FOR OFFICIAL USE.

HANDBOOK

ON

AMMUNITION.

1909.

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BY AUTHORITY OF THE LORDS COMMISSIONERS OF THE ADMIRALTY.

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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.

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

Saltpetre	75 parts.
Charcoal	15 ,,
Sulphur	10 ,,
	100

For sulphurless powder :—

Saltpetre	70 parts.
Charcoal (alder and willow)	30 ,,
	100

In addition, from 0·8 to 2·4 per cent. of water is a recognised ingredient in powder.

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.

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.

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.

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

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.—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.—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 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.

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

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 is the best shape for the grains.

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.

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.

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

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" powders are tested by measurement.
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) *Proportion and Purity of Ingredients.*—These are determined by analysis in the Chemical Department at Woolwich.

Precautions to be observed in Storing, &c.—Keeping powder in a damp atmosphere will tend to separate the ingredients by wetting a portion of the saltpetre, which, on a change of atmospheric conditions, may effloresce, *i.e.*, be carried to the surface of the grains.

Powder should not be allowed to remain in direct contact with metal, as if there is the least damp present, the powder will corrode the metal, thus damaging both.

Powder can be exploded by a blow or by friction, especially when a thin film of powder dust is nipped between hard surfaces, or if it receives a glancing blow even between wooden surfaces.

Powder ignites at a temperature between 550° F. and 600° F.

Powder is not stowed in magazines with cordite, as the sulphur in the powder accelerates the decomposition of the cordite, and, due to this, sulphurless powder is now used for all primers and igniters of cordite charges.

Classes of Powders and their Use.

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 manfacture ; the sieves being distinguished according to the number of sub-divisions in a linear inch ; thus, an eight-mesh sieve would have 64 holes in a square inch.

Cubical, or Cut Powders.—The grains are approximately cubical in form with rounded edges.

Blank Powders are used for saluting and exercise, and may either be powders reduced in class from "Service," specially manufactured as "Blank," or "converted," that is, remade entirely from various black powders.

Shell Powders are manufactured as such, converted or reduced (being unsuitable for "Blank" or "Service").

Pebble Mixture.—Consists of shell P. and shell F.G. It is used for filling all common shell, except 3 and 6-pr. Q.F.

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

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

Shell Q.F., F.G. converted is used for the bursters of 3-pr. Q.F. shells.

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

The following table shows the various descriptions of gunpowder and where used :—

Description of Powder.	Symbol.	Where used.
Grained	L.G. (Large grain).	Bursters for capped A.P. shell, and blank charges.
	F.G. (Fine grain).	Bursters for common shell (in conjunction with pebble) and 12-pr. shrapnel.
	R.F.G.[2] (Rifle fine grain).	Bursters for shrapnel, Very's cartridges, 1-inch electric aiming, 7 dram primers and may be found in igniters for cordite charges—until replaced by S.F.G.[2]
	S.F.G.[2] (Sulphurless fine grain).	Igniters for all cordite charges.
	Q.F. 1. (Quick firing).	May be used for bursters of common shell, 6-inch to 12-pr., in place of pebble.
	M.G. 1. (Machine gun).	Primers for shrapnel shell.
Pebble	P. (Pebble).	Bursters for common shell (except 3 and 6-pr. Q.F.).
	Special F.G.	Bursters for common shell, 3-pr. and 6-pr. Q.F.

Classification of Powder.

Class I.—Service.
" II.—Blank.
" III.—Shell powders.
" IV.—Doubtful powders.
" V.—Condemned for Service, but available for sale.
" VI.—Condemned for Service, used for the extraction of saltpetre.

Makers Initials

W. A. Waltham Abbey
B. Chilworth Gunpowder Coy.
K. Kynochs
C. Cottonpowder Coy.
N. National Explosive Coy.
D. Nobles
E. Ness
S. British
A. Curtis & Harvey
G. Greenwood & Batley

Mark I Cordite now known as C.
M.D. " " " " M.C
M.D.T. " " " " M.C.T
M.D.S " " " " M.C.S

CHAPTER II.

CORDITE.

The smokeless explosive used as a propellant in the Service is known by the name of "Cordite," owing to the cord-like form it finally assumes in manufacture.

Cordite is a mixture of nitro-glycerine, gun-cotton, and vaseline.

There are two varieties:—Mark I., and Modified Cordite (M.D.).

In Mark I. Cordite the proportions are:—

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

For M.D. Cordite:—

Nitro-glycerine	30 parts.
Gun-cotton	65 „
Vaseline	5 „

These ingredients are incorporated together and gelatinised by the aid of acetone, which is a solvent.

Owing to the large percentage of nitro-glycerine in Mark I. cordite, a very high temperature occurs on explosion, and, consequently, the effect of erosion is very great. This difficulty has been overcome, to a large extent, by using M.D. cordite, which has practically only half the percentage of nitro-glycerine that Mark I. cordite has.

Cordite M.D. is more difficult to ignite, and is harder and more brittle than Mark I. cordite. It is also somewhat darker in colour and smells slightly of acetone.

It gives the same ballistics as Mark I., with a slightly larger charge, and causes less erosion.

Nitro-glycerine is obtained by the action of a mixture of nitric and sulphuric acids on pure glycerine.

When pure, nitro-glycerine is a colourless, oily liquid, but it generally has a slight yellow tint. It is very sensitive to percussion.

Exposure to bright sunlight causes a decomposition.

It can be ignited by a naked flame or an electric spark, but not easily or with certainty.

Gun-cotton is obtained by the action of nitric acid on the best white cotton waste, which is freed from grease by boiling with alkalies.

It is without smell or taste, is neutral to test papers, is very sensitive to percussion or friction, especially when warm, and may easily be detonated by either method.

When dry gun-cotton, unconfined, is ignited by a flame, or by a heated body, it burns rapidly with a bright yellow flame, and almost without smoke or residue.

The mean igniting point of dry gun-cotton may be taken at about 340° F.

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 is a colourless, volatile, aromatic liquid, is highly inflammable, and burns with a luminous flame. It is used as a solvent in the manufacture of cordite, and 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, or mineral jelly, is obtained at a particular stage in the distillation of petroleum. It gives cordite its stability, the life of cordite varying directly in proportion to the amount of vaseline in it; also, it acts as a deadener, *i.e.*, reduces the rate of combustion, facilitates the shaping; prevents brittleness, and counteracts metallic fouling.

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 nitroglycerine.
C.—Incorporating.
D.—Pressing and reeling, or cutting.
E.—Drying.
F.—Blending and packing.

A.—*Drying the 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 brass wire 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 in the stove is kept as nearly as possible at 104° F. The gun-cotton is dried down to about 0·5 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 wires and placed in india-rubber bags, in which it is conveyed to the weighing room.

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

In the gun-cotton weighing room, the gun-cotton is weighed out into india-rubber bags, 27¾ lbs. for Mark I. or 32 lbs. 2 ozs. for M.D. cordite, and sent over in these bags 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 measured off. The quantity of nitro-glycerine is 43½ lbs. for Mark I. cordite, and 15 lbs. 6 ozs. for M.D. cordite. This amount is poured on to the gun-cotton in the india-rubber bags. The contents of each bag are mixed and broken up by hand so as to make the gun-cotton absorb all 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.*

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.

Clarified jelly is used for small arm-ammunition cordite instead of the ordinary mineral jelly.

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

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.

Cordite varies in diameter, and is known by numbers representing, in hundredths of inches, the diameter of the orifice through which the cordite is pressed.

Thus, size "3" is cordite which has been pressed through an orifice of ·03 inches in diameter, and may also be taken to be approximately the diameter of the cordite.

The sizes of cordite at present in use vary from size 1 to size 50.

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 and internal diameter thus:—

$$50\text{—}17 = \begin{cases} \text{external diameter} = \cdot 5 \text{ inch.} \\ \text{internal diameter} = \cdot 17 \text{ inch.} \end{cases}$$

The object of tubular cordite is to obtain a more constant burning surface, and, therefore, a more uniform pressure of gas during the combustion of the charge.

E.—*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 110° F. The period of drying varies from 3⅓ days for size 3¾ to 36 days for size 45 M.D.

F.—*Blending.*

After drying, small-arm cordite is blended as follows:—10 single-strand reels are mounted on a frame and wound off simultaneously on to a larger reel. The winding is done by a small machine in which the single large reel is made to revolve and draw the strands from the 10 single-strand reels: a lever, through which the 10 strands pass, guides them from side to side of the larger reel as they are wound on it. The lever is worked by means of a pin and roller attached to it, which is pressed up against a revolving cam by a weighted rope passing over a pulley.

Six of the full 10-strand reels are next taken, mounted on a stand, and the 60 strands wound off on to a drum in the same way as the 10 single strands were wound on to the 10-strand reel. When the reeling is completed, the ends are all secured by a band of stout tape wound round the drum, and the drum is packed in a box or barrel for transport.

Larger natures of cordite, which have been cut into lengths, are blended as follows:—As the trays come from the stove, their contents are packed into boxes, each containing about 100 lbs. of cordite. These boxes are divided into batches, the number of boxes in a batch varying with the size of cordite, and the cordite in each batch of boxes is blended by taking a few sticks from each box of the batch and packing them into another set of boxes, filling one box at a time, until the whole of the original boxes have been emptied. A box of the blended material is then taken from each blend, and the contents of these boxes again blended, as above described, so as to form, when completed, a uniform lot.

Cordite for Small-Arm Blank and Webley Pistol Ammunition.

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 size 20 sliced.

Cordite for the Webley pistol ammunition, Mark II., is size 1.

All lots of cordite from each manufacturer have consecutive numbers, irrespective of size, and one or more initial letters to identify the manufacturer.

To identify cordite completely it is necessary to quote the initial letter and lot number, thus :—Lot W.A. 123.

In appearance cordite is somewhat like a cord of brown india-rubber, and its colour varies from light to dark brown ; it has little smell.

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

Cordite is very slow burning, the rate of burning varying with the size or diameter of the cords, a charge made up of large size cords burning more slowly than one made up of small cords.

Cordite is difficult to ignite, and an igniter of sulphurless powder is always used to ignite the charge.

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

It suffers if exposed to direct sunlight, but not when enclosed in either shalloon or silk cloth cartridges. It is therefore ordered that when being made up into cartridges it should not be so exposed.

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

Cordite is not affected in any way by damp or water. If wetted with fresh water a cordite charge, on emergency, can be fired at once, if the igniter will fire. Before returning a wetted charge to store, it should be thoroughly dried in a ventilated building. Cordite wetted with sea water should be well washed in fresh water and dried before repacking.

Cordite sometimes has the surface moist ; this condition is called sweating. This is due to the exudation of nitro-glycerine, which is liable to take place when the cordite has been subjected to temperatures below 45° F., and subsequently warmed. Below 45° F. the nitro-glycerine freezes, and crystallises out on the surface, and the melting of these crystals forms the sweating.

Sweating 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 is not to be handled till it recovers its normal state, which it will do if its temperature is kept above 45° F., by the re-absorption of the nitro-glycerine ; when this has taken place it is serviceable.

An oily appearance is also sometimes seen on cordite ; this is due to exudation of mineral jelly, and does not affect the cordite.

To distinguish the exudation of nitro-glycerine from that of mineral jelly, wipe a stick of the cordite with a strip of clean blotting paper, about ¼-inch in width, so that the stain from the exudation appears 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 of nitro-glycerine, the flame will travel faster, and become distinctly green on reaching the stain.

Cordite which has deteriorated may be more brittle, and is usually darker than new cordite, sometimes having a reddish-brown translucent appearance. It has a sour smell, sometimes etheral in character.

Cordite, after manufacture, is subjected to the following tests :—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.

The *mechanical* tests are :—

(1) *Inspection:* to see that the cordite is dry, homogeneous and free from air-holes; and in the case of size 20 sliced, 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.

Tests for Cordite.

Periodical.

Samples of cordite, excepting small arm, machine gun, and pistol cartridges, stowed in magazines of H.M. Ships, are to be landed, for examination, by the Inspecting Ordnance Officer, twice yearly about the 31st March and 30th September.

Form. S. 1424.

Special.

Samples of cordite *older than five years*, which have been at any time exposed in magazines to a temperature of or above 90° F. for 56 consecutive days or more, or *cordite of any age* which has been at any time exposed in magazines at a temperature of or above 100° F. for 28 consecutive days or more, are to

be landed on the first opportunity for examination by an Inspecting Ordnance Officer.

Selection of Samples.

Samples are to be selected from each magazine for each nature of B.L. or Q.F. gun carried—

(*a*) When the magazines are fitted with cases that are not taken out of the ships—a single cartridge.

(*b*) When magazines are not so fitted, one complete unopened package of cartridges.

The single cartridge or the complete unopened package of cartridges, as the case may be, is to be selected from the cartridges which have been longest in the magazine without examination, and of these the oldest is to be selected. Cartridges of the same cordite "lot" should not, however, be selected from different magazines, if this can be avoided. The age of any lot of cordite can be ascertained from the Gunnery Manual, Vol. I., Addenda.

If any part of a magazine proves to be materially hotter than the remainder of the magazine, a sample for test is occasionally to be taken therefrom, irrespective of age. Each box and package landed is to have securely tied to it a label marked "For examination and testing," with the following information entered on it:—

Name of ship.
Description of magazine.
Manufacturer's initials, and lot number of cordite.
Date of landing.
Whether "periodical" or "special."

The Report of Inspection of Cordite on board His Majesty's Ships (Form S. 1429) is to be forwarded, in triplicate, to the Naval Ordnance Officer with the cordite landed. It is to be duly filled in for the actual cartridges landed for inspection.

The Inspecting Officer, on receipt of the samples sent in, will take sticks of cordite from all portions of the cartridge for testing by the Abel heat test as follows:—

The sticks are cut into 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 from the mill. Sufficient cordite is to be ground to admit of a second test if necessary.

No delay should take place between grinding the cordite and carrying out the test. Aeration is to be avoided.

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 inch by ·8 inch, 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 discolouration 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 nook 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 $\frac{1}{4}$ 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.

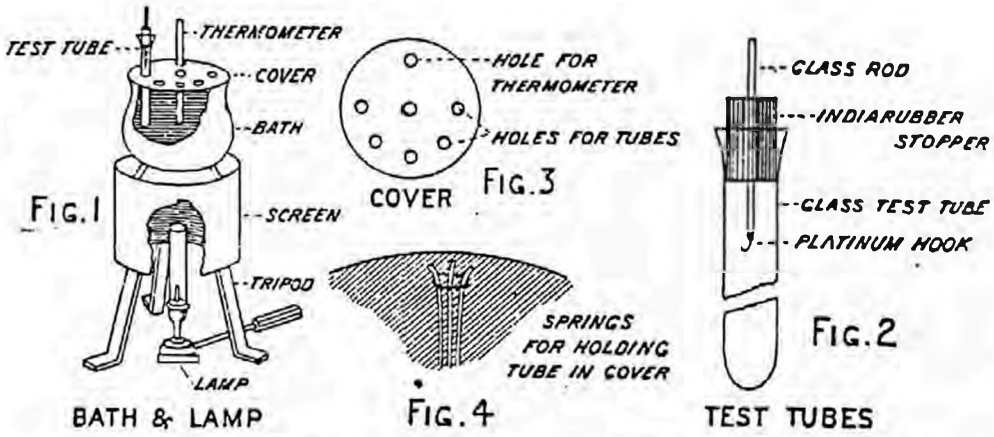
The test is completed when the faint brown line, which after a time makes its appearance at the margin between the wet and dry portions of the test paper, equals in depth of tint the brown line on the standard tint paper supplied.

Should the line make its appearance in four minutes or below it is sentenced "Unserviceable." Above four minutes and below eight minutes it is sentenced "Doubtful"; eight minutes and above it is sentenced "Serviceable."

The heat test is a very delicate one, and the presence of the slightest trace of acid from any extraneous source will render the test useless and misleading. The greatest care is therefore to be

taken that there is no trace 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 is to be avoided as much as possible.

No direct sunlight is to be allowed to reach the cordite before or during the test.



When a lot of cordite is sentenced locally as "Doubtful," owing to the heat test being 6 minutes or less, or "Unserviceable," the Senior Naval Officer present is to inform the Commander-in-Chief and the Admiralty, by telegraph, reporting the number and manufacturer's initials of the lot, and the number of minutes and seconds it stood the heat test, or the number of hours it stood the Silvered Vessel test. When the heat test is more than 6 minutes, but less than 8 minutes, the Admiralty is to be at once informed by letter. The orders to ships and depôts on the Station, on which cordite has been sentenced "Doubtful" or "Unserviceable" to take the action indicated in the table will be given by the Commander-in-Chief.

When any sample is sentenced "Unserviceable," further samples of other "lots" in the same magazine are to be selected for test. This process is to be continued until a "lot" is sentenced "Serviceable."

When a lot of cordite has been sentenced "Doubtful" owing to its having given a heat test of over four minutes but not over six minutes, or "Unserviceable," the Commander-in-Chief or Senior Naval Officer on other Stations will be informed by the Admiralty, and they are to take the action indicated in the table.

The Silvered Vessel test is abolished for all cordite except Cordite Mark I.

The following table indicates the procedure to be taken with a lot of cordite on the receipt of the results of a periodical or special heat test of a sample of that lot.

Duration of Heat Test.	Sample from Ship.	
	Same Ship.	Other Ships.
Eight minutes and above.	Nil.	Nil.
Below eight minutes and over six minutes.	Await result of Silvered Vessel test -	Nil.
Six minutes and over four minutes.	Pending result of Silvered Vessel test land as soon as possible. If no opportunity of landing within 30 days from receipt of result of heat test, the cordite is to be sunk in deep water. 6-pr. and 3-pr. ammunition to be retained on board, however, until opportunity of landing occurs. The result of the Silvered Vessel test will be communicated to the ship, and is to supersede the "Doubtful" sentence if the cordite has not already been disposed of or landed.	Land sample for testing at first opportunity.
Four minutes or below :—		
(*a*) If the Lot is over 12 years old.	Destroy.	Destroy.
(*b*) If the Lot is *not* over 12 years old. (*See* note.)	Destroy.	Land sample at first opportunity for testing by Silvered Vessel test.

Additional Test.

Every lot of Naval cordite is to be tested by Abel heat test and by Silvered Vessel as soon as possible after it becomes five years old, as follows :—

(*a*) from each Fleet or Squadron, one sample.
(*b*) from the stock at each Depôt, one sample.

These results, on examination, will give a good indication of the rate of gradual deterioration of each lot.

The age is to be reckoned from the dates in the printed lists of lots issued by the Inspection Department. Every quarter the Naval Ordnance Officer is to furnish the Commanders-in-Chief with a list of the lots of the several sizes of cordite in the Squadron which will reach the age of five years during the succeeding three months, and the Commander-in-Chief is to arrange for one cartridge or one package of cordite of each such lot represented in the Squadron to be landed for test. These tests are to be in addition to the periodical and Special Tests.

Silvered Vessel Test.—Cordite, which gives a heat test below eight minutes and above four minutes, is to be re-tested by the Silvered Vessel test at 80° C.

Mark I. Cordite which stands the Silvered Vessel test :—

(*a*) For 400 hours or more is to be sentenced "Serviceable."

(*b*) For 300 hours or more, but under 400 hours, is to be sentenced "Serviceable," but the cordite of which it is a sample is to be re-tested by the heat and Silvered Vessel tests after the lapse of two years.

(*c*) For 250 hours or more, but under 300 hours, is to be sentenced "Serviceable," but the cordite of which it is a sample is to be re-tested by the heat and Silvered Vessel tests after the lapse of one year.

(*d*) For 200 hours or more, but under 250 hours, is to be sentenced "Serviceable," but the cordite of which it is a sample is to be re-tested by the heat and Silvered Vessel tests after the lapse of six months.

(*e*) For less than 200 hours is to be sentenced "Unserviceable" and destroyed.

Should any cordite giving results as in (*b*), (*c*), or (*d*) be issued to a ship, the Naval Ordnance Officer will acquaint the Commanding Officer of the fact, and also of the date when a sample should be landed for testing. The Commanding Officer is to take steps to ensure that a cartridge or packet of the cordite is landed for testing at the prescribed period, if any should still remain in the ship.

Wherever facilities exist, the cordite in all cartridges except 6 and 3-pr. Q.F. taken for tests will, if serviceable, be replaced by the same weight of cordite of the same size from store, which has been tested at the Depôt within six months, and has given a heat test of over 12 minutes. No alteration will be made in the marking of cartridges so treated, except that the word "*Tested*," the date of re-making and the monogram of the station or depôt, will be placed on them.

The charges of 6-and 3-pr. Q.F. cartridges broken up for tests are to be destroyed locally. If the box can be completed from fractions in store, with cartridges of the same cordite lot, this is to be done, but if not, the box is either to be left incomplete, or, if the number of the cartridges left is small, it is to be filled with cartridges of odd lots, and issued as "first use" cordite.

All Q.F. cartridges in boxes that have been opened for the purpose of taking heat tests should be examined for cracks.

When it is necessary to destroy any cordite, if the ship is at a Depôt, the cordite is to be landed and destroyed under the direction of the Inspecting Officer, but if the ship is away from

a Depôt, or if for any reason it is impracticable to land the cordite, it is to be sunk in deep water.

The cordite in Q.F. cartridges, 12-pr. and above, is to be first removed from the brass cases; 6-pr. and 3-pr. Q.F. cartridges are to be thrown overboard complete.

Cordite is issued to H.M. Ships as follows:—

(*a*) Outfit cordite.
(*b*) "First use" cordite.

"First use" cordite differs only from outfit cordite in that it is approaching the age for condemnation and destruction. Its ballistic qualities are practically equal to those it possessed at the time of its acceptance into the Service.

