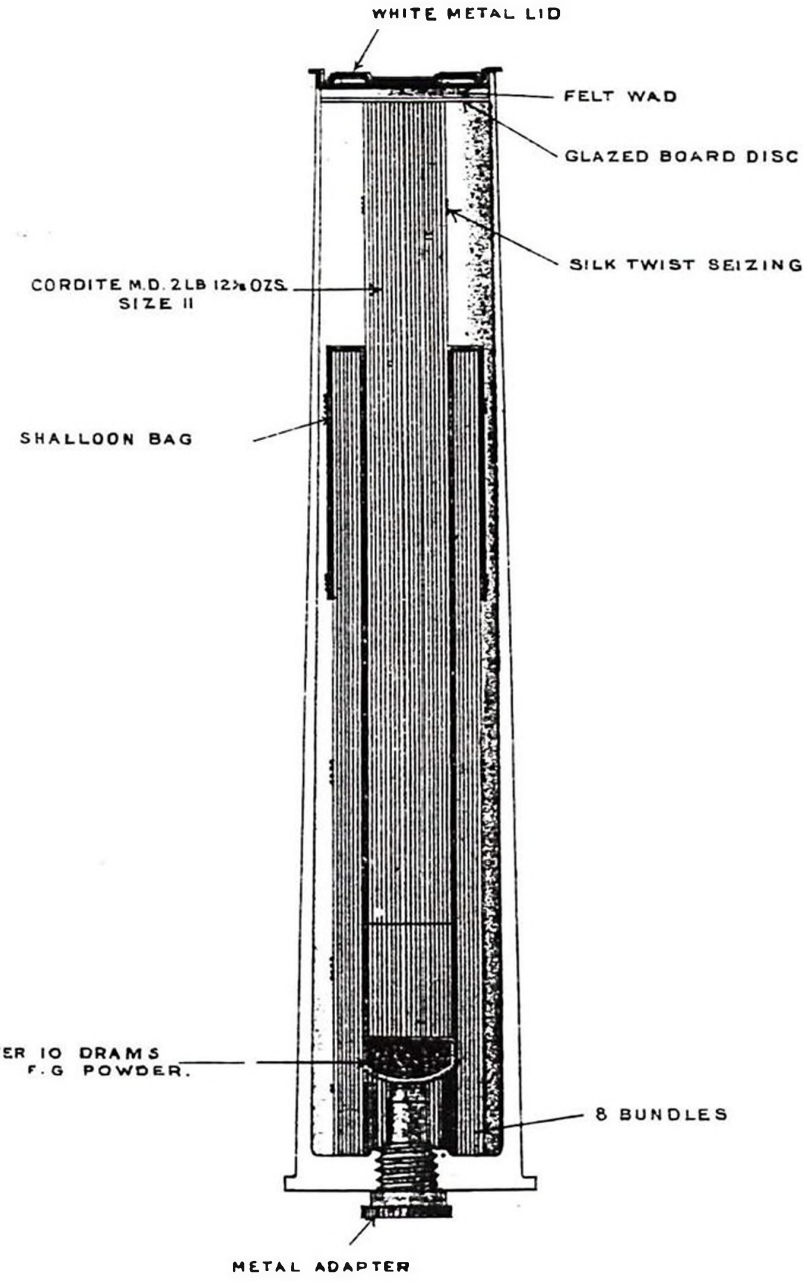
12-pr. 18 cwt.—Practice Charge 1 lb. 11 oz. 14 drs. Cordite M.D., size 8.

Practice.

This charge is made up in a similar way to the full charge, except that a cardboard perforated cylinder is placed on top of the cordite, to fill up the space. There is no felt wad.

CARTRIDGE, Q.F. 12 PDR 18 CWT.

CHARGE CORDITE M.D. 2 LB. 12⅛ OZS. SIZE II



12-*pr.* 12 *cwt.*— *Charge* 1 *lb.* 15 *oz. Cordite, size* 15.

Mark II. Cartridge.—Is made up in two diameters, the Mark III. igniter being used, the glazeboard disc, felt wad, and lid are placed on top of the cordite. The lower part of the charge is enclosed in red shalloon. 12 pr. 12-cwt. cartridge.

The 12-pr. 12-cwt. gun has also another charge recently introduced, consisting of 2 lbs. modified cordite, size 11. It is made up similar to the Mark II. cordite charge, with the base enclosed in a shalloon bag containing a pocket into which is inserted a M.D. cordite cylinder containing an igniter of 10 drams R.F.G.^{2} or blank F.G. new in a shalloon bag; on top of the cordite are the usual wads and lid. M.D. cordite charge.

12-*pr.* 8 *cwt.*—*Charge* 13¾ *oz. Cordite, size* 10.

Mark II. Cartridge.—Is similar to the Mark II. for the 12-cwt. gun except as to the weight and size of the cordite. 12-pr. 8 cwt.

12-*pr.* 8 *cwt.*—*Blank.*—*Charge* 1 *lb.* 8 *oz. L.G.*

The blank charge is made up in the 12-pr. 8-cwt. cartridge case. Blank.

It consists of a silk cloth bag containing the charge, having a "dome" igniter choked into its base. The silk cloth bag is enveloped, except at the base, in a felt bag with a loop in the head; the loop passes through the centre of a felt wad, with a felt ring stitched on the under side, which is made to fit the cartridge case tightly. The mouth of the case is not closed.

The cartridges are supplied with wads complete in a half metal-lined case, and have to be loaded into the cartridge case on board, and are to be unloaded and returned in the half metal-lined cases. *See* Plate XV.

12-*pr.* 12 *cwt.*—*Blank or Saluting.*—*Charge* 1 *lb.* 8 *oz.*

The blank or saluting charge for the 12-pr. 12 cwt. is always made up in the 12-pr. 12-cwt. cartridge case. The charge is the same as for the 8 cwt., contained in a silk cloth bag, hooped in the usual manner, and with a "dome" igniter choked in the base, but there is no felt bag envelope, as in the 8-cwt.; instead, a felt washer is placed over the charge, and afterwards a leather-board cupshaped washer is pressed down hard on to it. 12-pr. 12 cwt. blank.

These cartridges are filled on board ship; the cartridges are supplied in metal-lined cases, together with wads and leather-board washers. When supplied to T.B.D.'s the charges are supplied made up. *See* Plate XVI.

12-*pr.* 18 *cwt.*— *Blank or Saluting.*—*Charge* 1 *lb.* 8 *oz.*

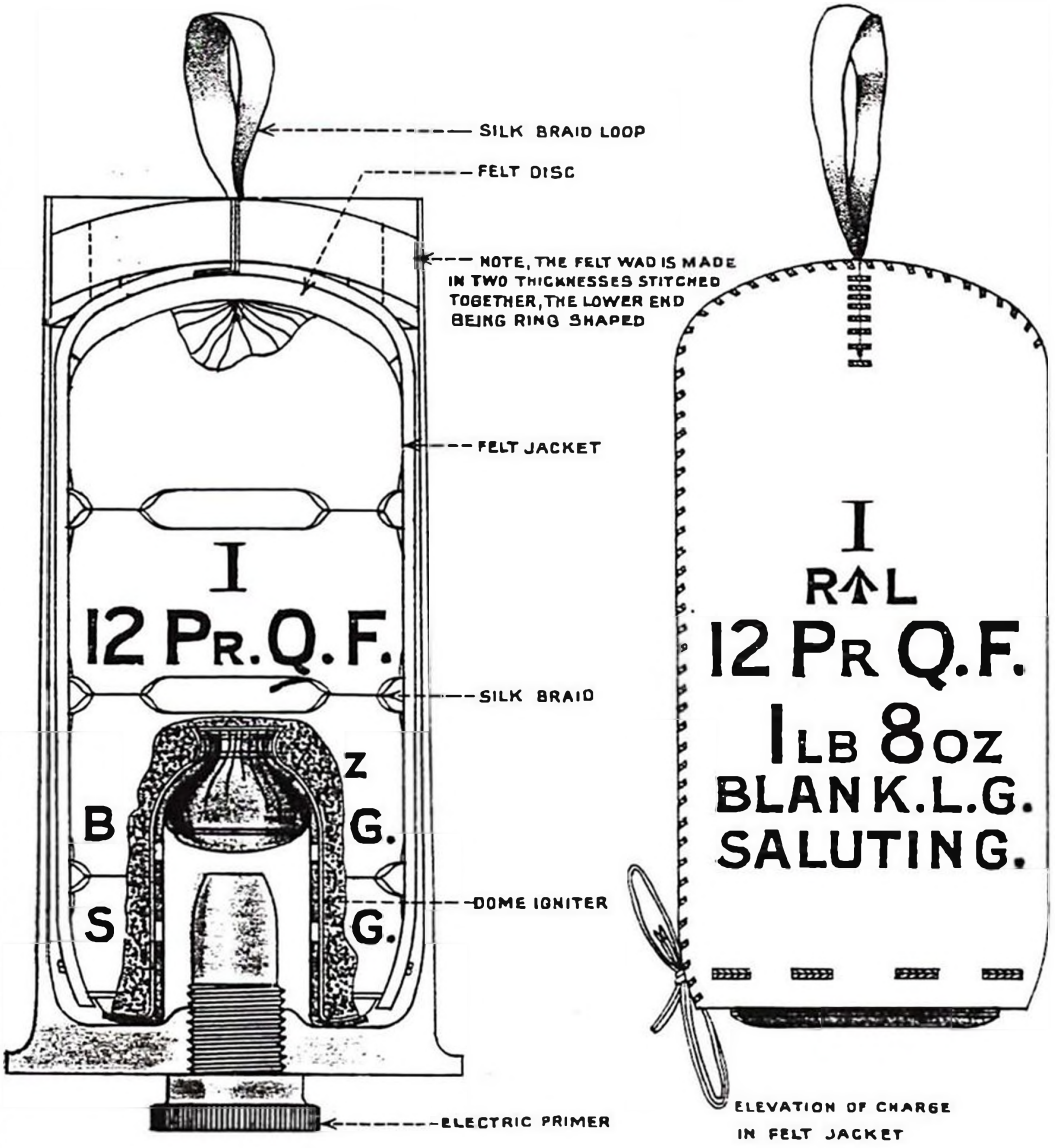
The charge is the same as for the 12-pr. 12 cwt., but a cardboard cylinder is inserted to fill up the space between the cup-shaped washer and the cylinder. 12 pr. 18-cwt. blank.

METHOD OF FILLING. CARTRIDGE Q.F. BLANK OR SALUTING

SILK CLOTH, 12 PR 8 CWT MARK I | N |

½ LB. BLANK L.G. WITH FELT WAD JACKET AND IGNITER

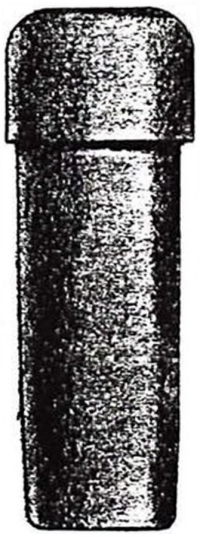
SCALE ½.



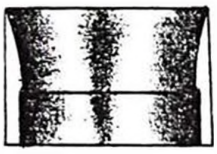
CARTRIDGE, Q.F. 12 Pr 12 Cwt. BLANK & SALUTING (1½ LBS. L.G.)

SCALE ¼

WOOD DRIFT



METAL RING FOR INSERTING CUP WASHER



For making up these charges, the following is required: wood drift, for driving in the leather-board washer; metal ring to prevent injury to cartridge case, and to assist in insertion of leather-board washer.

Drill Cartridges.

Drill cartridges.

Drill cartridges for Q.F. guns are make of teak with metal bands at each end to fit the chamber; the cartridge is weighted with lead to bring it up to the weight of the Service cartridge, and a dummy primer is screwed into the rear end; the head of the primer being recessed so that the firing battery may not be short-circuited.

The latest pattern has the rim of the base "milled," and the head of the primer bronzed and of an hexagonal shape.

Drill cartridges when once received on board are not to be altered.

Dummy cartridges.

Empty cartridge cases, filled with wood and painted black, are supplied, 12 per gun, for exercise in passing up from the magazine; these dummy cartridges are not to be entered in the gun.

Keys, &c. for Use with Q.F. or Q.F.C. Cartridges.

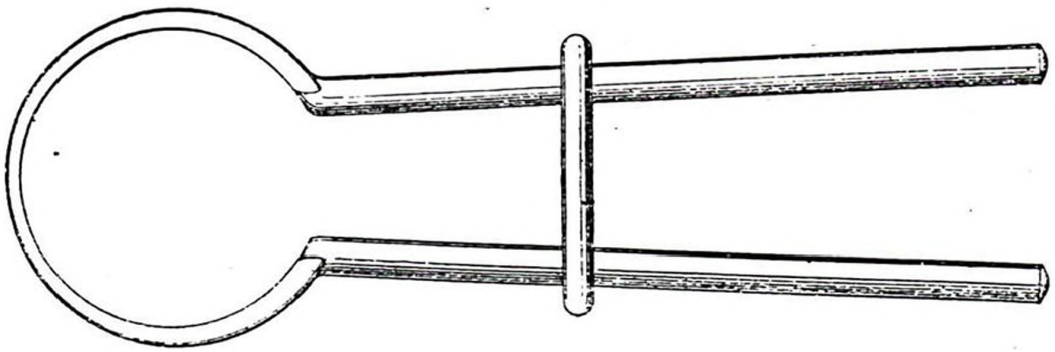
Holders.

The following keys, &c. will be found in the tool boxes for Q.F. guns.

Holders, Cartridges, see *woodcut below.*—This holder consists of a steel band which encircles the cartridge case. The steel band terminates at each end in long handles, which, being forced together, clips the band tight round the case. A link working on these handles keeps them together when forced away from the cartridge. This tool is used to hold the case when the primer or adapter is being actuated by the "key, removing primer."

Q.F. Cartridge Holder.

Scale = ¼.



The key, removing primer (see *woodcuts*) is a powerful key for removing the primer or adapter when the "key, inserting primer," will not move it. There are four marks, the Mark I. is shown in the woodcut, Fig. 1. Key, removing primer.

The Mark II. is very similar in construction to the Mark I., except that the jaws are bevelled, the distance at root being 1·28 inches, and at point 1·33 inches, so that the key will fit over head of primer after firing, as the latter expands somewhat, *see* Fig. 2.

The Mark III. key differs from the Mark II. in the central part of key, being shaped to fit over head of primer, with two projections on the inside of the ring to fit into slots in head of primer, *see* Fig. 3.

The Mark IV. key differs from the Mark III. in that it is self-adjusting, *see* Fig. 4.

Key, Removing Primer, Electric Q.F., Large, Mark I.

Fig. 1.

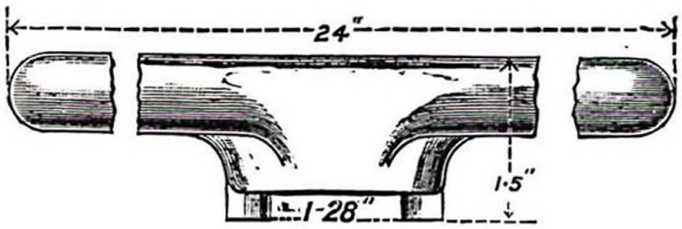


Fig. 2.

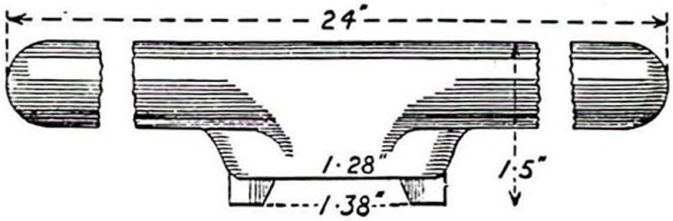


Fig. 3.

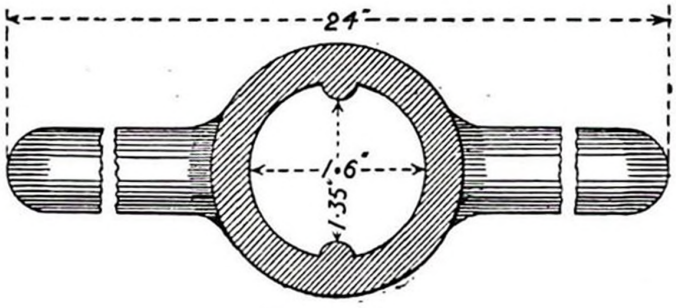
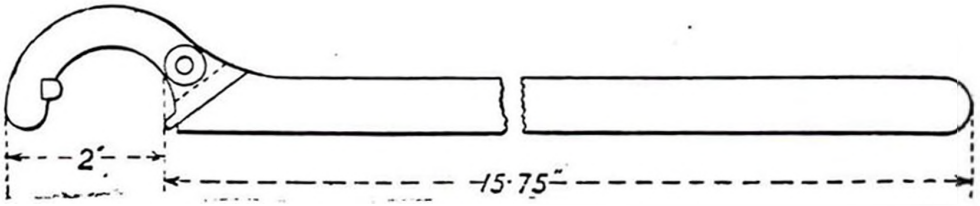


Fig. 4.

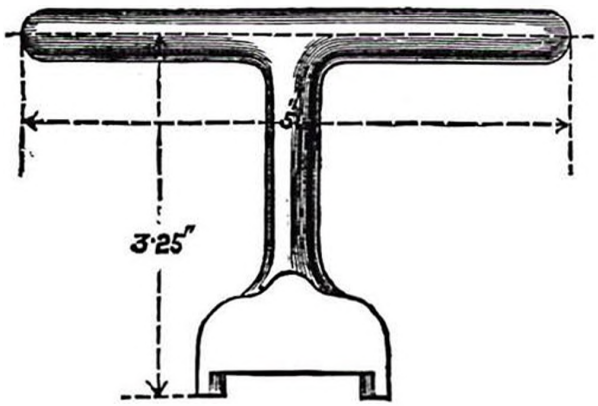


Key, inserting primer.

The key, inserting primer (see *woodcut*) is a small T-handled key used for inserting the primer or adapter.

Key, Inserting Primer, Electric, Q.F., Large, Mark I.

Scale, ½.



Instructions for Cleaning Cartridge Cases.

As soon as possible after firing, the cartridge cases are to be cleaned as follows :—

(1) Remove the fired primer or adapter.

(2) Immerse the cartridge case in clean fresh water (hot), which should contain ½ oz. soda to the gallon if the cartridge has been fired with cordite.

(3) Rub the cartridge case, inside and out, with a mop, formed by a piece of rag tied to the end of a stick.

(4) Rinse in clean fresh water and rub perfectly dry.

(5) Repack in their own boxes. *Fired cases are never to be repacked in boxes containing filled cartridges.*

NOTE.—The fired primers or adapters are not to be re-inserted in the cases, but are to be returned separately.

NOTE 2.—"1 inch electric aiming cartridges are to be cleaned in a similar manner."

General Instructions relating to Q.F. or Q.F.C. Cartridges.

Testing circuits.

On all occasions, before firing, both electric circuits should be tested by firing a primer or tube in an empty cartridge case.

Whenever exercising at general quarters a primer or tube is always to be fired from each gun, the firing to be electrical or mechanical at the discretion of the officer in command of the ship. Firing primers at general quarters.

To admit of this being done, and sufficient primers and tubes retained for testing purposes, the present supply will be increased as may be found necessary.

All Q.F. cartridges after being withdrawn from a gun are, if unfired, to be inspected by the officer of the quarters before being returned to the magazine; he is to satisfy himself that they are fitted with electric primers only, or if with Mark IV. adapter that there is no tube in them, and is to report the same to the commanding officer; this is to ensure that no percuesion tubes find their way into the magazine. Cartridges withdrawn from guns.

The electric primer of a cartridge that has missed fire is not to be removed till at least 10 minutes have elapsed after the cartridge has been withdrawn from the gun. Missfires.

No electric tube, primer, or detonator which fails to fire, and for which failure no cause outside the tube, &c., can be assigned, is to be opened for examination on board ship. All such are to be returned through an Ordnance Depôt to Woolwich for special examination. Not to open missfired primers.

All cases which are found to be split, either through developing cracks spontaneously or after being fired, are to be returned on the first opportunity to the nearest naval ordnance store depôt with a view to their being forwarded without delay to the Naval Ordnance Officer, Woolwich. Cases found split.

Marks on the base of a Q.F. Cartridge.

The manufacturer's initials or recognised trade mark will be found on the base of a Q.F. cartridge, also the date of manufacture. Identification of maker.

Marks will be found on the base of the cartridge to show how many times it has been filled, as follows:— Refilling.

When new cartridges are filled they will be stamped with the letter "C" to denote that the charge consists of cordite, followed by "F" or "R" in smaller letters to denote whether full or reduced.

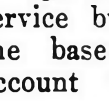
When again filled, it will only be necessary to add a small "F" or "R" to denote whether full or reduced.

e.g., C F R.

This would show that the—

1st was a full charge of cordite.
2nd „ reduced charge of cordite.

Q.F. cartridges will not be re-formed after having been fired six times with cordite.

Q.F. cartridges, 12-pr. to 6-inch, which are condemned for service but are retained for dummies, are stamped on the base thus  and when so stamped they are on no account to be again used for service.

 indicates that the cartridge case has been tested.

CHAPTER V.

Cases, Boxes, &c.

All boxes and cases containing ammunition are to be handled with care to prevent injury to their contents. This applies particularly when embarking ammunition and when manning and arming boats.

Neither evolution is to be performed against time.

Filled powder and cordite cartridges are stowed in the magazines in the following descriptions of cases and boxes :—

Air-tight lockers -	- All B.L. guns in later ships.
Rectangular corrugated cases	- Hand-loaded B.L. guns.
Cylindrical cases - -	- Turret guns.
Cartridge boxes, outfit -	- Q.F. gun.
Metal-lined cases - -	- Principally for boat work.
S.A.A. boxes - -	- For stowage of small-arm and machine-gun ammunition.

For transport of ammunition, zinc cylinders and transport boxes are also used. Transport cases.

Air-tight lockers are fitted in the magazines of later ships for the stowage of all charges for B.L. guns. They are built in the ship, and consist of corrugated brass cases with plain brass fronts. They are subdivided by platforms and partitions in the case of large ones, and have one or more doors, made air-tight by means of flanges and india-rubber strips, and secured by clips worked by a spanner. A small card is fixed on a frame on the locker, showing the lot number, description, and number of cartridges stowed.

Corrugated rectangular cases are made of corrugated brass with cast gun-metal top and fittings. Rectangular cases.

The sizes of these cases are distinguished by the letters A to O, as follows :—

Case.	Gun.
A	Blank for 6-inch Marks VII. and VIII.
B	6-inch B.L., Marks VII. and VIII., 20-lb. or 23-lb. M.D. charges.
D	10-inch B.L., "Devastation."
F	6-inch B.L., Marks VII. and VIII., 29-lb. M.D. charges and 6-inch B.L. Mark XI. 32 lb. 10 oz. charge.
G	9·2-inch Mark X.
I	9·2-inch B.L., Marks II. to VIII. guns.
J	10-inch B.L.
N	9·2-inch Mark X.
Rect. O	7·5-inch B.L.

In all cases the lids are 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.

Closing the case.

In closing the case the handles of the lid should be under the bar, as shown in the woodcut, to prevent the possibility of a tackle being hooked to these handles.

Marks II., III., or IV. metal key.

The cases are opened by the Marks II., III., or IV. metal key.

Air test plug.

All the circular lids of new and repaired cases have a hole in them closed by a gun-metal screwed plug; this hole is used for making connections to an air pump for testing purposes.

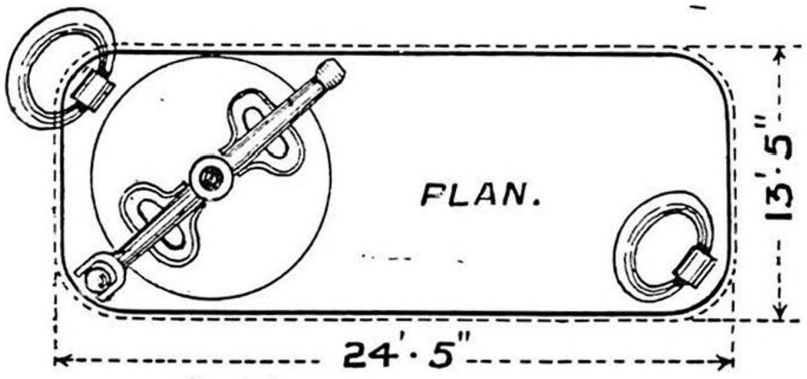
O, P, Q, and R key.

This plug is worked by means of the "O, P, Q, and R" key.

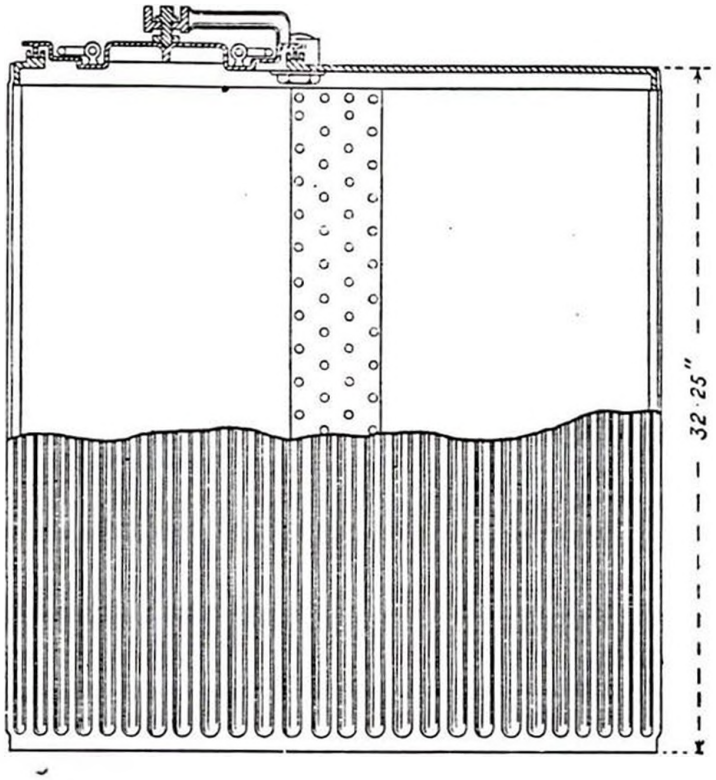
The woodcut shows the F case as a typical case.

Case, Cordite, Rectangular F (Mark I.).

Brass, corrugated for 16-6-inch B.L., Mk. VII. 14½ lbs. M.D. cordite cartridges.



PART SECTION AND ELEVATION.



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

D to J cases have a wood lining to the top to prevent the cartridge being cut by the lower ends of the top fittings. D cases when stowing 13·5-inch cordite charges have a packing piece in the form of a stool. Wood lining to the top.

F to J cases have packing pieces in them. Packing pieces.

All except the A cases have their openings on one side of the top; the A case has the opening in the centre. Position of opening.

The lids are made water-tight by well luted jute, yarn, or hemp placed in the groove with more luting placed round the lid. Screwing lids.

These rectangular cases are not intended to be moved when in action. Use and stowage.

In stowing those which have their lids in the corner or sides of the top, as far as practicable, four cases should be stowed with their lids together.

When emptied, or partially emptied, the cases should be clearly marked with a piece of chalk to show what remains in them. Ullages.

Cylindrical Cases.

These cases are lettered from O to W, and the design varies according to the method of loading the gun whose cartridges they contain.

Some are corrugated and some plain.

They are made of brass.

The following table shows the use and contents of the various cases :—

Case.	Gun and Ship.	Stowage.
O	12-inch B.L. Marks I. to VII. (cordite only).	Four quarter-charges.
P	13·5-inch B.L. - - -	One half- or two quarter-charges.
Q	12-inch B.L. Mark IX. - -	Two quarter-charges.
R	12-inch B.L. Mark VIII. -	One half- or two quarter-charges.
S	16·25-inch B.L. - - -	Four eighth-charges.
V	12-inch B.L. "Edinburgh" -	Four quarter-charges.
W	12-inch B.L. "Colossus" -	" "

Of these the O, P, Q, R cases are not moved from the bays during action; they hold only cordite charges, and open only at one end.

The remainder are moved in action and open at both ends so that a rammer may pass through the case.

Closing lids. The lids of all are made water-tight by being screwed up against a dermatine washer fixed by india-rubber solution.

R case. There are three marks of R case in use, viz., Marks I., II., and III. The Marks I. and II. cases were made the diameter of the chamber of the 12-inch Mark VIII. gun, and are therefore unnecessarily large for the cordite charge.

The lids of these cases are secured by cams on the lid which engage in grooves inside of the top of the case. The top of the Mark I. being weak, these cases are being converted to Mark II.

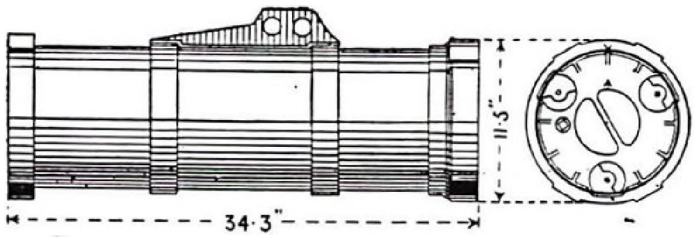
The Mark III. case is of smaller diameter, and has three locking cams, whereas the Marks I. and II. have four.

The cams are worked by means of the O, P, Q, and R key, which also serves for the air testing plug of these and all other cases so fitted. A mark on the lid and case shows the correct position for the lid.

Cases, Powder, Cylindrical, Plain, R Marks II. and III.

For 12-inch Mark VIII. guns.

To contain two ¼-charges of cordite.



The O, P, and Q cases are similar in construction to the R case, Mark III., but the P case has four cams. O, P, and Q cases.

The S, V, and W cases have their ends secured to the case by means of screw handles, which are pivoted on the lids and fit over lugs on the case. In the latest pattern S and V cases these handles work sideways, and the upper ends of the handles are formed into cams, which bear on lugs on the case to start the lid when opening. S to W cases.

In the earlier patterns of S, V, and W cases the lugs opened outwards.

The handles are screwed up with a metal spanner. Spanner.

Air test plugs are fitted as in the rectangular cases, except the S cases, which are too weak to stand the test. Air test plugs.

To prevent the lid revolving when screwing up the lids fitted with sideway handles, two stops on the case fit into slots on the lid.

To ensure the lids being replaced on the same ends of the same cases from which they were taken, and on the proper slew, a number is stencilled on the body and on both ends, also one handle and the corresponding lug are painted red at one end and blue at the other. Marks for putting on lids.

Air test plugs are fitted on the lid.

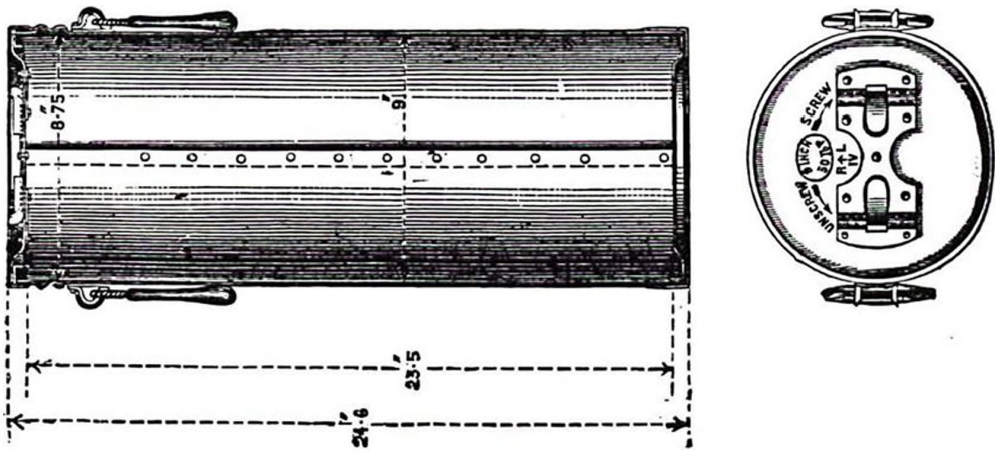
Transport Cylinders.

Zinc transport cylinders are in use for the transport of B.L. charges 6-inch and above.

There are a large number of different sizes of cylinders known by numbers, and the latest pattern known as "C" pattern is shown in the woodcut.

"C" Pattern.

Scale $\frac{1}{5}$.



The lids screw into the cases and are kept water-tight by a dermatine ring. A star (*) indicates an additional ring of zinc to make the dermatine ring take better.

Bearers. When drawing cartridges in these cylinders, "bearers, wood cartridge cylinder," are to be drawn from the depôt at the same time for opening them and returned with the empty cylinders.

To open. 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 direction required.

When cartridges are drawn to replace expenditure in these cylinders they are transferred in the magazine to the brass cases. A spare label showing the particulars of the cartridge will be found in the cylinder, or, if not there, it is supplied with the cylinder; this label is to be pasted on the brass case.

Boxes for Q.F. Ammunition.

Outfit boxes. *The "Outfit" boxes* for the 6-inch Q.F. and Q.F.C., 4·7 Q.F., 4-inch Q.F. and Q.F.C., and the 12-pr. Q.F., 8 cwt., 12 cwt., and 18 cwt., are of teak.

The boxes are zinc lined. The lid is fastened by a frame engaging four metal bolts, the frame being moved by an eccentric actuated by the Mark IV. key.

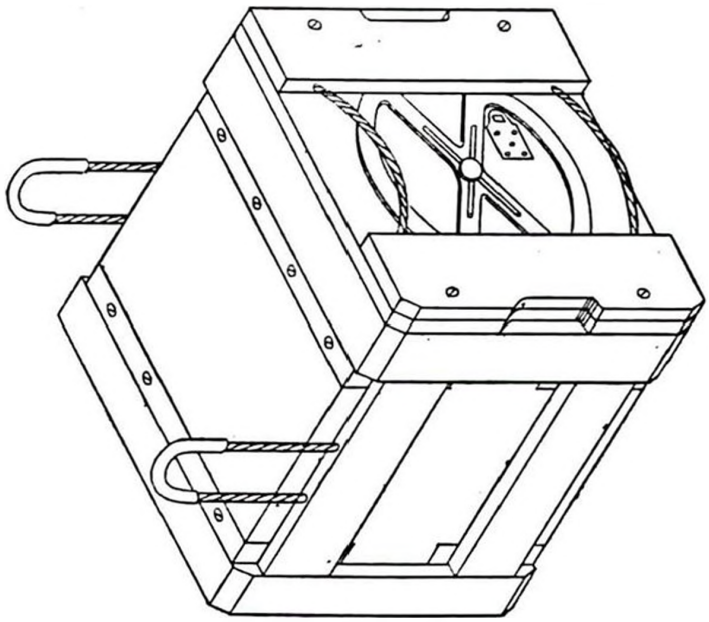
The box is strengthened by battens on the top and sides and by brass straps round the ends.

To force the lid up, should it be stuck by the luting or paint, a notch is made under two corners of the lid so that the handle of the key can be inserted and the key used as a lever.

The handles are of copper wire rope covered with leather.

The box is made air-tight by luting placed in a recess round the lid. Luting.

Box, Cartridge, Q.F. 6-inch, Cordite, Mark I.



The 6-inch box holds four cartridges, which are stowed two with heads down, and two with heads up. 6-inch box.

The 4·7-inch box holds six cartridges stowed horizontally, "heads and tails" each cartridge being packed with a wooden packing piece and two canvas lifting bands. 4·7-inch.

The 4-inch box holds eight cartridges stowed horizontally, "heads and tails," each cartridge having a wooden packing piece; a canvas lifting belt is snaked between the cartridges. 4-inch.

There are three sizes for the 12-pr. cartridges, one for the 18-cwt. gun, one for the 12-cwt. gun, and one for the 8-cwt. gun. The box for the 18-cwt. gun holds 8 cartridges, and for the 12 and 8-cwt. gun each box holds ten cartridges, which are stowed in a similar manner to those for the 4-inch Q.F. 12-pr.

Spring packing pieces are now superseding the wood packing pieces for all Q.F. cartridges from 12-pr. to 6-inch Q.F.

Transport boxes.

Transport boxes are also in use for the 6-inch and 4·7-inch Q.F. They may be distinguished from the *outfit* boxes by the lids being secured by screws.

Blank.

Blank charges for the 4-inch, 4·7, and 6-inch Q.F. are supplied already made up in outfit boxes painted red.

The empty cylinders for filling 12-pr. blank or saluting charges are supplied in outfit boxes painted red.

3 and 6-pr. boxes.

Boxes for 6-pr. and 3-pr. ammunition are of wood. The lid works on hinges and is secured by a hasp and turn buckle secured by white line.

These boxes are passed up to the gun when in action. A loose lining of zinc fits inside the box, having a groove round its top edge to receive luting in order to make an air-tight joint; a lid of zinc having a flange to rest in the groove closes the inner lining. There is a false top and bottom of zinc with holes to hold the cartridges base up, and a wooden bottom with recesses to take the point of the shell.

The 6-pr. box is painted stone colour, and holds 11 cartridges.

The 3-pr. box is painted lead colour, and holds 16.

Mark I.

The Mark I. boxes were not zinc lined, and are used for dummy cartridges.

Ordinary packing cases are supplied for tools, &c., used in making up blank and saluting charges for these guns. Special boxes are supplied to hold 20 cartridge cases empty for making up blank.

Primers.

Primers are supplied in tin cylinders holding 20 packed in cork.

Metal-Lined Cases.

Use.

These cases are used for small combustible stores, and for boat work, as after being opened they can easily be made water-tight again.

They are made of wood, lined with tinned copper.

The lining is closed by a circular bung made water-tight by luting, and the case has a square hinged wooden lid over the bung.

The lid is secured by two screw bolts which are actuated by the "metal-lined key."

There are two sizes, viz., the half metal-lined case, and the quarter metal-lined case.

The following are stowed in half metal-lined cases :—

2,850 rounds of blank ·303-inch ammunition, with mock bullet.
3,400 rounds of blank ·303-inch ammunition without mock bullet.
2,000 „ „ ·45-inch Maxim ammunition.
50 11-oz. saluting charges for the 3-pr. Q.F. Hotchkiss Mark I.
43 saluting charges for 3-pr. Vickers Mark I.
37 15-oz. saluting charges for the 6-pr. Q.F.
20 1 lb. 8 oz. blank charges for the 12-pr. 8 cwt.
30 1 lb. 8 oz. blank or saluting charges for the 12-pr. 12 cwt. Q.F.
20 6-pr. blank made up, for destroyers.
25 3-pr. blank made up for torpedo boats.
25 sound signal rockets.

The following are stowed in quarter metal-lined cases :—

1,200 rounds of ·303-inch ball ammunition for boat service and 840 ·303 ball in chargers.
1,200 „ „ blank, with mock bullet.
1,450 „ blank ·303-inch ammunition, without mock bullet.
9,100 „ Morris tube ammunition.
102 cartridges for Very's light.
60 powder charges for torpedo impulse.
50 Tonite charges for sound rockets.

Small Arm Ammunition Boxes.

There are two sizes of S.A.A. box in use for Naval Service, viz., the S.A.A. box Mark XI., and the S.A.A. box Half Mark I.

The Mark XI. box is made of wood with a tin lining. It has a sliding lid attached by a length of whipcord to the box to prevent its being lost when the box is open. When shut, the lid is secured by a split pin which has a short length of twisted copper wire by which to withdraw it. This wire lies in a groove which is covered by a calico seal label; a loop of leather for the finger is attached to the wire behind the seal, and the end of the wire is secured to the lid of the box. Thus to open the box the seal label must be broken. Mark XI.

The tin lining has a tin lid soldered to it, 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. Once opened, the box cannot be made water-tight except by soldering down this lid. Copper-wire handles, part of which are covered with leather, are fitted at each end for transport.

The S.A.A. box half is of similar construction to the above, except that it is only half the size and has a copper-wire handle at one end only.

For the various contents of these boxes, *see* p. 132. Contents.

Painting and Marks on Cases.

All cylindrical, rectangular, and metal-lined cases, and all Q.F. boxes containing Service cartridges except the 3-pr. Q.F., are painted stone colour.

The 3-pr. Q.F. box is painted lead colour.

All boxes containing blank or saluting ammunition are painted *red*, except S.A.A. boxes.

All boxes containing dummy ammunition are painted *black*, except S.A.A. boxes.

All cases containing explosives are painted with two bands of Chinese red.

Marking.

All packages containing filled gun cartridges will have the following information stencilled in black for Naval Service, except those containing blank and saluting charges, in which the stencilling will be white, except the letter N, which is blue.

The word "Cordite" is always stencilled in red paint.

Number of cartridges in package.

Designation and numeral of the cartridge :—

(1) Nature, lot number, and initials of the maker of powder, or size and lot or batch number (which includes initials of maker) of cordite—$\frac{1}{2}$, $\frac{1}{4}$, or $\frac{1}{8}$ charges as the case may be, if not whole ones.

(2) The date of filling.

(3) The monogram of filling station.

(4) The tare and gross weight (placed on the side of Q.F. boxes).

(5) The words "For practice only," or "For gunnery ships only," where necessary.

In the case of Q.F. boxes, in addition to the above :—

(1) Numeral and initials of manufacturer of empty cartridge case, 12-pr. and above, also date.

(2) Numeral and initials of manufacturer of primer and year of manufacture, and the letter "T" if the contact discs are of pure tin, except the Mark V. primer, which were all made of pure tin.

(3) The number of the box.

(4) The words "To be handled with care," and, in the case of 3 and 6-pr., the words "This end up."

In certain Q.F. boxes filled before 1899 the contents, &c. will be found on a label pasted on the outside of the lid.

In all cases the following labels will be found on the package.

On the outside :—

Group and class label.
Government explosive label.
Instructions for handling.
Station label.
Contents label on S.A.A. boxes.

On the inside :—

Packing label for the interior of the lid.

A loose label inside zinc cylinders.

Metal-lined cases containing S.A. ammunition have contents label also pasted inside lid.

6-pr. and 3-pr. boxes have, in addition to the above :— 6 and 3 pr.

A label containing all information as to the contents, which is stencilled outside, pasted inside the lid.

The numeral of the fuze and lot number used also pasted inside the lid.

A notice about repacking also pasted inside the lid.

The group and class label shows the classification of the contents of the box. Group and class label.

The Government explosive label is one with "Government explosives" in red round a broad arrow. Explosive label.

All filled packages have this so placed that it must be torn on opening the package.

The packing label shows the name of the workman responsible for the packing of the case, the place of packing, and date. Packing label.

The station label is a strip of muslin, 3 inches long, with the initial of the packing station on it in black. Station label.

It is placed over the junction of the lid and body, and must therefore be torn on opening the case.

S.A.A. boxes have a label (similar to that placed on the outside of the box) affixed to the centre of the closing plate. The particulars of the batch of cordite and the number of the box will be printed on the closing plate after it is soldered down.

Luting, which is used for making water-tight rectangular, and metal-lined powder cases, and all Q.F. ammunition boxes, and for other purposes such as making gas-tight large base fuzes, &c., is issued in 1 lb. tins. The latest pattern, Mark III., is composed of 80 parts of whiting, 20 of vaseline, and one part of castor oil. Luting.

Mark I. is used only for torpedo work. Mark I.

Keys.

Keys for powder cases are supplied, as a rule, three to each magazine in which the cases they open are stowed, and a proportion spare. Supply.

Keys are issued with lanyards, and are to be kept hung up in the magazines.

O, P, Q, and R key, Mark II.

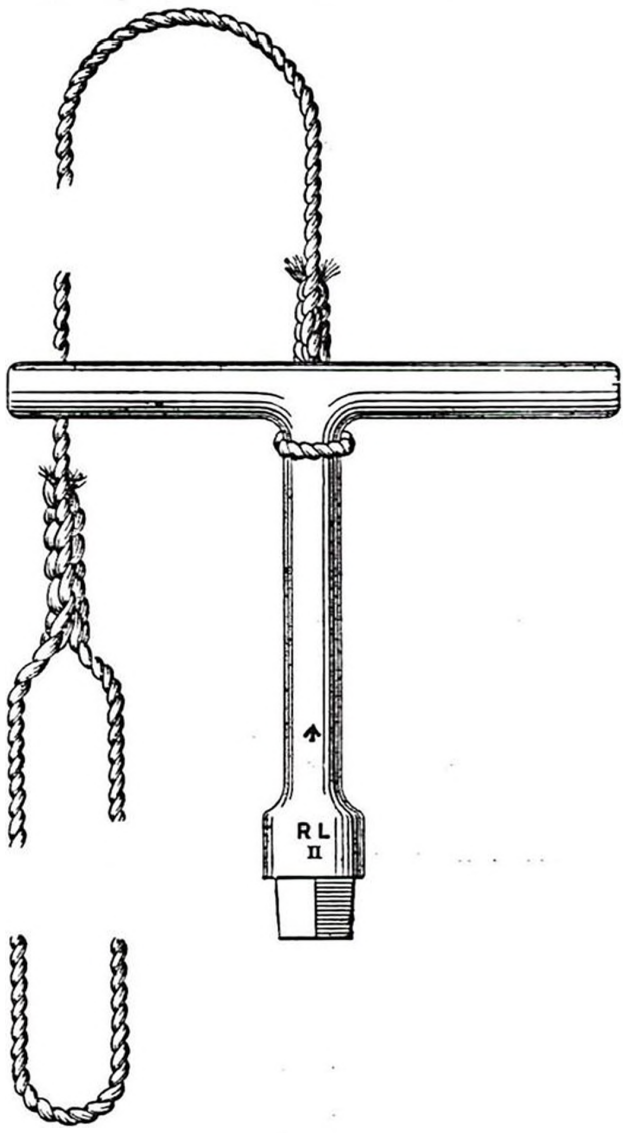
The O, P, Q, and R, key, Mark II., and the *R key, Mark I.* —The former only differs from the latter in being slightly longer in the shank.

Use.

Used for opening O, P, Q, and R cylindrical cases and for air-test plugs of *all* cases so fitted.

O, P, Q, AND R KEY, MARK II.

Scale ½.



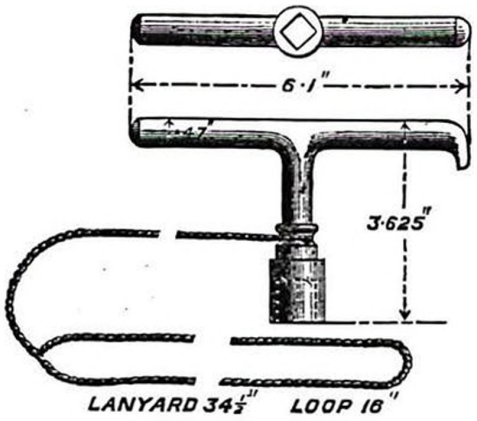
Spanners.

Metal spanners, 1 · 1-inch, are supplied for opening S, V, and W cases of the later marks, the earlier marks of cases required a 1-inch spanner.

The metal key, Mark III., is of gun-metal with a cross handle, one end of which is formed into a toe for raising the lid of the case. Metal key, Marks III. and IV.

This key will also open Q.F. outfit boxes 12-pr. and above, but is supplied only for rectangular cases.

Mark III.



The metal key, Mark IV., is similar to the above, but is stronger, being made of aluminium bronze.

It is supplied for opening rectangular cases and outfit boxes.

The toe in the handle is used for prising up the lid of the outfit boxes; a slot will be found under two corners of the lid for this purpose.

The key for metal-lined cases consists of a wooden handle carrying a piece of metal with two prongs; it is also used for the fire-work boxes, large and small, and wooden tube boxes. Metal-lined key.

In addition to the usual allowance for magazines the key is supplied to each boat's magazine for use with quarter cases when boats are "manned and armed."

Machine Guns.

The ·45-inch Maxim gun is allowed six boxes for belts per gun, and six for each travelling carriage or tripod.

The ·303-inch Maxim gun is allowed four boxes for belts per gun, and three for each travelling carriage or field stand.

Each box will contain one long belt of 334 rounds or two short belts each containing 140 rounds for ·45-inch gun, and Belts.

two long belts of 250 rounds or six short of 84 rounds for ·303-inch gun.

Five long and two short belts are supplied for each ·45-inch gun, six long and six short for each ·303-inch gun.

Cartridge Cases and Bags.

To convey the charges from the magazine to the guns, cartridge cases are used for B.L. guns, bags for Q.F. guns, and special bags for the charge for the 6-inch B.L. Marks VII. and VIII. and some of the larger guns.

Clarkson's cases.

Cartridge cases are known by numbers, which run from 9 to 42. They are marked with the number of the case and the gun they are used for. Numbers 9 to 36, except No. 30, are known as Clarkson's cases, and are made of Clarkson's material.

They consist of strips of cork cemented together, lined and bound with canvas. They are strengthened with bands of cork, and are covered with leather.

The guns the various cases are used for are as follows :—

No. 9, Clarkson's case—½-charge cordite for 9·2-inch Marks I. to VII. B.L.

„ 10 „ „ „ 9·2-inch Marks I. to VII.

„ 13 „ „ „ 13·5-inch B.L. until stock is used up, when No. 16 will be issued in lieu.

„ 16 „ „ „ 10-inch B.L.

„ 26 „ ¼ „ „ 12-inch B.L., Marks III. to VIII.

„ 28 „ ⅛ „ „ 16·25-inch B.L.

„ 30, K.A. Canvas bag—Full charge for 6-inch Marks VII. and VIII. B.L.

„ 31, Clarkson's case—Full charge for 6-inch Marks VII. and VIII. B.L.

„ 32 „ ½-charge for 12-inch Mark VIII.

„ 33 „ ½ „ cordite for 12-inch B.L., Marks III. to V.

No. 34, Clarkson's case—½ charge cordite for 10-inch B.L.
„ 36 „ ½ „ „ 51½ lbs. 9·2-inch Mark X. B.L.
„ 38, K.A. Canvas bag—Full charge „ 6-inch B.L. Mark VII. 29 lbs. charge.
„ 39 „ „ ¼ „ „ 12-inch Marks IX. and X. B.L.
„ 40 „ „ ½ „ „ 9·2-inch Marks X. and XI. B.L.
„ 41 „ „ ½ „ „ 7·5-inch Marks I. and II. B.L.
„ 42 „ „ Full „ „ 6-inch Marks VII. and XI. B.L.

For heavy guns that have their own machinery for the supply of ammunition, cartridge cases are only supplied as an auxiliary for use when the main loading arrangements break down.

Supply of cases.

Cases are supplied to each gun, 10-inch B.L. and below, in sufficient numbers to hold four full charges.

Hydraulic worked B.L. guns have sufficient cases to hold one full charge only per gun.

During peace time one half of the cartridge cases are to be hung up in the handing room with dummies in them, the remainder to be kept in the ready rack empty. In war time all should be kept full, in the ready rack.

Canvas bags, similar to those supplied to Q.F. guns, are now being supplied to some of the heavy guns, in lieu of Clarkson's cases.

Canvas bags.

Canvas bags edged with rope are used for the supply of ammunition to Q.F. and Q.F.C. guns, 12-pr. and above.

Guns.	K.A. Canvas Cartridge Cases.	Red Canvas Bags for Cartridges.	White Canvas Bags for Projectiles.	No. of Cartridges or Projectiles a Bag will contain.	Remarks
6-inch Q.F. - -	—	40	60	1	Per gun.
6-inch Q.F.C. -	—	30	50	1	„
6-inch B.L. Mark VII.	40	—	80	1	„
6-inch B.L. Mark VII.	2*	—	80	1	„
6-inch B.L. Mark VII. and VIII.	5	—	—	1	„ (twin mounting).
4·7-inch Q.F. -	—	20	20	1	Per gun.
4-inch Q.F. or Q.F.C.	—	10	10	2	„
4-inch Q.F. (in sloops)	—	20	20	2	Per ship.
12-pr. - - -	—	10	20	4	Per gun.
12-pr. (in Scouts) -	—	10	10	4	„
12-pr. (in T.B.D.'s) -	—	5	—	4	„

* For the "King Edward VII.," "Black Prince," and "Devonshire" classes.

Lockers are provided in the magazines, and shell rooms for the stowage of these bags, one third in the shell room, two thirds in the magazine.

Canvas cartridge cases for 6-inch Marks VII. and VIII. B.L.

Cases, Cartridge, Canvas, are now supplied to the 6-inch, 7·5-inch, 9·2-inch, and 12-inch guns. The case consists of a canvas bag edged with rope with a stiffened ring at the mouth, over which the cover fits as in the Clarkson's case.

Each case holds a full, half, or quarter charge, according to the nature of the gun.

Classification and Storage of Explosives.

Classification of explosives.

For purposes of storage and transport all Service explosives are classified as in the following table, and all packages containing explosives will have a label stating the group and class to which the contents belong; these labels are printed on white paper for N.S. and on blue paper for L.S.; 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. Any packages that are not already labelled will have the labels attached to them before issue from any store :—

Group.	Division.	Stores.
I.	—	Explosives, which must be placed in a magazine, each division in a separate compartment, except as provided under Group III., in which magazine conditions must be observed :—
	I.	Cordite in bulk. ,, cylinders without igniters. Ballistite. Gunpowder, except that which has been wetted. Cannon cartridges filled with gunpowder, ballistite, or cordite, except Q.F. cartridges, but including all charges for Q.F. cartridges. Puffs, powder. Igniters, powder. Cordite cylinders filled with igniter. Bags, primer, filled. Charges and primers, impulse torpedo. Fuze, instantaneous. Quick match. Stars, incendiary.
	II.	Gun-cotton, dry. Dynamite. Exploders filled for lyddite shell. Blasting gelatine. Tonite. Gelegnite.
	III.	Picric acid.

Group.	Division.	Stores.
II.	—	Explosives that must be stored in explosive stores, each division in a separate compartment, but not in magazines :—
	I.	Caps, percussion. Cartridges, small arm „ machine gun } which are safety cartridges. „ aiming tube „ signal, Very. Cases, cartridge, Q.F., capped and empty. Composition, priming. Fuzes, time. „ percussion. „ time and percussion. „ electric. „ safety. Match, slow. Port-fires. Primers, light G.S., and port-fires, 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 gun-cotton only.
	III.	Shells, filled and fuzed. Rockets, war and life-saving. Shells, filled but not fuzed.
	IV.	Detonators. Matches, Vesuvian.
III.	—	Explosives which may be stowed in explosive stores or magazines, each division in a separate compartment. If in Explosive Stores.—The latter must be under Home Office rules as to distances whenever the exigencies of the Service permits. If in Magazines.—Division III. may be placed in the same compartment with Group I., Division I. Division I. and II. of Group III. must each be placed in a separate compartment when stored with Group I.
	I.	Gun-cotton wet, except in mines.
	I.	Filled Q.F. cartridges, containing a cap or percussion primer.
	III.	Filled Q.F. cartridges, fitted with an electric primer or percussion adapter. Cartridge, impulse torpedo.

CHAPTER VI.

Tubes, and Stores connected with them.

Use.

Tubes are used for igniting the charge in a B.L. or Q.F. gun.

The satisfactory action of the tube is of much importance, as on this the accuracy of shooting greatly depends.

The designations of tubes are usually made according to the means adopted for igniting them, and they are known as—

Friction tubes.
Percussion tubes.
Electric tubes.

As electric tubes cannot be fired by jarring or a blow, they may be placed in the vent of B.L. guns when the breech is open, but percussion tubes must be placed in the vent with the breech closed.

Stowage.

Tubes are to be stowed in a special tin-lined locker under lock and key, in the gunner's store-room.

Vent-sealing tubes.

Vent-sealing tubes are designed to prevent any escape of gas through the vent on the gun being fired, hence this name.

The vent-sealing tubes used in the Service are known as "Percussion" and "electric" wireless.

Percussion V.S. (Plate XVII.)

Marks.

The following marks of this tube are in use, Marks IV. and VI.

The Mark IV. can be used in all B.L. and Q.F. guns, 12-pr. and above, but the Mark VI. tubes are only to be used in guns fitted with E or F locks.

Description.

Percussion Mark IV. (Plate XVII.).—This tube is made from solid drawn brass. The head underneath is chamfered to facilitate extraction. 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 cap. The 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.

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 fine grain powder, known as pellet powder. The end is closed by a varnished cork and paper disc.

Action.

The striker in the head of the tube is forced by the action of the percussion lock, or striker of the gun, in upon the cap, firing it, the fine grain powder, and the charge. The explosion of the fine grain powder expands the tube against the sides of the vent, in which it is retained by the percussion lock, or by the breech of the gun in Q.F. guns, while the head of the striker prevents any escape of gas through the interior.

Mark III.

The Mark III. tube was closed by a brass ball embedded in sulphur. This has been removed, and the tube is now very similar to the Mark IV.

Mark VI

V.S. Percussion Mark VI. is made from solid drawn brass and shaped externally as in the Mark IV.

A hole is bored through the head to receive a brass needle through which the blow is given to the detonator. The needle has an enlarged head which fits against a shoulder in the interior. The needle is surrounded by a copper cup to cause obturation. The front end is formed into a needle point, and the rear of the needle is riveted into a brass washer which fits in a hole in the head of the tube.

A copper shearing wire passes through a hole in the body of the tube and through a hole in the needle.

In front of the needle is placed a small detonator which rests against a shoulder in the tube and is retained there by a screwed anvil with one fire-hole. The detonator is similar, except in weight and dimensions, to the R.L. cap. The anvil is retained in position by a copper washer, and a disc of paper is secured to the outside of the washer. The body is filled with pellet powder, and the end is closed with a paper disc and a varnished cork plug.

Issue.

The Mark V. V.S. percussion tubes, of which only a few were issued, were similar in construction to the Mark VI., except that they had no gas-check ; all those manufactured have been altered, by insertion of a copper gas-check and a star added to their numeral.

All percussion tubes are now coloured black on outside, and have four notches equidistant around the head to distinguish them from electric tubes at night.

Percussion tubes are issued 10 in a flat tin box, the printing being in red lettering.

Drill.

Percussion Drill Mark I. is about half the length of the Service tube. Into the head is fitted a coned india-rubber plug; the end is closed by a gun-metal screw.

Percussion Drill Mark II. is similar to the above except that it is the same length as the service tube and has four external grooves down the body, and the head is milled. The tube is blackened on the outside.

P Electric V.S. Wireless. (Plate XVII.)

There are three Marks of this tube, Marks II., III., and IV.

This tube is used in all guns having wireless tube locks.

Wireless tubes.

Use.

Description.

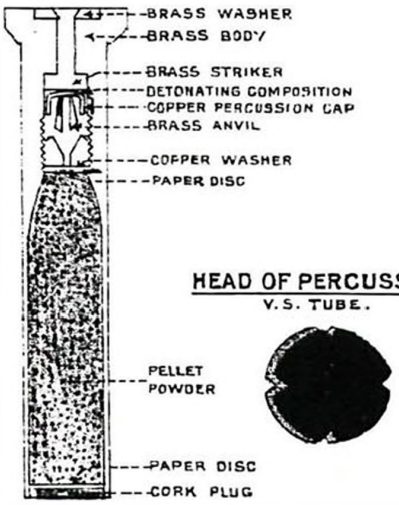
Mark IV.

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 brass conical plug at about ·25-inch from the head; this is insulated from the body by an ebonite coned cylinder, the front end of the cone is cupped out to form a gas-check, and a recess bored in the centre, into which screws an ebonite plug, and into the centre of which fits the tinned copper pole which extends the full length of the tube. This pole is bent and attached to the body of the tube with pure tin; to the pole and edge of brass cone is connected a bridge of iridio-platinum wire giving a resistance of from ·75 to ·95 ohm; at the rear end of the cone a small hole is drilled a little out of the centre to receive the bared end of an insulated copper wire, a turn is made in this short wire, and it is passed through a hole in the head, also drilled a little out of the centre, a recess is made in the head which contains an ebonite cup; screwed in, the inside of the ebonite cup is undercut, and a disc of pure tin place in the bottom, the copper wire is rove through a hole in the tin disc, a turn taken in it, and pressed down on to the disc, the remaining space in the ebonite cup is filled with pure tin poured in while in a molten state, this forms the contact disc, and is slightly below the surface of the head, the upper edge of the ebonite is bevelled away towards the contact, so that should the striker have any play, and come in contact with the ebonite, it will slide down on to the contact disc and so prevent missfires. The tube is primed with the usual priming of gun-cotton dust

VENT SEALING TUBES.

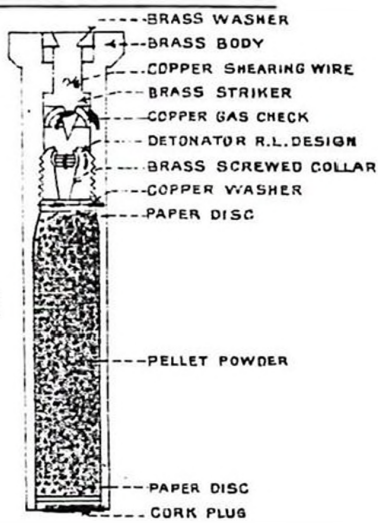
FULL SIZE

PERCUSSION V.S. MARK IV.

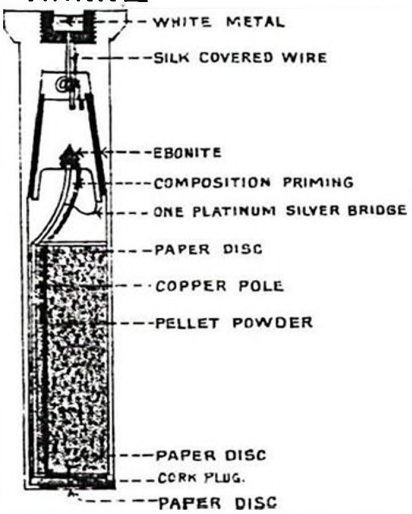


HEAD OF PERCUSSION V.S. TUBE.

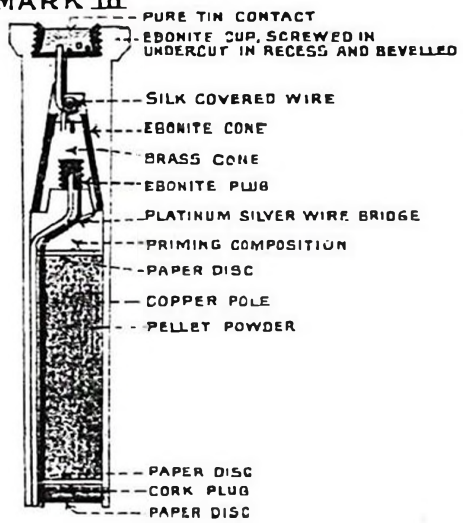
PERCUSSION V.S. MARK VI.



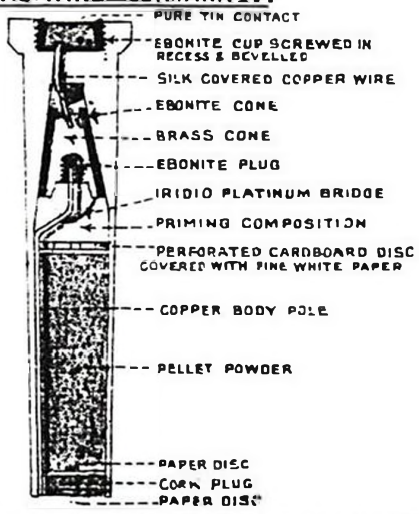
ELECTRIC V.S. WIRELESS MARK II



ELECTRIC V.S. WIRELESS MARK III



ELECTRIC V.S. WIRELESS. MARK IV.



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and mealed powder, over which is placed a perforated cardboard disc, which is covered with a fine paper disc, the remainder of the tube is filled with pellet powder, viz. (R.F.G.^{2} passed through a 24 to 32-mesh sieve and highly glazed), and the end of the tube is closed by a paper disc, then a cork plug, and then another paper disc on outside.

Action. On contact being made the current passes from the battery through the striker which is in contact with the pure tin contact piece, through the short wire, cone, the iridio-platinum 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.

Mark III. The Mark III. tube differs from the Mark IV. in that the bridge is made of platinum silver, and there is no perforated cardboard disc between the priming composition and the pellet powder, but only a paper disc.

Mark II. The Mark II. differs from the Mark III. in that the ebonite cup is much smaller, and it is pressed into the head of tube, which is slightly recessed ; the contact, which is of white metal, is also much smaller, and the rim of ebonite cup is flush with top of tube, thus causing many missfires should there be any lateral motion with striker.

In tubes manufactured since 1st February 1899, the ebonite cup containing the metal contact disc is screwed into the head of the tube, and the contact disc is secured by an undercut groove in the ebonite.

Issue. The tubes are issued similar to percussion, 10 in a box, the printing being in black lettering.

Note on V.S. Tubes.

Caution. No vent-sealing tube must be fired in an empty gun without the range being clear for at least 100 yards, the tampion being out and the bore clear. As vent-sealing tubes fit the vent very accurately, the latter must be kept thoroughly clean, and a bronze rimer is supplied which must be used thoroughly after each round.

Cordite Primers. *The Cordite primer.*—Consists of $4\frac{3}{4}$ inches of No. 20 cordite, which is placed in the vent before the tube.

Use. To be used with P tubes in 9·2-inch B.L. guns and above when firing powder charges.

Supply. Ten in a tin cylinder lined with felt.

Quill Friction Tubes.

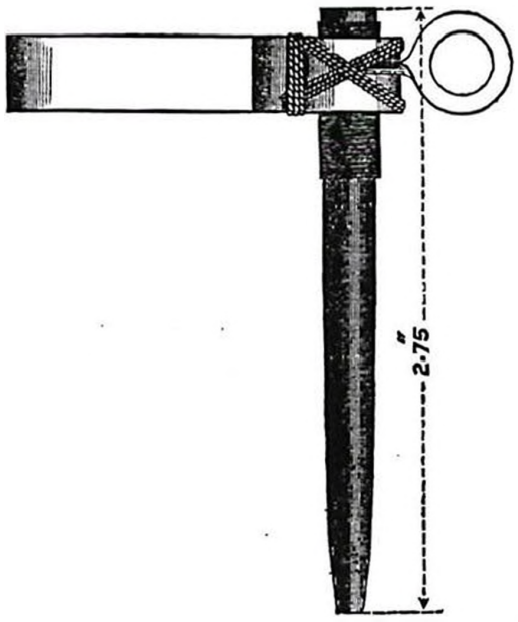
There are two sizes of quill friction tubes in use in the Service, viz., long and short.

Use. The long quill friction tube is used for Hale's war rockets.

The short quill friction tube is used for signal rockets when fired from a tube.

Description. The short quill friction tube is about 2¾ inches long, and consists of a goose quill rammed with mealed powder, pierced with a small channel. In the head is a little detonating composition, through which passes a roughened copper bar, called the friction bar, fitted with an eye for the hook of the tube lanyard.

A woolding of fine copper wire serves to straighten and support the top when the tube is in the vent, and, to support it when the pull of the lanyard comes on it, a leather loop is attached to the head. The loop slips over the friction tube pin screwed into the gun near the vent. 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.



Tube, Friction, Quill, Short, Mark VI.

The long quill friction tube differs from the short one in length only, being 4 inches long. The increased length is given by cementing two quills together.

Twenty-five in a tin box. Issue.

Identification of Tubes.

In every box of tubes will be found the operation paper which gives the details of manufacture necessary for identification. Operation papers.

Vent Implements.

The following implements are for use with vent-sealing tubes. Rimers.

There are four patterns of rimers, viz., the Marks II., III., and IV., and the Special.

The rimer is to keep the vent properly clean and free from fouling.

The Mark II. vent axial is made of bronze. It is $3\frac{1}{4}$ inches long and for $2\frac{1}{4}$ inches of its length it is slightly coned to fit the vent; one side of the cone has three flats, so as to form a cutting edge which removes the dirt or fouling without injury to the steel vent. Mark II.

The rimer has a cross-handle with a long shank, so that it may be used in guns fitted with vent heads as well as others fitted for V.S. tubes.

It is suitable for all axial vented guns having ordinary locks. The remainder, *i.e.*, the 9·2-inch, 10-inch, 12-inch, and 13·5, where the extractor forms part of the lock, cannot use this pattern of rimer on account of the shoulder. Use.

The Mark III. differs from the Mark II. in this particular, and can therefore be used in any gun except the 6-inch B.L. Marks VII. and VIII. Mark III.