Sufficient "first use" cordite for one year's practice and for calibration, if necessary, is to be carried by each ship. It will be supplied in lieu of an equivalent amount of outfit cordite, and is to be used for all practices and for calibration. It should also be used for battle purposes if required.

All returns of practices are to state whether "first use" cordite has been expended for the firings.

The cases containing "first use" cordite will have the letter "F" and the month and year of supply to the ship specially marked on the lid in large figures, thus:—F 6/08.

Packages containing "outfit" cordite supplied to torpedo craft are marked on the lid with the month and year of supply to the ship, thus:—6/08.

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 firing practices that the record of lot numbers is corrected.

When cordite ammunition (3-pr. and above) is supplied by one ship to another, or when it is returned into store, a list of the "lot" numbers of the cordite in the cartridges transferred or returned, showing when and where they were received, is to accompany it.

First use cordite not to be kept in Ship longer than 18 months

TEMPERATURES OF MAGAZINES CONTAINING CORDITE.

Every care is to be taken that the temperature of all magazines is kept as low as possible to prevent deterioration of the cordite.

An apparatus is now fitted in most ships for cooling the magazines, the temperature of which should not be allowed to rise above 70° F.

Temperatures are to be taken in the hottest parts of the magazines.

Self-recording thermometers (thermographs) are supplied to all magazines, except those for light Q.F. guns; care is to be taken that they are kept constantly working, and all records are to be carefully preserved in a separate guard book for each

magazine, in which book is also to be kept a copy of the Magazine Record for that magazine.

Form S. 1147*a* is to be forwarded half-yearly, on 31st March and 30th September, showing the records of temperatures of magazines where cooling arrangements are not installed. If temperatures exceed 90° F., ventilating fans are to be kept working, and, if necessary, hatches taken off and windsails used where practicable.

The following table gives the sizes which are in use for 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	10-inch B.L., Marks II. to IV., 9·2-inch B.L., Marks III., and V. to VII., 6-inch Q.F.
20	6-inch B.L., Marks VII. and VIII. 4·7-inch Q.F., Marks I. to IV.
15	4-inch Q.F., Marks I. to III. and 12-pr. 12 cwt. Q.F.
10	12-pr. 8 cwt. Q.F. and Practice charges 6-inch Q.F. for gunnery ships.
7½	Reduced charges for 4·7-inch Q.F. guns for gunnery ships.
5	Reduced charges for 4-inch Q.F. and full charges for Hotchkiss 6-pr. and 3-pr. Q.F.
3¾	·303-inch ammunition and for composite charges.
3	·45-inch machine gun ball.
1	Marks II. and III. Webley pistol ammunition.
20 sliced	Blank for ·303 rifle.

Modified Cordite.

Size.	Nature of Gun supplied to
45	12-inch B.L., Marks VIII., IX., X. and XI.
37	9·2-inch B.L. Marks X. and XI.
26	7·5-inch and 6-inch B.L. Marks VII. and XI., except 6-inch guns on twin mountings.
19	4-inch B.L. Mark VII.
16	10-inch B.L. Mark II. to IV. and 4-inch B.L. Mark VIII. 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 and reduced charges for 12-pr. 18 cwt. Q.F.
4¼	Full charge for 12-pr. 12 cwt. Hotchkiss, 6-pr. and 3-pr. Q.F. and reduced charges for 4-inch Q.F. and 3-pr. Vickers Q.F.

CHAPTER III.

Miscellaneous Explosives.

Picric Acid is a 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.

Picric acid can be readily detonated by fulminate of mercury. The mere contact of certain metallic salts or oxides with it, in the presence of heat, produces picrates, themselves powerful explosives, which are capable of acting as detonators to an indefinite amount of the acid, wet or dry.

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

It is poured into the shell where it solidifies.

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.

Fulminate of Mercury is produced by the action of alcohol upon a solution of mercury in nitric acid. In bulk, it is kept wet owing to its extreme sensitiveness in the dry state. It will explode when heated to 360° F. It is used in certain cap compositions.

CHAPTER IV.

Cartridges for B.L. Guns.

For safety, convenience, and rapidity in loading, the cordite for the 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:—

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

(2) It should be so close in texture that the explosive, even if slightly dusty, will not readily work its way through.

(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.

Silk Cloth is made of the refuse silk from the outside of cocoons. It was originally introduced on the score of safety for blank charges, as in firing these there is not so much heat and pressure as when shotted rounds are fired, and therefore less chance of the cartridge being entirely consumed.

The silk cloth is steeped in a cold solution of boracic acid, 5 oz. boracic acid to 1 gallon of water, and dried at a temperature not exceeding 120° F. This is to prevent a fungoid growth forming on the cartridge and consequent rotting, but it does not preserve the cloth from rotting from any other cause.

Silk cloth is divided into three classes:—

Class No. 1 is used for all cartridges for guns up to and including 6-inch.

Class No. 2 is used for all cartridges for 7·5-inch guns and upwards, except half charges for 12-inch and 13·5-inch.

Class No. 3 is used for half charges for 12-inch and 13·5-inch guns.

Cartridge bags, after being cut out, are marked with the following information in printer's ink:—

Numeral of the cartridge.
Initials of manufacturer of the bag.
Nomenclature of the gun.
Weight of the charge.
Nature of the cordite used.
Size of the cordite.
Nature of the charge.
Lot letter and number of the cordite.
Adjustment.
Monogram of station and date of filling. Also the letter "N" for Naval Service.

Paint must on no account be used for marking cartridges, as it holds fire.

After marking, the bag is sewn together with silk twist, which is treated with mineral jelly to prevent rotting.

Silk or shalloon braid, for beckets, is made in two sizes, 1 inch and 1½ inch wide. For hooping it is made in two sizes, ·35 inch and ·65 inch wide.

Shalloon is made entirely of "long" wool and is woven twilled. It is used for 7-dram primers, discs in fuzes, &c., blank charges for 3- and 6-pr. Q.F. guns, and for igniters for B.L. and Q.F. cartridges.

Cartridges, B.L. 12-inch to 7·5-inch, have a silk braid lifting becket stitched to the base, excepting the 12-inch 65 lbs. M.D., and the 7·5-inch Mark I. half and quarter charges.

All cartridges, B.L. 7·5-inch, and above, have fairleads of silk or shalloon braid secured to opposite sides, and one on the base, through which a length of 1-inch silk or shalloon braid is passed and tied on top, the lifting band thus passing completely round the cartridge.

Charges.

B.L. Guns.

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

Cordite charges for the 12-inch B.L. Marks IX., X. and XI. are made up in quarters; those for the 12-inch B.L. Mark VIII., 13·5-inch, 10-inch Marks II. to IV., 9·2-inch and 7·5-inch B.L., in halves and quarters. The charges for the 6-inch B.L. Mark VII. and VIII. are made up in halves laced together. The latest charge for the 6-inch Mark VII. and that for the 6-inch Mark XI. are made up in one-third and two-thirds laced together.

The practice charge for the 7·5-inch B.L. and above is a three-quarter charge, except for 13·5-inch, 10-inch Marks II. to IV. and 9·2-inch Marks III. to VII., where it is a half charge.

For 6-inch B.L., when made up in halves, one-half charge; when made up in one-third and two-thirds, a two-third charge; 4-inch B.L., a full charge.

The one-third charges, 6-inch B.L., which are detached, should be laced together, base to base, with a length of silk braid, to form a two-third charge.

The lacing should be finished off with a bow (so as to facilitate unlacing if necessary); two-third charges so made up will be primed at both ends.

For reeving the braid through the loops on the cartridges, the curved end of the handle of the key, metal, Mark IV., will be found suitable.

Owing to the slow burning properties of cordite, the great heat on ignition and the pressure in the bore being insufficient to cause radial expansion of the pad, cordite charges are unsuitable for blank firing and are not to be used for that purpose in any gun.

6-inch and 4-inch B.L. guns have charges of L.G. powder for use as "blank" only, the 6-inch having a 7-lb. charge and the 4-inch a 3-lb. charge contained in a silk cloth bag.

The bag is hooped, and choked at the mouth.

Whenever a powder charge is withdrawn from a B.L. gun, it is to be thrown overboard.

B.L. guns have cartridges supplied as below :—

Cordite, Mark I.

Nature of Gun.	Weight of Full Charge.	Size Cordite.	Weight of Igniter.	How made up.	Marks of Cartridges.	Shape.	Remarks.
			Oz.				
6-in. B.L. Marks VII. and VIII.	20 lb.	20	2	Halves	Mark I.	Cylindrical	For use with guns on twin mountings only.
9·2-in. B.L. Mark 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.	"	
9·2-in. B.L. Mark X.	99 lb. and 4 lb. of size 3¾.	44	8	"	Marks I., II.	"	
10-in. B.L. Marks II. to IV.	76 lb.	30	8	"	Marks I., II., III.	"	These charges when used up will be superseded by M.D. cordite.
12-in B.L. Mark VIII.	167 lb. 8 oz. or 166½ lb. and 7½ lb. of size 3¾.	50	8	"	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.	"	

Cordite M.D.

Nature of Gun.	Weight of Full Charge.	Size Cordite.	Weight of Igniter.	How made up.	Marks of Cartridges.	Shape.	Remarks.
	Lbs.		Ozs.				
4-in. B.L. Mark VII.	9·$\frac{1}{16}$	19	1	Full	I.	Cylindrical	Primed at each end.
" " " VIII.	5·$\frac{4}{16}$	16	1	"	"	"	
6-in. " " VII.	23	16	2	Halves	"	"	
" " " "	20	26	2	½ and ½	"	"	
" " " XI.	33	26	2	"	"	"	
7·5-in. " " I., II. or V.	61½	26	6	Halves and quarters.	"	"	
9·2-in. " " X.	120	37	8				
" " " XI.	130½	37	8	"	"	"	
10-in. " " II. to IV.	80	16	8	"	"	"	
12-in. " " VIII.	200	45	8	"	"	"	
" " " IX.	246	45	16	Quarters	"	"	"Duncan" class.
" " " "	254	45	16	"	"	"	E.E. VII. class.
" " " X. and X.*	260	45	16	"	"	"	
" " " XI.	307	45	16	"	"	"	

4-inch B.L. Mark VII. and VIII. (Plate I.).

The body of the empty cartridge is made of No. 1 silk cloth and is provided with hoops of ·35 inches silk or shalloon braid.

Each end of the cartridge consists of two rings of No. 1 silk cloth sewn to two discs of red shalloon, which are stitched across the centre to form four compartments.

The charge is built up of M.D. cordite and is cylindrical in shape, with an annular recess in each end to receive an igniter consisting of 1 oz. of S.F.G.$_2$ powder.

The charge for the 4-inch Mark VIII. is made up in a similar manner to that for the 4-inch Mark VII. (Plate I.), except that it is shorter and there are no broken sticks of cordite forming the core.

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

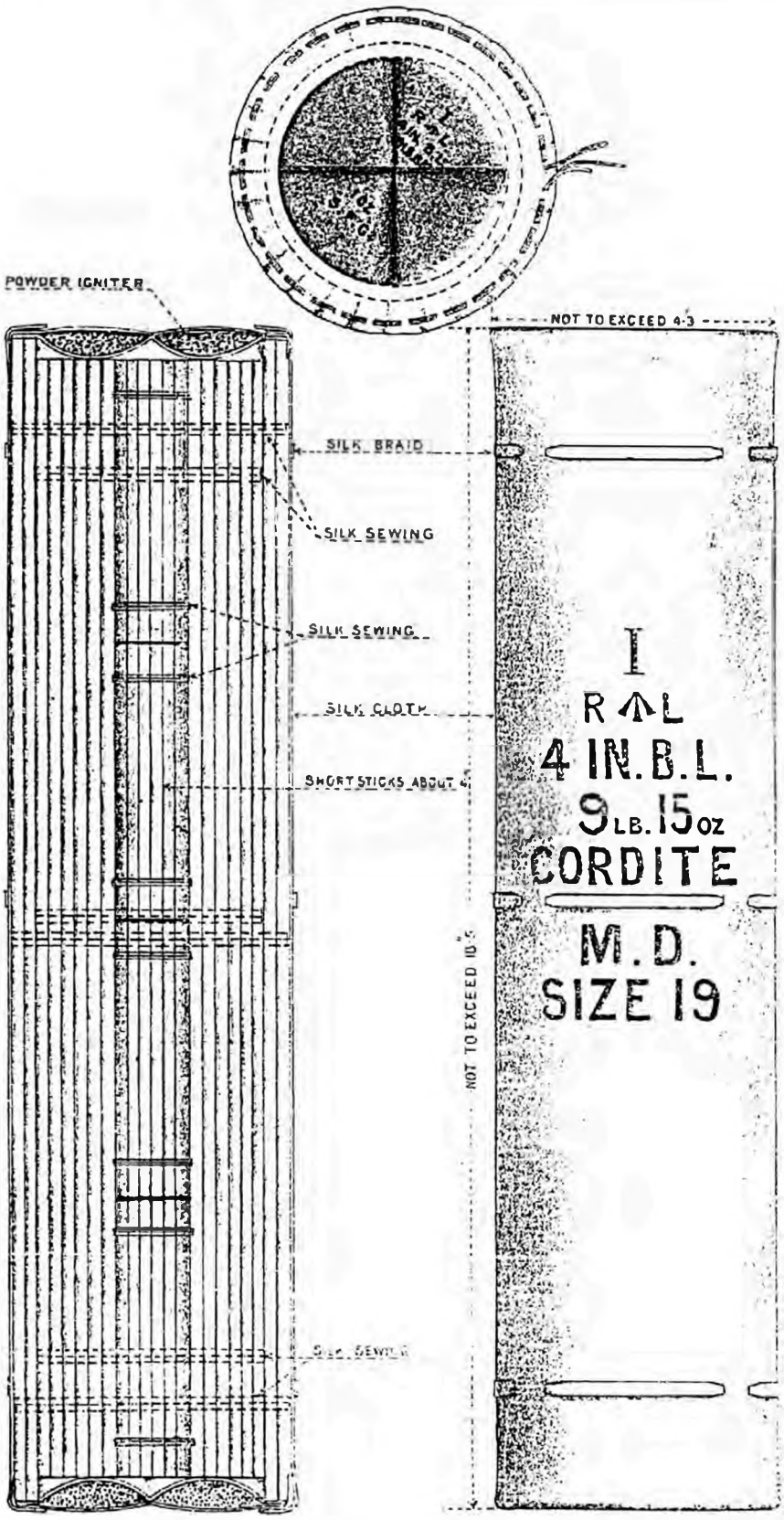
There are three descriptions of charges for these guns. They differ in their weight and the nature of the cordite used, the latest charges being of M.D. cordite.

The 20-lb. charge of size 20 cordite Mark I. is similar in construction to the 23-lb. charge of size 16 cordite M.D. (Plate II.), except that the outer layer of cordite is made up of short sticks.

This cartridge is used for guns mounted on the twin mountings of the "Monmouth" class, the width of the hoists

CARTRIDGE B.L. FOR 4 IN. Mk VII GUN FULL CHARGE.

SCALE ½.



of these mountings being insufficient to take the M.D. cordite charge.

The 23-lb. charge of size 16 cordite M.D. is made up in halves (Plate II.). The body of the cartridge is made of No. 1 silk cloth. The top consists of a layer of silk cloth, two layers of red shalloon and a ring of two thicknesses of silk cloth stitched together.

The layer of silk cloth and two layers of shalloon are stitched across the middle, making four compartments which carry an igniter of S.F.G.$_2$ powder. The silk cloth is next to the cordite.

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

The lower end of the body is strengthened by a band of silk cloth, 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 latest charge for the 6-inch B.L. Mark VII. is 29 lbs. of size 26 cordite M.D., made up in one-third and two-thirds, and is similar in construction to the charge for the Mark XI. gun (Plate III.).

With this charge projectiles having cupro-nickel driving bands must be used.

The charge for the 6-inch B.L. Mark XI. is 33 lbs. of size 26 cordite M.D., made up in one-third and two-thirds laced together (Plate III.).

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

The following description is typical for the latest charges for the heavy B.L. guns, 7·5 to 12-inch :—

The empty cartridges are made of No. 2 silk cloth with fairleads of silk or shalloon braid secured to opposite sides, and one on the base, through which a length of 1-inch braid is passed and tied in a bow on the top of the "tear-off" disc. It can then be used for lifting purposes, and is unrove before the charge is entered into the gun.

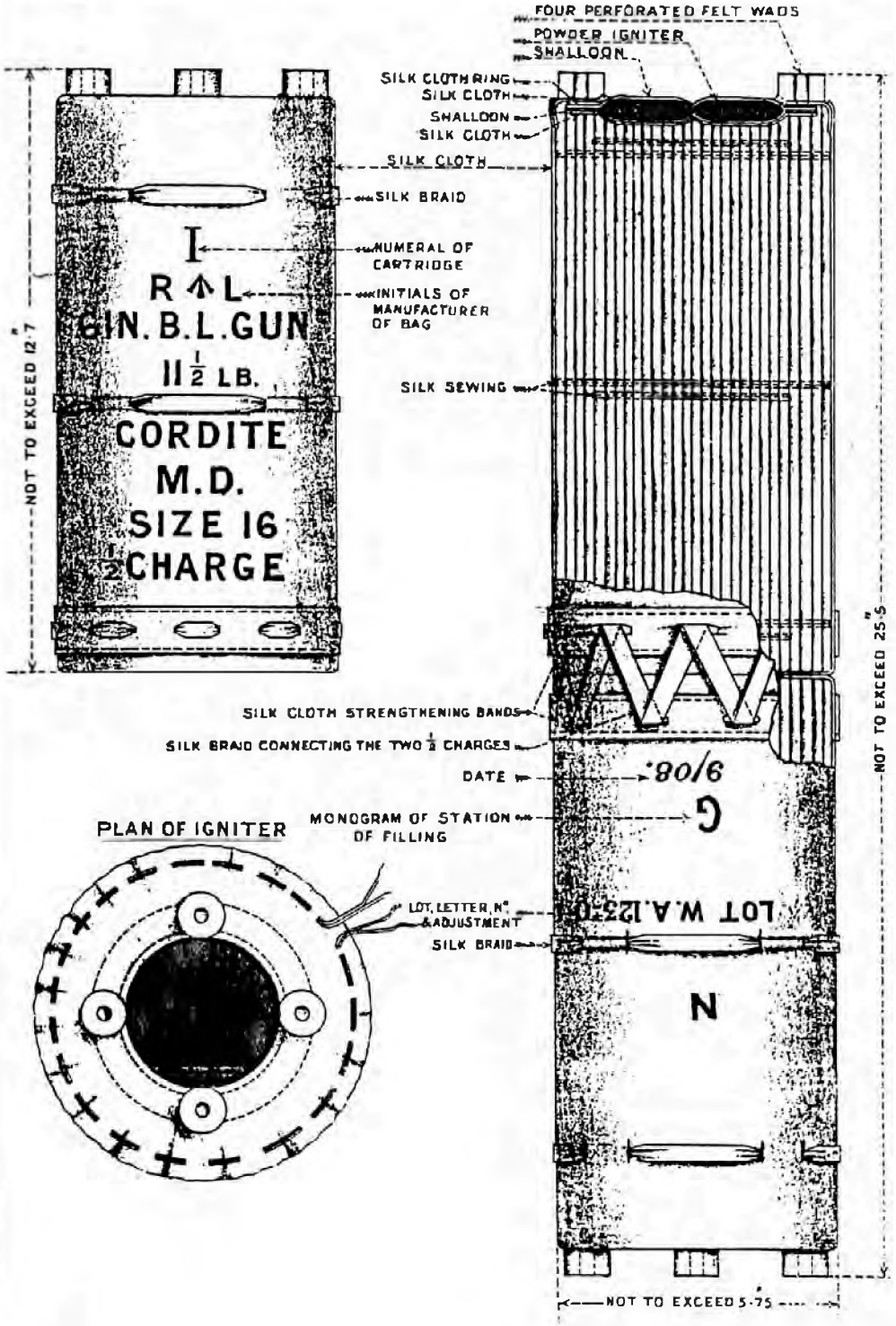
The charges are built up with M.D. cordite, and are cylindrical in shape, having an annular recess at the top to receive the igniter.

The top consists of one layer of silk cloth and two layers of red shalloon stitched together, the two layers of shalloon being stitched across the centre to form equal compartments which contain the igniter of sulphurless fine grain powder.

The reason for stitching the shalloon across the centre is to prevent all the powder of the igniter falling to the lowest part, thus leaving no powder in line with the vent.

CARTRIDGE B. L. 6" 23 LB. CORDITE M. D. SIZE 16 Mk I.

SCALE = $\frac{1}{4}$



The upper shalloon disc is of greater diameter than the cartridge, and the outer edge, being fitted with a draw-string, 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 igniter is to be completely filled, providing the increase in weight of powder to effect this does not exceed 10 per cent. of the Service weight shown in the tables on pages 26 and 27.

A mill-board disc, covered with silk cloth and marked with a red cross, is placed over the end of the cartridge to protect the igniter. It is secured to the cartridge bag by sewing in four places, and is to be torn off before firing.

The "tear-off" disc is removed from the cartridges as follows:—

When using the hydraulic loading position, in the Handing Room.

When using the hand loading position, in the Turret.

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

The igniter for the 7·5-inch B.L. and below is divided into four equal compartments. For the 9·2-inch B.L. and above it is in eight equal compartments.

Powder igniters of B.L. cartridges found damaged on board H.M. Ships are to be removed by cutting the stitching between the igniter and the silk cloth bag with a magazine knife (with phosphor bronze blade).