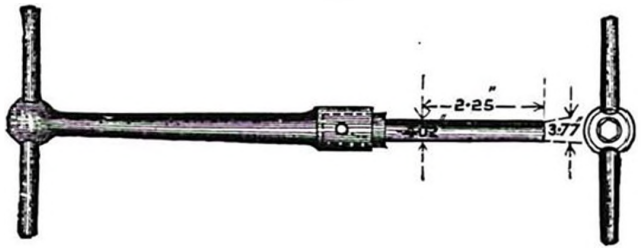
Both patterns are suitable for use in adapters for Q.F. and Q.F.C. guns.

The Mark IV. is similar to the Mark III., but is 10 inches long and can be used in any gun. Mark IV.

The Special rimer is for use in guns using cordite primers; it resembles the Mark III., but the bronze portion is 6 inches longer; it is reduced in diameter, and for about $4\frac{1}{2}$ inches is grooved spirally for removing the fouling of the cordite vent primer. Special. Use.

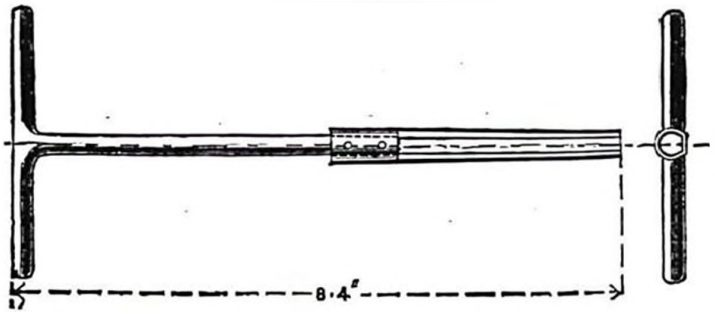
Mark II. Rimer.

Scale, ½.



Mark III.

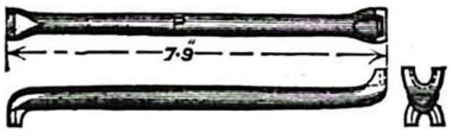
Scale, ½.



Extractors.

There are two patterns of extractors, tube, P, viz. :—

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 where the extractor is part of the lock.

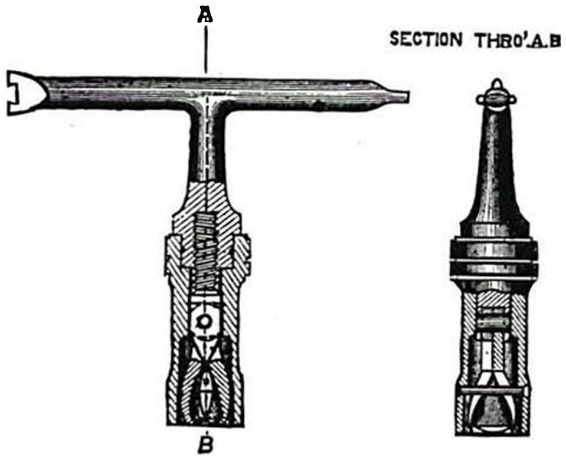


When the tube is so tightly jammed that it cannot be extracted by means of this instrument the *Extractor tube, P, special*, must be employed. In all cases the lock must be first removed before this extractor can be applied.

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 semicircular 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 lever 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.

Lever extractor.

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 locks where the *extractor* forms part of the lock.

Extractor tube box slide "A."

Extractor tube special box slide "A" Mark I. is generally similar to the extractor tube P special, from which it differs principally in the shape of 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.

The extractor is intended for use with B.L. and B.L.C. guns having the box slide "A," that is to say, all guns with the Wellin breech screw, when the vent-sealing tube is so tightly jammed in the vent that the extractor in the slide box fails to remove it.

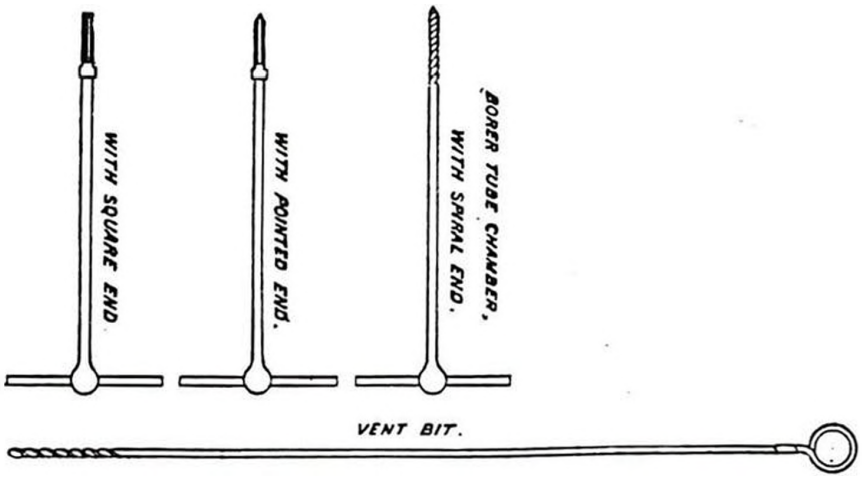
Vent bit.

B.L. guns are supplied with a vent bit for removing fouling from the vent. They are made of steel, with a spiral on one end, and the other end is formed into an eye as a handle. They are supplied to all guns, 7·5-inch and above, that for the

16·25-inch being 48 inches in length, for all other guns it is 36 inches.

Tube chamber bore.

All B.L. guns using cordite charges are supplied with tube chamber borers, of which there are at present three patterns. They are made of steel, and consist of a long steel shank with cross-handles at one end, the other end being formed into drills; the earliest pattern has a spiral end with sharp edges for cutting away the fouling. This type is being used up for 9·2-inch and above B.L. guns, except the 9·2 Mark X. and 12-inch Mark IX., and is superseded by the two later types, viz., the square end and pointed end. The former has eight cutting edges and the latter four, and can be used for all guns, 6-inch B.L. and above.



Vent syringe.

13·5 and 16·25-inch guns are supplied with a syringe for use in the vent.

CHAPTER VII.

Projectiles.

The following projectiles are in use in the Service. Chapter XI. shows how they are supplied.

Armour piercing shot.	Lyddite common shell.
„ „ shell.	Shrapnel shell.
Common shell, nose fuzed.	Practice projectiles.
„ „ base „	

Armour Piercing Shot.

All B.L. and Q.F. guns, 6 inch and above, are supplied with A.P. shot, which are intended solely for the attack of heavy armour. Guns to which supplied.

These shot are made chiefly by private manufacturers, and are of forged or cast steel, the points being specially hardened. Manufacture.

The weight, form of head, maximum length, diameter over bands, and size and shape of driving band are given, 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 the service key. They are made with a small cavity so as to admit of the insertion at any future time of a burster if required. After manufacture the shot, where possible, are kept for three months, as the hardening process is liable to set up a strain in the metal which may cause a shot to split spontaneously; or the whole or part of the batch may be tested by being immersed head downwards in hot water as far as the driving band until the shot is heated throughout, and then plunged into cold water. The difference in temperature between the hot and cold water is to be 130° Fahr. After this they are carefully inspected before being issued for Service.

A certain number out of every batch of shot delivered are proved by firing at armour plates.

The shot will have the following stamped on the base:— Nature of gun it is intended for; whether of cast steel or forged steel, when it would be marked "C.S." or "F.S." The letters A.P., indicating that it is armour piercing. The mark of Stamping and marking.

projectile, and manufacturer's initials or recognised trade mark, on the side of the projectile will be found stamped on the number of thousand, the date of manufacture, and other marks, and letters dealing with the manufacture, such as furnace, &c.

The shot are painted black with a white tip and with a white band to denote that they are of steel, and those that are brought up to the required weight by inserting dust shot and sawdust have the letter "W" stencilled in white on the head and stamped on the base plug. A.P. projectiles have no hole for the lifting bolt bored in them, so that the heavier natures, 9·2-inch and above, are supplied with a lifting band.

How supplied.

Uncapped A.P. shot are supplied with protectors on, to protect the points during transport, and great care must be taken not to injure the projectiles by knocking off the points, which though exceedingly hard, are brittle.

Capped A.P. shot.
Plate XVIII.

A.P. shot are now being capped with a soft iron or mild steel cap placed over the point; the weight of the cap varies according to the calibre, the 6-inch cap being 5 lbs., 7·5-inch 9 lbs., 9·2-inch 15 lbs., 10-inch 19 lbs., and 12-inch 30 lbs. There are several methods of attachment resorted to by the different makers. One maker has a cannelure around the head of the projectile and the lip of the cap pressed into it; another is to have a band of solder placed on the point of projectile and a thread turned on it, and the cap screwed on; another method is to have a number of small cannelures around point, and similar ones on the inside of cap, these cannelures are filled with white metal. The size and shape of cap also is left to the contractors, but the weight must not exceed the weight given; the capped projectiles must pass through an armour plate of different thickness according to the calibre of gun, and after passing through the plate the projectile, minus the cap and driving band, must be intact.

Capped A.P. shot do not require point protectors. All the existing stock of A.P. shot are being capped as opportunity occurs.

A.P. Shell.

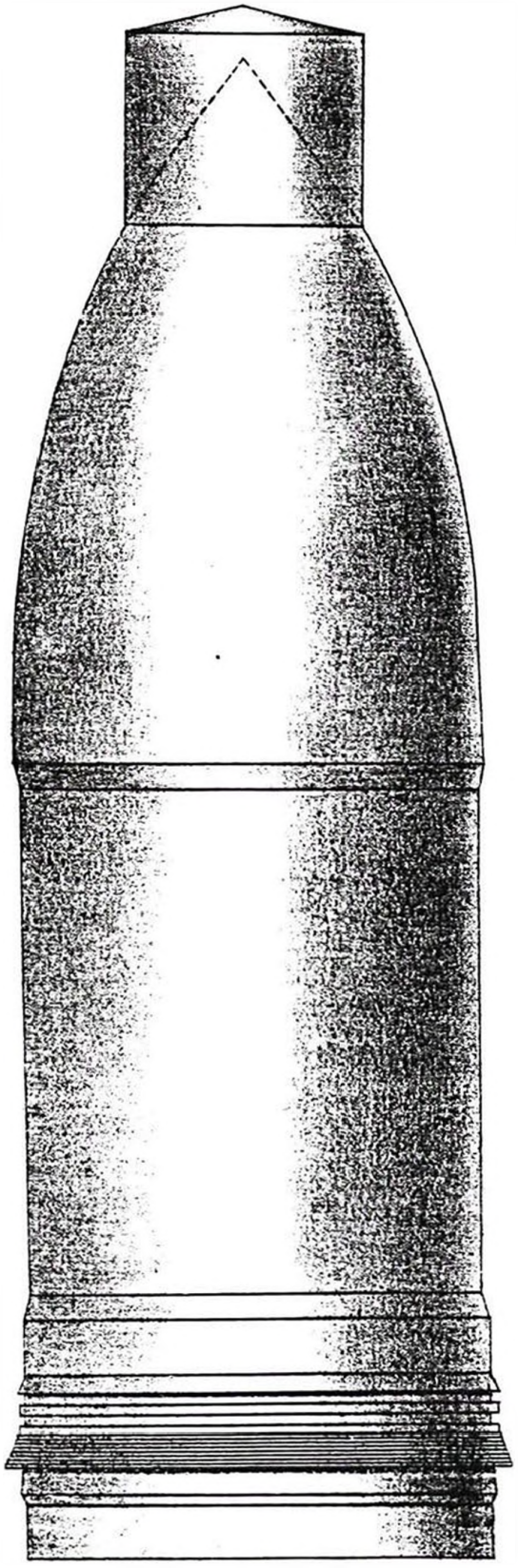
Armour piercing shell are supplied to all heavy Q.F. guns and B.L. guns, 6-inch and above, except the 16·25-inch.

Manufacture.

Armour piercing shell are made of forged or cast steel (except the 4-inch Q.F., which is always of forged steel), pointed, with a considerable thickness of metal in the head. They have a cavity in the body to contain the bursting charge, which is enclosed in a bag. The cavity is lacquered inside with vevril, a sort of enamel, which can be applied cold before the shell is filled, to prevent any friction between the powder and the steel. The present method of closing the base in the 7·5-inch and above, the hole in which for large shell must be larger for manufacturing purposes than that required for the base fuze, is to

CAPPED SHOT FOR 9·2 INCH B.L. GUN.

SCALE = 1/4.



screw in a steel bush as tightly as possible ; the bush is riveted over and threaded to receive the base fuze. This bush having been once put in cannot be removed for the purpose of filling the shell. The older method was to screw in a gun-metal adapter, the joint between it and the shell being made gas-tight by a lead ring hammered into an undercut groove over the joint. The adapter was threaded to receive the base fuze. The smaller shell are in most cases made with the base solid, except for the fuze hole.

A.P. shell are kept three months in stock, if possible, before issue, or may be tested for changes of temperature in hot and cold water in the same manner as for A.P. shot, to guard against spontaneous combustion, due to the hardening process.

Stamping and marking.

A.P. shell are stamped in the same way as A.P. shot, and are painted black with two white bands round the head, with a red band between, with the usual marks referring to the filling and fuzing, &c.

9·2-inch and above A.P. shell are supplied with a lifting band.

A new type of A.P. shell, capped, has been adopted ; they differ from the older pattern A.P. shell in having a smaller capacity for the burster, but larger than that for the A.P. shot ; they also differ in the head, the point in some cases being struck with a larger radius, viz. 2½°, while others are being struck with two diameters, 2½° and 1½° ; they have an iron or mild steel cap placed over the point similar to the A.P. shot.

Common Shell.

(Except Lyddite.)

Guns to which supplied.

All guns are supplied with common shell, which are of two descriptions, nose fuzed and base fused, the latter being sharp pointed.

Manufacture.

They are made of steel either cast or forged, contain a large bursting charge, and are about 3½ calibres long, with ogival heads struck with a radius of two diameters.

All common shell (except lyddite) are lacquered inside, and the 4-inch and above have their bursting charge in a bag.

Nose Fuzed Common Shell.

Guns to which supplied.

These are supplied to all B.L. guns except the 12-inch Marks VIII., IX., and X., 9·2-inch Marks X. and XI., 7·5-inch, and 6-inch XI. and 6-inch VII., using 29 lbs. charge, but existing stocks will be used up for practice, and their place taken by pointed common shell.

Manufacture cast steel shell.

These shell are cast head downwards ; after casting they are placed in an oven, where they undergo an annealing process for 24 hours.

They are all cast with a hole in the base as well as the head ; in the 6-inch and below the hole is closed by a solid gun-metal plug with a lead washer under its shoulder, the washer squeezing out and sealing the joint.

The 6-inch shell have their plug secured by a lead disc being hammered into a slightly undercut recess in the base of the shell.

The hole in the base in the 9·2-inch and above is closed by an adapter and gun-metal plug ; the adapter being screwed into the base of the shell, and secured by a lead ring hammered into an undercut recess in the shell and in the outer edge of the adapter; and the plug being screwed into the adapter with a lead washer under its shoulder to seal the joint. A flanged gun-metal bush is screwed into the nose, and is threaded to the G.S. gauge, and is countersunk so as to take the Naval wad when the Mark I. plug is used.

The increased strength of cast steel over cast iron enables a shell made of that material to carry a larger bursting charge. A cast-steel shell is also more efficient against earthworks, as a cast-iron shell, fired with high velocity, will generally break up on striking an earth parapet before the fuze has had time to act.

For the above reasons steel has superseded iron as the material used for the manufacture of common shell.

With forged steel still thinner walls can be used, increasing the weight of the bursting charge ; but a forged-steel projectile does not break up into so many fragments as a cast-steel.

Forged-steel shell.

These shell are all flat nosed, and in external appearance closely resemble the cast-steel common, but being made of a stronger material the walls are thinner and their capacity for the bursting charge increased.

With one exception they are forged with solid bases, and consequently filled through the nose.

The exception is the 16·25-inch, Mark II., which has the centre of the base bored out and screwed to receive the adapter. The adapter and plug are secured as in the cast-steel common shell.

They are supplied to the 16·25-inch guns, and a few have been manufactured for the 12-inch and 9·2-inch B.L. guns.

The shell are for use with powder charges, and are obsolete for future manufacture.

Pointed Common Shell.

Base Fuzed.

Plate XIX.

These are supplied to all modern B.L. and Q.F. guns. Guns to which supplied.

These shell differ from the cast-steel common shell nose fuzed principally in having a pointed head and a fuze hole in the base.

The present method of closing the base is the same as that already described for the armour-piercing shell, viz.:—For shell above 6 inch a steel bush is screwed as tightly as possible into the base of the shell, and the joint riveted over; no line can be seen afterwards on the base. The steel bush is threaded to take the base fuze. The threads of the fuze are smeared with thinned Mark III. luting and thick luting placed under the flange of the fuze before it is screwed in. *See* Plate XIX. Manufacture cast steel shell.

The 6 inch, 4·7-inch, 4-inch, and 12-pr. shell may be made with a solid base, except for the fuze hole. The hole for the fuze of the 6-pr. and 3-pr. would be too small for filling purposes, and these also are made with a bush. The older method is as follows:—

The 9·2-inch and above have adapters in the base, into which the base fuze screws, the joint between adapter and shell being sealed by a lead ring hammered into an undercut recess, and the joint between fuze and adapter by Mark III. luting under the shoulder of the fuze.

All base fuzed shell are supplied filled and fuzed, the 6-inch and above with fuze protectors on, 4·7-inch and below in boxes. How supplied.

All common shell except those for the 12-pr. 18 cwt. and "lyddite" are painted black, when filled a red band is painted on the head, and if made of steel a white band. Marking.

Common shell for the 12-pr. 18 cwt. are painted lead colour.

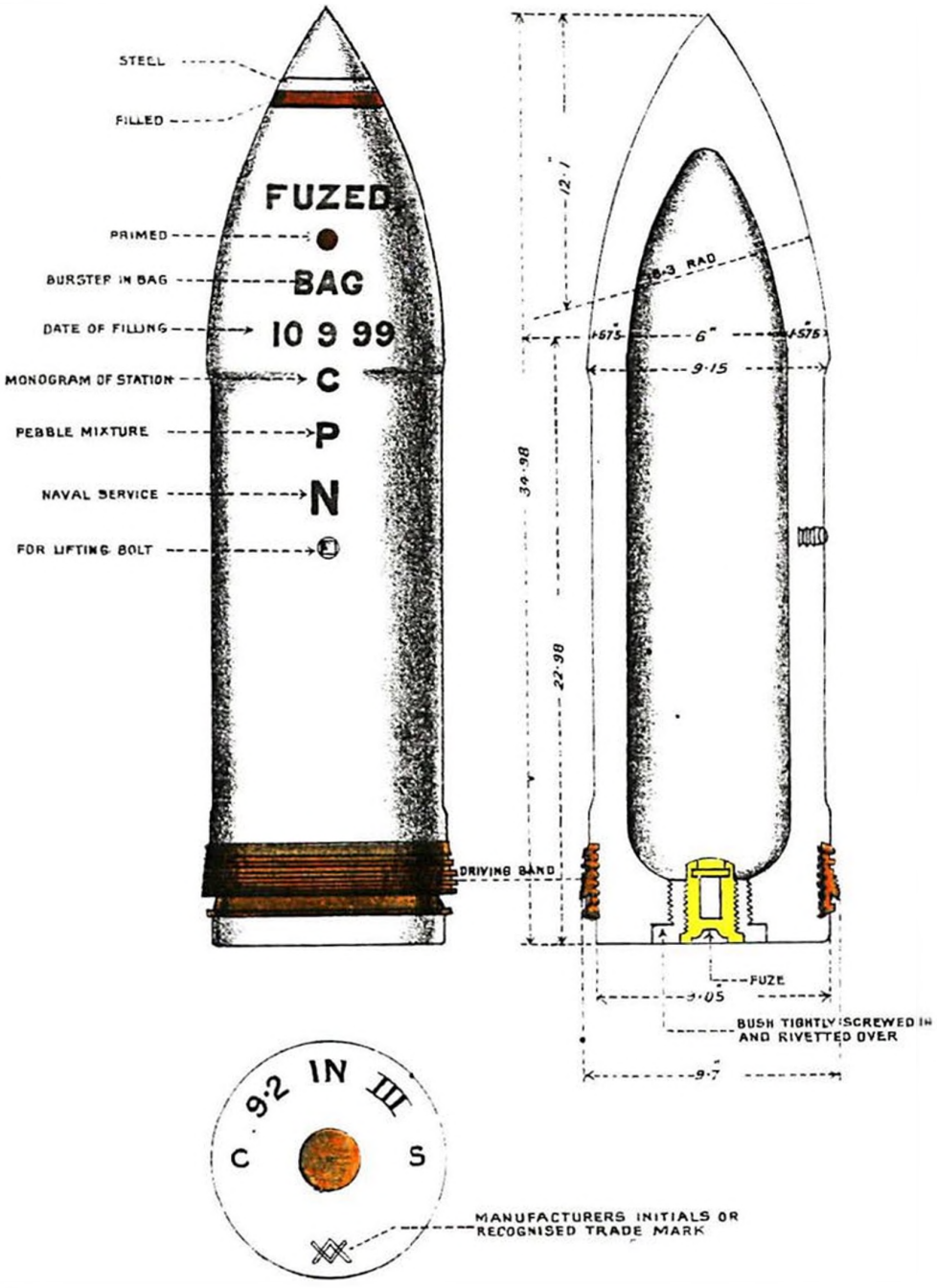
Lyddite Common.

These shell are 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, counter-

9·2 INCH POINTED COMMON SHELL MARK IV.

SCALE = 1/8

	LBS.	OZS.
AVERAGE WEIGHT EMPTY WITH DRIVING BAND	347	8.
BURSTING CHARGE 8 MIX. =	30	0.
FUZE BASE LARGE	2	8.
AVERAGE TOTAL WEIGHT	380	0.



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sunk to take the flange of a special plug, and the 9·2 inch have a hole in the side for the lifting bolt. Lyddite shell of 6-inch calibre and above are fitted with the cupro-nickel or gas-check driving band. The latest marks of 4-inch and 4·7-inch lyddite common have the plain driving band, the earlier issues having the Vavasseur type. The method of attachment, either by waved or straight ribs, is described further on in this work.

The shell are brown varnished inside instead of being lacquered, and their bursting charge of lyddite is poured in while in a molten state, a recess being left by means of a former for the reception of the exploder, and in the case of 6-inch shell and above a primer.

The exploder.

The exploder consists of dry mixed picric powder placed in a red shalloon bag, and then put into a cylinder of paper coated with waterproof paint and the top closed with an aluminium cap, the top of the cap having been perforated with a number of small holes and covered with fine white paper shellaced on.

The exploders used are $4\frac{1}{4}$ ozs. for 6-inch and above, 4 ozs. for the 4·7-inch, and 3 ozs. for 4-inch shell.

The primer.

6-inch shell and above have in addition to the exploder an 8-dram primer, consisting of R.F.G.^{2} powder, placed on the top of the exploder and inside the waterproof cylinder, with the choke of the bag down.

Supply.

Lyddite shell are supplied to the 4-inch to 9·2-inch B.L. Q.F. or Q.F.C. guns, and are always supplied in bulk and plugged.

Practice.

Practice with these shell is carried out annually, one round of lyddite being fired for every two guns which are allowed lyddite shell, the target being a rock or cliff, the range not less than 2,000 yards, and care is to be taken that the area over which fragments of shell may fall is clear for a distance of 1,000 yards from the point of impact. It is to be noted in the Half-yearly Report of Gunnery whether the shell detonated correctly or not. Detonation is judged by the spread of the fragments and the colour of the smoke. Detonation is assumed when the shell bursting spreads the fragments over a large area with an all-round effect. It is found that when this happens the smoke is black, gray, or sometimes nearly white; this latter appearance being caused by the steam produced, which shows up more clearly in some atmospheric conditions than in others. Whenever there is any yellow smoke, the detonation is incomplete, and the effect is much more partial as regards the spread of fragments. The proportion of yellow smoke may therefore be taken as a guide to the nature of the explosion; the greater the

proportion of yellow smoke to gray, black, or white smoke, the less is the power of the explosion, whilst in the absence of yellow smoke, complete detonation may be assumed, whether the smoke be black, gray, or white. The charge used is to be a practice charge where allowed, and is in addition to the ordinary quarterly allowance.

Landing for examination

One per cent. of the lyddite shell of each nature carried on board ships in commission and in reserve are to be landed annually for examination at the nearest ordnance store.

Form S. 1146 is to be used for sending in the particulars, &c., and the Inspecting Officer will fill in information regarding the test in the proper columns.

When shell are landed for examination, they are to be marked with the name of the ship, the monogram of the station at which landed, and the date. No other paint but vermilion is to be used.

The examination consists of an inspection of the cavity for the exploder, and a moisture test of the latter.

The cavity is examined by ocular inspection, and by probing with a thin smooth wooden rod. If in any shell the walls of the cavity are found broken, so that the exploder cannot be replaced, the shell is condemned for service. Should, however, the lyddite have shrunk only and the cavity be larger than is necessary for the exploder, the space is taken up by the insertion of a cardboard disc.

The exploder removed from the shell will be tested for moisture as follows:—The contents of the exploder bag should be emptied into a glass-stoppered bottle and turned over several times so as to thoroughly mix the powder; 100 grains of the powder should be accurately weighed in a weighed watch-glass and dried in a water oven at 120° Fahr. for 1½ hours. The sample should then be removed from the oven, covered with another watch-glass, allowed to cool, and weighed again. The loss of weight represents the percentage of moisture in the powder. The powder is to be considered serviceable unless the percentage of moisture is above 0·5.

Shrapnel Shell.

Guns to which supplied.

These are supplied to 12-pr. 8 cwt. guns only.

Shrapnel shell were originally supplied to nearly all guns, but these shell, with the exception of the 12-pr. 8 cwt., will now be plugged and used for practice.

They are designed to carry a large number of balls, and a small bursting charge which is only intended to break open the shell.

They are always fired with a time fuze which should act from 100 to 150 yards before reaching the enemy, in which case the bullets leave the body of the shell and spread in a "cone of dispersion" before reaching the enemy.

Types.

Shrapnel shell are made of forged steel, with the head very lightly attached. They are of two distinct constructions, those having the bursting charges in the *base*, and those having the bursting charge in the *head*.

The 12-pr. Mark I. have the burster in the head, later Marks in the base.

Shrapnel shell are painted black with a red tip, and when filled have a red band in addition.

Firing shrapnel shell.

Shrapnel are to be fired with a full charge.

Description.

12-pr. Q.F. shrapnel shell, Mark VI. (*see* Plate XX.). 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 on the inside to receive the shrapnel primer. The bullets are contained in a cage. This cage consists of a tin cylinder which rests upon the steel diaphragm, and has perforations to let the bullets pass through. There is a brown paper lining between the walls of the shell and the tin cylinder. The cylinder is filled with mixed metal balls, 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 fitted with molten rosin.

The head is made of Bessemer steel, 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 take the fuze, 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.

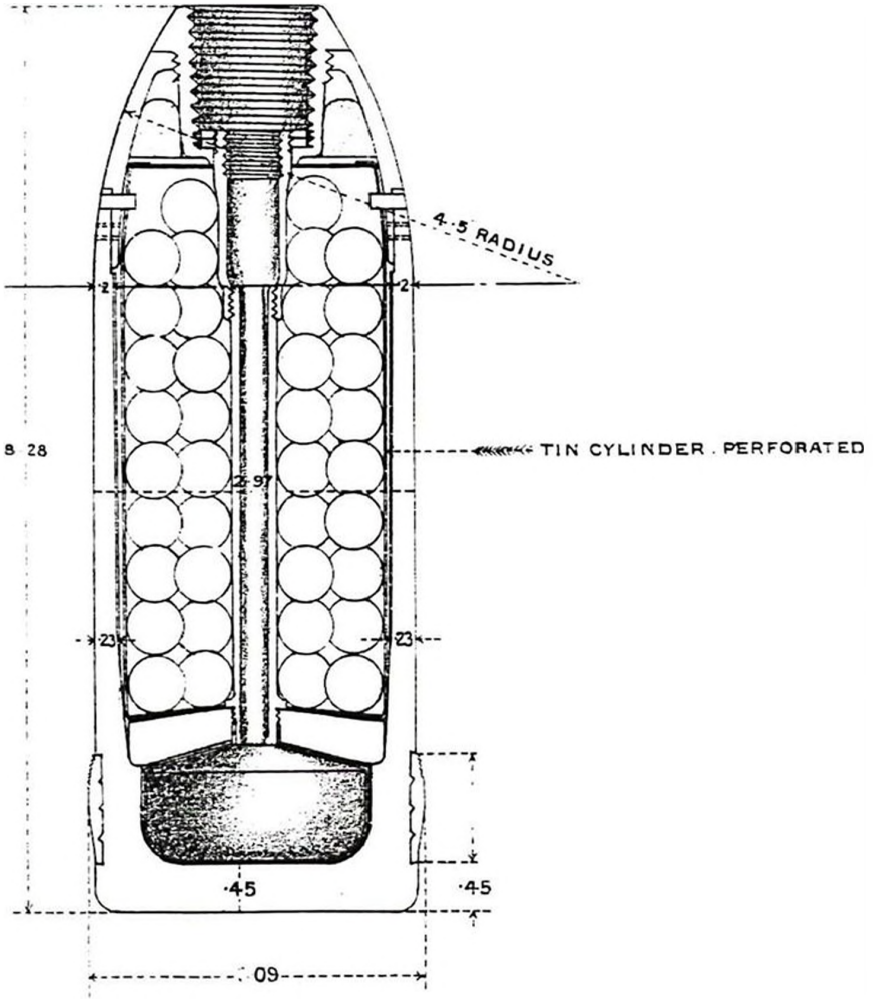
The driving band is plain, having a front and rear slope but no cannelures. The front slope is serrated. It is pressed into an undercut groove near the base of the shell which has waved triangular ribs cut on it.

SHELL Q.F. SHRAPNEL, 12 PR, 8 CWT, MARK VI.

FORGED STEEL.

SCALE 1/2.

AVERAGE TOTAL WEIGHT	12 · 8
ABOUT 158 MIXED METAL BALL	4 · 7¼
BURSTING CHARGE	1½



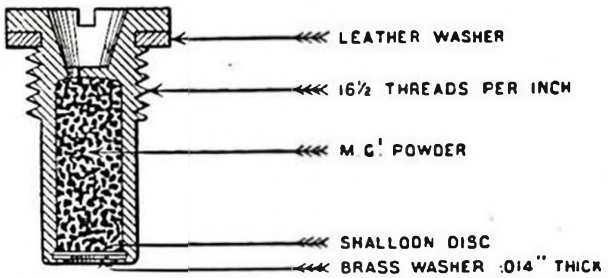
S325-12.05

Weller & Graham. Ltd Litho London.

The burster is placed in the head, and Marks II. to V. differ only in small details from the Mark VI. Mark I.

Shrapnel shell having their bursting charge in the base have, with one exception, a "primer" to convey the flash from the fuze to the powder. The latest pattern of "primer" is shown in the woodcut below.

Full size. Primer.



The top is solid, with a conical cup-shaped recess; the bottom of the cup is perforated with three small holes communicating, by loose powder, with the powder in the body of the primer. The bottom is close by a thin annular disc of brass covered with shalloon.

There are two slots in the head for the screwdriver, and a leather washer is placed under the shoulder.

Case Shot.

Case shot are supplied to 12-pr. 8-cwt. Q.F. Guns to which supplied.

Note.—They are now obsolete, but existing stocks will be used for practice for some time yet.

Practice Projectiles.

The following natures of projectiles will be used for practice only, and are in future to be termed Practice Projectiles:— Practice projectiles.

(1) Palliser shot,
(2) Palliser shell,
(3) Iron common shell,
(4) 12-pr. A.P. shell,
} Filled with salt and plugged.
(5) Service projectiles sentenced to be used for practice only.

Practice projectiles are now being manufactured for all guns; they are made of cast iron solid, and are cast as near as possible to their final dimensions, the body being turned down to proper diameters while the point is left in its rough state.

Palliser shot and shell, which are now only used as practice projectiles, are never to be fired with a full charge.

Practice projectiles are also supplied for use at "Loading Teacher" to all Q.F. guns, and also to the 6-inch B.L., Marks VII. and VIII., in the proportion of four projectiles to each "Loading Teacher," and are only to be used for this purpose.

There are now no drill projectiles supplied.

Driving Bands.

Driving bands are used to rotate projectiles for B.L. and Q.F. guns.

Vavasseur driving bands.

The band 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 groove is made near the base of the shell; on the bottom are ribs parallel to the circumference and triangular in section. These ribs are not continuous, in order 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 at a slope of 7°, so as to fit the cone between the bore of the gun and the powder chamber, and to hold the projectile in place even when loaded at considerable angles of elevation.

Cannelures.

Grooves, called cannelures, are cut round the band to receive the metal cut from the driving band by the rifling when the gun is fired. The number of cannelures differs according to the calibre. For the 4 inch and above they are ·15 inch wide and ·1 inch for the smaller natures, the bottom of the cannelure being in line with the exterior of the shell.

Gas-check driving bands.

The gas-check driving bands are now superseding the above for 6-inch guns and upwards firing cordite charges, and, as the name implies, are designed to seal the escape of gas, at the moment of firing; it differs from the previously described driving band in having a second slope near the centre of the band, and the metal is cut away behind it, thus forming a lip; the cut-away portion is called the "grave." 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, but not so many as the ordinary band, there being never more than two. The gas-check driving bands vary according to the gun they are intended for, in the shape and size of the grave. (*See* Figs. 3 and 4.)

Narrow bands.

Narrow driving bands are being used now for the 12-pr., 4-inch, 4·7-inch and 5-inch, it consists of a ring of copper cut from a tube as in the former bands, but there are no cannelures or gas-check. (*See* woodcuts, Figs. 1 and 6.)

Undercut groove for driving band.

The groove in the projectile for the driving band is now undercut, and the band when forced on takes the shape shown in the woodcut, and the serrations extend the whole breadth of the gas-check.

Serrations on driving band.

In order to make the driving band bite into the rifling of the gun when rammed home, and so prevent "slipping back," the front slope of the driving band, and in the case of gas-check bands the slope of the gas-check, is serrated by circumferential grooves.

A well-known makeshift plan to prevent "slipping back" is to tie a piece of spun yarn round the projectile in front of the band.