This operation is not to be carried out in the magazine, but in a clear space above the water line, and is to be superintended by an officer. Only one cartridge is to be dealt at a time, and no other explosives are to be present. Care is to be taken to prevent the powder escaping amongst the sticks of cordite.

Immediately upon removal the igniter is to be placed in a vessel of water and soaked, and is then to be thrown overboard. The cartridges are to be landed at the next opportunity at a Depôt for repair.

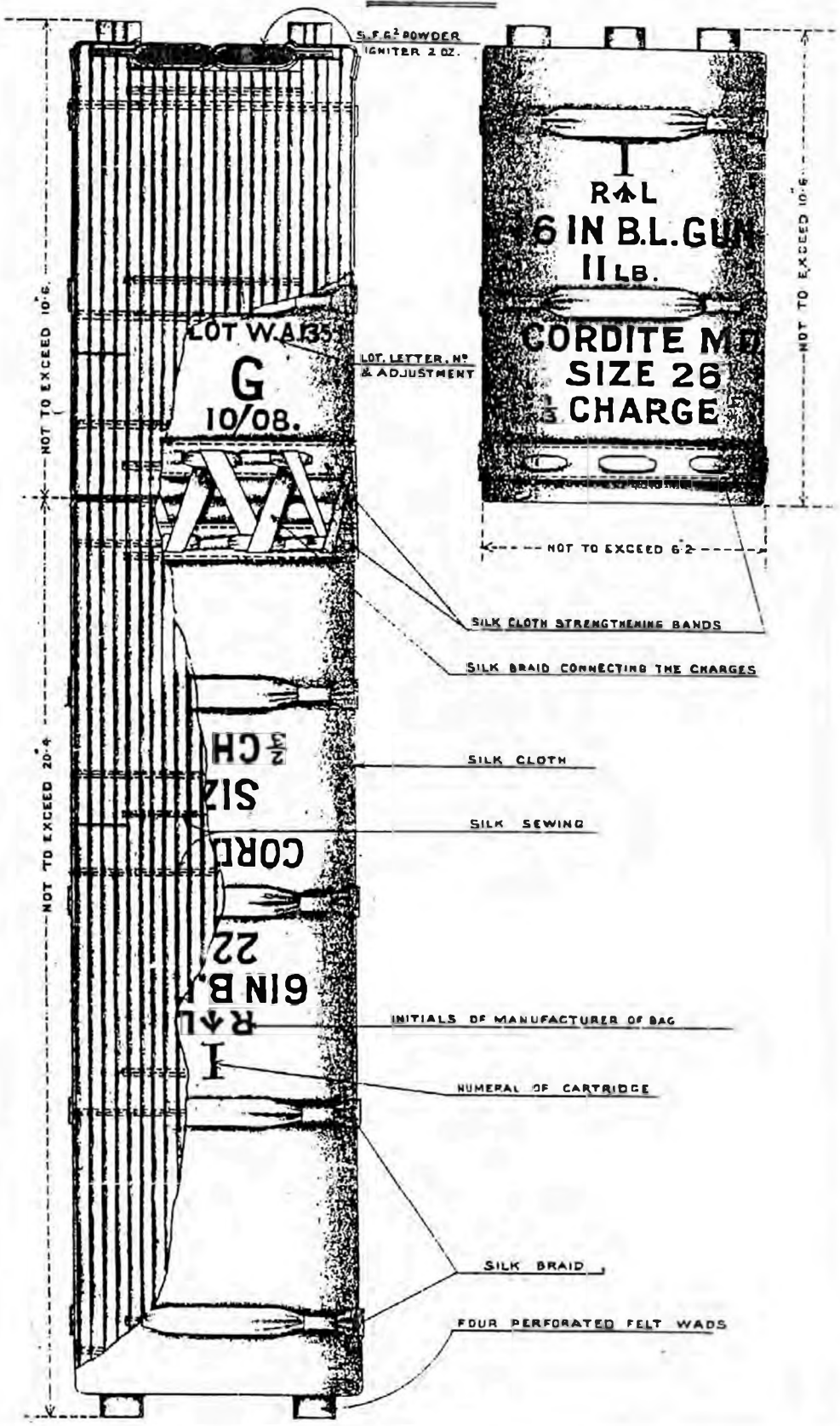
On no account should attempts be made to stitch or repair igniter bags.

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 is 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.

The charges continue to be designated by their nominal weight, and the amount of cordite (plus or minus) necessary for

CARTRIDGE B.L. 6" 33 LBS. CORDITE M.D. SIZE 26.
MARK I. FOR MK XI. GUNS.

Scale = 1/4



the adjustment will appear on the cartridge opposite the lot number of the cordite.

Plate IV. shows a section of the half charge for the 9·2-inch B.L. Mark XI.; the half charge for the Mark X. gun being made up in a similar manner.

Plate V. shows a section of the quarter charge for the 12-inch B.L. Mark X. and X*. The quarter charges for the Mark IX. guns being made up similarly.

A Composite Charge is a charge made up of two sizes of cordite, the smaller size used being size $3\frac{3}{4}$ in strands, which is wound spirally round the core, formed by the larger size cordite, from one end to the other. The remainder of the charge which is of the larger size cordite is placed outside it and secured with silk twist. 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 not increased.

This method was adopted in making up the latest "Mark I." Cordite cartridges for the 13·5-inch, 12-inch Marks VIII. and IX., and 9·2-inch Mark X.

NOTE.—When composite charges are landed for test, the $3\frac{3}{4}$ size cordite is tested as well as the larger size.

No more composite charges are being manufactured, and when existing stocks are used up, M.D. cordite charges will supersede them.

Whenever a cordite charge is withdrawn from a B.L. gun it is to be examined, and if free from fouling, is to be returned to the magazine.

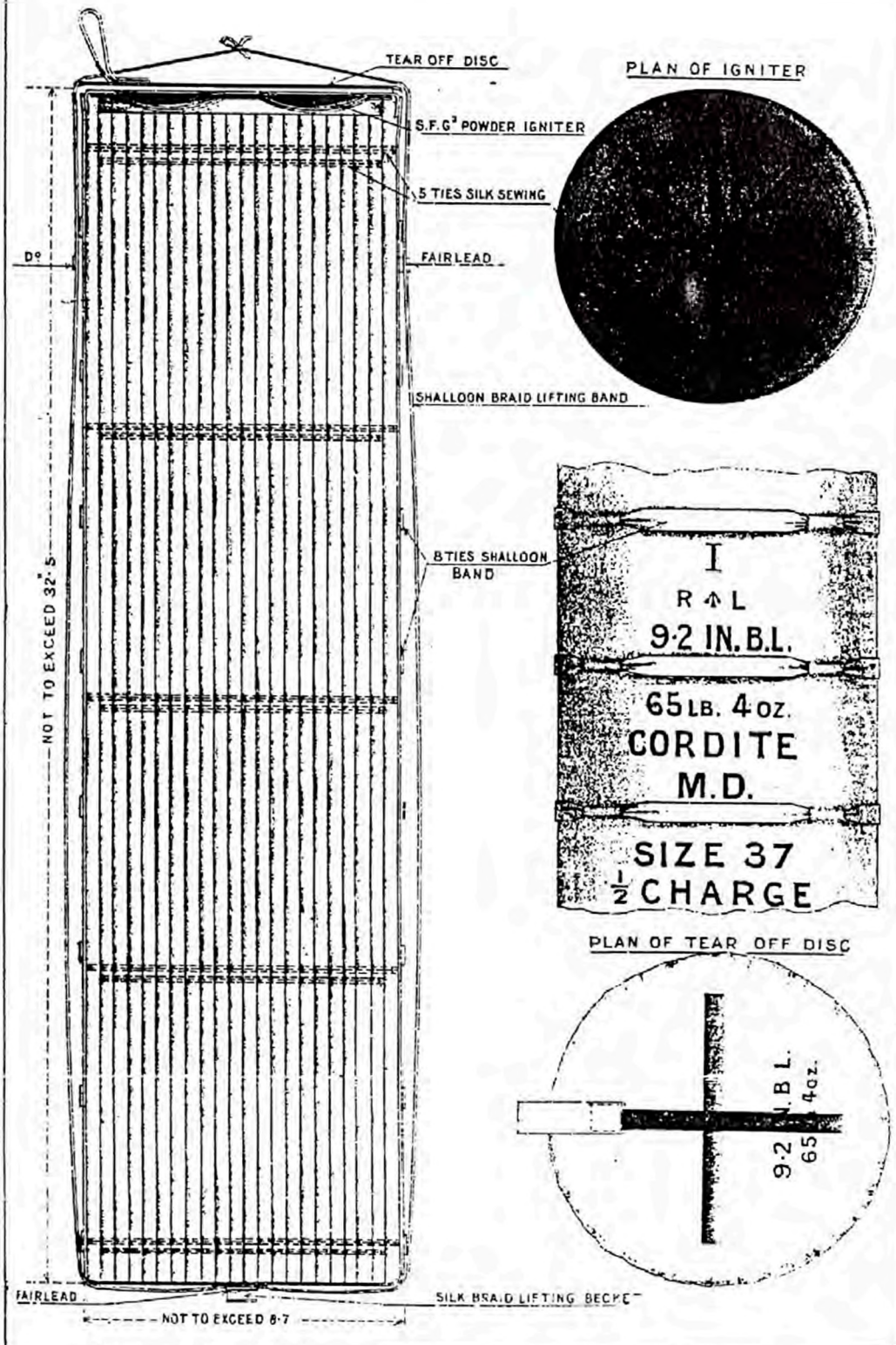
Drill Cartridges are made to the same shape, weight and dimensions as the service cartridges they represent. They consist of wooden cylinders, usually containing an iron core to give the necessary weight, and covered with raw hide.

The latest type of drill cartridges for 9·2-inch and below are made of rope covered with tanned canvas, and have a rope handle at one end.

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

CARTRIDGE 9·2 IN 65 LBS. 4 OZ CORDITE M.D. SIZE 37. ½ CHARGE. FOR MK XI GUN.

SCALE = 1/5



CHAPTER V.

Cartridges for 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 and termed "case."

(*b*) Those which have the projectile secured at 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	13¼ lbs.	30	S.F.G. 2 1¼ ozs.	I. to VIII.	
"	5½ lbs.	10	"	III.	Reduced.
4·7-inch	5 7/16 lbs.	20	"	I. to VI.	
"	2 lb. 5¾ oz.	7½	"	II.	Reduced.
4-inch	3 9/16 lbs.	15	"	I. and II.	
"	1 lb. 10⅞ oz.	4¼ M.D.	"	I.	Reduced.
12-pr. 18 cwt.	2 lbs. 12⅛ ozs.	11 M.D.	10 drs.	I. and II.	
" "	1 lb. 11 13/16 ozs.	8 M.D.	"	"	Reduced.
12-pr. 12 cwt.	2 lbs. 0 ozs.	11 M.D.	"	"	
" "	13⅞ ozs.	4¼ M.D.	"	I.	Reduced.
" "	1 lb. 15 ozs.	15	1¼ ozs.	I. to III.	
"	12½ ozs.	5	"	II. and III.	Reduced.
12-pr. 8 cwt.	13¾ ozs.	10	"	III.	
6-pr. Hotchkiss	8 ozs. 11½ drs.	4¼ M.D.	4 drs.	X.	
" "	7¾ ozs.	5	1½ drs. G.C.	VIII. and IX.	
3-pr. Hotchkiss	7½ ozs.	4¼ M.D.	4 drs.	IX.	
" "	6⅜ ozs.	5	1½ drs. G.C.	VII. and VIII.	
3-pr. Vickers	13 6/16 ozs.	8 M.D.	4 drs.	I.	
" "	6 13/16 ozs.	4¼ "	"	I. and II.	Reduced.

12-*pr. Q.F. and above.*—A *quick-firing* gun, as regards its ammunition, differs from a B.L. gun in having its charge contained in a metal case.

The cartridge consists of a brass cartridge case, adapter, igniter, charge, wad and lid.

The case is made of brass which is solid drawn. It has a projecting rim round the base to allow of extraction and a

central hole through the base is screw-threaded to receive the adapter. Round the mouth tongues are formed by which to secure the lid. The case is lacquered inside and out with the usual transparent lacquer.

All these cartridges can be fired either with electric or percussion tubes through the adapter (Plate VI.). The latest metal adapter is the Mark IV., which 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.

Electric primers were formerly used for firing these charges by electricity. The latest primer is the Mark V. (Plate VI.), which is being used up in gunnery ships and for saluting purposes.

The electric primer Mark V. consists of a body of manganese bronze threaded on the exterior to fit the hole in the cartridge case. The head is milled, and has two slots to receive the key, An ebonite cup is let into the head of the primer, and is filled with a disc of tin. The interior of the primer is coned, and into the cone is placed a brass cone, which is insulated from the body with oiled silk. A piece of copper wire, insulated, connects the cone to the tin disc. On the upper part of the cone is soldered a crown metal spindle, which is connected to a crown metal pin in the body by an iridio-platinum bridge, a tuft of gun-cotton is placed between them. The body is filled with priming composition, and the end closed with a glazeboard disc.

All marks of 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.

Adapters can only be used once.

The igniter Mark IV. consists of a cylindrical shalloon bag, containing $1\frac{1}{4}$ ozs. of S.F.G.$_2$ powder, the mouth of which is choked with silk sewing. It is secured in the end of a cylinder of Mark I. cordite, which forms part of the calculated weight of the charge, with its choked end away from the adapter.

The cordite cylinder is secured in the rear end of the charge, with its open end over the end of the adapter.

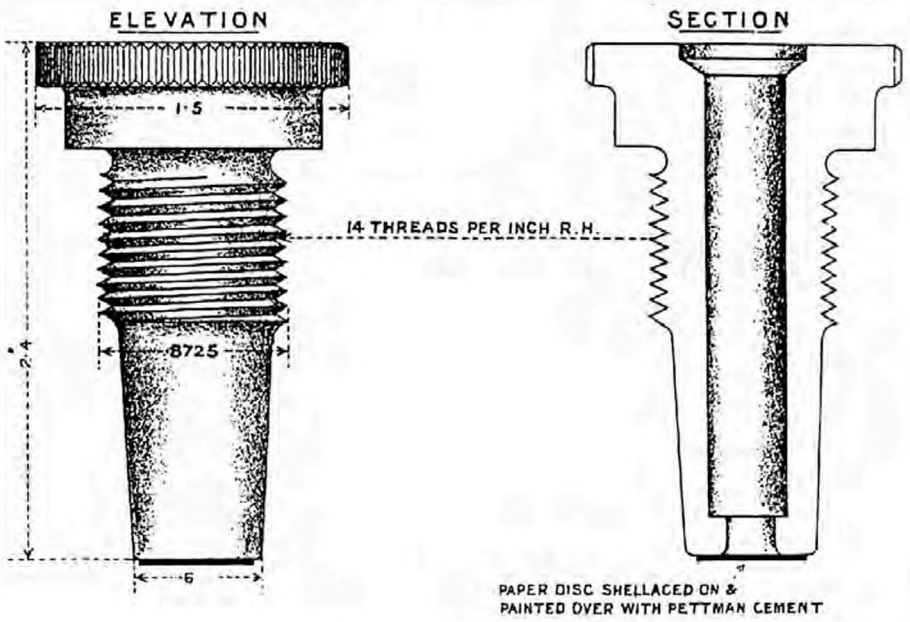
The Mark III. igniter differs from the Mark IV. only in the method of securing the mouth of the shalloon bag, the Mark III. being closed with a disc of shalloon sewn all round the top.

The igniter for the M.D. cordite charges of the 12-pr., 12 and 18 cwt., contains only 10 drams of powder and is secured in a shorter cordite cylinder. There are two marks of this igniter, the Mark II., which is the latest, differing from the Mark I., in a similar manner as the Mark IV. $1\frac{1}{4}$ ozs. igniter differs from the Mark III.

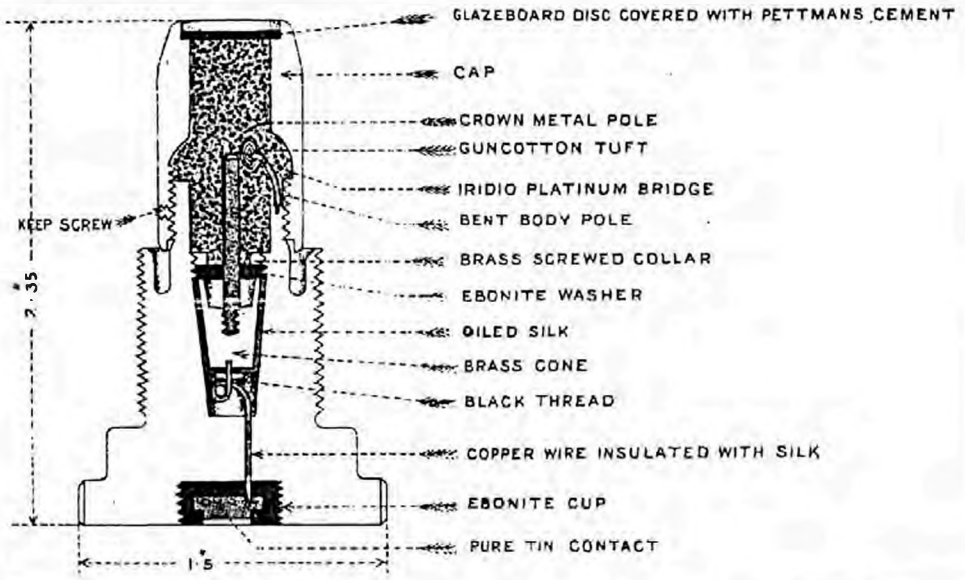
ADAPTER FOR CARTRIDGE Q.F. & PRIMER ELECTRIC MARK V.

FULL SIZE

ADAPTER MARK IV ALUMINIUM BRONZE



PRIMER ELECTRIC MARK V.



2252
Weller & Graham Ltd Litho. London

The charge consists of two bundles of cordite of full length. The cordite cylinder and Mark IV. igniter is secured in the base of the central bundle of cordite. The outer layer of cordite is formed round the central bundle, and secured with shalloon braid, the outer sticks of cordite being divided into equal bundles at the base to increase the diameter at that part of the charge.

The wad consists of a disc of felt, two rings of felt, and a disc of glazeboard. The felt disc is placed on the glazeboard disc, the two rings of felt on the top of the felt disc, and the whole sewn together, thus making the wad thicker at the edge than in the centre.

The lid, which closes the mouth of the case, is made of two parts of white metal soldered together and concave in shape, between which is a disc of strawboard. The metal discs are weakened by circular and radial grooves to ensure it breaking up easily. For the 4·7-inch and below the strawboard disc has a central hole punched; this is necessary owing to the liability of the strawboard clogging up the holes in the protecting plate of the medium base percussion fuze. Around the rim, notches are made for securing it, and it has a small projecting flange by which it is supported on the top edge of the case.

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.

The numeral of the filled cartridge refers to the mode of filling, *not* to the empty case.

The charge is placed into the brass cartridge, a glazeboard and felt disc 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, to make a tight joint.

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

Cartridge, Q.F., 6-inch, Mark VIII., Plate VII.

This cartridge is made up exactly as described in the general description of Q.F. cartridges. The ends of the braid, secured to the choke of the igniter, are led up through the sticks of cordite to the top of the charge, then passed through holes in the wad and disc, and firmly tied on top of the wad by a reef knot. The outer layer of cordite sticks at the base are divided into eight bundles and tied with shalloon braid.

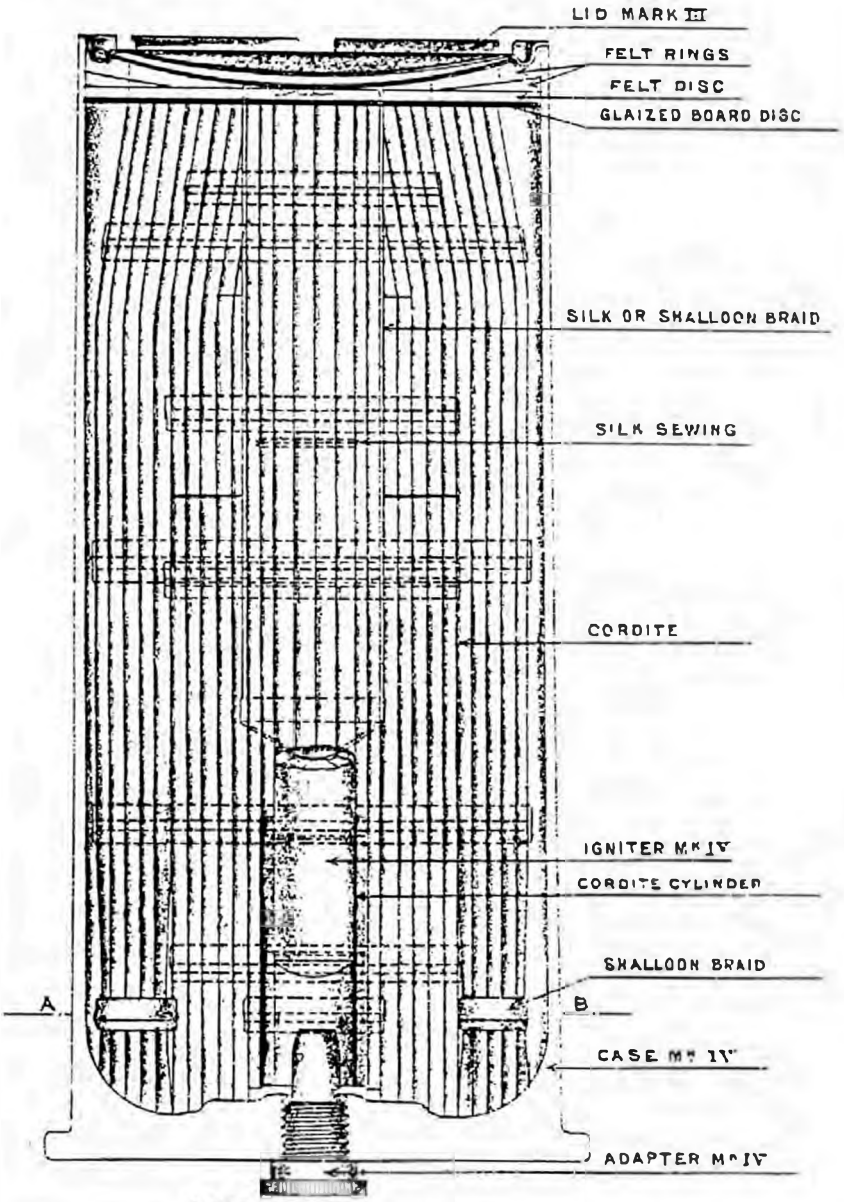
The cartridge case used is the Mark IV., which differs from the Mark III. in having six tongues at the mouth to suit the Mark III. lid, which is as described in the general description.