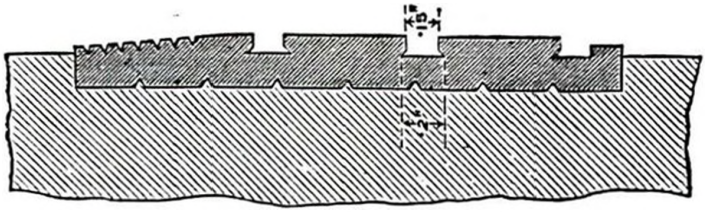
In the later manufactured projectiles, the ribs which are turned up in the groove for driving band are "waved" instead of being parallel to the base of the shell, and they are not equidistant as in the former case. The lower ribs are further apart, so that the "grave" of the driving band may not be weakened. There are also chisel cuts as shown, so that the air may escape when the band is being pressed on.

The serrations on the slopes of driving bands are ·05 inch pitch and ·032 inch deep. Cupro-nickel bands are now being manufactured for the 6-inch and above; it consists of 95·5 per cent. of copper and 4·5 per cent. of nickel, the bands are much smaller than the gas-check, and there is no "grave." (*See* Fig. 5.)

Typical Driving Bands.

Fig. 1.

Fig. 2.



Gas-check Driving Bands.
Full size.

Fig. 3.

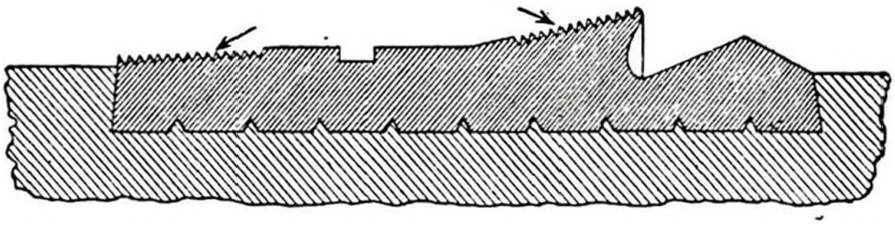


Fig. 4.

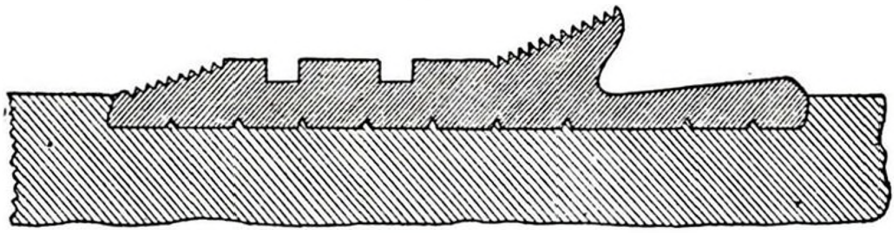


Fig. 5.

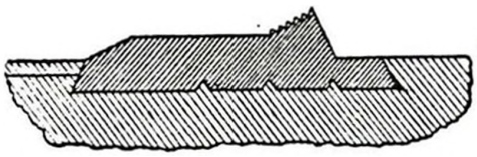
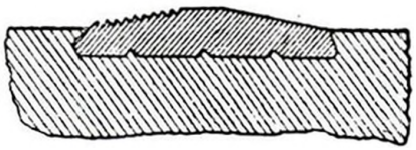
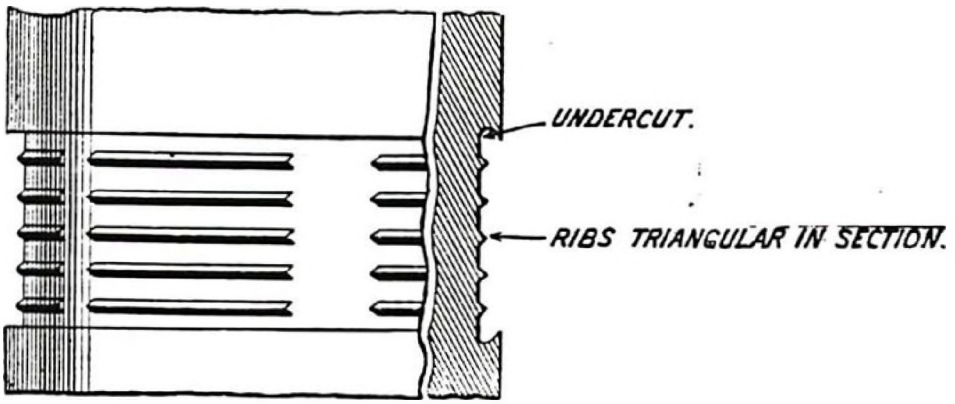


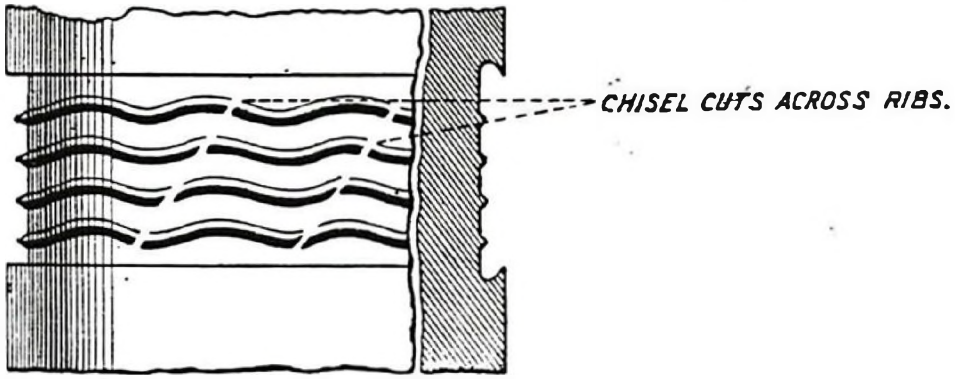
Fig. 6.



Old Method of attaching Driving Bands.



New Method of attaching Driving Bands.



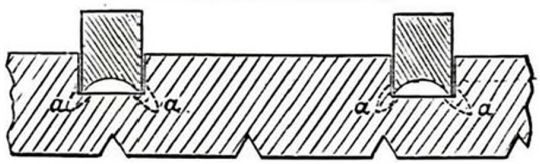
Augmenting Strips.

Strips, augmenting, are supplied to B.L. and Q.F. projectiles fitted with the Vavasseur broad driving band. They are never to be used with the gas-check driving band; when required for the former, they must be demanded from the ordnance depôts.

They are to be used when the gun is so worn that the rifling does not rotate the projectile properly.

Description. They consist of pure copper, of even section throughout, and grooved on one side (as shown in the sketch). The length

Scale, twice full size.



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.

Mode of using. By means of a special steel chisel, which is supplied for the purpose, 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; the augmenting strip is then placed in the cannelure, grooved side downwards, 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.

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.

To facilitate the attachment of these augmenting strips, undercut grooves are already made in the bottom angles of the cannelures of B.L. projectiles, 6-inch and upwards, made since October 1890, and are being made in projectiles for the 4-inch and 12-pr.; consequently with these projectiles the use of the "chisel" referred to above becomes unnecessary. The rear bottom angle of the rear cannelure is not undercut, as there is not sufficient thickness of metal to afford it the required support.

B.L. projectiles so undercut are stamped with the letter U on the driving band between the first and second cannelures.

All projectiles on board ships for 9·2-inch B.L., VIII., X., and XI., and 6-inch Marks VII. and VIII. and XI. B.L. guns, should have the gas-check or cupro-nickel driving band.

All projectiles on board ships for guns above 6-inch other than the above, which are fitted with the broad Vavasseur driving band should, if the outfit of cartridges are of cordite, be fitted with one augmenting strip in the rear cannelure, and any such projectiles in store will be so fitted before issue to such ships in future.

Projectiles fitted with gas-check driving bands are not to be fired with powder charges.

Distinguishing Marks. (Plate XIX., page 81.)

All shot, except case, have a *white* tip.

All common shell have a *black* tip, except lyddite common.

All shrapnel shell have a *red* tip.

A ½-inch *white* band round the head denotes steel, except steel shrapnel and lyddite common which have no white band.

An additional *white* band denotes an armour-piercing projectile.

A *white* band in addition to a *white* tip denotes a steel armour-piercing shot.

A ½-inch *red* band round the head denotes "filled."

A ½-inch *yellow* band round the body denotes that the projectile is supplied for practice only.

Steel common shell for the 12-pr. 18 cwt. gun are painted lead colour to distinguish them from the 12-pr. 12 and 8 cwt. common shell.

Lyddite common shell are painted yellow to distinguish them from other projectiles; the only distinguishing marks which are placed upon them are the *red* band denoting "filled," and a *red* disc if they contain an 8-dram primer, the words printed in black lettering with "?" oz. exploder, date of filling, and monogram of filling station; on the reverse side of shell a red rectangle is stencilled on with the letters "D.M." inside and the letter "A" placed on the apex.

The rectangle denotes that the exploder is placed inside a waterproof cylinder. The "D.M." indicates that the exploder consists of dry mixed picric powder and the "A" on top of rectangle that the case is closed by an aluminium cap.

Palliser and armour-piercing shot have the letter "W" painted on the head and stamped on the base plug when they have been brought up to weight.

Armour-piercing and common shell are marked "Salt" when filled with salt for practice.

All shell having fuzes in them, except the 3 and 6-pr., are marked on the head with the word "fuzed," and the base fuzes are painted red.

Filled shell have also the following marks painted or stencilled on them:—

The word "bag" if the burster is in a bag.

The letter "P" if filled with pebble mixture; or "Q.F." if filled with Q.F. powder.

A *red* disc (1 inch in diameter) if 7-dram primers have been inserted.

The date of filling.

The monogram of the place at which filled.

The letter "N" on a shell means Naval Service; and the letter "E" emptied, in red, also the monogram of the station at which emptied, if emptied.

All shell fitted with cupro-nickel driving bands will have a white band painted round the body of the shell near the band.

The letters "F.S." are stamped on the base of forged steel shell, and "C.S." on cast steel.

All A.P. shot and shell have the letters "A.P." stamped on the base.

On all projectiles certain manufacturing marks may be found *stamped* on the body of the shell, these refer to the date of manufacture, the furnace used, &c.

12-inch heavy and light have the letter "H" or "L" stamped on the base.

NOTE.—All *paint* marks on a projectile refer to the filling and not to the manufacture, except of course the white bands, which denote "steel" and "armour-piercing," and the red head of the shrapnel.

All paint-marks on projectiles are now placed well up on the shoulder, except the lyddite, where the marks are placed low down on the shell.

The paint marks on a filled-pointed common shell 9·2-inch, Mark IV., also the marks on the base, are shown on Plate XIX.

POINT PROTECTORS.

Point protectors.

Point protectors are now supplied for protecting the points of uncapped A.P. shot only of 6-inch calibre and above during transport.

The protector consists of an elm block coned out to receive the point of the projectile. An iron tray covers the base of the projectile and is secured to the elm block by two steel extensible straps as shown. The straps can be made long for the common shell as shown, or short for the A.P. shot or shell.

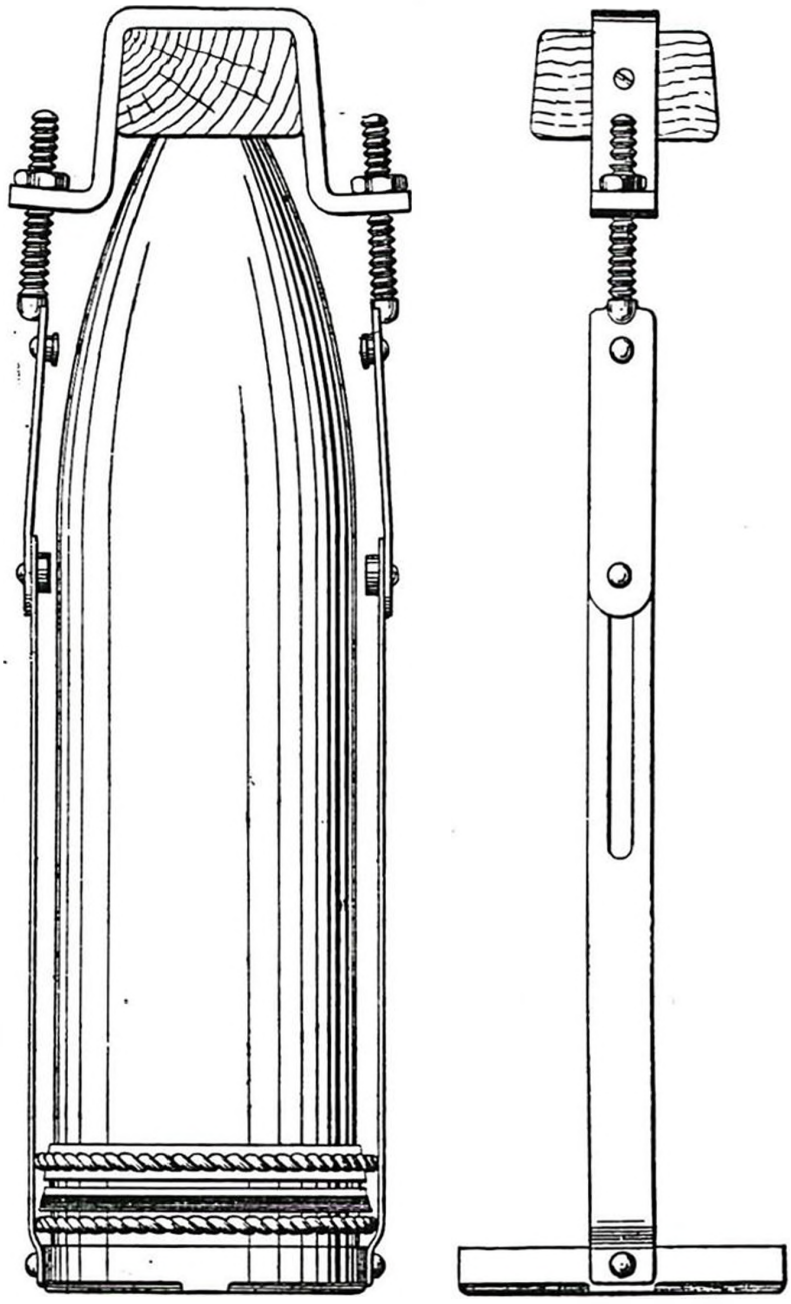
The Mark III. protector only differs from the Mark II. in that the strap is made in one piece, it passes under the tray and is secured by rivets to the bottom.

There is also an older pattern of protector, designed for the older pattern A.P. shot only. It is not extensible and has no tray for the base, but the strap passing under the base has two studs which fit into the holes of the base plug, and so retain the protector.

A.P. shell do not now have point protectors, and in future they will only be supplied to uncapped A.P. shot.

After any uncapped A.P. shot have been received on board the point protectors are to be taken off and returned to store, they will be demanded and replaced on the projectiles should the latter be ordered to return into store.

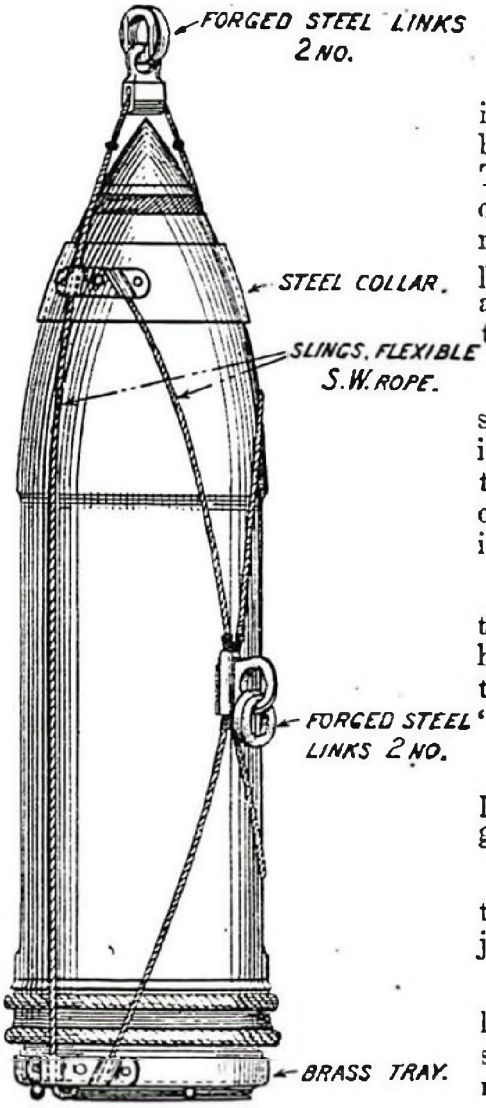
No spanners are supplied for actuating the nuts which require one of $\frac{7}{8}$ inch.



FUZE PROTECTORS.

The fuze protector is used for the protection of the bases of large base percussion fuzes No. 11 Marks I. and II., which have no steel protecting plate in them when embarking or returning projectiles. It consists of a small dished iron disc secured by a double glove fastener into the holes for fuze wrench, it is to be removed and returned to store before placing the projectiles in the shell bays.

Projectiles with the Marks III. or IV. fuzes do not require the fuze protector during transport.



Lifting Bands, Bolts and Slings.

All armour-piercing projectiles 9·2 inch and above are supplied with lifting bands, of which there are two patterns. The Mark I. is a steel band with handles or eyes riveted on each end, one eye being narrower than the other, and having two projections on it for the larger eye to rest against when the smaller end is rove through the larger.

The Mark II. band is very much the same in construction, except that one eye is removable; the band is fitted with three holes, and the eye with three bolts or keys with slots, so that they will lock in the band.

This type is much easier to place on the projectile than the Mark I.; but it has been decided to use the Mark I. for the 9·2 projectiles for ships of the "Drake," and "Cressy" classes.

The common shrapnel, lyddite, and practice projectiles for 9·2-inch and above guns are supplied with a lifting bolt.

The bolts are made with a thread on the shank to screw into the hole in projectile, which is also threaded.

Lifting bolts are of two sizes. The large is for the 16·25-inch B.L., and the small for the remainder; the threads are not the same on these bolts.

Bolts are supplied 15 per gun.

At the 9·2-inch in the "King Edward" and "Duke of Edinburgh" classes, and the 7·5-inch B.L. guns, a pair of tongs are supplied for lifting projectiles; it is called a "grab" and somewhat resembles the tongs used for lifting Whitehead torpedoes.

Base plug wrench.

An instrument, *base plug wrench*, is supplied to each shell-room, and is used also for removing the plugs from the lifting bolt holes.

Compound slings.

For lifting projectiles end on through scuttles, &c., where there is not room for the projectiles to be slung horizontally, compound *slings* are supplied to 9·2-inch and above B.L. guns. (*See* woodcut.)

Shot Gauges.

High ring gauges are supplied for gauging projectiles. Shot gauges.

For each calibre of B.L. and Q.F. guns, ring gauges are supplied; one for the body and one for each type of band.

Projectiles are to be gauged when first received, and those kept in bays in the shell-room every twelve months, those which may be kept in deck racks or armoured lockers every six months.

Projectiles stowed with grummets over the gas-check driving bands need not be periodically gauged.

They are always to be gauged before firing.

Shell are to be carefully examined when gauged, and all rust, &c., is to be removed.

Care is to be taken to guard against rust on the one hand, and excessive painting on the other.

One complete set of gauges, of the nature required, is supplied to each shell-room. Supply.

Filling Shell.

The "bursting charge" or "burster" of A.P. and common shell is of P. mixture, which is composed of P. powder with F.G. powder to fill up the interstices between the pebbles, or a mixture of shell Q.F. and F.G. powders. Burster.

For shrapnel shell, pistol, or any fine grain powder is chiefly used, but when the bursting charge is in the head loose, Service L.G. is used. Shrapnel.

Service powder, or shell powder specially manufactured as such, will always be used.

For shrapnel the charge is weighed out before entering, but for other shell as large a burster as the shell will contain is inserted.

For all powder filled common, and A.P., shell B.L. and Q.F., 4-inch and upwards, the bursting charge is contained in a bag, to avoid premature explosion through friction when the powder sets back on the shock of discharge. Bags.

Bags are made of Dowlas for common and Lasting cloth for A.P. shell with a neck for filling, and have red shalloon at the part next the fuze.

Some bags have collar cloth at the base to form a cushion when the charge sets back. These bags are for 9·2-inch and above nose-fuzed shell.

All bags are clearly marked with the nature of the shell for which they are intended.

Lyddite common shell have no bag, as the lyddite is run straight into the shell. Lyddite.

7-dram primers.

7-dram Primers are small shalloon bags containing seven drams F.G. powder, they are inserted in powder filled common and A.P. shell to convey the flash of the fuze to the burster.

8-dram primers.

8-dram primers are similar to above, but are only used in 6-inch and above lyddite shell.

Lyddite.

The filling of lyddite shell is "confidential," and cannot be given in this work.

General Remarks on Stowage of Projectiles.

Transport.

All projectiles are transported, and are supplied to a ship in bulk, with the following exceptions :—

Point protectors and boxes.

All pointed projectiles 4·7-inch and below are supplied in boxes.

Uncapped A.P. shot, 6-inch and above, are supplied in point protectors.

Fuze protectors.

All pointed shell, 6-inch and above, fitted with the Marks I. and II. base percussion fuze No. 11, will be fitted with a fuze protector to protect base of fuze during transport.

Grummets.

All projectiles having the gas-check driving band are provided with rope grummets to protect the gas-check.

Removing protectors, &c.

When receiving projectiles, where possible, the point and fuze protectors or boxes are not to be removed until the shell are in the shell-room ready to be placed in the shell bays.

Also the grummets on the gas check driving band are, where possible, to be on the projectile in the bay.

The boxes and protectors are to be returned after the projectiles are drawn.

When returning projectiles sufficient point and fuze protectors, if necessary, and boxes are first to be drawn and placed on the projectiles, if possible, before the latter are removed from the shell-room.

Stowage of base-fuzed shell.

Base-fuzed shell are never to be stowed in the bays base to point.

Sennet.

To protect the driving bands of B.L. and Q.F. projectiles when stowed in the bays of the shell-room, layers of sennet are placed between each tier of the small calibres, and sword matting between those for the larger calibres.

Sword matting.

When projectiles are stowed with their grummets on the sword matting packing will be dispensed with.

Returning shell.

When shell are returned from a ship, care must be taken that no filled shell are returned as "empty," and that all filled shell are properly marked.

Plugs.

Nose-fuzed shell have their fuze-holes closed by a threaded gun-metal plug, known as the G.S. plug, Mark II.

The Mark I. plug has been superseded in the Naval Service, but if found in a filled common shell it is covered by a red wad with a leather loop.

When plugs, primers, or metal fuzes are screwed into a shell for stowage, they must be lubricated with Mark III. luting mixed with mineral jelly.

Large and medium base fuzes.

All large and medium base fuzes which are not properly screwed up are to be rectified with the proper key—"Base fuze and plug key"—*see* p. 116.

Pointed projectiles are not to be passed up at General Quarters, but are only to be passed up for exercise once in six months, and then under the supervision of a Gunnery Lieutenant.

CHAPTER VIII.

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.

Fuzes may be either—

1. Percussion fuzes, which communicate fire to the bursting charge when the shell strikes or grazes.
2. Time and percussion fuzes, which combine the properties of both time and percussion. 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.

Until the introduction of pointed shell, all shell for Q.F. and B.L. guns were made with the fuze-hole in the head and of the general Service gauge, thus taking either time or percussion fuzes.

The advantages of pointed shell with base fuzes are :—

1. No delay in loading due to time required to fix fuzes.
2. No safety-pins, &c. to pull out before loading in order to allow the fuze to be put in action.

All percussion fuzes for nose-fuzed shell are supplied separately from the shell, and require to be fixed into it before loading, and a safety arrangement removed before ramming home.

Time fuzes are used for shrapnel shell.

They are supplied separately and have to be fixed into the shall before loading, and in all cases a safety arrangement has to be removed before entering in B.L. or Q.F. guns.

Stowage. Fuzes are kept in the shell-room.

Tin cylinders. Those fuzes which are not supplied already in the shell are in tin cylinders, to open which it is necessary to tear off a tin band which is soldered round the junction of lid and body.

The tins are supplied in wooden cases.

The tin cylinders bear a label showing their contents and all particulars of manufacture, and a label will be found in each cylinder showing the name of the packer.

The tin cylinders should not be opened until the fuzes are actually required for use.

For storage, fuzes are placed in Group II., Class I. Storage.

The following table gives all the fuzes which are in use in the Navy with the shell they are suitable for.

Fuze Table.

Percussion.

Fuze.	No. of Fuze.	Nature of Shell.	Guns.	Remarks.
Direct action, Marks I*., I**., and II.	1	Nose-fuzed common for all guns.	B.L., Q.F.	
Direct action, Marks III. and IV.	3	Nose-fuzed common for all guns.	B.L., Q.F.	
Hotchkiss base percussion, Marks II., III., and IV.	—	3 and 6-pr. Q.F. and for 12-pr. cast-steel common.	Q.F.	Only fitted in the 12-pr. projectiles manufactured previous to 1.3.95.
Base percussion, large, Marks I., II., II*., III., III*., and IV.	11	A.P. and pointed common for B.L. and Q.F. guns, 6-inch and above.	B.L., Q.F.	
Base percussion, medium, Marks I., I*., II., II*., III., and IV.	12	Common shell for the 12-pr. Q.F. 4-inch and 4·7 Q.F., and pointed common for the 4-inch and 5-inch B.L. and 5-inch B.L.C.	B.L., Q.F.	Only 12-pr. and 4·7-inch Q.F. shell ordered since 1.3.95.
Direct action impact, Marks I., III., and IV.	13	Lyddite common for all guns using this shell.	B.L., Q.F.	
Base percussion large Mark I.	15	Capped shell	B.L., Q.F.	

Time and Time and Percussion.

Fuze.	No. of Fuze.	Nature of Shell.	Guns.	Remarks.
Time and percussion, Mark IV.	56	Shrapnel shell for the 12-pr. Q.F.	Q.F.	
Time and percussion, Mark I.	63	Shrapnel shell for the 12-pr. Q.F.	Q.F.	This fuze will supersede the No. 56.

Proportions of Fuzes to be Supplied.

Where the fuze is supplied in the shell :—One for each shell; and 2 per cent. spare in the case of large and medium base fuzes.

Direct action fuzes :—One to each common for which the fuze is applicable.

Time and percussion fuzes :—One to each shrapnel.

Description of Fuzes in Present Use.

Direct Action Fuze.

There are two patterns of this fuze, known as No. 1 and No. 3, which are the same internally, but differ in external appearance, the No. 1 fuze having a cap and No. 3 a plug, which has to be removed before firing.

The No. 1 fuze is mostly used in the Land Service, but a few may be found in the Naval Service.

Direct Action Fuze, No. 3, Mark III.

The direct action is an impact fuze, but it will act on graze provided that the angle of descent is somewhat over 10°.

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.

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} powder, and the 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 universal fuze-key, 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 under side by a disc of fine white paper, and on the upper side by a disc of tinfoil; 3½ grains of cap

composition are pressed 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.

The screw plug for needle disc is tapped so as to screw into the body, and is recessed. It is slightly coned at the bottom, and has a hole through the centre.

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.

When filling the fuze, the "screw plug for needle disc" and the "safety plug" are smeared with Pettman cement to keep the fuze air-tight.

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.

The safety plug screws into the top over the screw collar with a left-handed thread. 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 fuze-key will fit the slot in the safety plug.

The exterior of the fuze is lacquered and the bottom coated with waterproof cement.

Action.—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 or water.

When either of these events occurs the needle is crushed down on the detonating composition, which fires, and ignites the meal powder in the conical fire-hole and the blowing charge; the flash passing into the shell and firing the bursting charge.

The Mark IV. fuze differs from the Mark III. in that the needle has only one point, instead of three. The detonator can be easily removed for examination, as it consists of an R.L. cap kept in place by a screw collar, called a detonator plug, screwed into a recess provided for it in the body of the fuze, there is a central fire-hole instead of nine conical fire-holes in the Mark III. fuze, and the magazine is somewhat smaller, it containing only 63 grains instead of 75 in the Mark III.; externally it is the same in appearance as the Mark III.

The advantage claimed for the Mark IV., as already mentioned above, is that the detonator can be removed for examination in perfect safety.

The action of the Mark IV. fuze is the same as for Mark III.

Direct Action Fuze Mark II. No. 1.

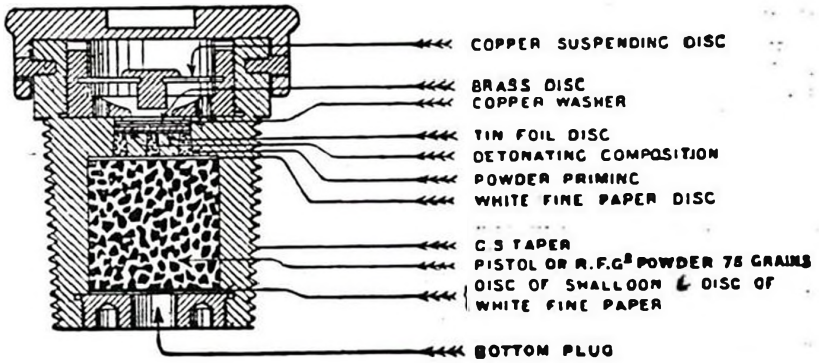
The D.A. Fuze No. 1, Mark II., is in general construction similar to the D.A. Fuze No. 3, Mark III.

The body, 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 key-hole 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.

Fuze, Percussion, Direct Action, No. 1, Marks I*., I**., or II., Metal, Five in a Tin Cylinder.

Scale, full size.



The Marks I*., I**., and II. are identical in construction, the former are conversions from Mark I., which are obsolete.

Hotchkiss Base Percussion. (Plate XXI.)

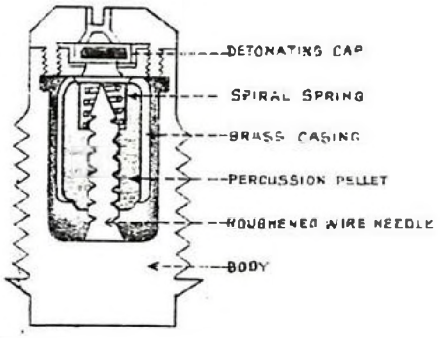
There are three marks of this fuze in use, viz., II., III., and IV.

Used in the 3 and 6-pr. Q.F., also the cast-steel common shell, ordered for the 12-pr. Q.F. gun prior to the 1st March 1895.

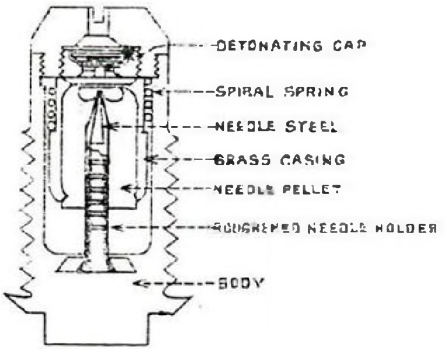
HOTCHKISS FUZE, BASE. PERCUSSION

FULL SIZE

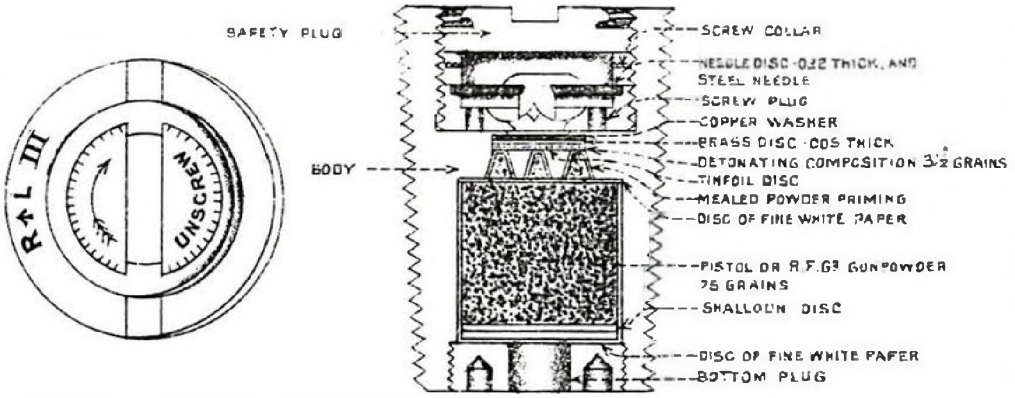
MARK III



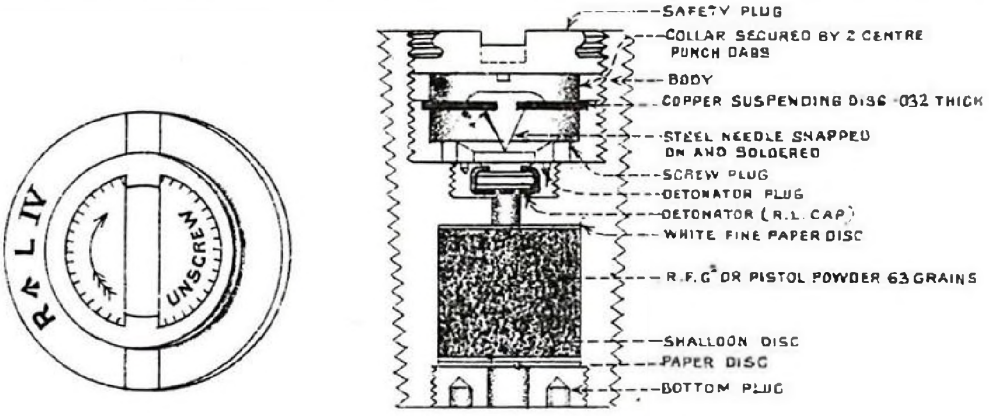
MARK IV



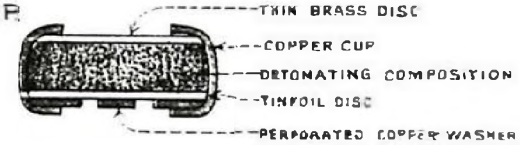
FUZE, PERCUSSION, DIRECT ACTION Nº 3, MARK III.



FUZE, PERCUSSION, DIRECT ACTION Nº 3. MARK IV



R.L. CAP



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Hotchkiss Base Percussion Fuze, Mark IV.

The body of the fuze is of gun-metal, threaded to screw into the base of the shell, and is fitted with a percussion pellet, gun-metal screwed cap, screw plug, a copper detonating cap, and a spiral brass spring. The percussion pellet consists of a brass casing filled with lead, the latter projecting beyond the gun-metal at the bottom to act as a cushion.