Cartridges with damaged Mark I. or II. lids, which consist of two white metalled discs soldered together, between which

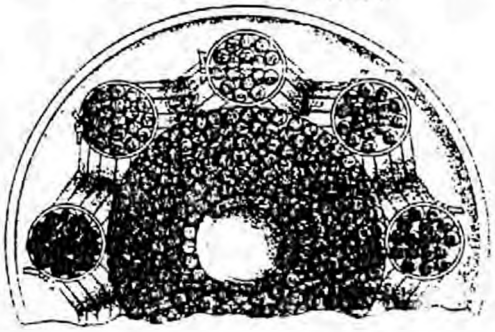
CARTRIDGES 6 INCH Q.F.

CHARGE CORDITE 13¼ LBS. SIZE 30.

MARK VIII.



SECTION AT A. B.



is placed a lubricant of beeswax and tallow in equal parts, will have the lid replaced by the Mark III. lid and wad, the cartridge being first emptied, and three additional tongues cut in the mouth. Cartridges so altered will have a star (*) added to the numeral of the empty case and also to the numeral of the filled cartridge.

The reduced charge Mark III., 5 lbs. 8 ozs. cordite, size 10, is made up in a similar way to the Mark VIII. full charge, differing only in the following particulars:—

The choke of the igniter is not secured to the felt wad on top of the charge, and the outer layer of cordite sticks at the base are divided into six bundles and tied with silk sewing. A perforated paper cylinder is used to fill up the space between the charge and the lid.

The latest cordite cartridges for the 4·7-inch, 4-inch, 12-pr., 18 cwt., 12 cwt., and 8 cwt. Q.F. guns, are all similar in construction to the 6-inch Q.F. Mark VIII. cartridge, but have no shalloon braid from the igniter passing up through the centre.

The 12-pr. 18 cwt. cartridge, owing to the length of the cartridge case, has a small perforated paper cylinder on the top of the charge to fill up the space (Plate VIII.).

The reduced charges are made up in a similar manner to the full charges, but have a long paper cylinder to fill up the space between the charge and the lid.

Drill cartridges for Q.F. guns are made of teak with metal bands at each end to fit the chamber. They are of the same dimensions and weight as the service cartridge.

The edge of the flange at the base, which is of gunmetal, is milled to identify it from the service cartridge when packed. It is weighted with lead. A steel tube passing through the cartridge allows of the testing of tubes.

The earlier marks of adapters which were made of hardened steel are being used up for use in these cartridges.

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

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

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 there is no tube in the adapter, and is to report the same to the Commanding Officer; this is to ensure that no percussion tubes find their way into the magazine.

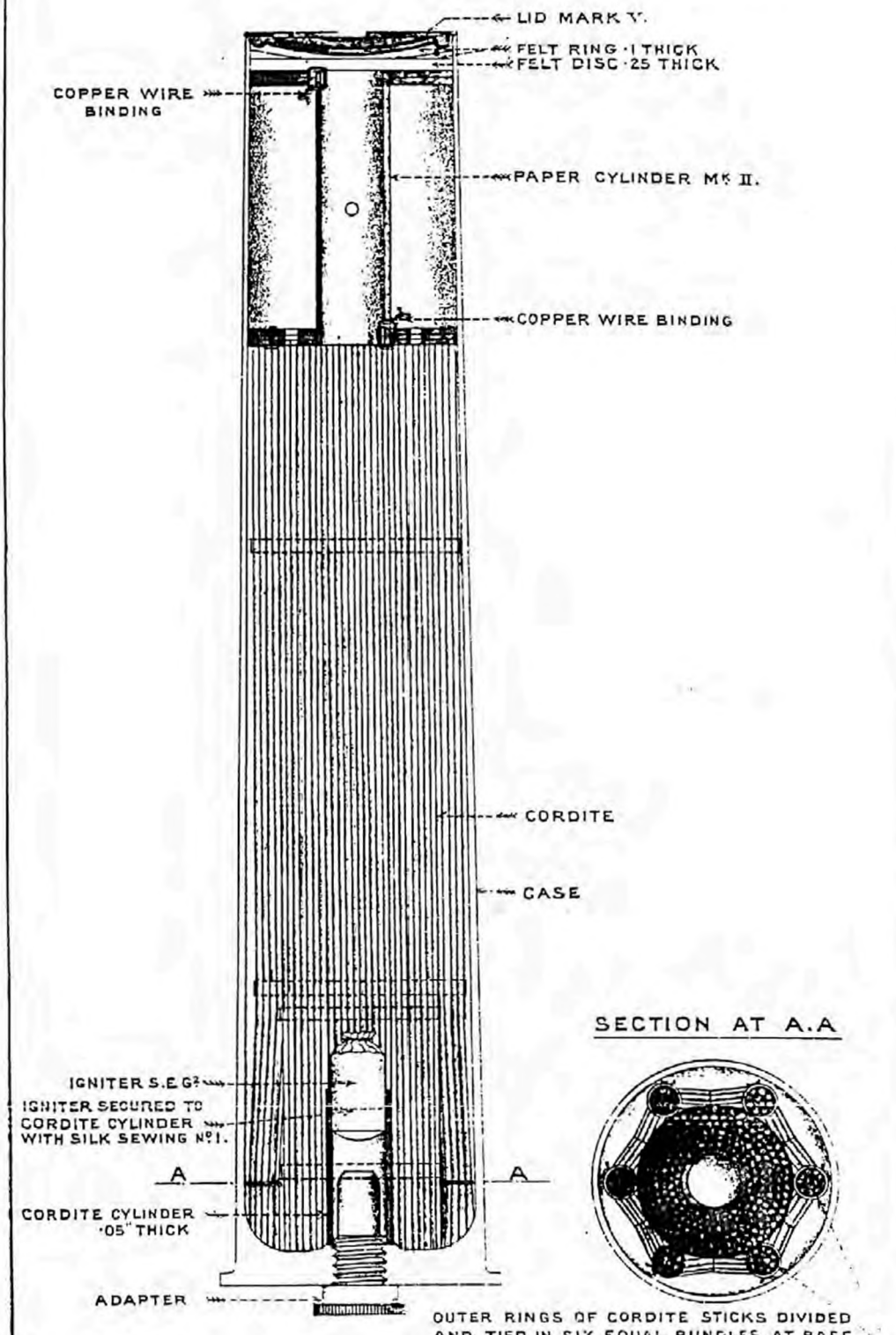
Before inserting an adapter or primer in a filled Q.F. cartridge, stand the cartridge upright on the small end.

Insert a finger in the hole in the base to ascertain that the cordite cylinder is in the correct position.

CARTRIDGE Q.F. 12 Pr 18 CWT. FILLED 2 LBS. 12 2/16 OZ.

CORDITE M.D. SIZE II.

SCALE = 1/3



Insert the adapter or primer, so that it enters the cordite cylinder and screw it well home. These precautions are to be strictly observed when re-inserting adapters or primers in cartridges from which they may have been removed for any reason.

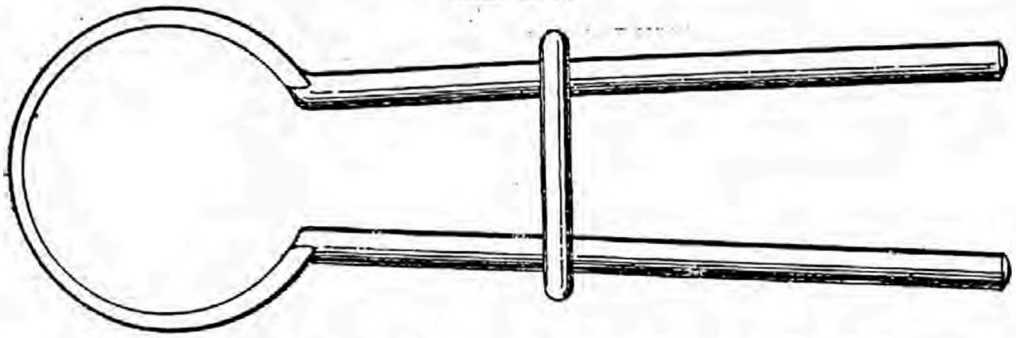
Keys, &c. for Use with Q.F. Cartridges.

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.

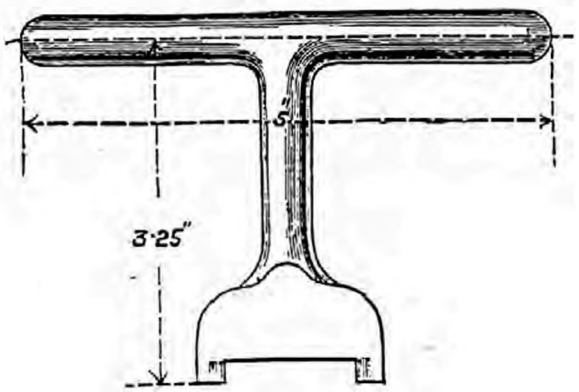
Scale = ¼.



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

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

Scale, ½.



The key removing adapter or primer is a powerful key for removing all adapters and electric primers either before or after firing. There are four marks, the Mark I. is shown in the woodcut, Fig. 1.

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).

Fig. 1.

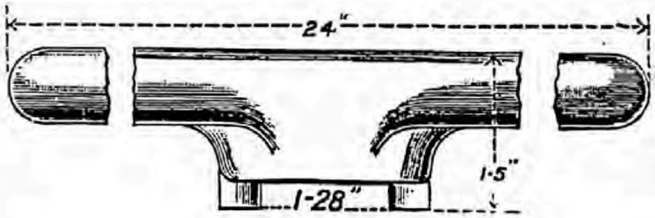


Fig. 2.

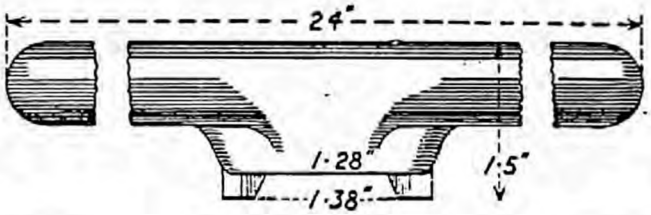


Fig. 3.

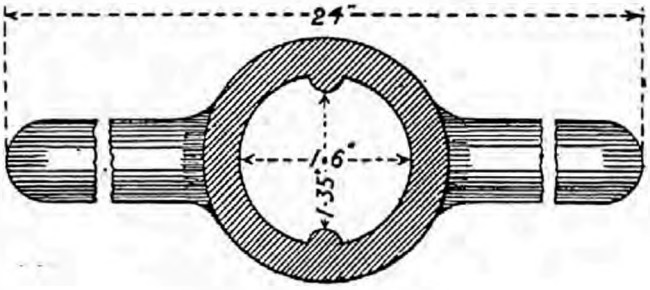
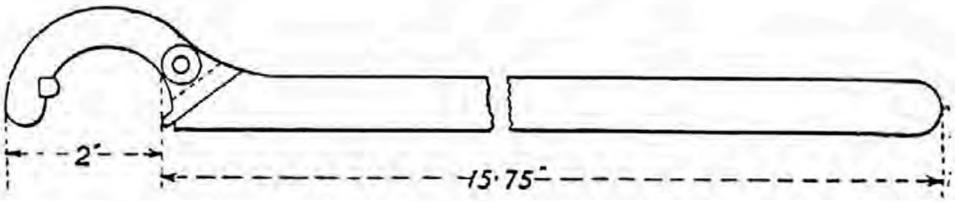


Fig. 4.



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.

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

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.

R or R denotes that the cartridge case has been emptied. The last filling mark being obliterated.

(A) • • denotes that the cartridge case has been re-annealed. The punch marks signifying the number of times this operation has been carried out.

Q.F. cartridges will not be re-formed after having been fired six times with cordite. After this they may be used for blank charges.

Q.F. cartridges, 12-pr. to 6-inch, which are condemned for service, but are utilised as dummies, are stamped on the base thus ● When so stamped they will on no account be used again as service cartridges.

6- AND 3-PR. Q.F.

For these guns the projectiles are attached to the case. Such ammunition is termed "fixed."

Cartridge, Q.F., 6-pr. Cordite, Steel Shell, Mark IX. (Plate IX.), consists of a brass case, percussion cap, igniter charge, paper cylinder, and fuzed shell. The case Mark III. is made of solid-drawn brass, and has a projecting rim to allow of extraction. A cap chamber is formed in the centre of the base to take the percussion cap. The case is lacquered inside and out with the usual transparent lacquer.

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.)

The percussion cap is protected by a clip. The latest pattern of these clips is the Mark III., which are made of brass with three arms and a central dome. The arms at the end are bent, and clip on to the projecting base of the cartridge. The dome protects the cap from any accidental blow.

The charge is made up of $7\frac{3}{4}$ ozs. of cordite size 5 in a bundle, doubled and tied in three places with silk sewing No. 1. The paper cylinder, inserted between the shell and the charge, keeps the charge in place.

The igniter, Mark V., consists of two discs of shalloon sewn together, containing 4 drams of sulphurless powder. The igniter is secured to the charge by silk sewing No. 1.

The shell, Mark V., is made of forged steel, pointed, the head being struck with a radius of nearly three calibres. It is rotated by means of a driving band, which is pressed into an undercut groove, some distance from the base, so as to allow the shell to be held in the case. Near the base is a cannelure for the purpose of securing it to the case, and below this the diameter is slightly reduced to facilitate insertion into the mouth of the case.

The interior of the shell is bored out to take a bursting charge, leaving a considerable thickness of metal in the head. The shell is oil-hardened, and the interior is lacquered and filled with 4 ozs. of special F.G. powder.

The base has a central hole, threaded with a left-handed screw thread to take the Hotchkiss base percussion fuze.

The body of the shell below the driving band is varnished and the shell is pressed into the mouth of the case, until the edge of the case bears against the driving band. It is then secured by three indents which force the brass into the cannelure round the base of the shell.

The shell is painted black, except the driving band, which is left unpainted. A white ring, denoting steel, is painted round the head, and below it a red ring, showing that the shell is filled. The numeral and manufacturer's initials are stamped on the body above the driving band.

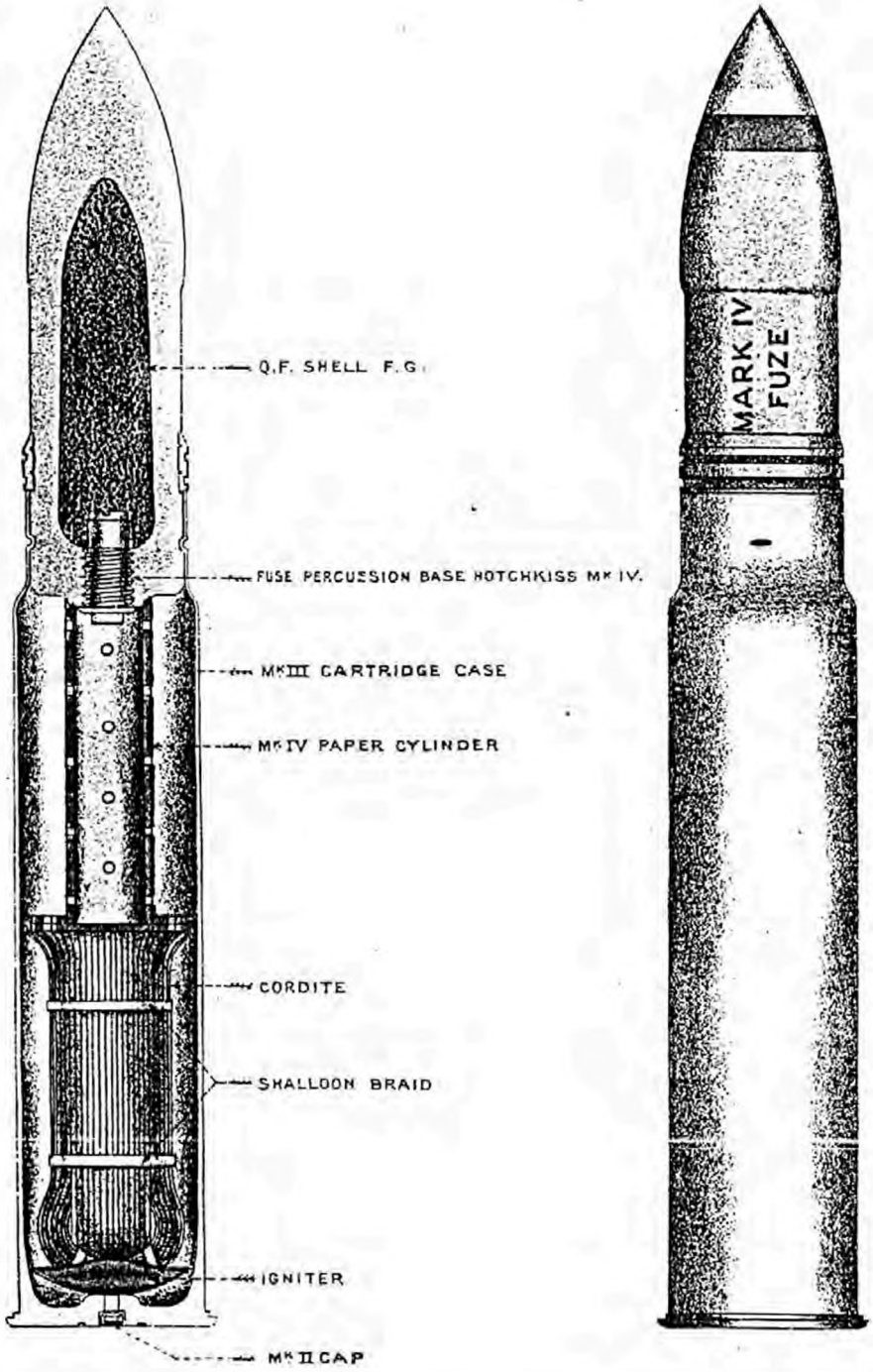
Stencilled in red on the body of the shell is the word FUZE, and the mark of the fuze, also the letter N.

On the base of the cartridge, stencilled in red, is the nature of the cordite, lot letter, and number, the monogram of the station and date of filling, and the mark of the complete cartridge. Stamped on the base is the mark of the empty cartridge case, the manufacturer's initials, the letter C, denoting cordite, followed by the letter F, denoting the number of times the cartridge has been filled with a full charge, also the

CARTRIDGE Q.F. 6 PR MARK IX.

CORDITE 7¾ OZ SIZE 5.

SCALE - ⅓.



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annealing mark (A), followed by punch marks denoting the number of times the cartridge case has been re-annealed.

Fuze, Percussion, Base, Hotchkiss, Mark IV. (Plate X.) consists of a body, percussion pellet, spiral spring, screwed cap, screw plug, and detonator.

The body is made of gunmetal, screwed externally with a left-handed screw-thread, the base is flanged to form a gas-check, and there is a projection to take the key by which it is screwed into the shell.

The body is bored out from the front to take the percussion pellet, the interior at the top screwed to receive the screwed cap, an undercut recess being formed in the bottom of the percussion chamber.

The percussion pellet consists of a brass casing, filled with an alloy (12 parts lead, 1 part tin), into which a roughened needle holder of hard brass wire, carrying a steel needle at its front end, is embedded.

The brass casing is reduced in diameter on the exterior at the front end.

The needle holder has an enlarged base and rests in the undercut recess and supports the pellet; the latter projects beyond the point of the needle and prevents it reaching the detonator.

The brass spiral spring fits round the smaller part of the brass casing and prevents rebound of the pellet.

The screwed cap is threaded left-handed and closes the front end of the fuze, the rear portion is bored out to take the screw-plug, and through the centre of the front end a fire-hole is bored to allow the flash from the detonator to pass out.

The screw-plug contains the detonator, which screws into the rear of the screwed cap.

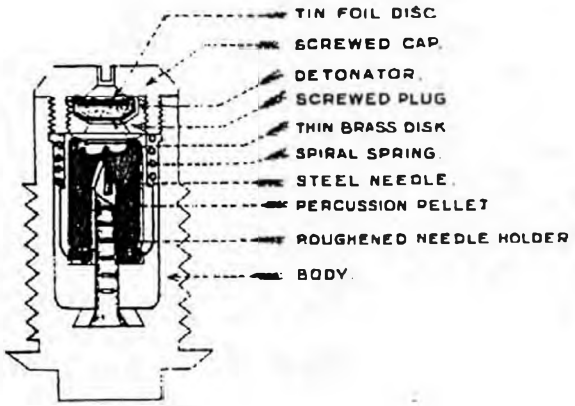
The fuze is lacquered externally and is stamped on the head with the numeral and manufacturer's initials or trade mark, and the number of thousand.