A hard drawn brass roughened wire needle is embedded in the lead. The point of the needle is of steel. The base of the needle projecting from the lead bears against the bottom of the fuze, which is recessed to retain the needle pellet during flight.

The cap is filled with detonating composition and covered with a thin brass disc.

The shock of discharge sets the pellet back along the needle, leaving the whole free to fly forward against the cap on graze or impact, the spiral spring preventing the rebound of the pellet.

The Mark III. fuze is the same as above, except that it has a shorter needle with no steel point, the bottom portion of the body not being undercut.

The spring is smaller and bears against the lead instead of the brass casing of the percussion pellet.

The Mark II. is the same as Mark III., except that it has no spiral spring, the needle is of smaller diameter, and the lead part of the pellet does not project beyond the gun-metal at the bottom.

Base Percussion, Large, No. II. (Plate XXII.)

There are four marks of this fuze in use, viz., Marks I., II., III., and IV., and the earlier patterns, when brought up to date, will have stars added to them.

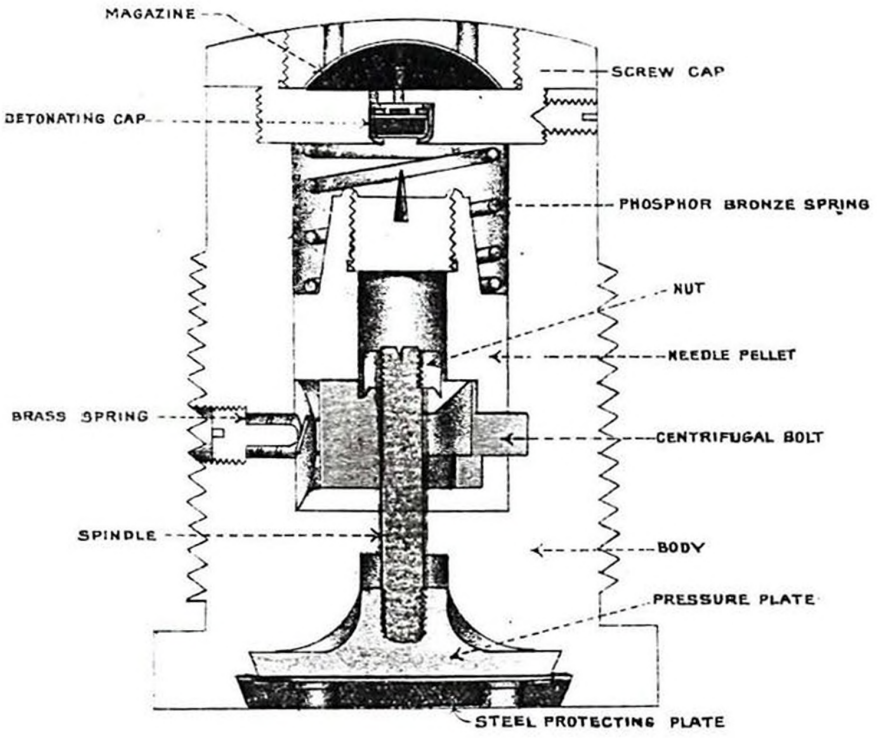
The fuze is used for all pointed shell, B.L. and Q.F. 6-inch and above; the description given below is for the Mark IV. The principal parts of the fuze are body, needle pellet, centrifugal bolt, protecting plate, pressure plate with spindle and nut, screwed cap with detonator and magazine, phosphor-bronze spring, brass spiral spring, and four screws.

Material.

The body and screwed cap are of manganese bronze, spindle and spiral spring of phosphor-bronze, needle pellet of gun-metal, centrifugal bolt of Bull metal, pressure plate of copper, protecting plate of steel, and a few minor parts of brass.

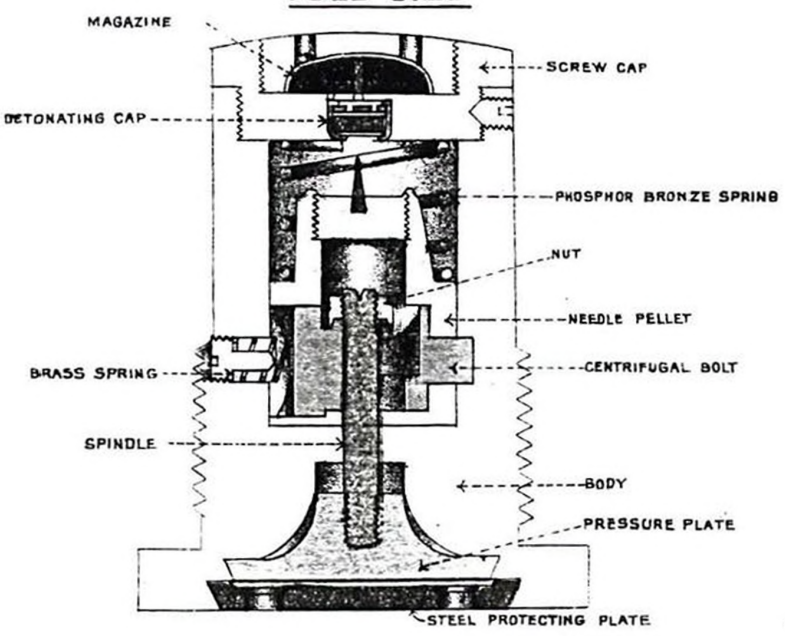
FUZE, BASE, PERCUSSION LARGE No. 11 MARK IV.

FULL SIZE



FUZE, BASE PERCUSSION MEDIUM No. 12 MARK IV.

FULL SIZE



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Body. The body, which will fit either the large or small adapter in B.L. common shells, 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. 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, which is closed by a brass screw plug; the end 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 in which the small end of the centri fugal 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.

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 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 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. A hole is bored through it from top to bottom, the upper surface on one side of the the 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.

Protecting plate. The protecting plate is made of steel, slightly countersunk on the upper part, and it has eight perforations to allow the pressure of gas due to the explosion of the charge to reach the pressure plate; it fits in the recess made for it in the base of the fuze, and the metal of the body is spun over it.

Pressure plate. The pressure plate has a boss on one side, into which screws the spindle; it fits in the recess in base of fuze over the protecting plate, and the lower part rests in the countersunk part of the steel protecting plate.

Pressure plate, spindle, and nut. The pressure plate spindle is threaded at both ends, one end screws into the boss on pressure place, and the other receives the brass nut on the top of centrifugal bolt; the end of the spindle is riveted over the nut when screwed home.

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 calico is placed 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, 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.

Mark III.

The Mark III. fuze is in every way similar to the Mark IV., except that the centrifugal bolt did not have so much protrusion into the body of the fuze.

Existing Mark III. will be altered to Mark IV. design, and a star added to its numeral.

Mark II.

The Mark II. fuze is the same as Mark III., except that it has no steel protecting plate.

Existing Mark II. will have a steel protecting plate screwed in with a thread 40 to the inch, and will be brought up to the Mark IV. and termed Mark II*.

Mark I., Plate XXIII.

This fuze is the same as Mark II., except that it had a slightly smaller cavity in the base for the pressure plate, when altered to conform to Mark II. pattern, called Mark I*. When again altered to IV. design, another star in added, and it is called Mark I**.

How secured in shell.

In the earlier issues of shell with this fuze, the fuze was screwed into the base of the shell against a lead washer to make a gas-tight joint.

The use of lead washers has been discontinued, and a gas-tight joint is made with Mark III. luting; unthinned luting being used under the flange, and thinned luting applied to the threads of the fuze before it is screwed into the shell.

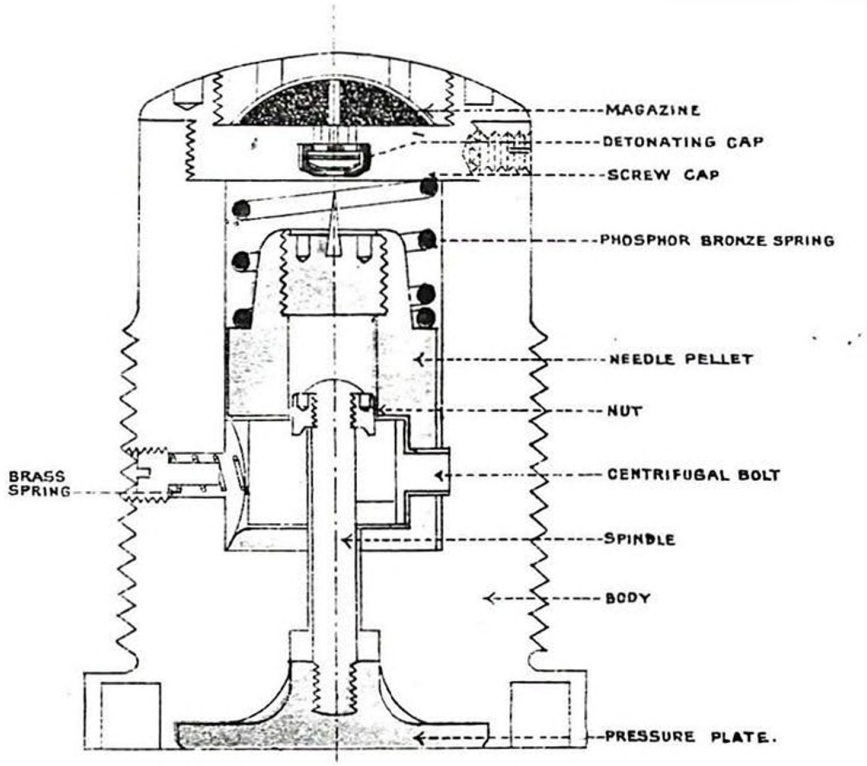
Those shell whose fuzes have the lead washers are being altered as they pass through laboratories for examination or repair.

"Action."

On discharge, the gas which is generated in the chamber of the gun passes through the holes in the protecting plate, the copper 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.

BASE PERCUSSION FUZE, LARGE, MARK I.

SCALE 1/1



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"Issue." Issued one in each shell and 2 per cent. spare. The base of the fuze when screwed into the shell is painted red.

Weight of the fuze, 2 lbs.

Base Percussion, Medium, No. 12.

Use. All pointed shell for the 12-pr., 4-inch, and 4·7 Q.F. guns except shell ordered for the 12-pr. Q.F. and the 4·7-inch Q.F. before 1st March 1895.

Description. In material, construction, and action it is similar to the fuze, percussion, base, large, but is smaller, and is screwed outside 12 threads per inch instead of nine.

Marks. The Mark I. medium is similar in design to the Mark II. large.

The Mark II. medium resembles the Mark III. large and the Mark III. medium the Mark IV. large.

The Mark IV. medium has the large end of the centrifugal bolt made heavier so as to withdraw the increased protrusion of the other end.

Issue. Issued one in each shell and 2 per cent. spare. The base of the fuze when screwed into the shell in painted red.

Weight, 1 lb. $4\frac{3}{4}$ ozs.

Base Percussion, Large, No. 15.

The base percussion, large, No. 15, is very similar in construction to the No. 11 fuze, except that it is made of aluminium bronze instead of manganese bronze, and the sealing for the nut on the centrifugal bolt is larger; it is used in Rendable shell.

Note on Base Percussion Fuzes.

Great care is to be taken in handling base-fuzed shell to prevent the point of one shell striking the base of another. This applies most particularly when the fuzes are not fitted with the steel protecting plate, and base fuzed shell are never to be stowed base to point.

Base percussion fuzes, large and medium, which have worked loose, *and this may be expected to occur*, are to be screwed up with the proper key. No other implement is to be used on any account whatever. A woodcut of this key is shown on p. 119, this requires special attention before target practice.

Base percussion fuzes, large and medium, will be supplied as components of the filled shell; the 2 per cent. spare are supplied to replace damaged ones removed.

Before target practice, the base of all fuzes are to be examined to see that the pressure plate is not damaged by indentation.

Should a fuze be found with the pressure plate indented, if the ship is at a port where there is an Inspecting Ordnance Officer, the fuze will be examined on board by that Officer, who, if he think it desirable, will cause the damaged one to be removed and replaced by one of the 2 per cent. spare, under his supervision. If he does not consider it desirable to remove the damaged fuze, the shell should be most carefully handled, and thrown overboard in deep water.

In the case of ships at sea or in ports where there is no Inspecting Ordnance Officer all base fuzes, medium or large, found with damaged pressure plates will be dealt with as follows:—

(*a*) If the external damage to the fuze is apparently limited to the indentation or crushing in of the pressure plate it is to be removed from the shell under the supervision of a qualified Gunnery Lieutenant or Gunner, and replaced by a serviceable fuze.

(*b*) If the fuze is damaged to such an extent, or in such an abnormal way, as to render its removal undesirable in the opinion of the Gunnery Officer referred to in (*a*), or if it is found impossible to remove the fuze with the key supplied for the purpose, the shell should be most carefully handled, and thrown overboard in deep water, observing that when the pellet is supported by the spring alone, a drop of 4 inches point downwards is sufficient to fire the detonator.

The operation of removing the damaged fuze and re-fuzing the shell are not to be carried out in the shell-room, but in a clear space above the water-line. Note that these fuzes have a left-handed thread.

Direct Action Impact Fuze.

Details of fuze.

The details of this fuze are confidential. It is used in all lyddite shell.

Instructions for fuzing lyddite shell on board ships.

I. Lyddite shell are to be fuzed when war is declared, or when hostilities are imminent.

II. The operation is not to be carried out in the shell-rooms, but in a clear space above the water-line, and it is to be carried out under superintendence of a Commissioned Officer.

III. Only one shell is to be fuzed at a time.

IV. The Service fuze-key only is to be used for unscrewing the plug and screwing in the fuze.

V. After unscrewing the plug, the threads of the fuze-hole are to be wiped, and care taken that there are no signs of picric powder left in the thread.

VI. Before screwing in the fuze, the threads on it are to be lubricated with Mark III. luting, thinned with an equal part of mineral jelly. The mixture is to be applied to the threads of the fuze with a brush in sufficient quantity to cover it, care being taken that it does not extend over the bottom.

VII. The fuze is to be screwed up as hard as possible by means of the fuze-key *only*.

VIII. When fuzed, the word "Fuzed" is to be painted in red on the shell. Vermilion paint *only* is to be used for this purpose. If vermilion is not available, no other paint is to be used.

IX. When once fuzed, the fuzes are not to be removed. The shell which are not used should be returned on the termination of the war.

To prepare for firing. To prepare the shell for firing, remove the safety pin (when so fitted) and the safety cap, these operations being carried out just before the shell is entered in the gun.

Action. This fuze acts on impact.

Time and Percussion Fuzes.

There are several different marks of this description of fuze in use. They are all very much the same in construction, but differ in several small details, and also in the time of burning. The several marks are—

T. and P. No. 56, Mark IV.
T. and P. No. 63, Mark I.

Time and Percussion, Mark IV. (Plate XXIV.)

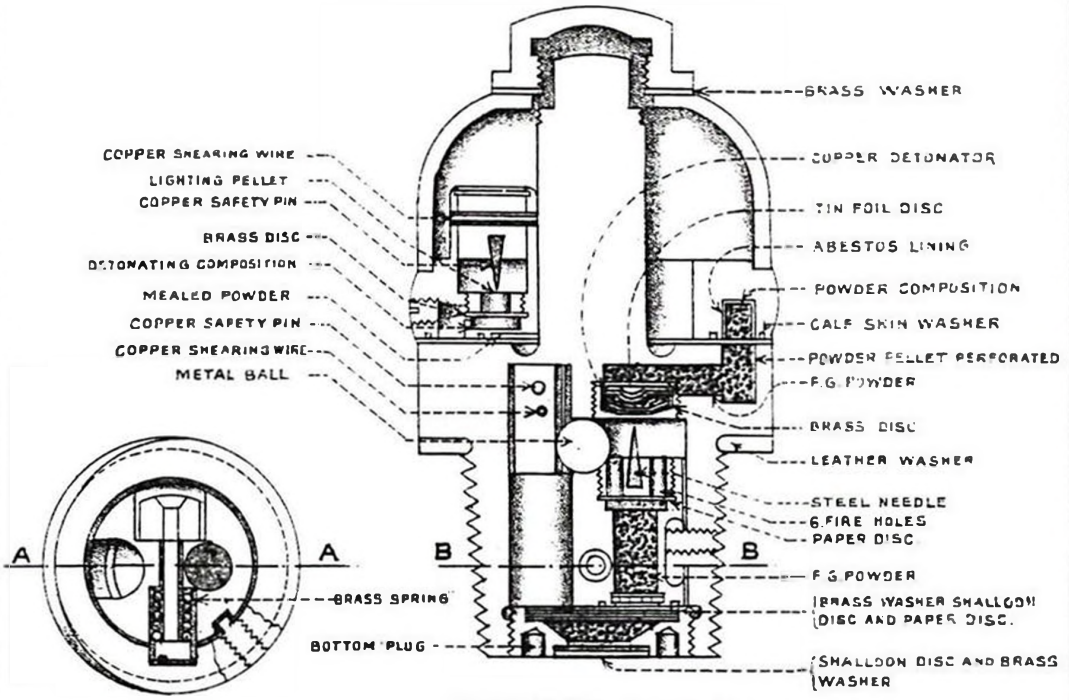
Use. It is used for the shrapnel of the 12-pr. Q.F. only.

Description. The fuze consists of the following parts :—Body, percussion pellet with steel needle and retaining bolt, spiral spring, detonating plug, safety pellet, brass ball, bottom plug, composition ring, dome, brass washer, nut, two safety pins, and two leather washers.

Material. The body, composition ring, percussion pellet, detonating plug, bottom plug, and nut are made of the usual gun-metal

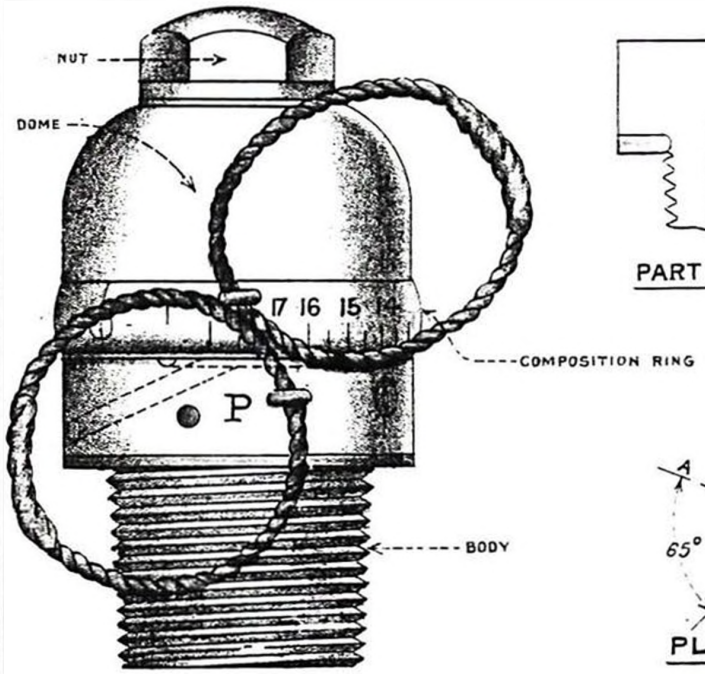
FUZE TIME AND PERCUSSION No 56 MARK IV.

FULL SIZE

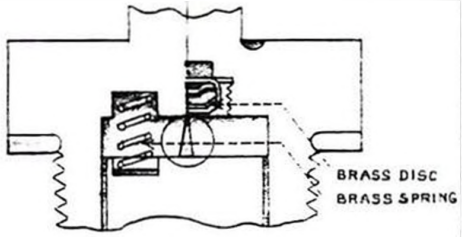


SECTION AT B.B.

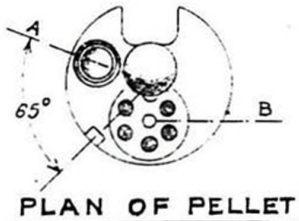
SECTION AT A.A.



ELEVATION



PART SECTION AT A.B.



PLAN OF PELLET

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alloy ; the dome, washer, ball, safety pellet, and spring of brass the time safety pin is made of phosphor-bronze and the percussion safety pin of copper.

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 halfway 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 copper 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 an arrowhead.* The arrow 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 leather washer on the flat part of the body prevents the composition in the ring from exploding.

The percussion safety pin has a whipcord loop coloured black.

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, 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 safety pin of split phosphor bronze wire passes through the ring from the outside and underneath the hammer which it supports.

The safety pin is retained by its ends being opened out after passing through the chamber. A whipcord loop coloured red is attached to the pin to facilitate its withdrawal.

When the safety pin is withdrawn, a small brass pellet having a spiral spring behind it closes the hole.

---

* Instead of an arrowhead, the adjusting mark, in future, will be marked with a black triangle for the sake of clearness.

The composition is indented at the end to secure its ignition by the flash from the denotator to it through a fire-hole in the bottom of the chamber.

The inner surface of the ring has three projections, which fit closely over the stem in the body, so as to keep it central; and a conical hole bored through it near the commencement of the composition channel and an elongated hole on top of ring allows of the escape of gas into the dome.

Round the exterior of the ring are divisions marked and numbered up to 18. The divisions are further sub-divided by unnumbered lines into quarters.

Safety point. An arrow or adjusting mark on the exterior of the ring denotes the position of the centre of the bridge. When this arrow is set opposite the arrow 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 nut. 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 prevents the washer turning, this washer prevents the dome being turned and the setting altered when screwing up the nut.

Nut. The nut 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, detonating plug, 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 under side 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 under side 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 detonating pellet, and

* In Nos. 1 to 11 thousand this spring was placed in a recess round needle.

its head projects into a recess in the body, where it is kept by a spiral spring as shown in the plate.

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 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.

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, 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, and the base covered with waterproof cement.

The action of the time arrangement is as follows:—The safety pin marked "T" having been removed, on the gun being fired, the shearing wire of the hammer is broken and the needle pellet falls, igniting the detonators, which in turn lights the composition in the time ring. This burns round to the fire-hole leading to the percussion arrangement, instantly conveying the flash through the bottom plug to 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. One in a tin cylinder wrapped in brown paper, with cardboard rings over the ends.

Weight of the fuze, about 13 oz.

The time of burning is about 13 seconds, but varies slightly with different lots.

Fuze, Time and Percussion, No. 63, Mark I.

The time and percussion fuze, No. 63, Mark I., is a double banked fuze, of similar size to the T. and P. fuze, Mark IV., No. 56, already described. The body of the fuze and the percussion arrangements are the same as those of No. 56, and will eventually supersede that fuze for the 12-pr. guns. In the time portion there are the following differences (*see* Plate XXV.) :—

There are two time rings, the lower being barrel shaped and milled, and having a setting pointer fixed at the commencement of the composition. The gas escape is external, *i.e.*, the gas escapes from the ring into the air instead of into the dome. For this a hole is bored in the ring at the commencement of the composition, and is covered by a thin brass patch cemented over with Pettman's cement. The patch is blown out when the ring lights. This ring is movable, for setting the fuze. At the commencement of the composition in this ring there is a vertical hole, communicating to the upper ring.

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, graduated from 0 to 44 divisions (half divisions being shown by dots), and has an external gas escape, similar to the lower ring. Above this ring is a brass dome secured by a circular nut and washer. This nut is always kept screwed down, and fixed by a set screw, and the lower ring may be turned without easing up the nut. A cloth washer is secured by shellac to the top of the body, and another to the top of the bottom ring, and the bottom of each composition ring is covered by a piece of paper secured by shellac.

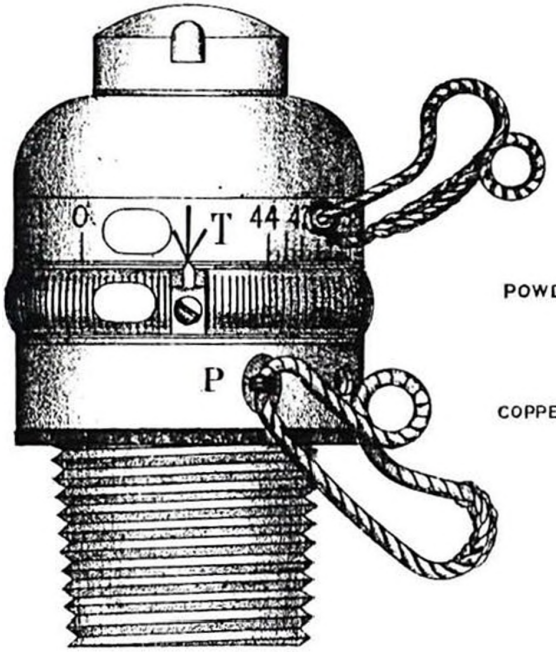
The percussion arrangements differ from those of No. 56 as follows:—In the lighting pellet there are a few grains of loose powder placed under the needle plug, and the remainder of the channel is filled with a pierced pellet of mealed powder.

Action. The fuze is set by turning the lower ring by a spanner supplied for the purpose, and the safety pins are removed as in No. 56. On the shock of discharge the composition of the upper ring is lighted as in No. 56, blows out the disc covering the gas escape hole, and burns round until it reaches the hole to the lower ring, which then lights and burns back in the

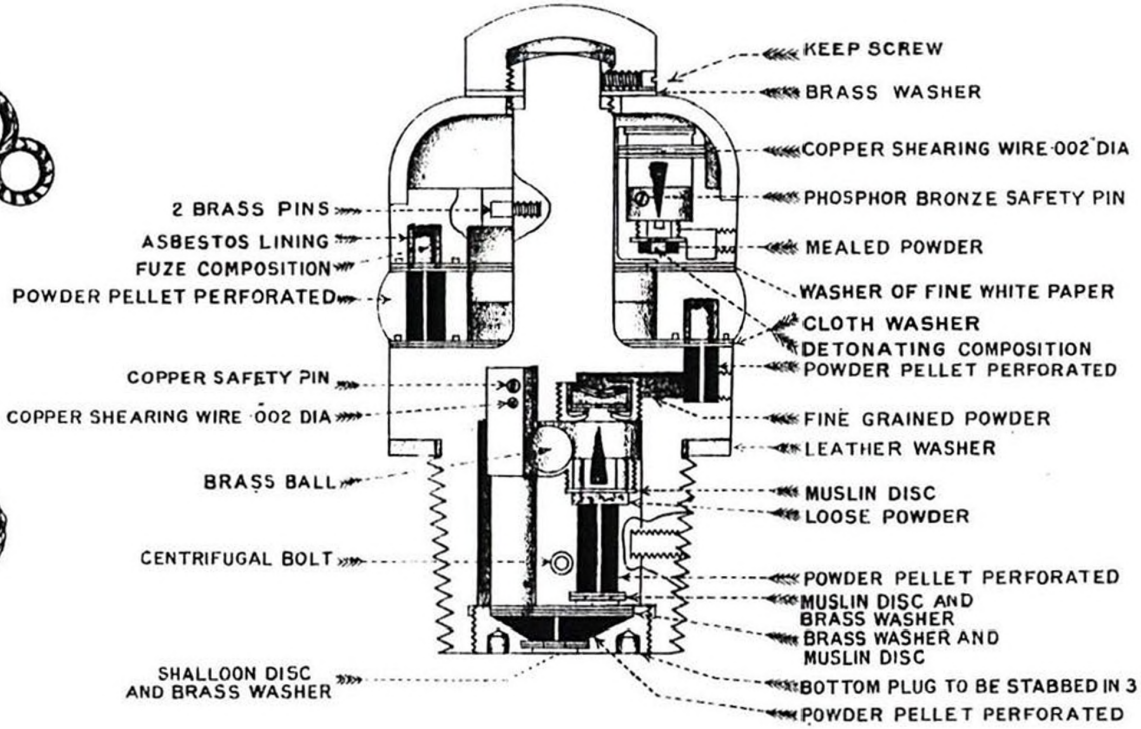
To face page 112.

FUZE T. AND P. Nº 63 MARK I.

FULL SIZE.



ELEVATION.



SECTION.

Plate XXV

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opposite direction until it reaches the channel to the percussion arrangement. It then passes down into the percussion arrangement, into the shell and bursts it.

The action of the percussion portion is the same as in the T. and P. No. 56, Mark IV.

Issued one in a tin cylinder in cardboard rings and wrapped in brown paper. Issue.

The fuze burns at rest for about 20 seconds and weighs about 14 ozs.

Fitting Fuzes.

Time and Percussion.

To fit these fuzes, first screw the fuze into the shell, tightening it up with the universal fuze key, then with the same key loosen the nut, then turn around the composition rings or ring until the number indicating the required length is opposite the pointer on the body, then screw the nut hard down.

A special spanner is supplied for setting No. 63 T. and P. fuze.

If the time and percussion fuzes are required to act as time fuzes only, the safety pin marked "T" is to be removed at the moment of loading; if as percussion fuzes only, take out the pin marked "P"; if they are required as time and percussion fuzes, take out both pins.

Fixing Fuzes.

Rules to be observed in fixing fuzes in nose-fuzed filled shell. *B.L. guns loaded by hydraulic power:—* Hydraulic loaded guns.

"Admiral" and "Royal Sovereign" class.—The fuze is to be screwed into the shell, and the cap, or plug, removed as the shell is being rammed home, a pause being made for this purpose. "Admiral" and "Royal Sovereign" class.

"Colossus" Class.—The fuze is to be screwed into the shell just before placing it in the loading trough. The cap, or plug, is to be removed just before ramming home. "Colossus."

Note.—The 12-inch Marks VIII. and IX. have only pointed shell, which are already fuzed, and no instructions are therefore necessary in the drill. Later ships.

Other B.L. and Q.F. Guns.—The fuze is to be screwed into the shell when the latter is supplied to the gun, and the safety arrangement removed just before entering the projectile in the gun. Other B.L. and Q.F.

Direct action.

Direct Action.—These fuzes require no preparation except the removal of the cap in the No. 1 Marks I*. or II., or the plug in the No. 3 Marks III. and IV.; they are screwed firmly into the fuze-hole by means of the fuze-key. As the ignition of this fuze is effected by a direct blow, great care is necessary in the manipulation of the shell after it has been entered, and the cap or plug of the fuze should not be removed till the last moment.

Base percussion, large and medium.

Base Percussion, Large and Medium.—These fuzes require no preparation, but are supplied screwed into the base of the shell. Care is to be taken to see that they are screwed hard up before firing (*see* Note, page 109).

Hotchkiss base.

Hotchkiss Base Fuze.—This fuze requires no preparation, but is supplied screwed into the shell.

T. and P. fuzes.

Time and Percussion Fuzes.—These fuzes are screwed into the shell with the fuze-key. The safety pin (or pins) are not to be removed until the moment of loading.

Direct action impact.

Direct Action Impact.—At the moment of loading the safety pin in the cap is removed, and then the safety cap itself removed.

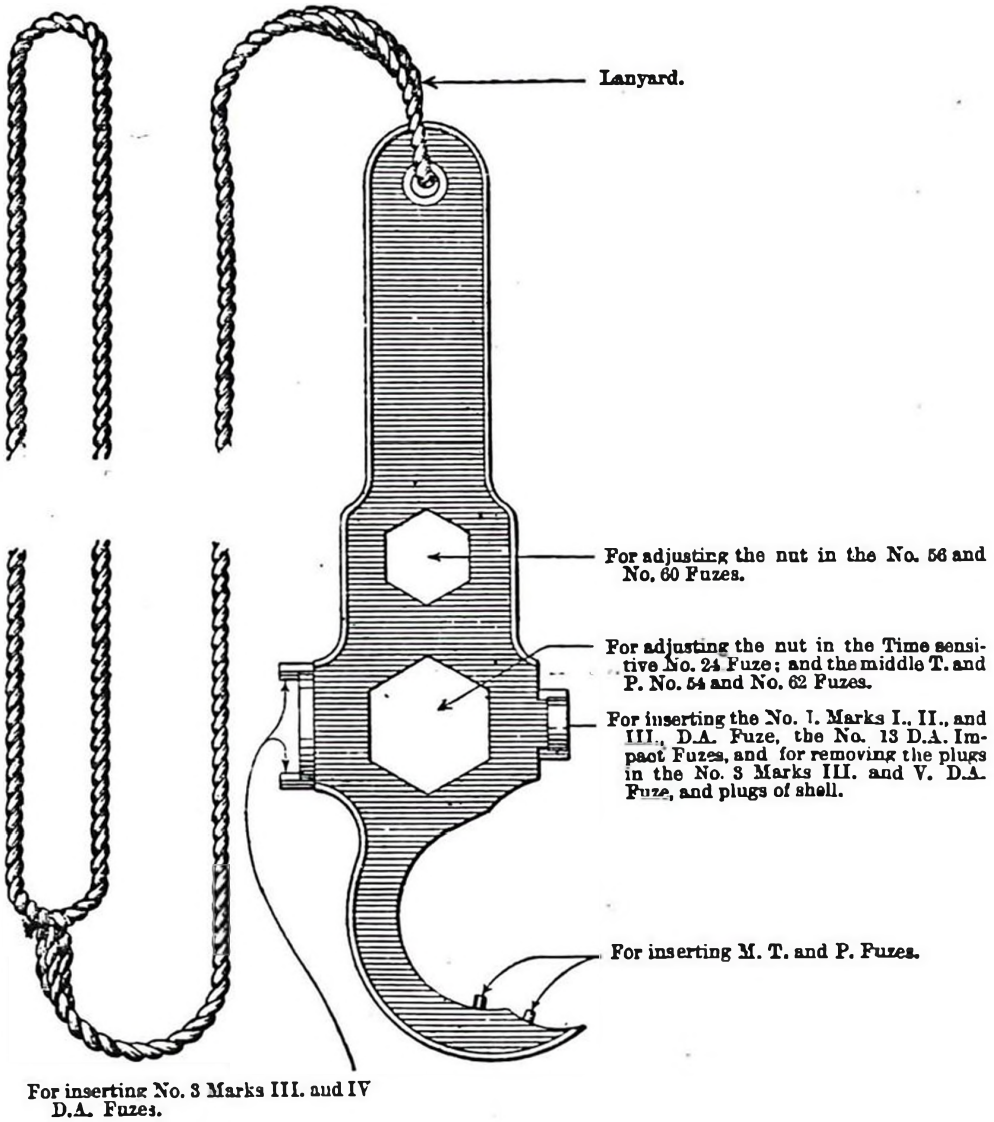
Fuze Implements.