Action.—On the shock of discharge, the pellet sets back over the needle holder, thus allowing the steel needle to project beyond it. The lead at the bottom of the pellet cushions against the bottom of the fuze, and a small portion of it dovetails into the undercut recess, round the base of the needle. This forms a weak connection between the pellet and fuze body, and assists the spring in checking rebound action. On graze or impact the pellet and needle set forward, the needle pierces the detonator, and the flash passes through to the bursting charge of the shell.

Mark III. fuze differs from Mark IV. in the following particulars:—There is no undercut recess for the lead of the pellet to dovetail into; the needle is shorter and is formed entirely of roughened brass wire, having no steel needle let into

FUZE PERCUSSION BASE HOTCHKISS MARK IV.

FULL SIZE.



it; the spiral spring is weaker and is placed round the needle instead of round the pellet, and the front end of the brass casing of the pellet is consequently not decreased in diameter.

These fuzes are on no account to be removed on board ship.

The Mark IV. paper cylinder is made of brown paper pierced with holes. To one end two discs of millboard, also pierced with holes, are glued, and secured by copper wire. To the under side of these discs a glazeboard disc is attached by copper rivets, so that the glazeboard is next the cordite when the cylinder is in position.

Cartridge, Q.F., 6-pr. Mark VIII., differs from Mark IX. as follows:—The cordite charge is tied with silk sewing instead of shalloon braid. The Mark III. paper cylinder was used, but being 1 inch shorter than the Mark IV., it did not keep the charge firmly in position in the case. These cartridges, when broken down for examination, will be fitted with the Mark IV. paper cylinder, and will be distinguished by the addition of a star (*) to the numeral, the cordite charge also will be tied by shalloon braid.

6- and 3-pr. cartridges, if fitted with a gun-cotton igniter, will have the letters "G.C.," and those with "S.F.G.$_2$" gunpowder igniters will have "S.F.G.$_2$" stencilled in red on the base in addition to the other markings.

Cartridge, Q.F., 6-pr. Practice, Mark VII., is generally similar to the service cartridges, but the shell is filled with salt and plugged instead of being fuzed. Plugs or fuze bodies used as plugs are stamped with the letter P to prevent fuzed shell on recovery being mistaken for plugged shell. The shell is painted black, with a yellow band round the centre and the word "Salt" stencilled on it in white.

Cartridge, Q.F., 6-pr. Practice, Mark VIII. differs only in having a solid cast-iron shot instead of a shell. The shot has the usual white tip and yellow band.

3-pr. Q.F. Ammunition is made up in a similar manner as described for the 6-pr. When these cartridges are fitted with a steel shell, the 3-pr. are always a mark behind the 6-pr. thus:—The cartridge Q.F. 3-pr. steel shell Mark VIII. is similar to the 6-pr. Mark IX., and so on.

The latest shell, which is the Mark VI., differs from its previous marks in having a slightly larger burster capacity.

Cartridge, Q.F., 3-pr. Vickers, Cordite, Steel Shell, Mark I. (Plate XI.).—The cartridge case Mark II. is similar to the latest mark of 6-pr. Q.F. Hotchkiss case, and differs from it only in the shape of the shoulder. The charge consists of $13\frac{6}{16}$ ozs. of cordite M.D., size 8, made up in a bundle and secured with silk sewing No. 1. In making up this mark of cartridge a short paper cylinder is placed to fill up the space between the top of the charge and base of the shell. The shell is the same as that

used with the 3-pr. Hotchkiss, and takes the Mark IV. Hotchkiss fuze.

Cartridge, Q.F., 3-pr. Vickers, Practice, Full Charge.—The Marks I. and II. are made up in the same way as the Service cartridges. The Mark I. is fitted with a plugged steel shell. The Mark II. with a practice shot. These practice charges are for use with 3-pr. Vickers guns, except from the top of turrets, or barbettes, for which a reduced practice charge is supplied.

The Reduced Practice Charge, Mark I., is as follows :—The same cartridge case, percussion primer, and plugged shell are used as with the practice full charge. The reduced charge consists of a bundle of M.D. cordite, about 14 inches in length, round the lower end of which are placed several layers of cordite 2½ inches in length. The whole charge weighs 6 ozs. 14 drs., and is enclosed in a shalloon bag, the mouth of which is enclosed by an igniter of 4 drs. of S.F.G., contained between two discs of shalloon. No paper cylinder is used.

The Mark II. reduced practice charge differs from Mark I. in having a practice shot instead of a plugged shell, and the lower part of the charge only enclosed in a shalloon bag (Plate XI.).

To readily distinguish between the 3-pr. Vickers full and reduced practice charges, the word "FULL" or "REDUCED" will be stencilled in red on the base of the respective cartridges.

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.

Dummy cartridges are supplied for drill purposes. They consist of a brass case fitted with a hollow wooden shell secured by brass screws through the neck of the case. They are brought up to Service weight by means of a lead core. The edge of the flange of the case is milled, and the base is fitted with a dummy primer. Holes are bored through the case to distinguish it from the Service case.

Dummy cartridges should always be used when at drill.

They are stowed in boxes painted black, with "DUMMY" in white painted on the lid.

Steel gauges are supplied for gauging 6- and 3-pr. cartridges. The supply is one to every four or less number of guns, including those supplied as sub-calibre, but not more than two are supplied.

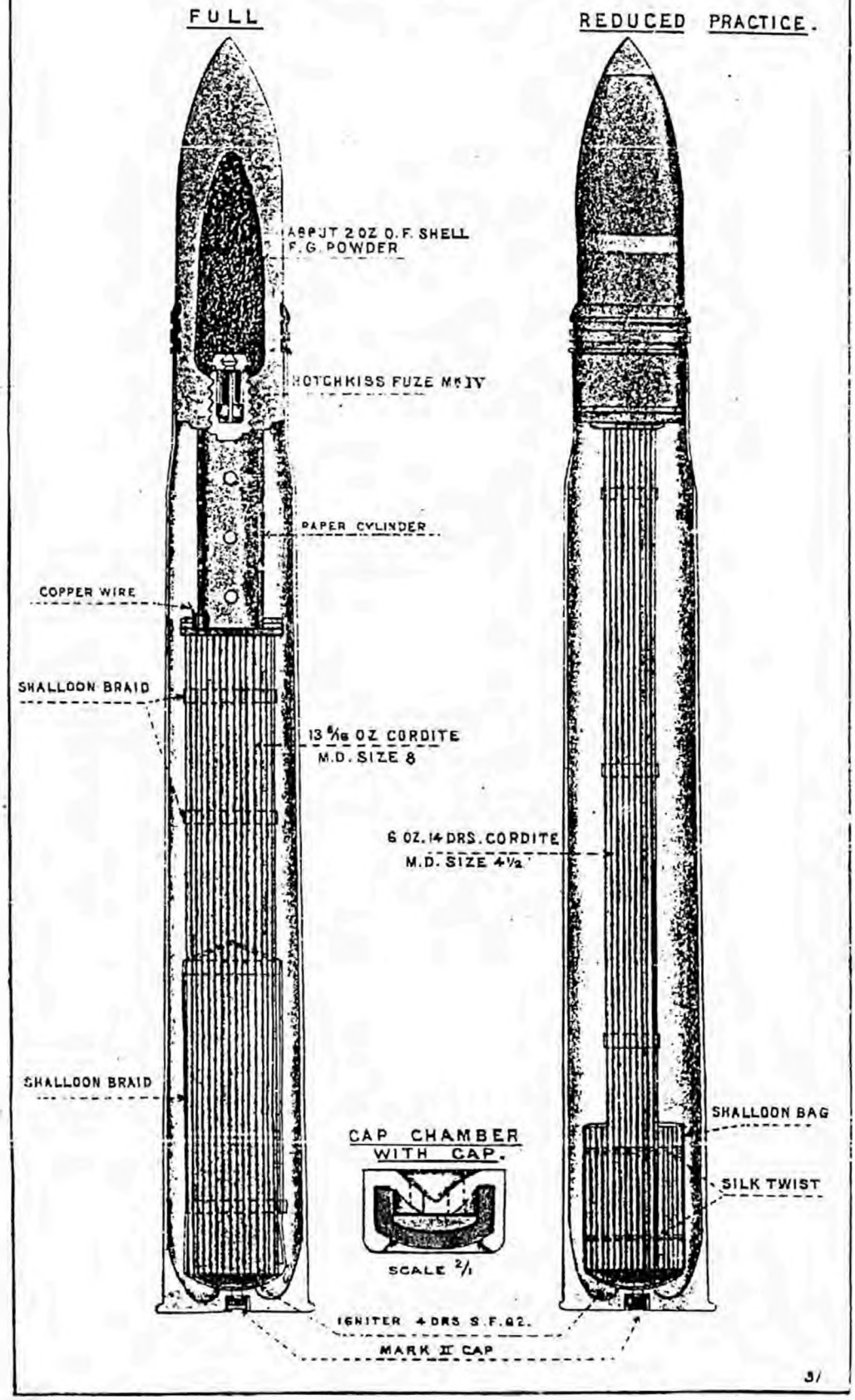
The cartridges are packed base up, in zinc-lined ammunition boxes.

The 6-pr. stow 11 in a box painted stone colour.

The 3-pr. Hotchkiss } 16 in a box painted grey colour.
The 3-pr. Vickers }

CARTRIDGE Q.F. 3 PR VICKERS.

SCALE 1/3.



After firing the cases should be cleaned as soon as possible in accordance with the instructions, and repacked ready for returning into store. The clips are to be returned to store separately.

Instructions for Cleaning Cartridge Cases.

As soon as possible after firing, the cartridge cases of all Q.F. guns are to be cleaned as follows :—

(1) Remove the fired adapter or primer.
(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) Mop inside and out with mineral jelly.
(6) Repack in their own boxes. *Fired cases are never to be repacked in boxes containing filled cartridges.*

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

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

All Q.F. cartridge cases which are split or cracked at the base, either spontaneously or on firing, are to be returned to the nearest Naval Ordnance Depôt with a view to their being forwarded to the Naval Ordnance Office, Woolwich.

CHAPTER VI.

Blank Charges.

Powder charges, which are supplied for saluting and for exercise without projectiles, are called "Blank" charges.

Cartridge, Q.F., Blank, 6-inch Gun, Filled Mark IV.—The charge, consisting of 7 lbs. of blank L.G., is enclosed in a silk cloth bag with a dome-shaped igniter into which is secured a bag containing 8½ drams R.F.G. or new blank F.G. powder. The bag is hooped in the ordinary way, but the hoops pass under strips of silk braid, which are attached to the bag so as to form loops, instead of through the silk cloth. This prevents the escape of powder dust from the bag into the interior of the brass case. The Service case is used, and the space above the charge is filled by an asbestos cylinder which consists of two perforated sheets of asbestos, each cut down the centre for half its length and fitted one across the other at right angles, with a disc of asbestos secured at each end. The cartridge is closed by the white metal lid in the usual way.

Cartridges, Q.F., Blank, 4·7-inch Mark IV., and 4-inch Mark. III. (Plate XII.).—These cartridges are made up in a similar manner to the 6-inch Mark IV., differing only in the weight of the charge, which consists of 3 lbs. of blank L.G.

Blank cartridges are issued "Filled" in their respective "Outfit" boxes, which are painted red, for 6-inch, 4·7-inch and 4-inch Q.F. guns which are not used for saluting purposes.

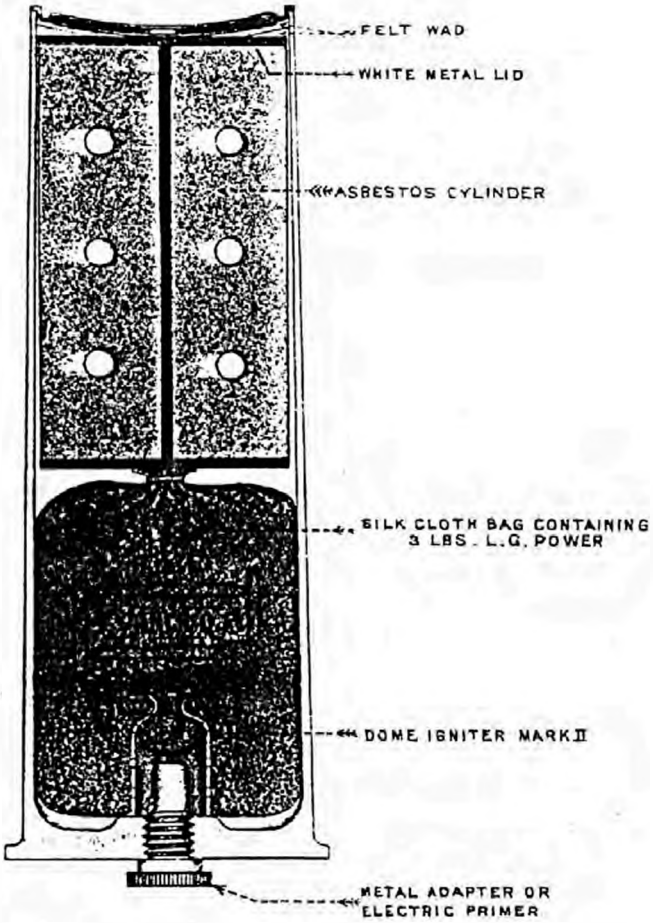
Cartridge, Q.F., Blank, 4-inch Mark IV.—The charge is the same as described for the Mark III. blank charge, but there is no lid or asbestos cylinder. The charge is kept in position by a felt wad being placed on top, and afterwards a leather board cup is pressed hard down on to it. This method is adopted for filling the blank cartridges of the 4-inch Q.F., as mounted in the "Indomitable" class which are used for saluting.

Cartridge, Q.F., Blank, 12-pr. 18 cwt., Filled.—The 12-pr. 18 cwt. Service case is used. The charge is 1-lb. 8-oz. blank L.G., made up in a silk cloth bag. A calico and paper dome igniter fits into a pocket in the base. The charge is choked and hooped in the ordinary manner. A felt wad is placed on top of the charge, a split cardboard ring is then inserted, after which a leather board cup is driven hard down on to it. As these cartridges take the same leather board cup as the 12-pr. 12 cwt., this split cardboard ring is necessary to fill up space between the cup and the cylinder.

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

SCALE = ¼ ..

MARK IV.



Cartridge, Q.F. Blank, 12-pr. 12 cwt. (Plate XIII.).—The charge is the same as that for the 12-pr. 18 cwt. The cartridge is made up in a similar manner, except that no split cardboard ring is used.

Cartridge, Q.F., Blank, 12-pr. 8 cwt. (Plate XIV.).—The charge is the same as that for the 12-pr. 18 cwt., but the cartridge bag is completely covered, except the base, by a felt jacket, with a drawstring at the bottom which is pulled in and tied. There is a loop of silk braid at the top and over the charge comes a felt wad to the underside of which a felt ring is attached. The loop on the jacket passes through a slit in the centre of the wad which fits the case tightly. The mouth of the case is not closed.

The Cartridges Q.F. Blank for the 12-pr. 18 cwt., 12 cwt. and 8 cwt., also the 4-inch when used for saluting, are filled on board in a place above the water-line, except those supplied to T.B.D.'s, and T.B.'s, which are supplied "Filled."

The cartridge cases are supplied in outfit boxes painted *red;* the charges, which are marked with the monogram of Station and date of filling, in half metal-lined cases painted *red;* the wood drifts, metal rings, leatherboard cups, wads, and split cardboard rings, in packing cases.

Method of Filling :—

(1) See cartridge case perfectly clean and dry.
(2) Insert a metal adapter or electric primer.
(3) Stand the case vertically where it will remain steady on its base.
(4) Insert the charge and felt wad, and in the case of 12-pr. 18 cwt., a split cardboard ring.
(5) Place the "metal ring inserting cup."
(6) Insert cup-leather and press hard home with wood drift.

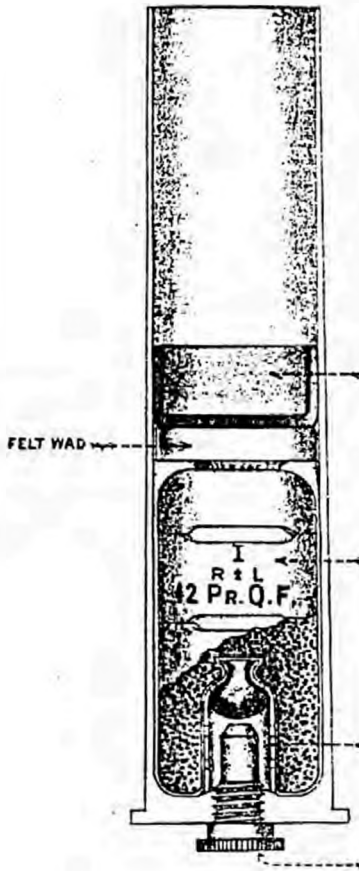
6-pr. and 3-pr. Blank Ammunition.

The blank ammunition for these guns is known as the Mark IV.

The case Mark IV. is of solid-drawn brass, varnished inside. A hole is bored through the centre of the base. The hole is recessed, and a spiral groove is cut in the recess to take a removable primer, two slots are made in the case near the mouth. The primer is of brass, with a cap chamber and anvil formed in its rear end ; three fire-holes communicate the flash from the copper percussion cap to about 5½ grains of R.F.G.[2] powder, with which the body of the primer is filled. The front is closed with a glazed-board disc, spun over and coated with shellac. A small brass pin projects from the head of the primer, by which it is secured to the case. There are also two

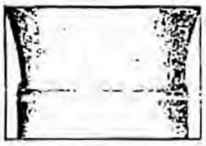
CARTRIDGE, Q. F, 12 PR. 12 CWT. BLANK (1½ LBS. L.G.)

SCALE = $\frac{1}{6}$



WOOD DRIFT

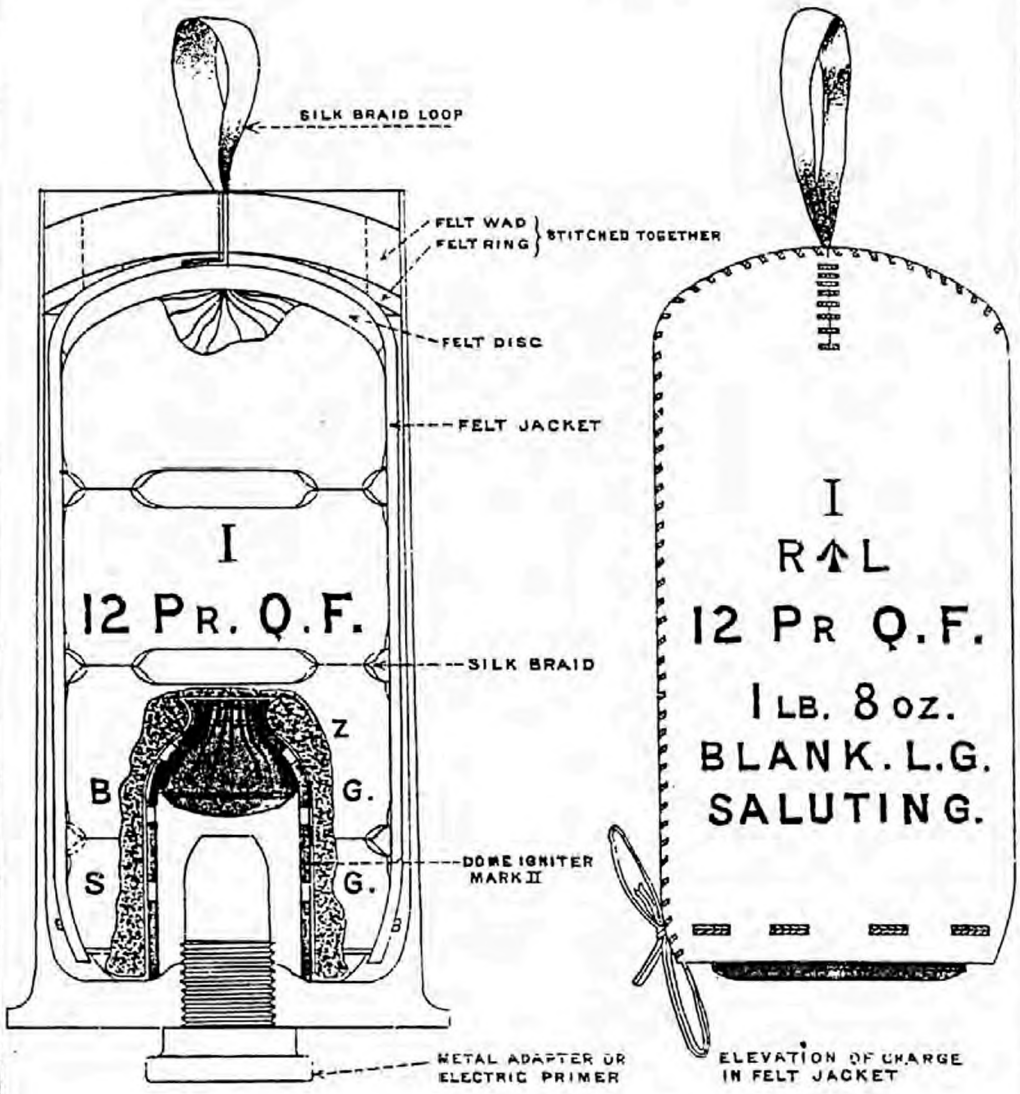
METAL RING FOR INSERTING CUP WASHER



CARTRIDGE, Q.F. 12 Pr 8 Cwt BLANK.