The following keys and implements are supplied for fixing and removing fuzes and for adjusting them :—

Universal Fuze Key, Marks I., II., and III.—The woodcut shows the Mark III. key and the use of the several parts— Fuze-key.

Universal Fuze Key, Mark III.

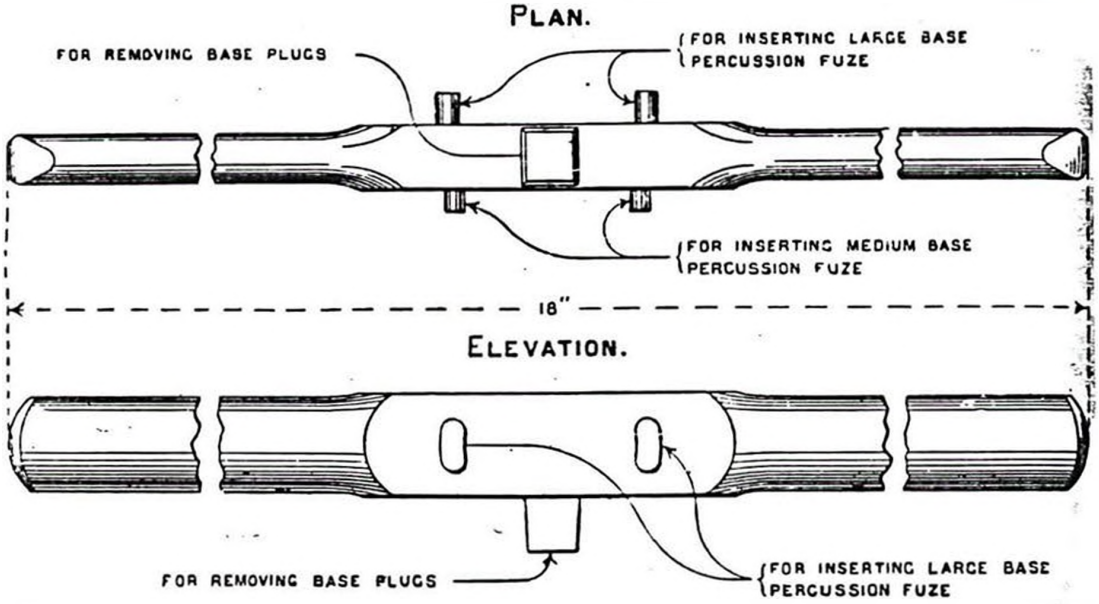
Scale, ½.



Base Fuze and Plug Key.—This key is for fixing and removing large or medium base fuzes. It is supplied to ships one per shell-room. Base fuze and plug key.

Base Fuze and Plug Key.

Scale, ½.



Base plug wrench.

Base plug wrench is for removing the plugs from the lifting bolt-holes of projectiles, and will also remove the plugs from the fuze-holes of nose-fuzed shell.

G.S. wads.

G.S. Fuze Hole Wad with Loop.—Is a millboard wad, saturated in beeswax, and fitted with a small loop of leather on the top. It is fitted into the recess provided for it in the common shells that are noze-fuzed, filled and plugged, and is coated with red cement.

G.S. Fuze Hole Wad.—Serves to prevent the powder from working up in the fuze-hole of a shell. It is made of papier-mâché, and has a hole in the centre covered by thin black shalloon cemented to one side. This wad is forced in by fixing the fuze. It is used in all common shell which do not have their bursters in a bag, and shrapnel which have their bursters in the head.

Failure of Fuzes.

Fuzes may fail, being either "blind," *i.e.*, not bursting at all, or premature, *i.e.*, bursting too soon.

The former may be due to the fuze not being sufficiently sensitive with regard to the target used, or may be due to the safety arrangement of the fuze not having been removed before loading, or in the case of time fuzes faulty setting may be the cause.

A premature may occur in the gun or during flight, the former is a serious matter, especially with projectiles of hard metal, as the gun may be much injured thereby. Prematures.

The following may be the cause—

1. Defective filling of the shell, or a defective design of shell.
2. The fuze being improperly prepared.
3. Base fuzes not gas-tight, due to not being properly screwed up, or the cap displaced in the case of the Armstrong base fuze.
4. Projectile not being properly rammed home.

CHAPTER IX.

Ammunition for Light Q.F. and Machine Guns and Small Arms.

6-pr. and 3-pr. Ammunition.

Weights, &c.

For these guns the projectiles are attached to the case. Such ammunition is termed "fixed."

The details of the ammunition are—

Charge—

6-pr. Q.F. charge, cordite 7¾ oz., size 5.
3-pr. Q.F. charge, cordite 6⅜ oz., size 5.

Shell—

6-pr. Q.F. steel shell, weight 6 lbs., burster 4 oz.
3-pr. Q.F. steel shell, weight 3⅓ lbs., burster 2⅛ oz.

The cartridge for 6-pr. Q.F. gun is shown on Plate XXVI.

Cartridge case.

The cartridge cases are made of brass, solid drawn, a hole is bored through the centre of the base, the rear portion of which is enlarged to contain the cap chamber.

The case, inside and out, is lacquered with 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 1½ grains of cap composition 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.

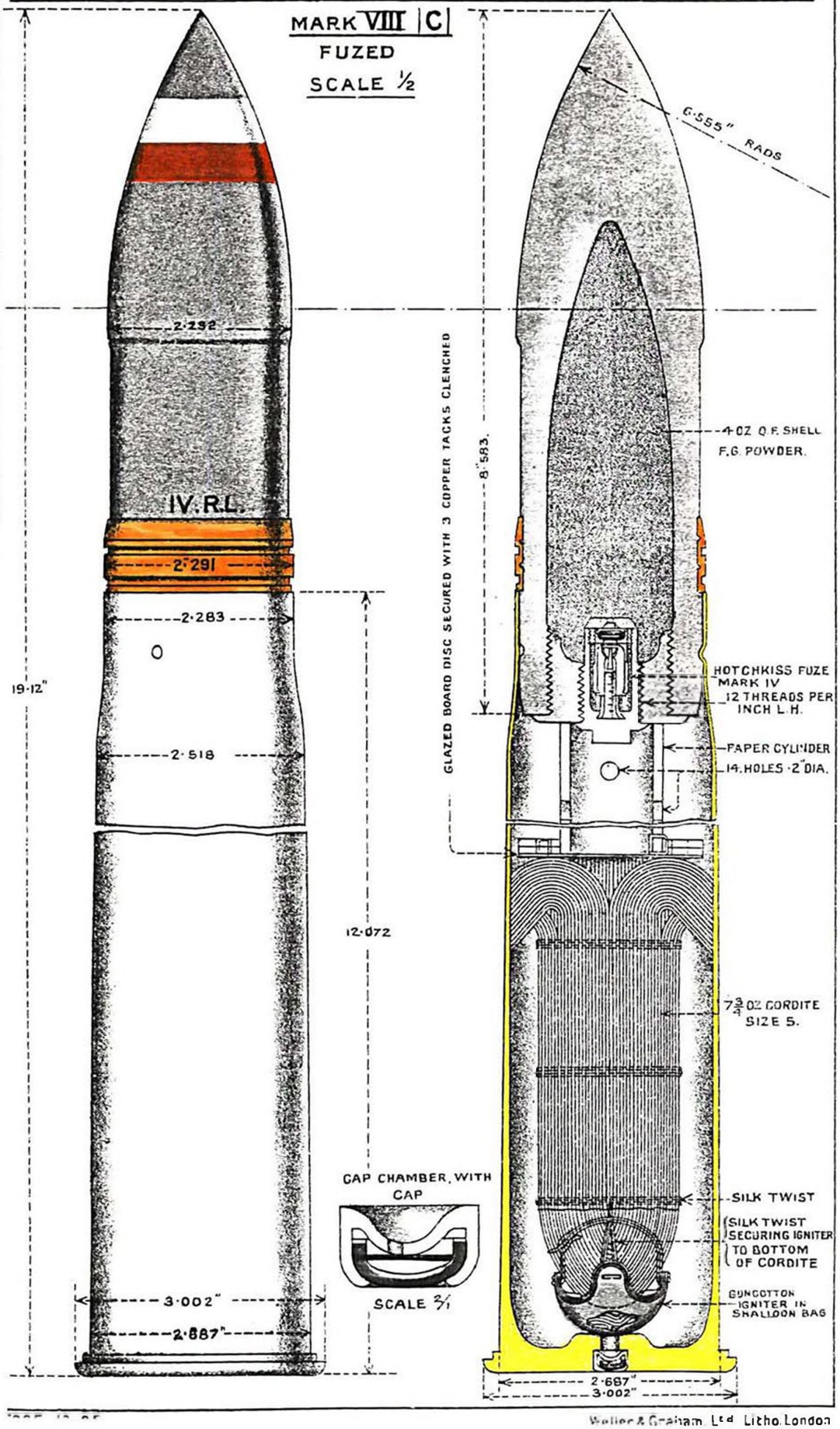
The Mark II. cap differs from the Mark I. in being made of thinner copper; cartridges fitted with the Mark II. cap will be marked on the base with the Arabic numeral one in a circle, thus (1)

Cordite.

The charge, is made up of 12-inch sticks doubled and tied with silk twist in three places. In the early marks of 3 and 6-pr. ammunition there is an igniter of 4 drams of R.F.G.^{2} powder contained in a flat circular bag of shalloon, tied on to the bight of the cordite, but in the later marks and in all cartridges when returned into store for examination, the R.F.G.^{2} powder is being replaced by a strand of gun-cotton 1½ drams in weight. The charge is inserted in the case with the igniter next

To face page 118.

CARTRIDGE, QUICK FIRING, 6 PR CORDITE, STEEL SHELL.



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the cap. A paper cylinder placed over the cordite keeps the charge in position at the bottom of the case. It consists of a hollow cylinder of brown paper with double discs of millboard secured to the end next the cordite. In the latest pattern a glazeboard disc is placed next the cordite to insure no absorption of nitro-glycerine. The cylinder and discs are pierced with holes.

The shell. The shell is made of forged steel, hardened, and rotation is imparted to it by a broad Vavasseur driving band. Near the base is a cannelure for the purpose of securing it to the mouth of the case.

The interior is lacquered, and takes a bursting charge of Q.F. shell F.G. powder.

The base may either be solid or closed by a steel plug screwed in. The base has a central hole threaded to take the Hotchkiss base percussion fuze.

The shell is painted black with a white ring, denoting steel, painted round the head, and a red ring to show it is filled.

The shell which is filled, &c. is coated with shellac varnish below the driving band, placed in the mouth of the case, and forced in as far as the driving band by means of a press worked by hand.

The cartridge is then placed in an indenting machine, and the mouth of the case indented in three places into the cannelure on the shell, it is then taken out, cleaned, and gauged, clips cartridge placed on, and packed away.

On the base of the cartridge is stencilled in red the word "*Cordite*," and Lot No. which includes the initials of manufacture.

Mark IV. fuze. The Mark IV. Hotchkiss base percussion fuze will be found in the 6-pr. Mark VI. ammunition, and the 3-pr. Mark V.

Cartridge clips. The caps in the cases of 3-pr. and 6-pr. cartridges are protected by a *Clip cartridge Q.F.* Those of the present pattern (Mark III.) are of brass with three arms and a central dome. Mark II. had a felt cushion bearing against the cap.

Treatment of cases. After being fired the cases should be cleaned as soon as possible in accordance with the instructions on p. 48, and repacked ready for returning into store. The clips are to be returned to store separate.

Fuzes not to be touched. The fuzes of these shells are on no account to be removed on board ship.

Refilling. The cartridge case is marked when refilled as described on p. 49.

Stowage. For storage 6 pr. and 3-pr. Service cartridges are classed as Group III., Division II.

Packing. The cartridges are packed base up; 6-pr., 11 in a box, 3-pr., 16 in a box. The boxes are zinc lined and painted stone colour for the 6-pr., and lead colour for the 3-pr.

Service ammunition not to be passed up for exercise.

Service ammunition is not to be passed up for exercise, and is to be handled with great care. The ammunition boxes are packed in dry air, and should therefore only be opened when absolutely necessary. Should any ammunition be found in a bad state when passed up for quarterly practice, the whole of the 3-pr. and 6-pr. ammunition in the ship should be landed as soon as convenient at the local ordnance store for cleaning and repainting. If this course is impracticable, the ammunition should be cleaned on board, but not painted, and should be landed on the first opportunity for examination. It should be distinctly understood that nothing further is to be done to this ammunition on board ship beyond removing rust from the shell and verdigris from the cartridge cases. Special mention is to be made in the Half-Yearly Report of Gunnery as to the condition of the 6-pr. and 3-pr. ammunition.

Dummy cartridges.

Dummy cartridges are supplied for drill purposes. They consist of an ordinary service case with a teak projectile, and a receiver in the base containing an india-rubber plug backed up by a spiral spring. Dummy cartridges should always be used when at drill, but are not to be kept in the guns at other times.

Steel gauges are supplied for gauging 3- and 6-pr. cartridges. The supply is one to every four guns, but not more than two are supplied.

6-*pr. and* 3-*pr. Blank and Saluting Ammunition.*

The blank ammunition for these guns is known as the Mark IV., previous marks now being obsolete.

The terms "blank" and "saluting" have reference only to the proportions in which it is issued; that for the 6-pr. is also used with the Nordenfelt 6-pr. Q.F. guns.

Description.

The ammunition consists of a short, solid drawn cartridge case with two slots near the mouth, fitted with a hole in the base, into which is inserted a removable primer, which is held in place by a small stud or pin engaging in an inclined circular groove formed round the hole in the base. The primer consists of a small brass tube, capped, and primed with fine grain powder; two slots are formed in it, with the aid of which and a special screwdriver the primer is forced into place or removed. The cartridge cases are supplied in wooden boxes, 20 in each box, and the primers are supplied in tin cylinders, 20 in each cylinder.

Supply of cylinders.

The charge for the 6-pr. is 15 ozs. L.G. powder, and that for the 3-pr. is 11 ozs. of the same powder.

Charge.

The charge is made up in red shalloon, and is then half enveloped in a felt jacket, attached to the top of which is a silk braid loop, which passes through a felt wad and a millboard disc.

Silk braid, 0·35 inch wide, is supplied (packed in the half metal-lined case with the charges) for securing the charges in the cylinders, in the proportion of 1 yard to every three charges.

Thirty-seven 6-pr. or fifty 3-pr. charges for Hotchkiss or forty-three charges for Vickers I. are stored in a half metal-lined case, with necessary wads and braid. Storage.

For storage the charges are grouped in Group I., Division I., completed cartridges in Group III., Division II. Storage of charges.

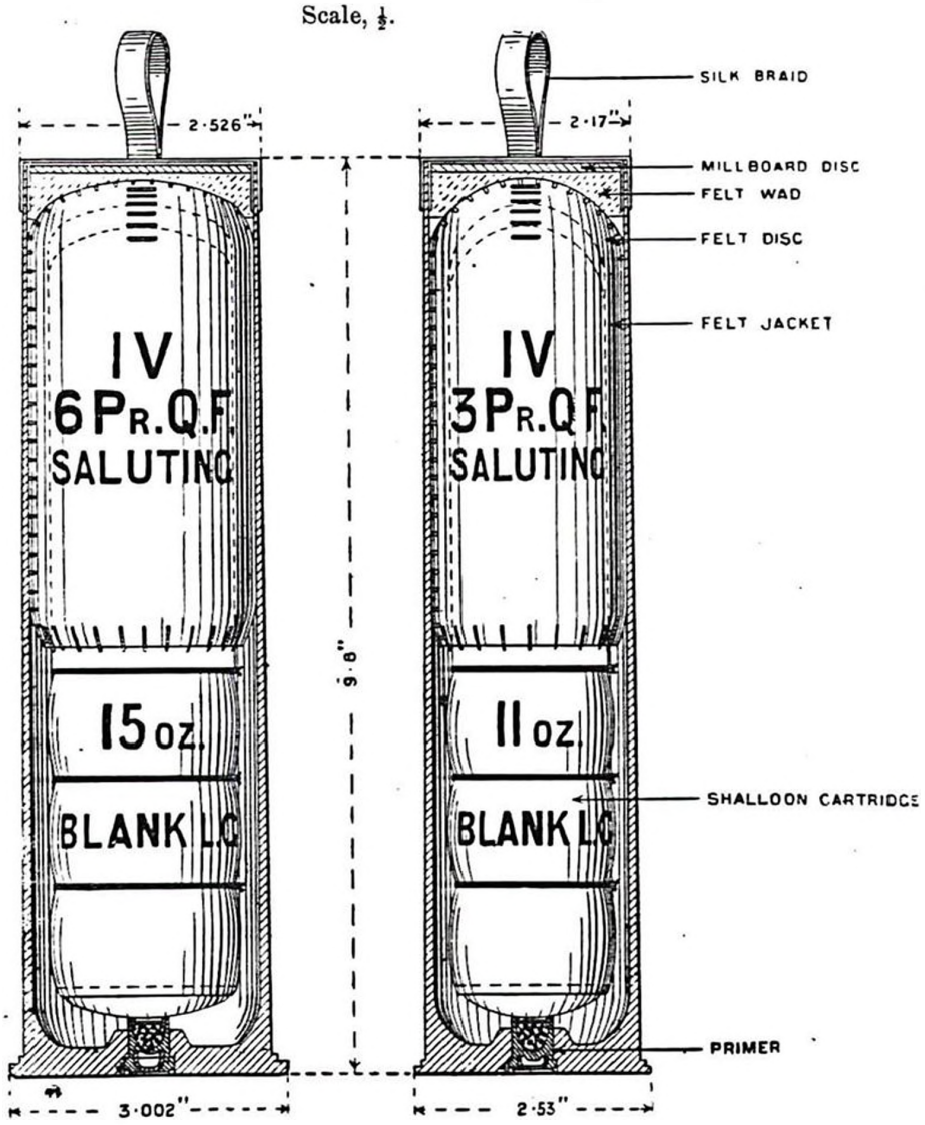
The tools for repriming are issued in an ordinary packing case.

In addition to the special screwdriver for inserting or removing the primers, a 12·7-inch rod is supplied for driving out the primer if set fast, or if the pin of it has been broken. Repriming tools.

Cartridge, Q.F., Saluting, 6-pr., 15-oz., Blank, L.G., Mark IV.

Cartridge, Q.F., Saluting, 3-pr., 11·oz., Blank, L.G., Mark IV.

Scale, ½.



Instructions for Repriming and Refilling Mark IV. Blank and Saluting Ammunition.

1. The case being perfectly clean and dry, insert a new primer and place a clip over the base of the case to protect the cap.

2. Stand the case vertically on a small board, suitably recessed for the clip, so that the case will stand steadily on its base.

3. Insert the charge with felt and millboard discs attached in the case, the felt wad being placed next to the charge, then pass a piece of ·35-inch silk braid through the loop on the charge and slots in the case, and securely tie it across the mouth of the case. If there is any difficulty in inserting the charge, it should be slightly rolled on a bench or board, by hand, to reduce the diameter, but it is necessary that the charge should fit tightly into the case.

NOTE.—Care is to be taken that the silk braid after being passed through the slot in the cylinder is made to lie flat, as otherwise a difficulty in entering the cartridge might be experienced.

Blank filled on board.

Procedure to be followed with blank and saluting cartridges, which are filled on board:—

1. The cartridge cases are only to be filled as required, but should a greater number have been filled than are found necessary for immediate use, those not fired are to be returned to their boxes for re-storage in the magazine, safety clips having first been placed on the caps. The safety clips removed from the Service cartridges expended for practice can be used for this purpose, or, if none are available, they can be obtained from the local ordnance depôt.
2. Cartridge cases, which have been filled on board, are to be emptied before being returned into store, the charges being re-stowed in the half metal-lined case.

Note.

NOTE.—In case of a missfire with blank ammunition, the breech is not to be opened for 15 *minutes*, and then gently; the cartridge complete is to be thrown overboard at once.

MACHINE GUN AND SMALL ARM AMMUNITION.

This includes ammunition for aiming rifles and tubes.

1-inch electric aiming.

One-inch electric aiming ammunition.—There are five marks of 1-inch electric aiming ammunition, which differ principally in the construction of the electric primer.

The Mark V. consists of the case, electric primer charge, wads, and bullet. Mark V.

The case is made of solid drawn brass, with a threaded hole through the centre of the base to receive the primer, the case is varnished internally with brown hard varnish, except that part which envelops the bullet. The case.

The electric primer consists of a brass tube, screwed externally, two ebonite plugs as insulators, a fibre washer, and a brass contact pin; an iridio-platinum wire bridge connects the contact pin to the body of primer by being soldered with pure tin. The I.P. bridge is of ·0015 inch diameter, and the resistance 1 to 1·5 ohms. The primer is then filled up with gun-cotton dust or cotton powder, and closed by a plain card wad ·05 inch thick, then shellaced over. The primer.

The charge is 400 grains of R.F.G.^{2} powder; on top of powder there is a grease-proof wad, then a felt wad lubricated with pure beeswax, and finally a white cardboard wad.

The bullet is made of 12 parts lead and 1 of tin, and weighs 9 ozs. 408 grains, and is pointed; it has three cannelures which are filled with beeswax. The bullet is covered around its lower part by a patch of fine white paper which is also lubricated with beeswax. Bullet.

The bullet is placed in the case, which is slightly reduced in diameter at the mouth, and the edge of the brass is coned into the upper cannelure.

The Mark IV. cartridge is very similar in construction to the Mark V., except that the primer was not screwed in, and there was no fibre washer in the Mark IV., and there is no paper around bullet, which is secured into the case by three indents into the cannelure. Mark IV.

In the Marks I., II., and III., the principal difference was in the primers, except in the Mark I., which also had a brass bullet. Earlier marks.

In the Mark III. cartridge the primer consists of a brass body with enlarged head, bored out, the front end being slightly coned internally. In the head there is a copper contact piece cupped out in front, and insulated from the body by ebonite. In front of the copper contact piece there is a brass centre piece cupped out in rear, and insulated from the body by ebonite, the rear end fitting inside the cupped out portion of the copper contact piece. The P.S. wire bridge is connected to the brass centre piece, and to a slot in the front end of the body of the primer, it is embedded in gun-cotton dust and mealed powder. Mark III.

The front end is closed by a disc of paper.

Marks I. and II. — The primer of the Marks I. and II. cartridges consists of three tubes which fit one into another, the central and intermediate tubes being insulated from one another by means of gold-beater's skin round the body of the former, and a vulcanised fibre washer under its head.

A P.S. bridge, round which is a tuft of gun-cotton, connects the ends of the central and intermediate tubes, the space beyond the bridge in the intermediate and outer tubes being filled with fine grain powder. A conical brass plug closes the mouth of the inner tube to prevent the escape of gas. The head of the inner tube is raised in the centre to form a contact point, round which is a ring of insulating material.

Issue. — The cartridges are packed, 96 in a S.A.A. box, in bundles of 12.

Distinguishing marks. — The distinguishing mark on the box of this ammunition is a black diamond, connected at the angles to a skeleton black diamond.

Use. — Used in all 1-inch aiming rifles fired by electricity.

Proof. — When firing for proof, it should give a muzzle velocity of 1,130 f.s. + or − 30, and when the aiming rifle is fixed in place 80 per cent. of the bullets in a bull's-eye of 6 inches at 100 yards.

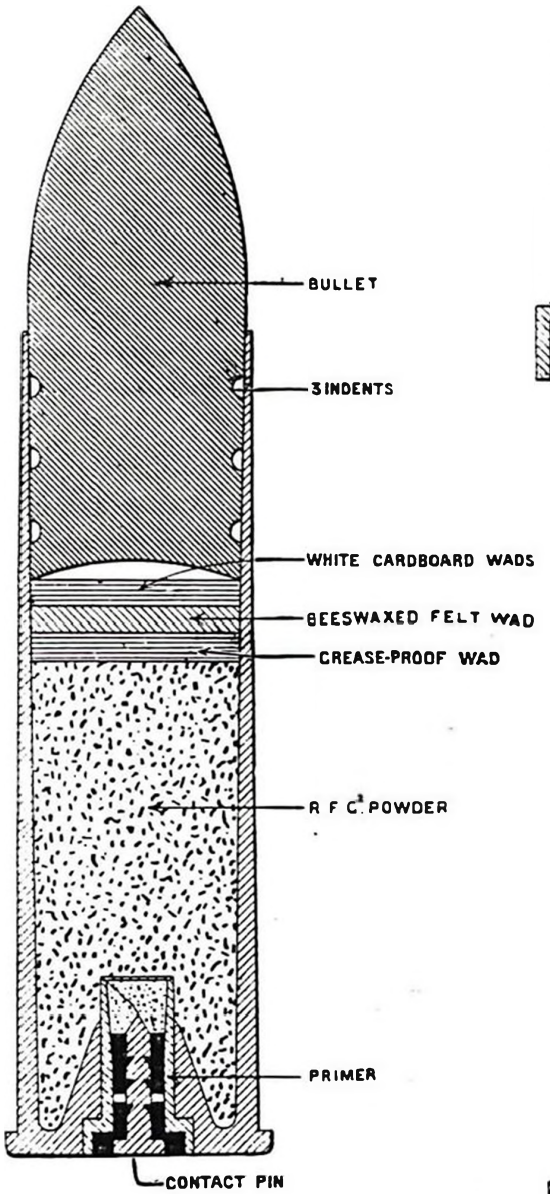
Supply. — Is 400 rounds per gun that uses the 1-inch aiming tube.

Quarterly expenditure. — Is 100 rounds per quarter from each gun.

Empty cases. — Are to be cleaned as described for Q.F. cartridge on page 48.

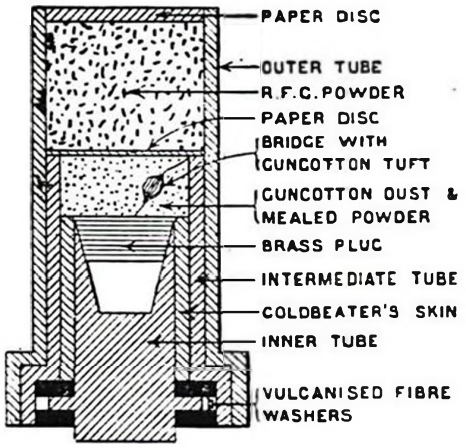
Electric Aiming Ammunition.

Mark IV. Cartridge.
Scale, ½

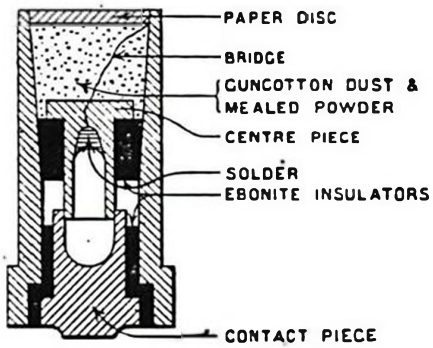


Primers.
Scale, 2/1

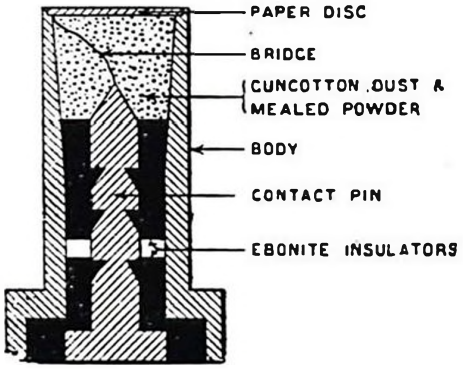
MARK I & II.



MARK III.



MARK IV.



·45-inch Machine Gun Ammunition G.G. Chamber.—For all ·45-inch machine guns and aiming rifles, having the "G.G." chamber, *i.e.*, all Maxim guns, and the Elswick aiming rifle for 6-pr. and 3-pr. guns.

·45-inch G.G. chamber. Use.

The ·45-inch M.G. Ball Cartridge, Cordite, Mark I.—The case is made of solid drawn brass, the base being pressed out to form the projecting rim necessary for extraction. The cap chamber with raised anvil is formed in the metal of the base, and two fire-holes pass from the bottom of the chamber into the interior.

Cap. The cap is of copper, and contains ·7 grain of cap composition pressed and varnished; it is secured in the cap chamber by being pressed into it.

Cap composition. The cap composition is composed of—

Fulminate of mercury	8 parts.
Chlorate of potash	14 „
Sulphide of antimony	18 „
Sulphur	1 „
Mealed powder	1 „

Charge. The charge is 38 grains of size 3 cordite.

Wad. On top of the charge is a millboard wad, paraffin waxed.

Bullet. The bullet is made of 12 parts of lead to 1 part of tin, and weighs 480 grains. It has a cannelure near the base. A small hollow in the base of the bullet tends to slightly expand it when fired.

The bullet has two turns of orange-coloured paper wrapped round it from right to left, so that the paper untwists in passing through the bore. The paper is lubricated with beeswax, and its function is to prevent leading.

The bullet is secured to the case by the latter being choked into the cannelure.

The case has the letter "C" stamped on the base.

Powder charge. The ·45-inch M.G. ball powder ammunition is similar to the above.

The charge being 85 grains of R.F.G.^{2} powder.

Charge. There is no "C" on the base of the case, and the paper round the bullet is white.

The detonating composition used in S.A. cartridges filled with powder is composed of the following:—

Fulminate of mercury	6 parts.
Chlorate of potash	6 „
Sulphide of antimony	4 „

Packing and issue. The cartridges are packed in bundles of 10; 680 rounds in a S.A.A. box.

Distinguishing mark. The distinguishing mark for ·45-inch ammunition, G.G. chamber, is a triangle which, for powder ammunition, is black; and for cordite ammunition is red with the letter "C" in white upon it.

Blank. *The ·45-inch Machine Gun, Maxim, G.G. Chamber, Blank Cartridge, 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.G.F.^{2}, covered by a glazed-board cup secured with shellac. The top of the case is crimped over.

Mark I. differs from the above in dimensions only.

Packed in bundles of 10; 2,000 cartridges in a half metal-lined case. Packing and issue.

·45-*inch Martini-Henry Ball.*

This cartridge is used for all ·45-inch aiming rifles having the M.H. chamber. M.H. ball. Use.

The cartridge is made of rolled brass with an iron base. Description.

The cap chamber contains a brass anvil, on the shoulders of which rests the copper cap which contains cap composition varnished over.

The charge is 85 grains R.F.G.[2] powder.

Above the powder is placed a glazed-board disc, then a wad of beeswax, cupped out to the front to ensure its expanding, and then two more glazed-board discs.

The bullet is made of 12 parts lead to 1 part tin, and weighs 480 grains. It has two cannelures, which allow the case to be secured by choking to the bullet. The latter has two turns of fine white paper wrapped round it from right to left. The paper is lubricated with beeswax, and its function is to prevent leading.

In packets of 10; 600 rounds in a S.A.A. box. Packing, &c.

Distinguishing mark on the box is a red rectangle. Distinguishing mark.

In the case of other S.A. ammunition a red mark denotes cordite.

·303-*inch Ammunition.*

The ammunition now being manufactured of this calibre is known as the Mark VI., all other marks being obsolete except the Mark II., which is still in use.

The Mark VI. Cordite Ammunition consists of a case, cap, charge, wad, and bullet. The case is made from solid drawn brass and has a cap chamber with a solid anvil formed in it, and two fire-holes. The cap is of copper and contains ·6 grains of composition, pressed in and varnished; it is secured by being pressed into the cap chamber.

The charge is 31 grains of size 3¾ cordite in 60 strands. A single glazed-board wad is placed over the cordite. Charge.

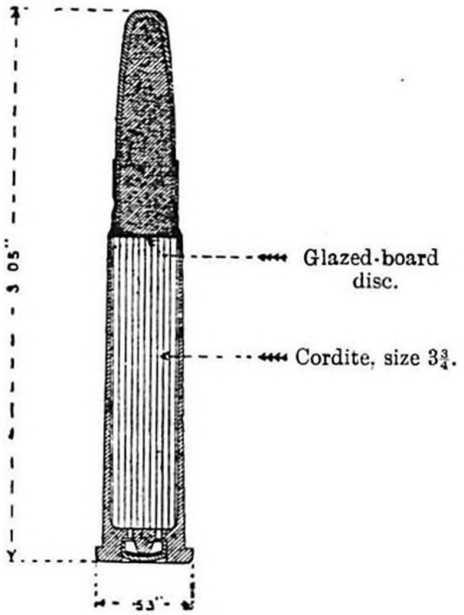
The bullet consists of a pellet (98 per cent. lead, 2 per cent. antimony) enclosed in a cupro-nickel envelope, and weighs 215 grains. The envelope is solid drawn from on alloy of about 80 per cent. of copper to 20 per cent. of nickel, with about ·5 per cent. of iron added. The pellet is secured in the envelope by the edge of the latter being turned over the pellet. The bullet is coated near its base with beeswax and has a cannelure. It is secured into the case by the latter being coned and indented in three places into the cannelure. Bullet.

The base of the cartridge is marked with a "C."

The Mark II. only differs from the above in the distribution the metal of the envelope.

·303-*inch Ball Ammunition.*

Mark II.



Packing, &c.

The ·303 cartridges are made up in packets of 10, and stowed in—

A.S.A. box, whole, holds 1,100 rounds, or

A.S.A. box, half, holds 500 rounds, or

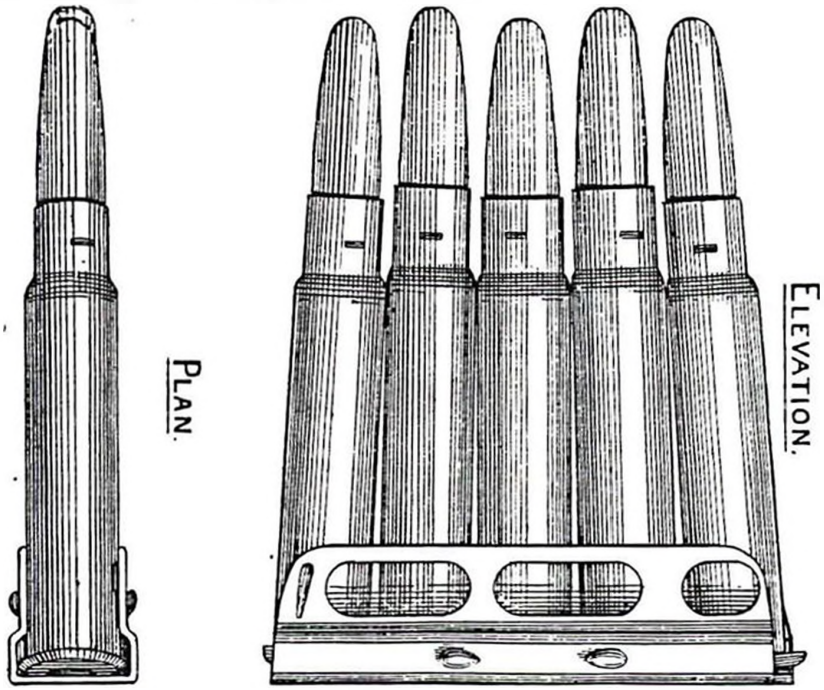
Quarter metal-lined case, for boat service, holds 1,200 rounds.