1½ LBS. BLANK WITH FELT WAD JACKET AND IGNITER.

SCALE = ½



slots in the head to take the "driver, screw, primer," for inserting or removing it. The primers are issued in hermetically-sealed cylinders, 20 in each cylinder.

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. It is contained in a shalloon bag, hooped with silk sewing. The shalloon bag is sewn into a felt jacket, having a loop on the top. Over the charge is placed a felt and a millboard wad, the loop on the jacket being passed through holes in them; the whole is secured in the case by a piece of narrow silk braid, which is passed through the loop, then through the slots in the case, and finally tied to the loop.

Silk braid, 0·35-inch wide, is supplied (with the charges) for securing the charges in the cylinders.

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.

The empty cartridge cases are supplied 20 in a box painted red. On the inside of the lid is a lithograph, and instructions for making up.

The tools for reprimming are issued in an ordinary wooden 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.

Method of Filling 6-pr. and 3-pr. Blank 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.

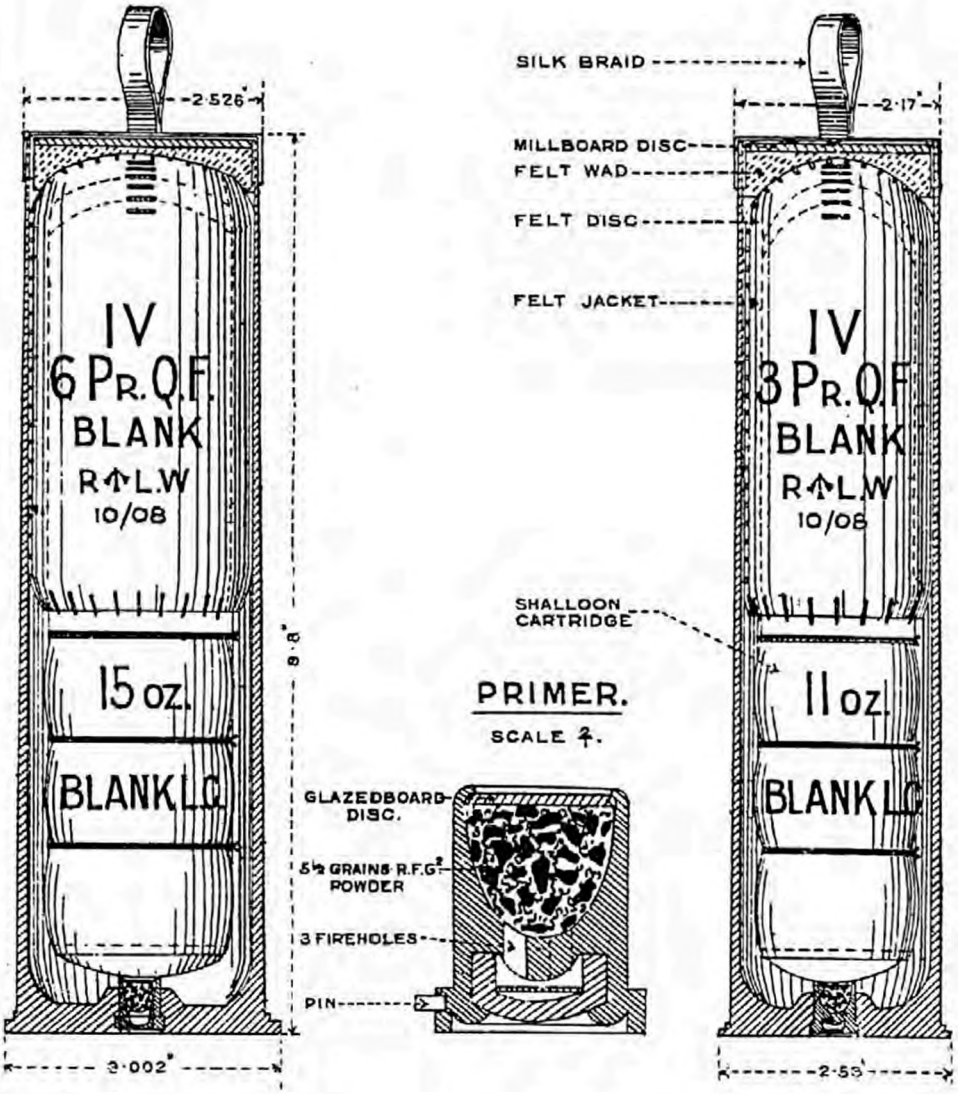
3. Insert the charge with felt and millboard discs attached in the case, the felt wad being placed next to the charge, then pass a piece of ·35-inch silk braid through the loop on the charge and slots in the case, and securely tie it across the mouth of the case. If there is any difficulty in inserting 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.

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.

CARTRIDGE Q.F. BLANK 6 Pr FILLED MARK IV. 15-Oz., BLANK L.G.

CARTRIDGE Q.F. BLANK 3 Pr FILLED MARK IV. 11-Oz., BLANK L.G.

SCALE = ½



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Procedure to be followed with all blank Charges for Q.F. Guns 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 where necessary, 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.

For the stowage of a ready supply of blank ammunition for saluting purposes, steel lockers, capable of being locked, and holding 60 rounds, are fitted and in a position conveniently situated to the saluting guns in flagships only.

CHAPTER VII.

Cases, Boxes, &c.

All boxes and cases containing ammunition are to be handled with care to prevent injury to their contents.

Rough usage of ammunition cases and their contents is calculated to cause miss-fires, hang-fires, or even premature explosions; and, further, ammunition boxes so handled cannot be expected to retain their air-tightness or the contents their efficiency. 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:—

Rectangular corrugated cases -	B.L. Guns, 12-inch "King Edward VII." class, 10-inch and below.
Cylindrical cases - -	B.L. guns, 12-inch and above (except 12-inch "King Edward VII." class).
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 boxes cartridge.

Corrugated Rectangular Cases are made of corrugated brass with cast gunmetal top and fittings.

The sizes of these cases are distinguished by letters, as follows:—

Case.	Gun.
A	Blank for B.L. 6-inch Marks VII., VIII. and XI., 4-inch B.L. and Q.F.
B	B.L. 6-inch Marks VII. and VIII., 20-lb., Mark I. or 23-lb. M.D. charges.
F	B.L. 6-inch Marks VII. and VIII., 29-lb. M.D. charges, and Mark XI. 33 lb. charge.
I	B.L. 9·2-inch, Marks II. to VIII. guns.
J	B.L. 10-inch, Marks II. to IV.
N	B.L. 9·2-inch Mark X.
Rect. O	B.L. 7·5-inch Marks I., II., or V.
Rect. R	B.L. 4-inch Marks VII. and VIII.
S	B.L. 9·2-inch Marks X. and XI.
T	B.L. 6-inch Marks VII. and XI.

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.

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

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

All the circular lids of new and repaired cases, excepting the "A" case, have a hole in them closed by a gunmetal screwed plug; this hole is used for making connections to an air pump for testing purposes.

This plug is worked by means of the "P to R" key.

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

F to J cases have a wood lining to the top to prevent the cartridge being cut by the lower ends of the top fittings. They are also fitted with packing pieces.

All except the A and R cases have their openings on one side of the top; the A and R cases have their openings in the centre.

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

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

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.

Cylindrical Cases are lettered L, N, P, Q and R and are made of brass.

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

Case.	Gun.	Stowage.
L	12-inch B.L. Mark XI.	Two quarter charges.
N	12-inch B.L. Mark X.	Two quarter charges.
P	13·5-inch B.L.	One half or two quarter charges.
Q	12-inch B.L. Mark IX., X.	Two quarter charges.
R	12-inch B.L. Mark VIII.	One half or two quarter charges.

These cases are not moved from the bays during action, and they open at one end only except the "L and N" cases, which open at both ends.

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

Air test plugs are fitted in the lid.

The lids of these cases (except the L and N cases) are secured by cams on the lid which engage in grooves inside the top of the case.

The cams are worked by means of the P to 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.

The latest pattern "R" case has the lifting bar, with two eyes, replaced by a copper wire handle covered with leather, and held by two lugs formed on the lifting plate.

The P, Q and R cases are all similar in construction, the P case differing only in being shorter and having four locking cams instead of three.

Rectangular and cylindrical cases are now being manufactured with weakened ends, so that in case of premature ignition of the cordite charges the gases generated will burst open the cases and escape into the magazine, thereby minimising the risk of an explosion.

The rectangular "R" case with two transporting bands (Plate XV.) contains six full charges for the 4-inch B.L. Mark VII. or seven full charges for the 4-inch B.L. Mark VIII. guns. It is weakened at one end by having the top of the case soldered to the body. No handles are fitted on account of this weakening, but the two bands passing completely round the case are used when transporting. These bands are removed before stowing the case in the magazine, and are returned to the Ordnance Depôt. This case has now been superseded by a new design without transporting bands.

The cylindrical "N" case (Plate XV.) is weakened at both ends and is used for stowing charges for the 12-inch B.L. Mark X. The lid is fitted with lugs which engage under arms in the rim of the case.

When the lid is revolved to the right, the lugs take under the strong arms, which are part of the rim of the case, and this would be the position of the lid for transporting. When the case is stowed in the magazine the lid is revolved to the left, causing the lugs to take under copper arms which are lightly secured to the rim of the case, this being the weakened position.

A spanner, fitting into two holes in the lid, is supplied for moving it as required.

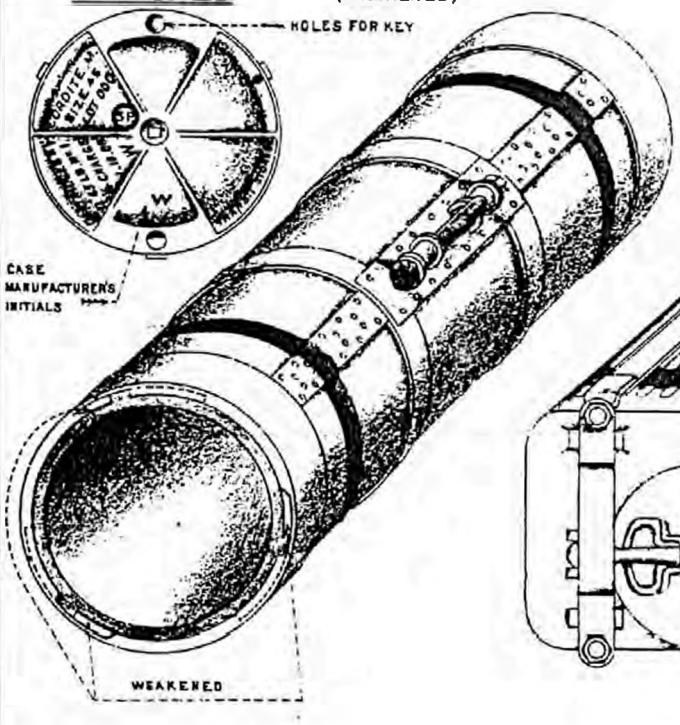
The cylindrical "L" case is similar to the "N."

Zinc transport cylinders are in use for the transport of B.L. charges, 6-inch and above. The zinc cylinders, which are of various sizes, are known by numbers and marks. The lids screw on to the cases and are kept watertight by a dermatine

POWDER CASES.

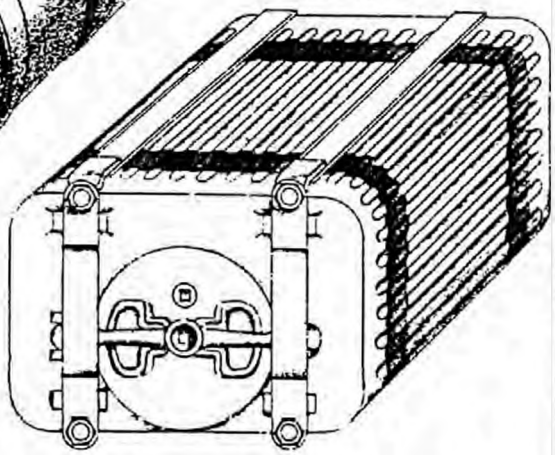
CASE, CYLINDRICAL N.

PLAN OF LID. (WEAKENED)

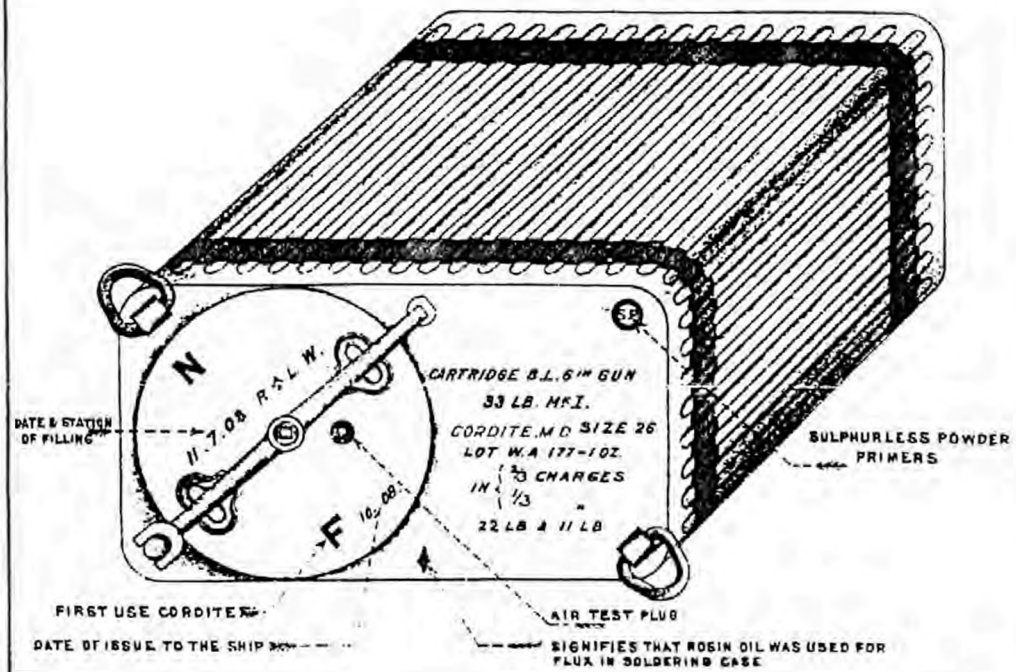


CASE, RECTANGULAR R.

WEAKENED



CASE, RECTANGULAR F.



ring. The edge of the lid bears on white spun yarn and luting, contained in a recessed ring of zinc soldered to the outside of the case.

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 they are to be returned to store with the empty cylinders. To open the cylinder, place the "cylinder bearer" between the lugs on the lid, and give it a smart wrench in the direction indicated by the arrow on the lid.

During transport, zinc cylinders are protected by being placed in wooden skeleton cases.

Boxes, cartridge, are of wood. A loose lining of zinc fits inside the box, having a groove round its top edge to receive luting for making an airtight joint with the flange on the lining of the lid. The lid works on hinges, and is zinc-lined; it is secured by a hasp, through which passes a leather tongue, the latter being further secured by a piece of white line. They are used for the transport of cartridges for the 6-inch to the 12-inch B.L. guns.

When cartridges are drawn in either zinc cylinders or boxes cartridge, they are transferred in the magazine to the brass cases, and the empty cylinders or boxes returned to the Naval Ordnance Depôt. A spare label showing the particulars of the cartridges will be found in the cylinder or box; and these labels are to be securely pasted on the brass cases.

Boxes for Q.F. Ammunition.

The "Outfit" Boxes for the 6-inch Q.F., 4·7-inch Q.F., 4-inch Q.F., 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 locking plate engaging four metal bolts, the plate 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 airtight by luting placed in a recess round the lid.

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

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.

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.

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 eight cartridges, and for the 12 and 8-cwt. gun each box holds 10 cartridges, which are stowed in a similar manner to those for the 4-inch Q.F.

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 airtight 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.

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

Special boxes painted red are supplied to hold 20 cartridge cases, empty, for making up blank.

Metal-Lined Cases.

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

They are made of wood, lined with tinned copper.

The lining is closed by a circular bung made watertight 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:—

3,400 rounds of blank ·303-inch ammunition without mock bullet.
2,000 rounds of blank ·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. and 18 cwt.
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.
1,450 rounds of blank ·303-inch ammunition, without mock bullet.
9,100 rounds of Morris tube ammunition.

120 cartridges for Very's light.
60 powder charges for torpedo impulse.
50 Tonite charges for Mark III. sound rockets.

Small Arm Ammunition Boxes.

There are two sizes of S.A.A. boxes 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.

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 watertight 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. The lid is secured by a brass split pin having a T-shaped handle attached to it.

To open the Boxes:—Take out the split pin, slide back the lid, and then tear off the cover of the tin lining according to the printed directions found there.

The tin lining of the small arm ammunition boxes is liable to deteriorate; in consequence—

(*a*) The oldest ammunition in the ship is to be used for target practice as far as possible.

(*b*) The tin lining of all boxes which are passed up for target practice is to be lifted out and examined by unscrewing the wooden top. If the lining of any box is found defective, others of the same date are to be examined, and, if necessary, the ammunition to be exchanged at the first opportunity.

Painting and Marks on Cases.

All cylindrical, rectangular, and metal-lined cases, firework boxes, 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.

6-pr. and 3-pr. Q.F. boxes containing "practice" ammunition have their lids painted yellow.

All boxes containing blank ammunition are painted *red*.

All boxes containing dummy ammunition are painted *black*.

All cases containing explosives are painted with two *red* bands, except S.A.A. boxes.

All packages containing "Filled" cartridges have the particulars of the contents stencilled on them with black paint except packages containing blank cartridges, which have the stencilling in white paint.

The word "Cordite" is always in red.

The letter N on Naval packages is in all cases black.

Packages containing B.L. filled cartridges have the following general information stencilled on each package :—

(*a*) Number of cartridges in the package.
(*b*) Designation and numeral.
(*c*) Lot letter and number of the cordite. The adjustment of weight of cordite.
(*d*) Full, half or quarter charges.
(*e*) Monogram of station and date of filling.
(*f*) The words "For Practice only," or "For Gunnery Ships only," where necessary.
(*g*) F and date of issue to the ship, month and year, if "First use" Cordite.

Cylindrical and rectangular cases, which have a "blue diamond" stencilled on them, and a diamond stamped on the body near the makers' initials, signify that the flux used in soldering the cases was "rosin oil." Chloride of zinc was formerly used as a flux, but was found to accelerate the decomposition of cordite if it came in contact with it.

The stencilling should allow room for the group and explosive labels, and should be in the following positions :—

Cylindrical cases—On the body and both ends.

Rectangular—On plain part of top, except the date and monogram of station where filled, which are placed on the lid.

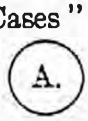
Metal-lined cases—On the top, except tare and gross weight, which are placed on the sides.

Zinc cylinders—On the body and on the top of skeleton wood frame.

Boxes containing Q.F. cartridges, 12-pr. and upwards, have the following information on them :—

(*a*) Number of cartridges; words "Cartridges Q.F."
(*b*) Designation and numeral.

Monogram of station, and date of filling—

(*a*) "Cordite" size and lot number.
(*b*) "Primers" manufacturer's initials, mark and date, or "Adapter."
(*c*) "Cases" manufacturer's initials and date, and 

if repaired and annealed, or "Repd." if repaired and not annealed.

(*d*) "S" lids (if so fitted). Also a disc (in black) ½ inch in diameter if lids have circular hole cut in underside, or an arc ⌣ if lids are dished.

The letters (S.P.) if the cartridges have S.F.G.2. powder igniters.

The following information will also be added:—

On the side of the box:—Full descriptive label giving details as stencilled on the lid, the number of the box, and the Group and Division label.

On inner side of lid:—Full descriptive label similar to that on the side of the box.

Over junction of lid and side of the box:—Government Explosive Label.

Boxes containing 6 and 3-pr. cartridges have the following information on them:—

(i) Stencilled on the lid—
- (*a*) The number of cartridges in the box.
- (*b*) Designation and numeral of filled cartridge.
- (*c*) Weight of charge and cordite lot number.
- (*d*) Monogram of station and date of filling.
- (*e*) Tare and gross weight.
- (*f*) "To be carried with care, this end up," in red.
- (*g*) The Arabic numeral "(1)" or "Caps Mark II." when Mark II. caps are used.
- (*h*) The word "Full" or "Reduced" on boxes containing 3-pr. Vickers practice cartridges.

(ii) Inside the lid, and also on the front of the box, a label containing the information in (i) *a*, *b*, *c*, *d*, *g*, *h*, gross weight, and—
- (*a*) The numeral of the fuze used, and the lot number.
- (*b*) A notice that if the cartridges are repacked, fresh labels must be substituted for existing ones.
- (*c*) Government explosive label over junction of lid and front of box.
- (*d*) Group and division label, front of box.

(iii) Stencilled in black on the front cleat—
The number of the box in the lot.

(iv) Packages containing 6-pr. and 3-pr. practice cartridges, have their lids painted yellow, and the stencilling in black, except the word "Cordite." Packages may still be met with, containing practice cartridges, where the lids are the same colour as the boxes, the stencilling being in yellow paint, except the words "Full" or "Reduced," on boxes of 3-pr. Vickers cartridges which are in black.

(v.) Packages containing 6- and 3-pr. Q.F. cartridges that have been repaired by means of indenting machine, either after having been opened for inspection, or found with loose shell, will be placed in boxes, labelled in manuscript as follows:—

Re-indented_____.
Station_____.
Date_____.

Packages containing cartridges fitted with igniters of sulphurless powder have "(S.P.)" in black, stencilled on the top right-hand corner of Q.F. boxes and rectangular cases, and on both ends of cylindrical cases.

Packages containing cartridges with igniters of S.F.G.[2] powder must not contain cartridges with igniters of other natures of powder.

All packages containing repaired Q.F. cartridge cases which have been annealed will have "(A.)" stencilled in black on the lid.

The group and division label shows the classification of the contents of the box.

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

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.

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

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 lot letter and number of the cordite is not stencilled on these boxes, nor printed on the label inside the lid, but in order to facilitate identification of the make of ammunition when the boxes are stacked, the initial or initials of the manufacturer of the cartridges will be stencilled on the ends of the boxes in addition to the date.

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 two long belts of 250 rounds or six short of 84 rounds. Six long and six short belts are supplied for each gun.

Luting, which is used for making watertight rectangular, and metal-lined powder cases, and all Q.F. ammunition boxes, and for other purposes such as making gastight 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.

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.

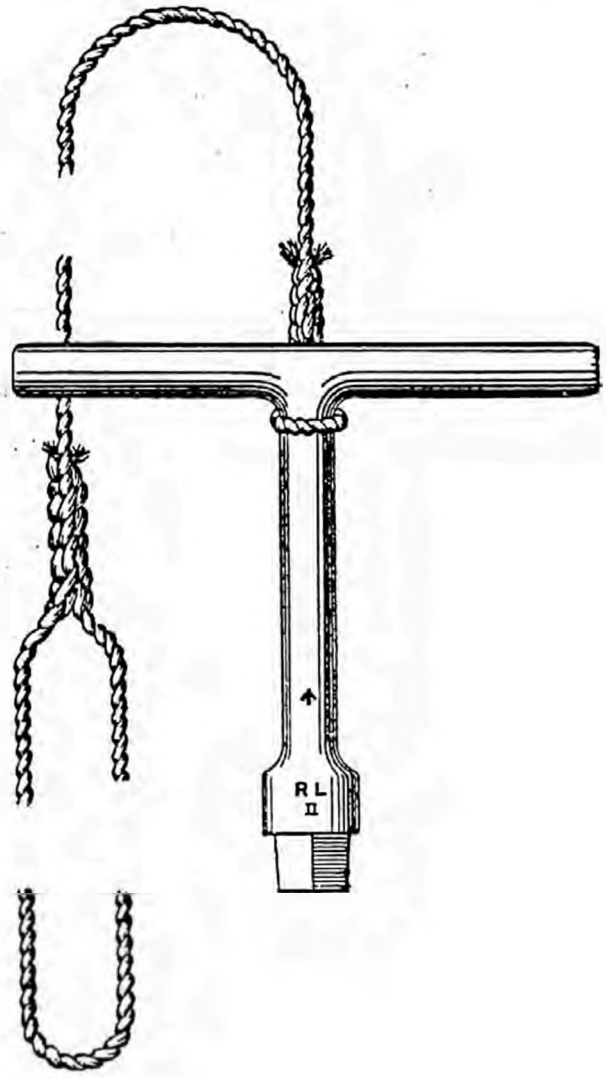
Keys are issued with lanyards, and are to be kept hung up in the magazines.

The 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.

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

P, Q, and R Key, Mark II.

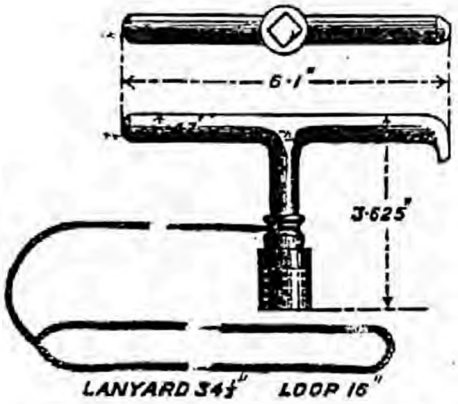
Scale ½.



The metal key, Mark III., is of gunmetal with a cross handle, one end of which is formed into a toe for raising the lid of the case.

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, large and small.

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."

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 charges for some of the larger guns.

Cartridge cases are known by numbers, which run from 9 to 43. 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.

K.A. duck cases are now supplied in lieu of Clarkson's cases to all B.L. guns.

The Mark II. case is made as follows:—

The body is of duck, the bottom of two thicknesses of canvas secured together with solution, the exterior being

stiffened by a rope grummet at the bottom. The mouth of the case is formed by the material of the body being turned down and sewn over a circular brass band.

The lid is of leather, blocked into the form of a cup to fit tightly over the rim of the body, the latter having a length of webbing sewn to opposite sides and across the bottom, the ends are passed through fairleads on the lid and sewn together forming the handle. Each case holds a full, half, or quarter charge, according to the nature of the gun.

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

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

„ 10 „ „ „ 9·2-inch Marks III. to VII. B.L.

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

„ 19 „ Full „ „ 4-inch Marks II. to VI. B.L.

„ 30, K.A. Duck—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. B.L.

„ 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. Duck bag—Full charge „ 6-inch Mark VII. B.L.

„ 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., II., and V. B.L.

„ 42 „ „ Full „ „ 6-inch Marks VII. and XI. B.L.

„ 43 „ „ „ „ „ 4-inch Marks VII. and VIII. 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.

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.

Special canvas bags are supplied for sending up cordite charges to the 12-inch Mark VIII. and IX. guns from the handing rooms by hand whips, but when stocks are used up they will be superseded by the cartridge cases shown above.

Canvas bags edged with rope are used for the supply of ammunition to Q.F. guns, 12-pr. and above, except where Dredger hoists are fitted.

The canvas bags used for the supply of cartridges are red, and those for projectiles white.

The 6-inch and 4·7-inch bag holds one cartridge or one projectile.

The 4-inch bag holds two cartridges or two projectiles.

The 12-pr. bag holds four cartridges or four projectiles.

Lockers are provided in the magazines, and shell rooms for the stowage of these bags.

Classification and Storage 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 :—
	1 A.	Ballistite.
		Cannon cartridges filled with Ballistite or Cordite, except Q.F. cartridges, but including all Cordite or Tonite charges for Q.F. cartridges.
		Charges, Impulse Torpedo.
		Cordite in bulk.
		,, cylinders, without igniters.
		Cordite cylinders filled with igniter.
	1 B.	Bags, primer, filled.
		Cannon cartridges filled with gunpowder except Q.F. cartridges, but including all gunpowder charges for Q.F. cartridges.
		Gunpowder except that which has been wetted.
		Igniters, powder.
		Puffs, powder.
		Fuze, instantaneous.
		Quick match.
		Stars, incendiary.

Group.	Division.	Stores.
I.	II.	Gun-cotton, dry. Dynamite. Exploders filled for lyddite shell. Blasting gelatine. Tonite. Gelegnite. Deadened blasting gelatine (in bulk).
	III.	Picric acid.
	—	Explosives that must be stored in explosive stores, each division in a separate compartment, but not in magazines :—
II.	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.
II.	III.	Shells, filled and fuzed. Rockets, 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.
	I.	Gun-cotton, wet, except in mines.
	II.	Filled Q.F. cartridges, containing a cap or percussion primer.
	IIIA.	Cartridges, impulse torpedo (Cordite), Q.F. cartridges fitted with electric primers or adapters, and filled with Cordite.
	IIIB.	Cartridges, impulse torpedo, powder, Q.F. cartridges fitted with electric primers or adapters, and filled with gunpowder.

CHAPTER VIII.

Tubes, and Stores connected with them.

Tubes are used for igniting the charges in B.L. or Q.F. guns, where the latter have their cartridges fitted with "Adapters."

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

Percussion tubes.
Electric tubes.
Friction tubes.

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

Percussion and electric wireless tubes used in the Service are known as "Vent Sealing." These tubes, which fit a seating in the vent with great accuracy, are held there when the charge is fired, by the lock or breech mechanism.

The heads of these tubes are closed in such a manner as to prevent the passage of gas through them, while the tube itself is expanded against the walls of the seating and so prevents escape of gas past it.

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.

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

Tubes V.S. Percussion.

The following Percussion Tubes are in use :—

Tubes V.S. Percussion Mark VII.
" " " " IV.
" " " Large " I.

Tube V.S. Percussion Mark VII. (Plate XVI.).—This tube is used in all Q.F. guns, and B.L. guns having percussion locks, except the 4-inch B.L. Marks VII. and VIII. and the 12-inch Mark XI.

It 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 and screw-threaded, to take the striker collar and capholder. The centre of the body is left solid, an anvil being formed by the metal of the tube itself, on which a copper cap, containing cap composition, is placed. Two fire-holes are bored through the solid part of the body forming the anvil, to allow the flash from the cap to ignite the pellet powder with which the body of the tube is filled. The bottom of the tube is closed by a disc of suberit

with a paper disc on either side, the end of the tube being burred over.

The percussion cap is retained in position on the face of the anvil by the cap-holder, which is recessed to fit over the cap and fitted with a centre hole for the point of the striker. The striker collar is threaded externally to screw into the top of the tube. A hole is bored through it for the striker, and is enlarged on the underside for the striker head, and on the top for the washer on the end of the striker, which is forced in when the tube is fired.

The striker is fitted with an enlarged head, which fits against the shoulder formed in the collar and has a small cylindrical point which fits into the hole of the cap-holder and is directly over the centre of the cap. To the outer end of the striker, which is reduced in diameter, is riveted a brass washer, and the striker is still further secured by means of a copper shearing wire passing through the striker head and screw collar.

The collar itself is prevented from unscrewing from the body of the tube by being stabbed in two places.

The body of the tube is blackened externally, and has four notches cut in the rim for identification.

The head of the tube is stamped with the manufacturer's initials and its numeral.

Action.—The striker of the tube is forced inwards by the action of the percussion lock, shearing its copper shearing wire, the point of the striker firing the cap on the face of the anvil. The flash from the cap passes through the fire-holes in the body, igniting the pellet powder in the tube, which ignites the charge.

The explosion of the pellet powder expands the tube against the walls of the vent, preventing any rush of gas past the tube, while the copper cap and head of the striker prevent any escape of gas through the tube.

The Mark IV. Tube (Plate XVI.) is similar in external dimensions and appearance to the Mark VII. tube.

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.

There is no shearing wire supporting the striker.

Underneath the head is screwed a brass anvil carrying a percussion cap of special manufacture, and retained in position by a copper washer at its base. There are three fire-holes in the anvil to allow of the flash passing from the cap to the powder in the body. A disc of fine white paper is placed outside the copper washer. The body is filled with pellet powder. The end is closed by a varnished cork and paper disc.

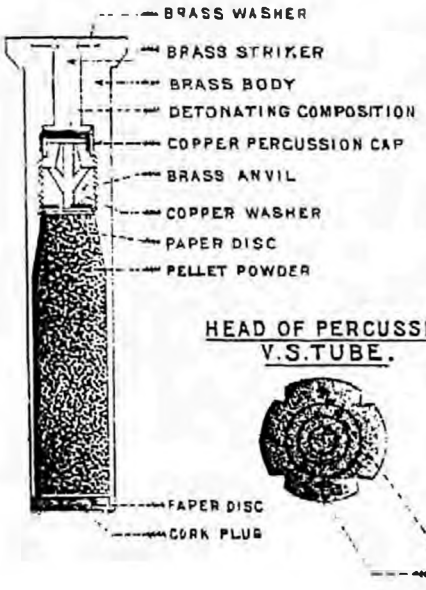
The action of the tube is similar to the Mark VII.

The V.S. Percussion Large Mark I. is similar to the Mark VII., only larger.

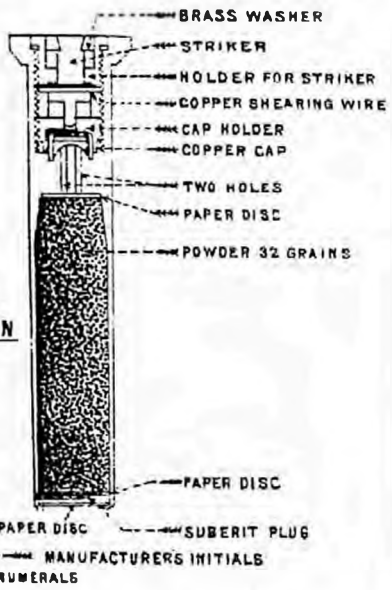
VENT SEALING TUBES.

FULL SIZE.

PERCUSSION V.S. MARK IV.

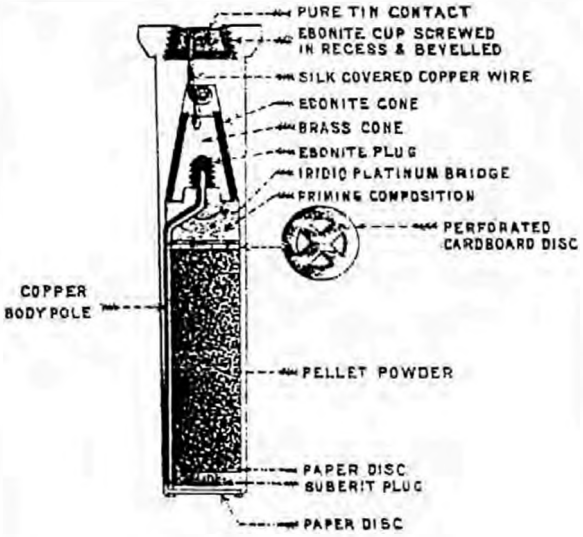


PERCUSSION V.S. MARK VII.

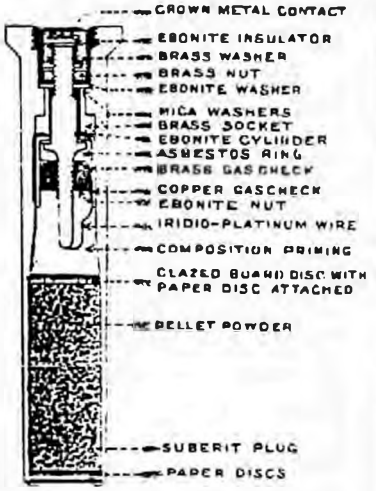


HEAD OF PERCUSSION V.S. TUBE.

ELECTRIC V.S. WIRELESS MARK IV.



ELECTRIC V.S. WIRELESS Mk V.



BR52.
Weller & Graham, L^td Litho London

It is used for the 4-inch B.L. Marks VII. and VIII. and the 12-inch B.L. Mark XI.

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

Percussion Drill Mark II. 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. Into the head is fitted a coned india-rubber plug; the end is closed by a gunmetal screw.

Tubes V.S. Electric Wireless "P."

The following electric wireless P tubes are in use:—

Tube V.S. electric wireless "P" Mark IV. and V.
" " " " Large Mark I.

Tube V.S. Electric Wireless P Mark IV. (Plate XVI.).—This tube is used in all guns having wireless tube locks, excepting 4-inch B.L. Marks VII. and VIII. and the 12-inch B.L. Mark XI.

In exterior form and dimensions it is similar to 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; in the centre of this plug fits a tinned copper pole extending the full length of the tube. The pole is bent and attached to the body of the tube with pure tin; and between the pole and edge of the brass cone is connected a bridge of iridio-platinum wire giving a resistance of from ·9 to 1·1 ohms. 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 into which screws an ebonite cup; the inside of the ebonite cup is undercut, and a disc of pure tin is placed in the bottom, the copper wire 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 tube is primed with the usual priming composition of gun-cotton dust and mealed powder, over which is placed a perforated glazed-board disc with a paper disc attached, the remainder of the tube being filled with pellet powder. The end is closed a suberit and paper disc shellaced in, and on the outside of the suberit is a second paper disc to prevent the shellac sticking to the box in which the tubes are packed.

The tube is stamped on the head with the initials of the manufacturer, mark of tube, and letter "P."

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, iridio-platinum wire bridge, long copper pole, 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.

The "P" Electric Mark V. tube differs from the "P" Mark IV. in the internal gas sealing being effected by a square shoulder, instead of a cone seating. It has a central brass pole which is screwed into a crown metal contact piece, and is insulated from the body of the tube by ebonite. This pole has a shoulder formed at the centre of it, over which passes a copper gascheck, which is insulated from the pole by an ebonite cylinder. An asbestos ring is pressed into the copper gascheck and held by a brass gascheck and an ebonite nut, the latter being screwed on to the central pole. At the lower end of the copper gascheck a projection is made and bent inwards, and the bridge formed from it to the brass pole.

The V.S. Electric Wireless Large Mark I. is similar in construction to the "P" IV., only larger.

It is used for the 4-inch B.L. Marks VII. and VIII., and the 12-inch B.L. Mark XI.

The tubes are issued 10 in a box, the printing being in black lettering.

Notes on V.S. Tubes.

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.

Tubes that have the annealing carried too far up the body, are not to be used in B.L. guns.

The boxes containing them are marked, For use with Adapters in Q.F. Guns.

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 to a Naval Ordnance Depôt for special examination.

There are three causes of failures with tubes—

(*a*) Missfires.
(*b*) Faulty vent sealing.
(*c*) Jambs.

Missfires may be due to the following causes:—

1. Eccentricity of striker.
2. A foreign substance of high resistance on the contact disc.

3. The wire connecting the cone to the contact disc broken, or bared of its insulation, and touching the body of the tube.
4. Centre pole in contact with the cone.
5. Broken bridge.
6. Defective priming.

Faulty vent sealing may arise from:—

1. Body of tube not expanding and thus allowing cordite gas to escape between the tube and vent seating.
2. The cone failing to prevent the rush of gas through the head of the tube.
3. Defective metal in the tube.

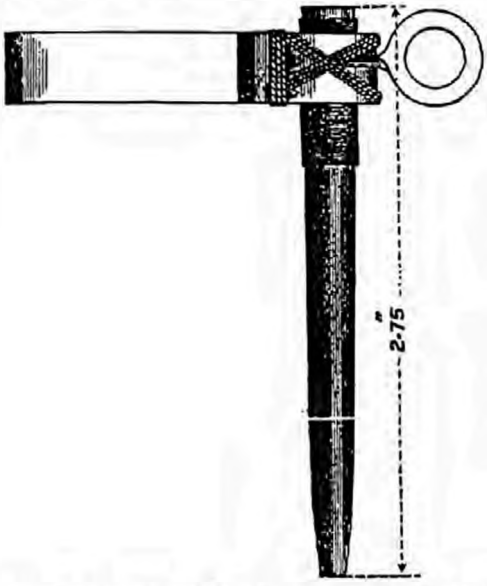
The Quill Friction Tube in use in the Service is known as "tube friction quill short" Mark VI.

It is used for signal rockets when fired from a rocket machine.

The tube is about $2\frac{3}{4}$ 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 seizing 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 rocket machine 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.

When the stock of these is used up, the "Tube, friction, copper, solid drawn, Mark III." will be used in lieu.



TUBE, FRICTION, QUILL, SHORT, MARK VI.

They are supplied twenty-five in a tin box.

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

Vent Implements.

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

There are three patterns of rimers, viz., the Marks III., IV., and the Large Mark I.

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

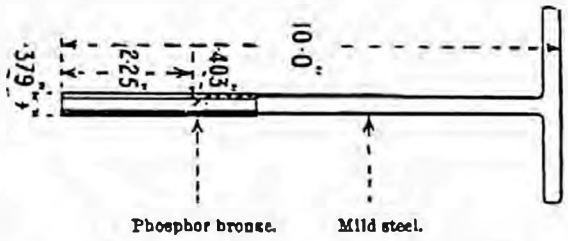
The Mark IV. rimer is made of bronze, and is 10 inches long, being slightly coned to fit the vent; one side of the cone has three flats, so as to form a cutting edge which removes the dirt or fouling without injury to the steel vent.

The rimer has a cross-handle with a long shank, and can be used in any gun, except 4-inch B.L. Mark VII. and VIII. and 12-inch B.L. Mark XI., also for adapters in Q.F. guns.

The Mark III. rimer only differs from the Mark IV. in length, being slightly shorter, and for this reason is unsuitable for use in guns with the Welin breech screw.

Rimer, Vent, Axial, Short, Mark IV.

Scale, ½.



The Mark I. large rimer is similar to the Mark IV., except that it is larger and is used in the 4-inch B.L. Marks VII. and VIII., and the 12-inch B.L. Mark XI. only.

The Lever Extractor is for use in the extraction of vent-sealing tubes which are found jammed, in guns fitted with electric or percussion locks having hinged extractors. It 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.

Extractor Tube Special Box Slide "A" Mark I. is for use with all B.L. and B.L.C. guns having the box slide "A," that is to say, all guns with the Welin 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.

It consists of a sheath containing a bolt with a screw thread on the inner end, and two small levers hinged to the outer end. A revolving cross-handle actuates the threaded portion of the bolt, a small bar between the levers causes them to diverge on passing out of the sheath; and their outer ends, which are semi-circular in form, are lipped so as to clip the extractor.

The cross-handle is then turned till the ends of the lever protrude sufficiently to admit of their being placed over the extractor. On turning the handle in the opposite direction the extractor is gripped and forced to the rear, bringing the tube with it.