Distinguishing mark.

The distinguishing mark for ·303-inch cordite ball ammunition is a red rectangle with a bar across centre and the word "Cordite" above and below.

A whole box A.S.A., full, weighs about 80 lbs.

When ·303 cartridges are supplied in "chargers," the whole A.S A. will contain 840 rounds, each charger holding five rounds and four chargers stowed in a leather-board box, the A.S.A. box thus holding 168 chargers in 42 leather-board boxes.



The distinguishing mark for ·303-inch cordite ball ammunition is the same as above, except that it has the words "·303-inch in chargers" printed above the rectangle in red letters. On the small labels which are placed on the cleats of box, across the usual ·303 label, the words "chargers" will be printed diagonally across in black letters.

Cartridge S.A. ball ·303-inch, short range practice, Mark II., for use at certain coastguard ranges.

The case and cap of this ammunition is the same as for the Service cartridge, except that the case is blackened half way from the bullet end 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 similiarly to the Service ·303 cartridges, and it requires a force of not less than 24 lbs. to extract.

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.

·303-inch blank.

The Mark V. Blank Cartridge, ·303-inch, consist of a Service case crimped at the mouth to retain the charge of 10 grains of No. 20 sliced cordite. The charge is covered by a strawboard wad. As cases used for ball cartridges are available for making up this ammunition, the numeral on the base does not necessarily agree with that shown on the wrappers and labels of packages.

On the base of the cartridges is the letter "C."

·303-inch blank powder.

The Mark III. S.A. blank ·303-inch blank powder is much the same as the above; the charge is 40 grains of powder.

Packing and issue.

Packed in bundles of 10 in purple paper; 1,450 rounds in a quarter metal-lined case; or 3,400 rounds in a half metal-lined case.

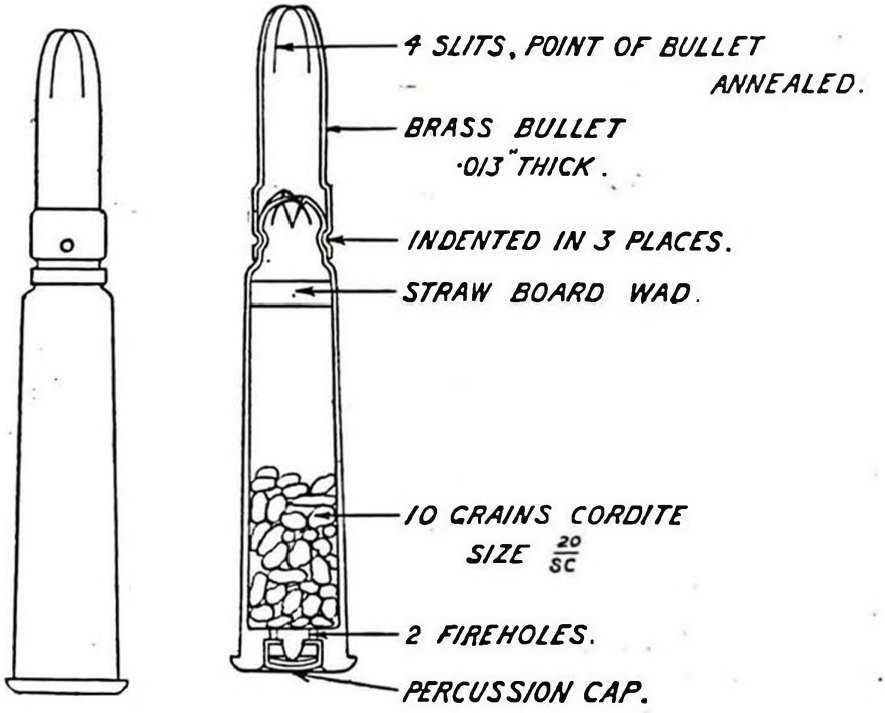
Cartridge S.A. blank ·303-*inch cordite with mock bullet Mark VI.*

This cartridge (*see* Plate) differs from the Mark V. ·303-inch blank, described above, in having a mock bullet which admits of the cartridge being loaded through the magazine and carried in bandoliers.

The mock bullet is composed of brass ·013 inch thick, and is secured over the neck of the case by indents, the nose is annealed and has four slits.

The case is blackened for identification.

These cartridges are packed for issue to ships in half and quarter metal-lined cases, 2,850 in the former and 1,200 in the latter; and for issue to torpedo boats in boxes A.S.A., pistol "Enfield," containing 420.



Pistol Ammunition.

The ·455 Webley pistol ammunition is used for both Webley and Enfield pistols.

There are three marks of this ammunition in use, viz.:—Marks I., II., and III.; future supplies will be Mark II.

Mark II. *The Mark II. Webley Cordite Cartridge.*—The case is made of solid drawn brass, the cap chamber and anvil being formed in the base. The cap contains ·4 grain of cap composition. There are two fire-holes. The charge consists of about 7½ grains of size 1 cordite placed in loose.

The bullet, which weighs 265 grains, is an alloy of lead and tin ; it is recessed in the base, and has three cannelures, into one of which the case is indented. There is a glazed-board disc between the bullet and the cordite.

The Mark I. cordite ammunition had the conical bullet. The anvil is separate from the case, fitting inside the cap. Marks I. and III.

The Mark III. has a bullet of the man-stopping type and an anvil similar to the Mark II.

The Mark III. is being used up for practice.

The following table shows the difference in weight, &c. of these marks of ammunition :—

Mark of Cartridge	Charge.	Bullet.	Bundles contain
I.	About 6·5 grains, size 3¾ sliced cordite.	265 grains -	12 cartridges.
II.	About 7½ grains, size 1 cordite	265 grains -	6 cartridges.
III.	About 7 grains, size 1 cordite -	218½ grains -	6 cartridges.

The Mark I. cartridges are made up in packets of 12. The Marks II. and III. in packets of 6. Packing.

The S.A.A. box, half, will contain 768 Mark I., 828 Mark II., or 864 Mark III. cartridges.

Red ring and cross-bar with letter "C" in red above and below the bar. Distinguishing mark.

Morris Aiming Tube Ammunition.

There are two marks of this cartridge, which is used in all Morris aiming tubes. Description.

The cartridge is of solid drawn brass, with cap-chamber and anvil formed in the base.

The charge is 3¼ grains. Curtis and Harvey's Diamond No. 2.

The bullet weighs 37 grains, and there are two wads fastened to its base, that next the bullet being greased, and the other of grey cloth

The Mark II. differs only from the Mark I. in the arrangement of wads.

These cartridges should put 75 per cent. of their bullets in a 3-inch circle at 25 yards. Accuracy.

One hundred in a cardboard box, 9,100 rounds in a quarter metal-lined case. Packing.

Distinguishing mark.

Black ring with black centre.

Storage.

Small arm ammunition for storage are placed in Group II., Division I.

Fired cases.

Fired cartridge cases of all S.A. ammunition are to be returned into store in any convenient package.

Plate XXVII. shows the marks on all the S.A. and M.G. boxes.

The following table shows how each of the S.A. cartridges are stowed for Naval Service :—

Ammunition.	How Stowed.	Number of Cartridges.	Description of Box.	Distinguishing Mark on Box.
·45-inch M.G. ball, G.G. chamber.	Packets of 10	680	S.A.A. box whole.	Black triangle or red triangle with letter "C" in it in white.
·45-inch M.H. rifle	"	600	"	Red rectangle.
·303-inch in chargers	5 in a charger	840	"	Red and white rectangle with the word "Cordite" above and below the line, and the word "chargers" printed diagonally across in black.
·303-inch ammunition.	Packets of 10	1,100	"	Red and white rectangle with the word "Cordite."
		500	S.A.A. box, half.	
		1,200	Quarter metal-lined case.	
·45-inch Maxim blank.	"	2,000	Half metal-lined case.	No special mark.
·303-inch M.L.M. blank.	"	3,400	"	" "
		1,450	Quarter metal-lined case.	
·303-inch M.L.M. blank with mock bullet.	"	2,850	Half metal-lined case.	" "
	"	1,200	Quarter metal-lined case.	" "
Webley pistol, Mark I.	Packets of 12	768	S.A.A. box, half.	Brown ring with cross-bar for powder cartridges. Red ring with cross-bar and letter "C" above and below the bar for cordite cartridges.
Webley pistol, Mark II.	Packets of 6	828	"	
Webley pistol, Mark III.	"	864	"	
Morris tube - -	Cardboard box containing 100.	9,100	Quarter metal-lined case.	Black ring with black centre.

DISTINGUISHING MARKS FOR S.A. & M.G. AMMUNITION BOXES.

Devices of the colours and forms shown are used to distinguish packages of the several descriptions of S.A. and M.G. ammunition mentioned, the device will be printed on the wrapper of each bundle of ammunition and on descriptive label and distinguishing labels of each packages.

CARTRIDGES

M.G. BALL ·45 INCH. POWDER.

M.G. BALL. ·45 INCH. CORDITE.

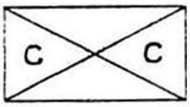
S.A. BALL. M.H. RIFLE, POWDER.

S.A. BALL ·303 INCH, CORDITE.

S.A. BALL. PISTOL, WEBLEY, POWDER.

S.A. BALL. PISTOL. WEBLEY, CORDITE.

AIMING TUBE. 0·23 INCH, POWDER.



CARTRIDGE S.A. BALL. ·303 INCH. CORDITE. SHORT. RANGE PRACTICE.

AIMING RIFLE. 1 INCH ELECTRIC.

S.A. BALL. ·303 INCH. IN CHARGERS.

CARTRIDGE. S.A. DUMMY DRILL. MAGAZINE RIFLE.

5325 12.35.

Waller & Graham Ltd Litho London

CHAPTER X.

Fireworks and Life-saving Apparatus.

Fireworks.

This chapter deals with rockets and various descriptions of lights used in the Service, life-saving apparatus, and life buoys.

Rockets.—The rockets to be described are of four descriptions, viz., war rockets, signal rockets, sound rockets, and life-saving rockets. Rockets.

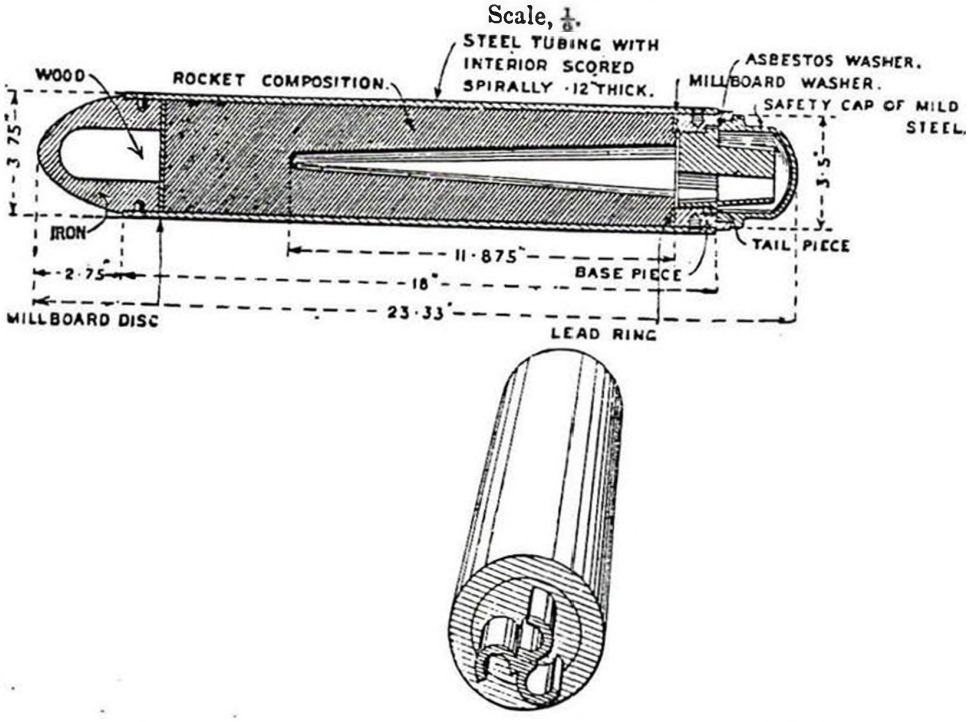
In all cases a rocket consists of a cylinder closed at the head and having a vent at the rear end. In this cylinder is a rapidly burning composition with a conical hole bored up the centre. When in flight this composition burns, giving off a large quantity of burning gas, which causes a pressure in the rocket. The gas therefore streams out to the rear through the vent, driving the rocket in the direction in which its head may be pointing. If the rocket were a simple cylinder it would in flight tend to turn over and over in the same way as an elongated projectile would do if it were fired from a smooth-bore gun. As the composition burns away the centre of gravity of the rocket is always altering its position. It is therefore necessary to provide some means of keeping it point first in flight, and this end has been obtained in two ways :—

1st. Rotation, as in the war rocket, imparted by an application of the force of the gas escaping from the rocket.

2nd. The attachment of a stick, as in the signal rocket, when fired from the machine, or a short stick and tail of rope, as in the signal rocket, when fired from the hand. In either case the rocket is kept fairly straigth by the rush of air past the stick or tail. In any breeze this has the effect of turning the point of the rocket to the wind, and it will therefore be found to travel to windward.

War rocket.

The 24-pr. Hale's War Rocket, Mark VII., consists of a head case base piece, tail piece, and safety cap.



Head.

The head is of cast iron lined with wood, and is fastened to the case by screws, in the earlier pattern rivets.

Case.

The case is made of steel tubing. Each tube is tested by water pressure of 1 ton per square inch. The interior is roughened by scoring it spirally, and scoured till it is quite clean and bright, in which condition the composition is pressed into it.

Base piece.

The base piece, of wrought iron, fits into the end of the case, and is secured by 10 screws. Its inside is bored out and screwed to receive the tail piece, and also to receive the 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, giving rotation to the rocket, thus keeping it end on.

Safety cap.

The safety cap is of mild steel, and is screwed into 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.

War rocket key.

A special implement is supplied for unscrewing the caps. All these parts are put together and marked with the number of the rocket before the latter is filled.

The composition consists of ground saltpetre, sulphur, and alder charcoal. Filling.

The composition is pressed in from the top and a millboard disc placed on top of it, and the head of the rocket is fastened on.

A conical hole about 12 inches long is drilled in the composition from the base.

Round the edge of the base is a lead ring to seal the joint with the base piece, and between the latter and the composition is a millboard washer.

The tail piece is retained in position by a keep screw.

All war rockets are painted red. Paint.

The numeral and date of manufacture are stamped on the base of the rocket. Marking.

Each rocket, moreover, has a letter of the alphabet and a number stamped on both head and case.

Previous marks of the rocket are obsolete. Previous marks.

Issued three in a wooden case. Packing and issue.

Supplied to ships only on *special demand.*

Great care is to be exercised in the handling of these weapons as they are very liable to be injured, and they should not be disturbed from the place where they are stowed except when required for actual service.

After any of these rockets have been unavoidably exposed to any rough usage, they are not to be made use of as long as there are others available, but are to be returned into store for examination and repair.

They are not to be taken away in boats for exercise.

Ten per cent. of the war rockets of each year's manufacture on charge at depôts are tested annually. If one does not burn correctly for the proper time, or burst, the rockets of the same date from which it was selected are provisionally condemned and a report made to the Admiralty. All war rockets more than 10 years old, reckoning from date of manufacture, are destroyed locally.

War rockets are to be kept in the shell room when supplied to ships.

The Rocket machine 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. Machine.

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.

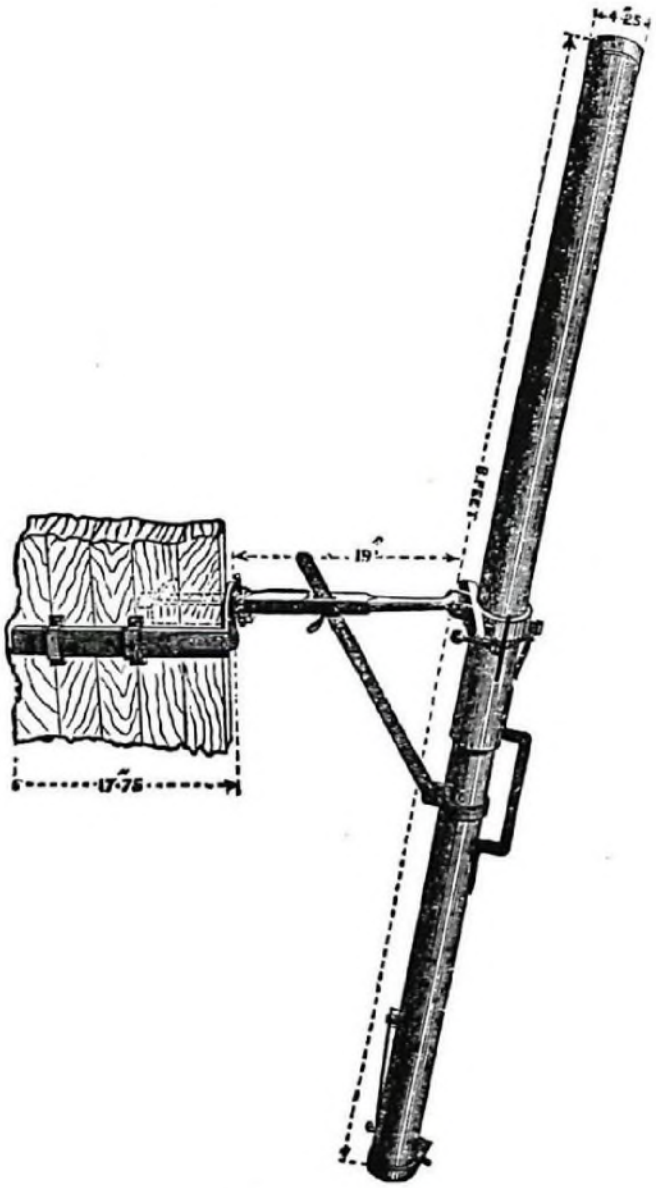
When it is required to fire abeam or thereabouts, the stanchion should be shipped in the stem or stern according as the wind is

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.

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.

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.

To load, the clutch must be unshipped, and the heel of the tube turned into the boat; the rocket is gauged by being passed through the tube, the safety cap is then removed and the rocket then entered point first from the rear, care being taken to see that the base of the rocket rests against the spring, and that one of the gas-escape holes is under the vent, the heel of the tube is then turned out of the boat and the clutch shipped. After placing a long quill friction tube, the firer should direct the tube with his outer arm (placed over it), aligning the tube on the object by means of the small directing bar, and firing with the other hand. The elevation is given by a straight bar, marked in degrees, attached to the tube and working in a slot in the stanchion. Firing.

The wind has a great effect on the missiles, but the following rough rule gives the required elevation approximately. One degree of elevation for each 100 yards of range up to 900 yards, beyond that an extra degree should be given. The maximum elevation is 30 degrees which gives a range of 1,800 to 2,300 yards. Elevation.

Accurate practice cannot be expected.

The war rocket is chiefly of use in bush warfare and its moral effect is believed to be great, especially against savages and cavalry, and owing to the lightness of the apparatus required for firing it can be transported easily in a rough country. Use.

It is very easily deflected by any object it strikes and by the wind; indeed, rockets have been occasionally deflected so as to come back at the people who fired them; this property enables one rocket to set fire to a native village in a large number of places.

For use on shore a tripod is supplied with a socket into which the stanchion of the machine ships. Use on shore.

The socket is fitted with a clamp, and the tripod is made low and with one leg projecting well to the rear.

The following stores are supplied for use with the war rocket, and are to be in the boat's magazine when a cutter is "manned and armed" with war rocket equipment, and to be with the rocket tube party on shore—

Pair of leather gloves.
Tube pocket with strap.
Long quill friction tubes.
Vent bit.
War rocket key if required.

Fog Signal Rocket.

The fog signal or sound rocket, Mark III., consists of a case made of brown paper rolled into a cylinder and filled with rocket Description.

composition, viz :—Dogwood charcoal, sulphur and saltpetre, a conical hollow passing up through the centre. The base of the rocket is choked somewhat by a twine seizing leaving a small hole through which passes a piece of safety fuze to the composition inside. The recess in bottom outside the choke is primed with large grain powder and isinglass. The other end of the safety fuze is laid up the side of rocket and is covered by a strip of paper; the bottom of the rocket is also covered with paper. The upper end of the cylinder is closed by a clay plug having a hole through the centre, through which passes a few strands of quickmatch to the composition inside; another cylinder of brown paper, called the tonite chamber, is attached to the upper end of rocket and closed by means of a wood plug having a bayonet joint. On the lower end of rocket a small paper cyclinder is attached with a small steel tongue at the upper end for attaching

Stick. the stick to the rocket. The stick for use with the sound rocket is 4 feet 2 inches in length, and it has several notches at the smaller end for the steel tongue before mentioned to fit into.

The rockets are painted black, and have a label on the outside giving directions as to firing, &c.

Supply. Supplied in half metal-lined cases, 25 in a case.

Tonite charge. The tonite charge for use with the sound rocket is composed of 1,729 grains of tonite (equal parts of nitrate of barium and gun-cotton), and is recessed at one end to receive a detonator, on the outside it is covered with paper waxed over, but not the top and bottom.

Supply. Supplied in quarter metal-lined cases containing 50 in each.

Detonators. The tonite detonator is a copper tube, closed at one end, containing a fulminating composition (fulminate of mercury, chlorate of potash, and gun-cotton) strongly pressed in. It is primed with mealed powder, a disc of paper being placed between the meal powder and composition.

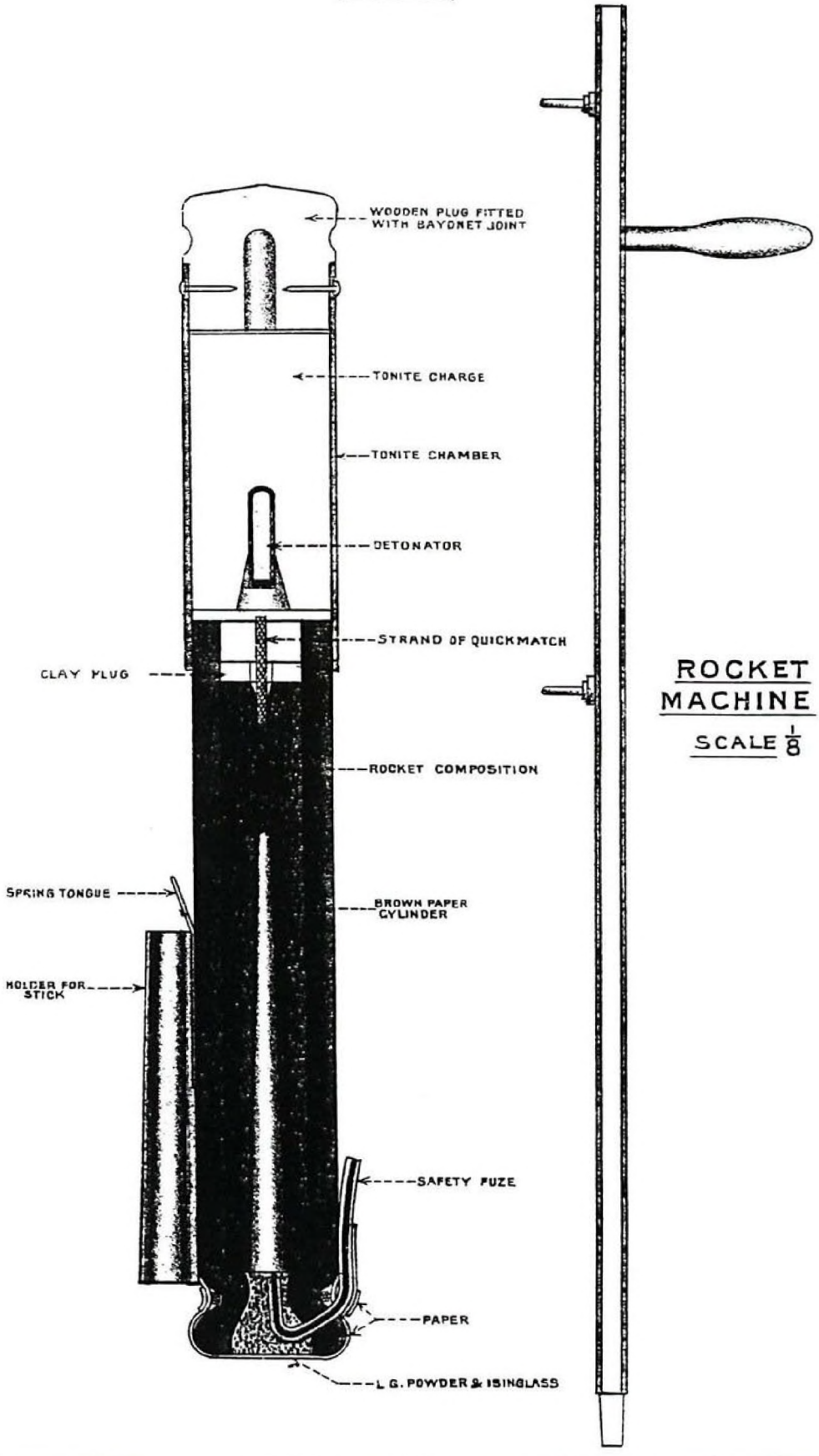
Supply. Supplied in tin cylinders, five in a cylinder, packed in cork.

The rocket machine. A rocket machine is supplied for firing the sound rocket (*see* Plate XXVIII.) consisting of a piece of wood having a handle about two-thirds the way up, placed at right angles to the stick; there are two metal eyes placed on the stick, as shown, for the rocket and stick to rest in.

Method of firing. The rocket should first be placed on the stick, being careful to see that the tongue bites into one of the notches on the rocket stick; then place the stick through the two metal eyes so that the base of the rocket rests on the upper eye; then take the tonite charge and place the detonator, with the open end down, into the recess in the bottom of tonite, and place the charge into the tonite chamber with the detonator down; next place on the wood plug and secure it with the bayonet joint, tear off the paper covering the safety fuze and ignite it with

ROCKET SOUND. ½ LB. MARK III |C|.

½ SIZE.



ROCKET MACHINE

SCALE ⅛

5925. 12 05.

Weller & Graham. Lith. London.

a port-fire or any available means of ignition, keeping the rocket machine in an upright position.

Action. On the safety fuze being ignited, it will burn quietly away for a few seconds until the flame reaches the priming and rocket composition inside the rocket, when the latter will ascend into the air. The burning composition will eventually reach the strands of quickmatch, which will in turn ignite the detonator and so detonate the tonite charge, which makes a loud report resembling a 3 or 6-pr. gun.

These rockets are supplied to ships doing steam trials, &c., or which have no guns on board for signalling purposes.

Mark I. The Mark II. Sound Signal Rocket is superseding the Mark III. It differs from it in having a 2-oz. primer of dry guncotton coated with paraffin instead of the tonite charge. Also instead of the wooden plug is a piece of calico, which is tied with tape when the guncotton primer has been inserted.

Signal rocket. *The* 1-*lb. Signal Rocket, 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.

Description. 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 also 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 tne top which can be bent down into the notch.

Composition The composition consists of ground saltpetre, ground sulphur, and dogwood charcoal. The stars consist of small pellets of composition.

Sticks. The sticks are 5 feet long, tapered to the end, and are supplied in bundles for use when the rockets are fired from the tube.

For boat service the stick is only about 1 foot 6½ inches long and has a 5-foot rope tail.

Supply. The rockets are supplied in the firework boxes, which are to be kept in the shell room, and the various boxes such as boat's magazines, &c. are to be kept complete from the firework boxes.

Each rocket is packed in a tin cylinder, the lid of which is secured by a tape band.

Signal Lights.

Long light. *The Long Light G.S., Mark III.*, is used for illuminating; it burns about five minutes.

It has a wooden handle fixed to it, containing a wooden plug coated with Brock's composition.

It consists of a brown paper cylinder driven with composition consisting of ground saltpetre, ground sulphur, and red orpiment, on top of which is placed a disc of calico smeared with composition; over the top is placed a paper disc with a piece of tape attached.

To ignite the light, tear off the disc, pull out the plug, and draw its primed end lightly across the exposed surface of the light holding the latter so that it points away from the body, *on no account is the prepared surface to be struck with the igniter.*

Issue. Issued one in a tin cylinder.

The Mark II. long light is the same in construction, except that the priming composition is smeared on paper instead of calico.

The Mark I. long light differed from the Mark II. in that it had no handle attached, and was ignited by means of a G.S. primer; both the Mark I. light and primer are now obsolete.

Short light. The short light, Mark II., is similar in construction to the Mark III. long light, except that it is much shorter and only burns from 1½ to 2 minutes.

Supplied one in a tin cylinder.

The Mark I. short light differed from the Mark II. in the priming being smeared on paper instead of calico.

Slow match. *Slow Match* is made of pure hemp slightly twisted and boiled in a ley of water and wood ashes.

It burns at the rate of one yard in eight hours, and is used for keeping a light going in a boat, &c.

About four yards of it go to a pound.

It should be demanded by weight.

Quick match. *Quick Match*, which is used particularly for priming, is made of cotton wick boiled with a solution of mealed powder and gum, and afterwards dusted over with mealed powder before it is quite dry. Unenclosed, it burns at the rate of about one yard in 13 seconds, but is practically instantaneous when confined.

Safety fuze. *Safety Fuze* was formerly called Bickford's fuze.

It consists of a train of F.G. powder enclosed in jute yarn contained in a tube of gutta-percha with its outer covering of waterproof tape.

It burns at the rate of a yard in 60 to 75 seconds.

It is used for exploding mines and will burn under water. Use.

It can be easily ignited by a portfire or vesuvian, but there is a special pistol supplied for the purpose.

The Pistol is breech-loading and has a cartridge specially made for it. The charge is 3 grains of R.F.G. powder. Pistol.

The cartridges are issued 25 in a tin cylinder.

The safety fuze is issued in tin cylinders. Issue.

The common Portfire consists of a brown paper cylinder 16 inches long, driven with portfire composition; it burns very fiercely for 12 to 15 minutes, and can be lighted by slow match or any other handy means such as a quill friction tube. Portfire.

The exposed ends are secured by a paper cap tied on with twine.

Used for incendiary purposes. Use.

A Portfire Holder is supplied. Portfire holder.

Portfire Clipper, supplied for extinguishing portfires. As portfires burn very fiercely, a clipper is supplied for cutting off the burning end. This may be done with a knife if no clipper is available, or the portfire may be extinguished by violently waving it. Portfire clipper.

Very's Lights.—Are supplied for signalling purposes; they consist of a cartridge which is fired from a "Very's light pistol." Each cartridge contains a pellet which burns white, red, or green. Very's lights.

The colour may be known by the cardboard on the top end of the cartridge, or in the dark by the feel of the rim of the cartridge.

The rim is milled all round in the case of the red light, half round for the white light, and that of the green light is plain.

The latest pattern cartridges are Marks II. and III. Description.

The cases are rolled or solid drawn, at the option of the manufacturers, and the former are known as Mark II. and the latter Mark III. cartridges.

The charge is 65 grains of R.F.G.^{2} powder.

There is a felt wad on top of the powder, and then the pellet, which is made of composition wound round with quickmatch. Another wad is placed on top of the pellet.

Packed in bundles of six. A quarter metal-lined case containing 120 cartridges. For torpedo boats and torpedo-boat destroyers, special waterproof cases are supplied for use on deck when the lights are taken from the quarter-lined case. Packing and issue.

Very's lights belong to Group II., Division I., and are therefore to be stowed in the small arm magazine.

Coloured lights and Roman candles.

Lights long, blue, green, and red, Mark II., and Roman Candles, are issued on special demand for illuminating purposes. These lights are painted externally according to their colour, and are ignited in the same way as the Long light G.S. Mark II. and the Short light G.S.

Firework Boxes.

Signal rockets, portfires, and tin cylinders containing lights, are packed in Naval firework boxes; large and small.

These boxes will pack the following stores :—

Stores.	Large Box.	Small Box.
Lights, long, G.S. - - -	24	8
„ short - - - - -	24	16
Portfires, common - - -	14	10
Rockets, signal (1 lb.) - - -	24	12

Closing.

The lids are screwed down by a metal-lined key.

Stowage.

Firework boxes are stowed in the shell room, and the various boxes on deck and elsewhere are replenished from them.

Boxes in which fireworks are kept.

These are :—

Boats magazines, night signal box, and sea boat's box.

Night signal box.

The Night Signal Box.—Is supplied for the stowage of stores which may be needed at a moment's notice for signalling purposes. Two boxes are supplied to flag ships, one to other ships.

The night signal box is to be placed where it can readily be got at.

Night signal box contains :—

3 signal rockets in tin cylinders.	1 Very's pistol, 4 green, 4 red, and 4 white Very's lights.	60 rounds of rifle blank in a leather pouch.
2 long lights. 25 short quill friction tubes in a tin cylinder.		

The rocket tube, with a stick in it ready for use and some spare sticks, are always to be kept close to the box.

The night signal box is provided with a lock and key.

Sea boat's box.

A sea boat's box is supplied for each sea boat.

Sea boat's box contains :—

4 short lights.
60 rounds of rifle blank in a leather pouch.
1 Very's pistol.
10 Very's lights, 5 green and 5 red.

The gunner is responsible (K.R. and A.I., Art. 914), that, on proceeding to sea, a sea boat's box and a rifle are placed in each sea boat. He will report that this has been done to the captain, and each evening at sea will satisfy himself and report they are there to the captain.

The list of stores and stowage of the magazines for the different classes of boats, are given below :—

Boats' magazines.

Boat's Magazine.

For 12-pr. Boat's Gun.

2 signal rockets.
5 boxes of P. tubes.
1 lb. of slow match.
1 key for metal-lined cases.
2 sticks with rope tails.
2 common portfires.
24 time and percussion fuzes, Mark IV.
2 universal keys.
1 metal key, Mark IV.
204 rounds of pistol ammunition in a leather pouch.
2 trigger lanyards.

Boat's Magazine.

For Boats armed with 3-pr. Q.F. or Maxim Gun, or for both Q.F. and Maxim Gun.

204 rounds of pistol ammunition in a leather pouch.
1 lb. of slow match.
1 key for metal-lined cases.
2 signal rockets.
2 sticks with rope tails.
2 common portfires.

Boat's Magazine.

For Pulling Cutter. With War Rocket Equipment.

204 rounds of pistol ammunition in a leather pouch.
1 lb. of slow match. 1 key for metal-lined cases.
1 spare tube lanyard with pulley and block.
36 long quill friction tubes (11 in a tube pocket, and 25 in a cylinder).
2 signal rockets.
2 sticks with rope tails.
2 common portfires.
1 pair of leather gloves.
1 tube pocket with strap.
1 vent bit.
1 war rocket key if required.

Gig's Magazine.

As supplied to each boat armed with rifles only :—

1 signal rocket.
1 stick with rope tail.
1 common portfire.

96 rounds of pistol ammunition in leather pouch.	1 key for metal-lined cases. 1 strap for pouch. 1 lb. of slow match.

Contents of Shot Boxes.

12-pr. 8 cwt. Q.F.

2 each, containing	- - -	12 shrapnel.
2 „ „	- - -	12 common.
Total	- - -	48

Life-Saving Apparatus.

The Life-Saving Apparatus is worked chiefly by coastguards and volunteers, and the fireworks now to be described are for use in connection with it.

The Life-Saving Rocket Apparatus.—Consists of a special rocket of peculiar construction, which is designed to carry a line over a wreck, by which means a communication may be established between the ship and the shore. Rocket apparatus.

Special waggons are supplied which carry the whole apparatus.

The Rocket, Mark V., used with the apparatus, is shown in the woodcut. It is a compound rocket so arranged that when the first rocket has expended its force the second rocket is ignited. The rocket.

Each rocket is coned, and the two are separated by a pellet of quicker burning composition than that employed for the remainder of the rocket.

Each rocket is made of solid drawn steel, and is filled with composition, and the two are fastened together.

The interior of the case is blackened in burnt oil, and receives three coats of paint before it is filled.

The head is formed of a hemisphere of wood, under which comes a disc of wrought iron and one of lead, to prevent any escape of gas, under which a third disc of millboard prevents contact between the composition and the lead. At the bottom of the leading rocket is a disc of wrought iron, cupped out and pierced with a central vent. To this disc the lower rocket is fastened by screws, under this cup is a washer of lead, and beneath that one again of millboard.

The bottom of the lower rocket terminates in a wrought iron cup, which is closed by a gun-metal screw plug, the object of which is to ensure the rocket being burst instead of projected, if it should be accidentally ignited.

Key plates for drawing the plugs are attached to the rocket box, &c.

Underneath it will be found a disc of paper, which must be broken through before firing the rocket.

The life-saving rocket is painted red all over.

The stick is 9 feet 6 inches long, and is secured to the rocket by a spring. Stick.

The rocket line is attached by passing it through a hole at the bottom of the stick, and a figure of 8 knot taken in it, so as to prevent it getting free should the line be burnt. Rocket line.

It is then bent to a snotter, or passed along the upper edge and through a hole at the top of the stick.

Two washers of india-rubber, and then a metal washer, are next placed at the end of the rocket line, which is then secured by another figure of 8 knot.

Kamptulicon fuze.

The rocket is fired by a *kamptulicon fuze.*

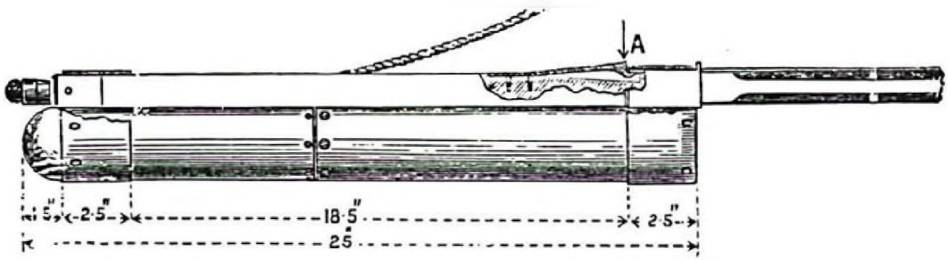
The exterior of the fuze is conical to fit the vent of the rocket. The body is of paper and is driven with composition, which burns 10 seconds. The exterior of the fuze is covered with kamptulicon. Over the priming is a waterproof paper cap tied on, which need not be removed before firing.

Portfire, life-saving.

A special portfire is supplied for firing the fuze, which differs from the 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 a Mark I. signal light. A metal handle is used with this portfire.

The primer portfire, life-saving, consists of a roughened metal pin coated with friction tube composition, which on receiving a blow is driven through a wedge-shaped copper case exploding the composition.

Scale, $\frac{1}{5}$.



Machine.

The Machine Rocket from which the rocket is fired is a trough of sufficient length to hold the rocket and stick. The elevation is ascertained by means of a dial and pendulum at the side of the trough.

The fuze is ignited by applying the lighted portfire through the opening on the side of the trough.

Rocket line.

The rocket line is of 1-inch Manila hemp, and is 250 fathoms in length, and tanned to make it durable. A piece of bunting should be fitted in each line at both ends, to mark the place for the lower figure of 8 knot.

The rocket line when ready for use is flaked in a box on pins. The layers should be alternate and laid in slack.

The lines should always be kept on the pins in the boxes, and can then be carried any distance without getting out of order, and should be ready at a moment's notice when the pins are withdrawn.

Whip.

The whip is of left-handed 1¼-inch rope rove through a single tail block, and is 250 fathoms in length.

The ends of the whip are connected by an iron swivel, so as to convert it into an endless rope.

The Hawser is of 3-inch Manila rope right-handed, and is 120 fathoms long. Hawser.

An anchor and tackles are provided for setting up the hawser, and a triangle of iron for use on parts of the coast where the shore is flat.

The *modus operandi* is as follows :—

On arriving at the scene of the wreck the rocket machine is placed in the most convenient place, and the rocket line, being wetted, is attached to the rocket; the former is placed in the machine, which is then laid as necessary for the wreck. The line box is placed about 6 yards in rear and lifted clear of the pins, and a length of stray-line is flaked in rear of the machine.

When the line has been thrown over the ship and has been grappled by the crew, a signal should be made by the ship, and the end of the rocket line on shore is made fast to a becket in the block of the whip. The rocket party make a signal to the ship by showing a red flag or red light when this is done, and the crew of the ship haul on the rocket line.

A tally board, with instructions in English and Foreign languages, is attached to the block telling them how to proceed.

The tail of the block is made fast to the mast, well up, or if masts are gone, to the best place available. The crew of the wreck then cast off the rocket line and make a signal.

The hawser, with another tally board, should be hauled off to the wreck. On being received the hawser is made fast about 18 inches above the place where the tail of the whip block is secured, and cast off from the whip.

The hawser is then set up on shore.

A traveller block on the hawser now carries the breeches buoy, which is hauled to and fro by means of the whip.

If there is no time, or for other reasons the hawser cannot be sent off, the breeches buoy should be hauled off by the whip alone.

The life-saving rocket must be treated with the same care as other rockets. If accidentally ignited it may become a most dangerous missile.

The rockets range from about 300 to 470 yards. Range.

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 to windward.

2nd. It is very desirable to start the rocket at a momentary lull.

If the rocket machine be brought into action on uneven ground, causing the foot on one side to be lower than on the other, or if one foot sink deeper in the sand than the other, the effect will be to carry the rocket towards the lower side.

Buoyant rocket.

There is also a *Rocket Life-Saving Buoyant*, which is intended for use in communicating with lighthouses, &c. when unapproachable by boats.

Call rocket.

Signal rockets and also *land rockets* are issued to the Board of Trade.

The latter is fired with a 2-oz. primer of gun-cotton in its head and a detonator of fulminate of mercury, which is ignited by a strand of quickmatch passing into the top of the rocket composition.

This rocket should be lighted by a length of safety fuze.

Wreck light.

The light, illuminating wrecks is about 30 inches long, and is made up of 10 segments attached to each other by solder. Each segment is filled with composition, and an internal diaphragm in each segment with a central hole separates the composition.

The light hangs by a bracket in its head from a special tripod and carries priming at the bottom covered by a cap.

The bottom being ignited as the light burns away the segments drop off.

Time of burning.

Burns 22 to 27 minutes.

Paint.

Painted red, with white rings at the joint of the segments.

Coastguard lights.

The light, coastguard, Mark II., burns about five minutes, and is much the same as the G.S. long light, Mark II., and is ignited in the same way.

It has a spike to stick in the ground instead of a handle.

The Mark I. is ignited by a G.S. primer.

For further details and for the drill with the life-saving apparatus, *see* the "*Board of Trade Instructions relating to the Rocket apparatus.*"

Life-Buoys.

The latest pattern of night life-buoy is shown in the woodcut, and the buoy itself requires no explanation.

Calcium light.

To each buoy is attached an arrangement for carrying the calcium lights as shown, but to the earlier pattern of circular buoy the light was attached to a float, which was connected by 4 feet of chain to the buoy.

The lights contain phosphide of calcium, chalk, and phosphorus, in certain proportions, combined at a high temperature; they emit flame when immersed in water.

The preparation is non-explosive, is not affected by heat, friction, or percussion, and, so long as kept from contact with moisture, does not become impaired by keeping.

The case is fitted with a small hole in the top, closed by a copper plug or stopper, slightly soldered to it, so as to keep the case water-tight.

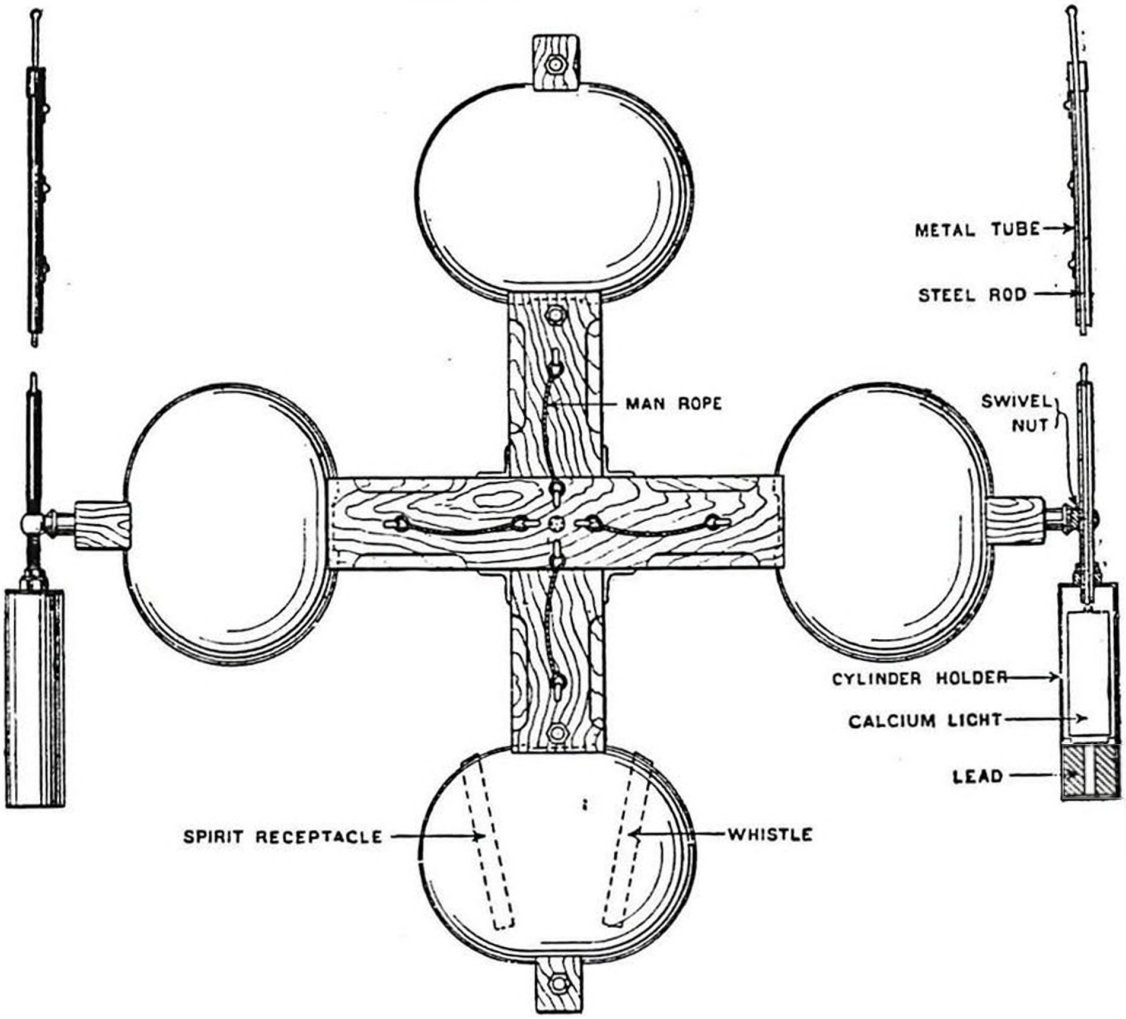
Two hollow tubes are fitted to the life-buoy, which are screwed into the mouth of two holders, which carry the lights. The tubes are secured to the buoy by swivel nuts, and the holders are weighted with lead so that when let go, and the buoy is horizontal, the tubes will be vertical.

The calcium light is entered in the holder when unscrewed from the tube, and a steel rod with a knob at the top screws into the stopper of the light.

On the buoy being let go, the steel rod being held, the stopper is torn out of the light, and water entering through a hole in the bottom of the holder, gets access to the calcium, and causes ignition. A flame will shortly appear and continue for about half an hour at the top of each tube.

Night Life-Buoy.

Scale, $\frac{1}{12}$.



Testing. (K.R. and A.A.I., Art. 914).

Life-buoys should be tested once a week by letting go without the calcium lights being in place, if in harbour, or by lowering the buoy about a foot if at sea, first unscrewing the steel rods from the lights.

The result is to be entered in the ship's log book.

The buoy should also be tried every six months with lights and rods in place, and the results entered in the ship's log.

The buoys are to be let go on all occasions of the ship's company bathing, so as to accustom the men to their use. The calcium lights are first to be removed.

The lights should always be in place, and the buoy ready for service, except when testing as above; care is to be taken when painting ship to avoid the trigger bolts and other working parts.

Spare lights.

Spare lights, 20 for each buoy, are always to be kept in the boxes provided for them, which are not to be stowed in the magazine, but kept in a store room where they are not likely to ignite by being damaged by coming into contact with water.

Any leak may readily be detected by a strong odour of phosphorus.

Immediate notice is to be taken of this, and any cases found damaged are to be thrown overboard.

Torpedo boats and T.B.D.'s.

In torpedo boats and destroyers, which do not carry the Service night life-buoys, a calcium light is to be attached as follows to an ordinary Kisbe life-buoy.

An ordinary calcium light, as supplied for the Service night life-buoy, is attached by a lanyard to a Kisbe life-buoy; another lanyard is fitted having one end secured to the rail and the other attached to a screw eyebolt, which is screwed into the plug of the calcium light, so that, on throwing the buoy to a man the plug is automatically drawn, and the calcium light actuated.

Screw eye-bolts are supplied for fitting into plugs of the calcium light.

CHAPTER XI.

Tables of Ammunition for each Gun.

Ammunition for each B.L. gun.
„ „ *Q.F. and Q.F.C. gun.*

16·25-*inch B.L.*

Nominal weight of gun.—111 tons.

Full Charge.—Powder.—960 lbs. S.B.C., made up in eighths. Primed with prism, black, powder.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Primer.—Cordite vent primer.

Projectile.—Approximate weight, 1,800 lbs.—
Armour-piercing shot.
Pointed common, cast steel, weight of burster 9·9 %
Nose-fuzed common, steel „ „ 10 %
Practice, iron.

Fuzes.—For all pointed shell - Base percussion, large.
For nose-fuzed common - Direct action No. 1.
Direct action No. 3.

Powder Case.—Cylindrical "S."

Cartridge Case.—Clarkson's, No. 28.

13·5-*inch B.L.*

Nominal weight of gun.—67 tons.

Full Charge.—Cordite, 187½ lbs., consisting of 177½ lbs. size 44, and 10 lbs. size 3¾, made up in halves and quarters. Primed with 8 oz. R.F.G.^{2} powder.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 1,250 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - 5 %
Pointed common, cast steel, weight of burster - 6·7 %
Nose-fuzed common, steel, „ „ - 6·8 %
Practice, iron.

Fuzes.—For all pointed shell - Base percussion, large.
For nose-fuzed common - Direct action, No. 1.
Direct action, No. 3.

Cases for Charges.—Cylindrical "P." for cordite. Rectangular "D" and "G" cases supplied for transport.

Cartridge Case.—Clarkson's, Nos. 13 or 16.

12-*inch*, *Marks X. and XI.*

Nominal weight of gun.—

Full Charge.—

Tubes.—

Projectiles.—

Fuzes.—

Cases for Cordite.—

Cartridge Cases.—No. 39 canvas bag.

12-*inch*, *Mark IX., B.L.*

Nominal weight of gun.—50 tons.

Full Charge.—*Cordite*, 201 lbs. 8 oz. size 50, and 9 lbs. 8 oz. of size $3\frac{3}{4}$, primed with 12 oz. R.F.G.^{2} powder, made up in quarters.

M.D. Charge, 254 lbs. of size 45 M.D., primed with 12 oz. R.F.G.^{2} powder, made up in quarters.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 850 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - - 5 %
Pointed common, cast steel, weight of burster - 9·5 %
Practice, iron.

Fuzes.—For common and older pattern A.P. shell, base percussion, large, No. 11, and for capped A.P. shell, base percussion, large, No. 15.

Case for Charges.—Cylindrical "Q."

Cartridge Case.—Canvas bag, or K.A. canvas case No. 39.

12-*inch, Mark VIII., B.L.*

Nominal weight of gun.—46 tons.

Full Charge.—*Cordite*, 167½ lbs. size 50, or 166½ lbs. size 50, and 7½ lbs. size 3¾, made up in halves and quarters, primed with 8 oz. R.F.G.[2] powder.

M.D. charge (for certain ships with 12-inch Mark VIII., where the cages are sufficiently large for loading), 200 lbs. size 45 M.D. cordite, primed with 12 oz. R.F.G.[2] powder in eight compartments, made up in halves and quarters.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. Percussion.

Projectile.—Approximate weight, 850 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - - 5 %
Pointed common, cast steel, weight of burster - 9·5 %
Practice, iron.

Fuzes.—For common and older pattern A.P. shell, base percussion, large, No. 11, and for capped A.P. shell, base percussion, large, No. 15.

Case for Charges.—Cylindrical "R."

Cartridge Case.—Clarkson's Case No. 32.

12-*inch, Marks III. to Vw.*

Nominal weight of gun.—46 tons.

Full Charge.—*Powder*, 295 lbs. prism, brown, primed with prism, black, made up in quarters. *Cordite*, 88⅓ lbs. size 30, primed with 8 oz. R.F.G.[2] powder, made up in quarters.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V S. percussion.

Primer.—Cordite vent primer when using powder charges.

Projectile.—Approximate weight, 714 lbs.—

Armour-piercing shot.
„ „ shell, weight of burster - 4·9%
Pointed common, cast steel, weight of burster 10·8%
Nose-fuzed common, steel, „ „ 13·3%
Practice, iron.

Fuzes.—For all pointed shell - Base percussion, large.
For nose-fuzed common - Direct action, No. 1.
Direct action, No. 3, Marks III. and IV.

Powder Case.—Cylindrical U, W, and V for powder. The "V" Mark III. will be universal. Cylindrical O for cordite.

Cartridge Case.—Clarkson's No. 26 for powder, No. 33 for cordite.

10-*inch B.L.*

Nominal weight of gun.—29 tons.

Full Charge.—*Cordite*, 76 lbs. size 30, primed with 8 oz. R.F.G.^{2}, made up in halves and quarters.

M.D. Charge.—Cordite M.D., 80 lbs. size 16, primed with 8 oz. F.G. powder, made up in halves and quarters.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 500 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - 5%
Pointed common, cast steel, weight of burster 7·5%
Nose-fuzed common shell, „ „ 7·5%
Practice, iron.

Fuze.—All pointed shell - - Base percussion, large, No. 11.
Nose-fuzed common - Direct action, No. 1.
Direct action, No. 3.

Case for Charges.—Rectangular J. (D. is fitted in "Devastation.")

Cartridge Case.—Clarkson's No. 34.

9·2-*inch B.L., Mark XI.*

Nominal weight of gun.—

Full Charge.—

Tubes.—

Projectiles.—

Fuzes.—

Cases for Cordite.—

Cartridge Cases.—No. 40, canvas bag.

9·2-*inch B.L., Mark X.*

Nominal weight of gun.—28 tons.

Full Charges.—Cordite, 99 lbs. of size 44, and 4 lbs. size 3¾, primed with 8 oz. R.F.G.² powder, made up in halves and quarters.

M.D. Charge.—Cordite M.D., 120 lbs. size 37 M.D., primed with 8 oz. R.F.G.² powder, made up in halves and quarters.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 380 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - 4·7 %
Pointed common, cast shell, weight of burster 7·9 %
Practice, iron.
Lyddite, common, F.S., weight of burster from 6·74 to 10·5 %.

Fuze.—Pointed shell - Base percussion, large, No. 11.
Capped A.P. shell - Base percussion, large, No. 15.
Lyddite shell - Direct action, impact, No. 13.

Case for Charges.—Rectangular N.

Cartridge Case.—Clarkson's No. 36, or K.A. canvas cases No. 40.

9·2-*inch, Mark VIII., B.L.*

Nominal weight of gun.—25 tons.

Full Charges.—Cordite, 63 lbs. size 40, primed 8 oz. R.F.G.² powder, made up in halves and quarters, or 63 lbs. size 44, and 3 lbs. size 3¾, with 6 oz. R.F.G.² powder, made up in halves (cylindrical) and quarters (conical).

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 380 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - 4·7 %
Pointed common, cast steel, weight of burster 7·9 %
Practice, iron.
Lyddite, common, F.S., weight of burster 6·74 to 10·5 %.

Fuze.—For all pointed shell - Base percussion, large, No. 11.
Lyddite, common, F.S. - Direct action, impact.

Case for Charges.—Rectangular I.

Cartridge Case.—Clarkson's No. 29.

9·2-inch, *Marks III., V., and VI., B.L.*

Nominal weight of gun.—24 and 22 tons.

Full Charge.—*Cordite*, 53½ lbs. size 30, primed with 8 oz. R.F.G.[2] powder, made up in halves and quarters.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 380 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster - 4·7 %
Pointed common, cast steel, weight of burster 7·9 %
Nose-fuzed „ „ „ „ 8·7 %
Practice, iron.
Lyddite, common, F.S., weight of burster 6·74 to 10·5 %.

Fuze.—For all pointed shell - Base percussion, large, No. 11.
For nose-fuzed common Direct action, No. 1.
Direct action, No. 3.
Lyddite - - - Direct action, impact, No. 13.

Powder Case.—Rectangular "I."

Cartridge Case.—Clarkson's No. 9.

7·5-inch *B.L., Mark I.*

Nominal weight of gun.—16 tons.

Full Charge.—62¾ lbs. M.D. cordite, size 26, primed with 6 oz. R.F.G.[2] or blank F.G. new powder, made up in halves.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles :—

Armour-piercing capped shell, weight of burster - 2·25 %
Common, pointed, cast steel, weight of burster - 8·125 %
Lyddite, common, forged steel, weight of burster - 9·7 %
Practice iron.

Fuzes.—A.P. capped shell Base percussion, large, No. 15.
Pointed common shell. Base percussion, large, No. 11.
Lyddite shell - Direct action, impact, No. 13.

Cases for Charges.—Rectangular "O."
Cartridge Cases.—K.A. canvas case No. 41.

7·5-inch B.L., Mark II.

Nominal weight of gun.—
Full Charge.—
Tubes.—
Projectiles.—
Fuzes.—
Cases for Cordite.—
Cartridge Cases.—K.A. canvas case No. 41.

6-inch B.L., Marks VII. and VIII.

Nominal weight of gun.—7½ tons.

Full Charges.—*Cordite*, Mark I., size 20, 20 lbs.; or M.D. cordite, size 16, 23 lbs.; or M.D. cordite, size 26, 29 lbs.; each of these charges are primed with 2 oz. R.F.G.^{2} powder. The 20 lb. charge of Mark I. cordite and the 23 lb. charge of M.D. cordite are made up in halves, while the 29 lb. charge of size 26 cordite M.D. is made up in one third and two thirds laced together.

Blank Charge.— 7 lbs. L.G. powder.

Tube.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 100 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster 4½ to 5½ %
Pointed common, cast steel, weight of burster - 9¼ %
Practice, iron.
Lyddite, common, forged steel, weight of burster 13¼ to 10½ %.

Fuzes.—For pointed common and older pattern A.P. shell. Base percussion, large, No. 11.
For capped A.P. shell - Base percussion, large, No. 15.
For lyddite common - Direct action, impact.

Cases for Charges.—Rectangular "B" for Service charges, either 23 lbs. or 20 lbs.
Rectangular "F" for Service charges, 29 lbs.
Rectangular "A" for blank charges.

Cartridge Case.—Canvas, No. 30, and for the 29 lb. charge No. 42.
Clarkson's No. 31.

6-*inch B.L., Mark XI.*

Nominal weight of gun.—8½ tons.

Full Charge.—32 lb. 10 oz. M.D. cordite, size 26, primed with 2 oz. F.G. powder.

Tubes.—P. percussion and electric, wireless.

Projectile.—A.P. capped shot, A.P. capped shell, steel common and lyddite.

Fuzes.—Base percussion, large, No. 11, No. 15, and direct action, impact, No. 13.

Cases for Cordite.—F.

Cartridge Cases.—No. 42 canvas bag.

6-*inch Q.F. and Q.F.C.*

Nominal weight of gun.—7 tons and 5 tons.

Full Charge.—*Cordite*, 13¼ lbs., size 30. Igniter, 1¼ oz. R.F.G.² powder. *Blank*, 7 lbs. L.G. powder. Igniter, 1¼ oz. R.F.G.² powder.

Primer.—*Electric*, primer, large.

Tubes.—*Electric*, V.S. "P." electric, wireless, for use with cartridges fitted with adapters. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 100 lbs.—

Armour-piercing shot.
Armour-piercing shell, weight of burster, 4½ to 5½ %
Pointed common shell, cast steel, weight of burster 9¼ %
Nose-fused common shell, steel, „ „ 9¾ %
Practice, iron.
Lyddite common, forged steel, weight of burster 13¼ % to 10½.

Fuzes.—For pointed common and older pattern A.P. shell. Base percussion, large.
For capped A.P. shell - Base percussion, large, No. 15.
For nose-fuzed common - Direct action, No. 1. Direct action, No. 3.
For lyddite common - Direct action, impact.

Case for Charges.—6-inch outfit box.

Cartridge Case.—Canvas bag.

4·7-*inch Q.F.*

Nominal weight of gun.—41 cwt.

Full Charge.—*Cordite,* 5 lbs. 7 oz. size 20. Igniter 1¼ oz. R.F.G.² powder. *Blank,* 3 lbs. L.G. powder. Igniter 8½ oz. R.F.G.² powder.

Primer and Tube.—*Electric,* primer, large. *Percussion,* V.S. percussion and electric wireless tube when fitted with adapters.

Projectile.—Approximate weight, 45 lbs.—

Pointed common, steel, weight of burster, 9·4 %
Practice, iron.
Lyddite, common, forged steel, weight of burster, 10 %.

Fuzes.—Base percussion medium.
For lyddite common - Direct action, impact.

Cases for Charges.—4·7 outfit box.

Cartridge Cases.—Canvas bag.

4-*inch Q.F. or Q.F.C.*

Nominal weight of gun.—26 cwt.

Full Charge.—*Cordite,* 3 lbs. 9 oz. size 15. Igniter, 1¼ oz. R.F.G.² powder. *Blank,* 3 lbs. L.G. powder. Igniter, 8½ drams. R.F.G.²

Reduced Charge for 4-inch Q.F.C.—1½ lbs. cordite, size 5.

Note.—The 4-inch Q.F.C. is not now allowed to fire a full charge.

Primer.—*Electric,* primer, large.

Tubes.—*Electric,* V.S. "P." electric wireless, for use with cartridges fitted with adapters. *Percussion,* V.S. percussion.

Projectiles.—Approximate weight, 25 lbs.—

Pointed common, cast steel, weight of burster - 8 %
Practice, iron.
Lyddite common, forged steel, weight of burster 12·9 %.

Fuzes.—For pointed shell - Base percussion, medium.
For lyddite common - Direct action, impact.

Case for Charges.—4-inch outfit box.

Cartridge Case.—Canvas bag.

12-*pr. Q.F.,* 18 *cwt.*

Nominal weight of gun.—18 cwt.

Full Charge.—*Cordite,* M.D., 2 lbs. 12⅛ oz., size 11, primed with 10 drams F.G. powder.

Practice Charge.—1 lb. 11$\frac{1}{16}$ oz. Cordite M.D., size 8.

Blank Charge.—1$\frac{1}{2}$ lbs. L.G.

Adapter.—Mark IV. metal adapter.

Tubes.—*Electric*, V.S. wireless and V.S. percussion.

Projectiles.—Approximate weight, 12·5 lbs.—

Pointed common, cast steel, weight of burster, 9 °/₀
Practice, iron.

Fuze.—For pointed common shell. Base percussion medium.

Case for Charges.—12-pr., 18 cwt. outfit boxes for Service charges.
Half metal-lined case for blank and saluting charges.

Cartridge Case.—Canvas bag.

12-*pr. Q.F.*, 12 *cwt.*

Nominal weight of gun.—12 cwt.

Full Charge.—*Cordite*, 1 lb. 15 oz. size 15, primed with 1$\frac{1}{4}$ oz. R.F.G.^{2} powder, or 2 lbs. Cordite M.D., size 11, primed with 10 drams R.F.G.^{2} powder.

Blank Charge.—1$\frac{1}{2}$ lbs. L.G. powder.

Primer.—Electric, primer, large.

Tubes.—*Electric*, V.S. "P." electric wireless, for cartridges fitted with adapters. *Percussion.*—V.S. percussion.

Projectile.—Approximate weight, 12·5 lbs.—

Pointed common, cast steel, weight of burster 9$\frac{1}{2}$ °/₀
Practice, iron.

Fuze.—For pointed shell - Base percussion, medium, except shell ordered before 1/3/95, which has the Hotchkiss base percussion.

Cases for Charges.—12-pr., 12 cwt. outfit box for Service charges.
Half metal-lined case for blank and saluting charges.

Cartridge Case.—Canvas bag.

12-*pr. Q.F.*, 8 *cwt.*

Nominal weight of gun.—8 cwt.

Full Charge.—*Cordite*, 13$\frac{3}{4}$ oz. size 10, primed with 1$\frac{1}{4}$ oz. of R.F.G.^{2} powder. *Blank*, 1$\frac{1}{2}$ lbs. L.G. powder.

Primer or Tube.—*Electric*, primer, large.

Tubes.—Electric, V.S. "P." electric wireless, for use with cartridges fitted with adapters. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 12½ lbs.—

Pointed common, cast steel, weight of burster 9½ %.
Practice, iron.
Shrapnel.

Fuze.—For pointed shell - Base percussion, medium, except shell ordered before 1/3/95, which has the Hotchkiss base fuze.

For shrapnel - Time and percussion, No. 56 or 63.

Powder Case.—12-pr., 8 cwt. outfit box for Service charges. Half metal-lined case for blank and saluting charges.

Cartridge Case.—Canvas bag.

Q.F. 6-pr. and 3-pr.

Detail.	6-pr.	3-pr.
Nominal weight of gun - -	8 cwt.	5 cwt.
Full charge, Cordite, size 5 -	7¾ oz.	6⅜ oz.
Blank charge, L.G. Powder -	15 oz.	Mark IV., 11 oz.
Projectile Steel shell } Approximate weight	6 lbs.	3¼ lbs.
Weight of burster - -	4⅛ %	3⅝ %

Fuze.—Hotchkiss base percussion.

Box.—Ammunition box.

Q.F. 3-pr., Vickers.

Nominal weight of gun.—6 cwt.

Full Charge.—13$\frac{6}{16}$ oz. M.D. cordite size 8.

Reduced Charge.—6$\frac{4}{16}$ oz. „ „ „ 4¼.

Projectile.—3⅓ lbs.

Weight of Burster.—

Fuze.—Hotchkiss base percussion.

Box.—Ammunition box.

S.—1429. (Revised—July 1904.)

REPORT
OF
INSPECTION OF CORDITE ON BOARD
H.M.S. _____

This return is to be forwarded, in duplicate, to the N.O.O. when Cordite is landed from H.M. Ships for inspection, as laid down on page 358 of the Gunnery Manual, Vol. I., and amended by Circular Letter G. $\frac{9371}{1901}$, dated 1st January 1902.

The columns 1 to 16 and 21 are to be filled in on board the ship.

Columns 5 to 11 are to contain complete information with regard to *all* cordite cartridges (except S.A. and G.M.) on board the ship.

After inspection the remaining columns will be filled in by the Inspecting Officer, and one copy of the form will be returned to the Commanding Officer of the ship for transmission, through the Commander-in-Chief, to the Admiralty. The other copy is to be retained by the N.O.O. for future reference.

Passed—	Date.	Initials.	Remarks and Recommendations, if any, by Departments concerned in Manufacture, Supply, or Inspection.
D.N.O. to D. of A. -			
D. of A. to C.I.W. -			
C.I.W. to W.D. Chemist			
W.D. Chemist to S.O.S.			
S.O.S. to C.I.W. - -			

Further Papers, if any subsequent action is taken _____

G. 1320/02.
G. 9702/04.

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