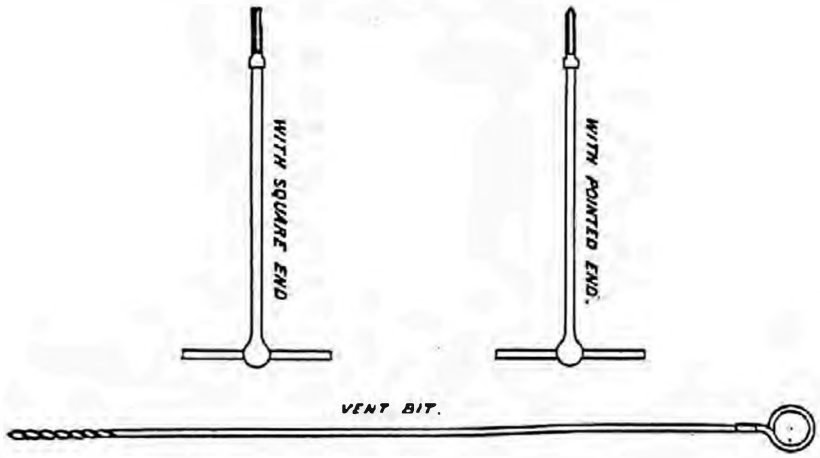
A *Vent Bit* is supplied to B.L. guns 6-inch and above for removing fouling from the vent. They are made of steel, with a spiral on one end, and the other end is formed into an eye as a handle.

Tube Chamber Borers are supplied to all B.L. guns. They are made of steel, and consist of a long steel shank with cross-handles at one end, the other end being formed into a drill.

There are two sizes in present use, the large and the small, each size consists of a set of two, one with a pointed end and four cutting edges, the other having a square end and eight cutting edges.

The large size borers are for use in the 4-inch B.L. Marks VII. and VIII. and 12-inch Mark XI., the small size for all other guns, 6-inch B.L. and above with Welin screws. For guns with parallel screws a spiral tube chamber borer is supplied.

Tube Chamber Borers.



CHAPTER IX.

Projectiles.

The following projectiles are in use in the Service :—

Armour Piercing Shell (capped).
Common Shell (capped and un-capped).
Lyddite Common Shell.
Shrapnel Shell.
Practice Projectiles.

Armour Piercing Shell, as their name implies, are intended for the attack of armour. They have a comparatively small cavity for the bursting charge, and are carefully hardened by special processes, the point being made extremely hard, while the body is softer so as to give greater tenacity and enable the shell to hold together when it strikes hard-faced armour.

They are supplied to all B.L. and Q.F. guns 6-inch and above.

Armour-piercing shell are made of forged or cast 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 lasting cloth bag. The cavity is varnished before the shell is filled to prevent any friction between the powder and the steel. The 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 screw in a steel bush as tightly as possible; the bush is riveted over and threaded to receive the base fuze.

A.P. shell may be either water, oil, or air hardened. The hardening process is confidential.

A.P. shell are stored for three months before being filled, owing to their liability to split spontaneously from the strains set up in the metal by the hardening processes. The sudden fracture of the metal might be sufficient to cause the explosion of the bursting charge.

A.P. shell are stamped on the base as follows:—Nature of gun intended for,—C.S. or F.S. denoting cast or forged steel; A.P. indicating armour piercing; "H" denoting heavy; the mark of the projectile and manufacturers' initials or recognised trade mark.

The weight of the shell empty is stamped on the driving band; the examiner's initials, the broad arrow, and date of examination above the driving band; the date of manufacture on the body of the shell, and consecutive number of shell on the shoulder. The shell are painted black, with two white bands round the head and a red band between them, with the usual marks referring to filling, fuzing, &c., stencilled in red; the

calibre of the gun and mark of projectile being stencilled in white.

A.P. shell are capped with a soft iron or mild steel cap placed over the point; the weight of the cap varies according the calibre, 6-inch caps not to exceed 5 lbs., and the 12-inch 30 lbs. There are several methods of attachment resorted to by different makers' those of "Firth" and "Hadfield" being chiefly met with in the Service.

Firth's Method.—Three shallow grooves are cut round the head of the projectile, and a corresponding number of grooves on the inside of the cap near the lower rim, the point of the projectile is tinned over, the cap pressed on and secured by tin in the grooves of the projectile and cap.

Hadfield's Method.—A number of indentations are made round the head of the shell, the cap is pressed on and secured by the metal on the lower rim of the cap, being indented and pressed into the indentations in the head.

The employment of a soft iron or mild steel cap on the point of a shell gives it greater penetration at normal impact against hard-faced armour.

The specification for A.P. shell with cap is, that it should strike with a certain velocity at the normal, penetrating a K.C. plate one calibre thick, and be in a condition for bursting when recovered.

Firth's A.P. capped shell have a groove cut round the base and the weight of metal thus saved put into the head, where strength is most needed.

The earlier types of armour-piercing projectiles were not capped.

The inside of these shells were lacquered, and the bursting charge was pebble mixture contained in a dowlas bag.

Common Shell are designed to hold as large a bursting charge as possible, but must be strong enough to stand the shock of discharge without deformation, and the shock of impact without breaking up.

The interior of the shell is lacquered to give it a smooth surface.

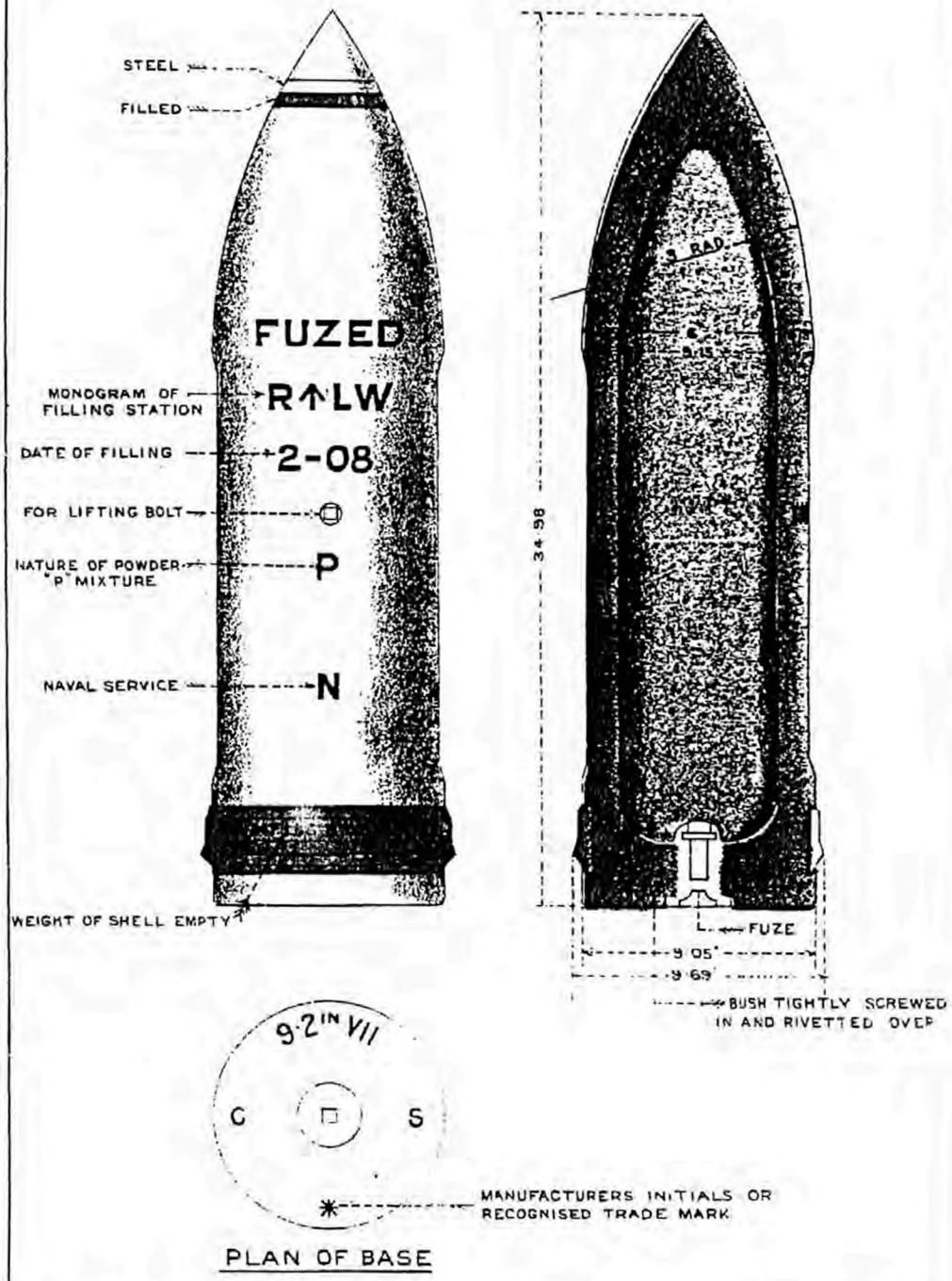
The bursting charge for 4-inch shell and upwards, which consists of P mixture, is enclosed in a bag as a precaution against the premature explosion of the charge from the shock of discharge and friction against the walls of the shell.

Common pointed shell are supplied to all B.L. and Q.F. guns. They are made of forged or cast steel.

The 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.

9·2 INCH POINTED COMMON SHELL MARK VII.

SCALE 1/8.



PLAN OF BASE

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6-inch shell and below are made with a solid base except for the fuze-hole.

All base fuzed shell are supplied filled and fuzed, the 6-inch and above with fuze protectors on, except those shell where the fuze is fitted with a steel protecting plate, 4·7-inch and below in boxes.

All common shell, except those suitable only for the 12-pr. 12 and 8 cwt. guns and "lyddite," are painted black; when filled, a red band is painted on the head, and if made of steel a white band.

Common shell suitable only for the 12-pr. 12 and 8 cwt. guns are painted lead colour.

Capped common shell are being manufactured for 6-inch, 7·5-inch, 9·2-inch, and 12-inch. These shell have an open base which is screw-threaded, and is closed by a large steel bush screw, which is bored out and screw-threaded for the fuze. The front end of the steel bush has the threads removed forming a recess to support the bottom of a copper container. The copper container is placed inside the shell and expanded so as to be a tight fit, the screw bush being then screwed in (having the threads smeared with red lead) retaining it in position.

The bursting charge is contained in a dowlas bag inside the container, and is primed with 7 dram primers.

The caps are ogival in shape, and struck to a radius of four calibres.

Plate XVIII. shows a common pointed shell with cap for a 12-inch B.L. gun.

Common shell of earlier types were nose-fuzed; these are being used up for practice in 13·5-inch, 9·2-inch Mark III. to VII. B.L. and 6-inch Q.F. guns.

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 superseded iron as the material used for the manufacture of shell.

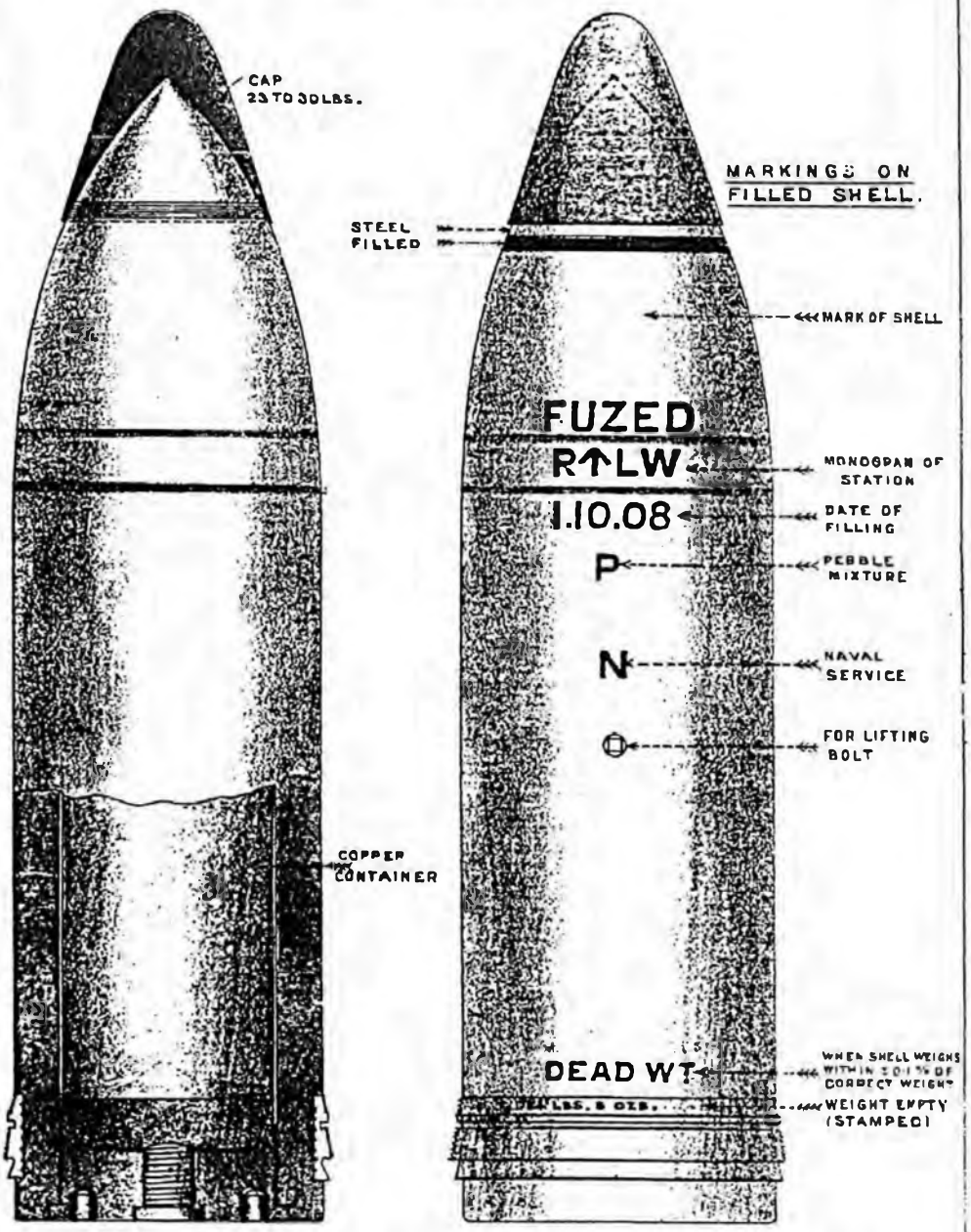
With forged steel still thinner walls can be used, increasing the weight of the bursting charge; but a forged-steel projectile does not break up into so many fragments as a cast-steel.

Lyddite shell are supplied to all guns 12-pr. 12 and 18 cwt. and above B.L. or Q.F., and will be supplied to 12-pr. 8 cwt. Q.F. guns in Torpedo Boat Destroyers when the stock of common shell is worked down. They are always supplied in bulk and plugged.

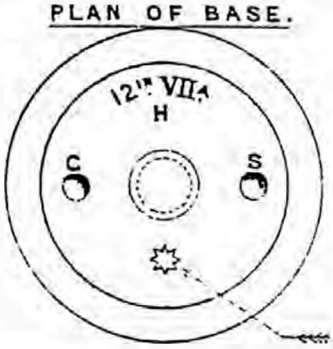
These shell are made of forged steel with solid bases so as to prevent any chance of premature action from the penetration of gas through a base fuze or between the plug and body of the shell. For future manufacture a plate steel disc will be inserted in the base sufficiently large to cover the bottom of

SHELL B.L. COMMON PAINTED, WITH CAP.

12IN HEAVY. MARK VII A



PLAN OF BASE.



TOTAL APPROXIMATE WEIGHT CAPPED, FILLED AND FUZED. 850 LBS.

SCALE 1/8.

the cavity in the shell as a further protection against premature action due to *piping* or other defect in the metal. They are fitted with flanged gunmetal bushes, countersunk to take the flange of a special plug, and the 9·2-inch have a hole in the side for the lifting bolt.

The interior of the shell is varnished with a hard brown varnish, and filled with lyddite, which is poured in while in a molten state, a cavity being left in the centre, by means of a "Former," on which is an asbestos cylinder. This cylinder is left in the cavity to contain the exploder, when the "Former" is withdrawn. The exploder consists of a cylindrical "Batiste" bag filled with dry mixed picric powder.

The bag is choked at one end, and on it is printed, in black, particulars of the weight, &c. of the picric powder. The bag fits into a waterproof paper cylinder in order to keep it dry, which is important. The top of the cylinder is closed by a perforated aluminium cap shellaced on, a disc of paper being shellaced inside. Earlier issues had a paper cap. The cylinder is fitted with a silk loop to facilitate its removal from the shell on examination. On it is marked in black its length, weight of exploder, D.M. if dry mixed picric powder is used, manufacturer's initials, ⅄, and mark, lot number and date of manufacture of the picric powder. A layer of kit composition is run in on the top of the lyddite to preserve its surface.

In earlier issues the bag containing the dry mixed picric powder was of shalloon.

Exploders which have been re-dried will have the word "re-dried" stencilled on the waterproof cylinders.

The above description of filling is applicable for all lyddite shell 4·7-inch and below.

Lyddite shell 6-inch and above are now filled on the "solid" system. No cylindrical cavity is left in the lyddite, but a slight depression is made at the top. The shell is then filled with exploders, consisting of 7 drams of picric powder enclosed in "Batiste" bags; the 6-inch taking generally 12 to 15, the 7·5-inch and above generally 8 to 10, but these numbers can be *increased* if necessary to bring the shell within the limits of weight as laid down.

These exploders are known as the Mark II.

The earlier method of filling these shell (6-inch and above) was the same as described for the 4·7-inch and below, but an 8-dram primer, consisting of R.F.G.^{2} powder, was placed on the top of the exploder and inside the waterproof cylinder, with the choke of the bag down.

Lyddite shell may be treated in the same way as fuzed powder filled shell, and no special precautions are necessary.

Lyddite shell are supplied empty, in the proportion of one to each nature of gun allowed lyddite, for instructional purposes.

Shrapnel Shell are manufactured for all guns 12-pr. and above.

They are issued for use with field mountings to the 12-pr., 8, 12 and 18 cwt., 4 in B.L. Mark VII. and 4-inch Q.F. guns.

The remaining stock are kept at the Naval Ordnance Depôts and are maintained in a serviceable condition for issue, if required, for special operations.

Shrapnel shell are made of forged steel.

They are designed to carry a large number of balls, and a small bursting charge which opens the shell; upon which the balls contained in the body of the shell continue their flight and disperse.

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

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

Shrapnel are to be fired with a full charge.

The 12-pr. 12 and 8 cwt., Q.F. Shrapnel Shell, Mark VIII. (Plate XIX.).—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 balls are contained in a cage. This cage consists of a tin cylinder which rests upon the steel diaphragm, and has perforations to let the balls 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 balls is fitted with molten resin.

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 gunmetal 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.

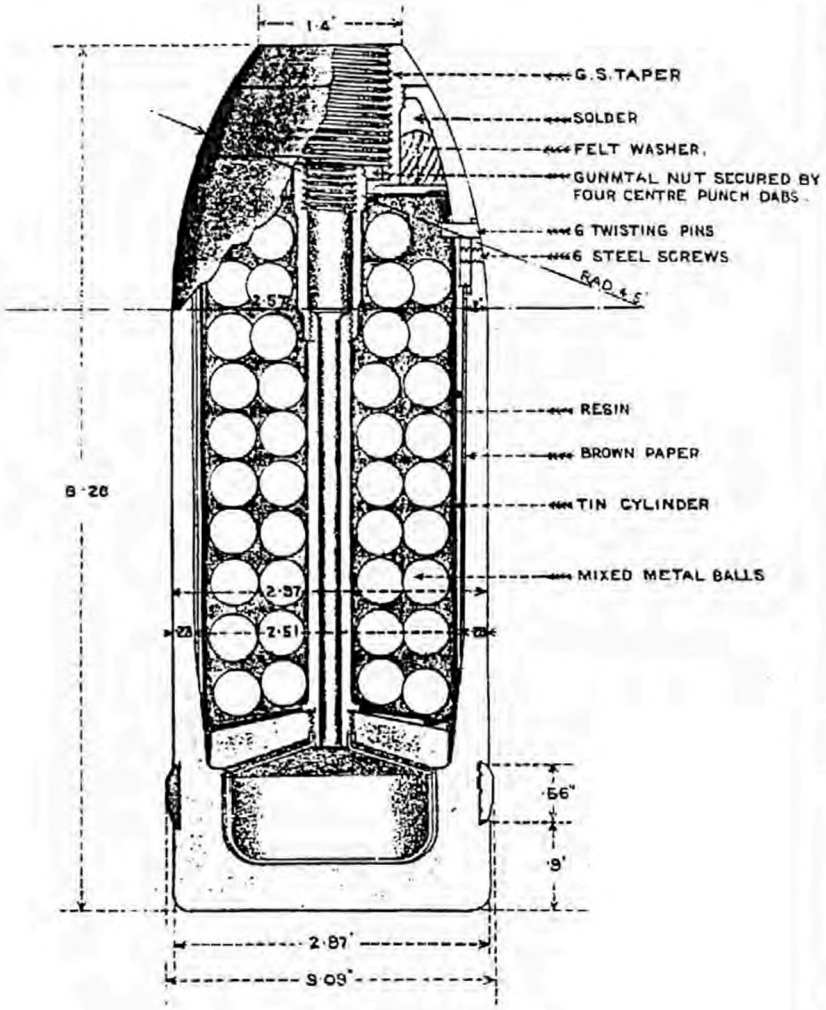
The driving band is plain, having a front and rear slope but no cannelures. It is pressed into an undercut groove near the base of the shell which has waved triangular ribs cut on it.

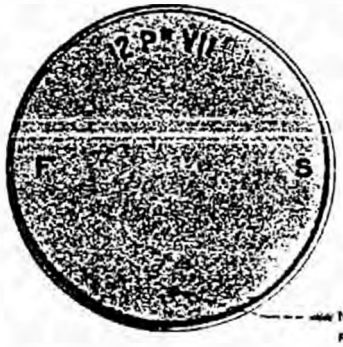
To convey the flash from the fuze to the bursting charge, a "Primer" is used, the top of which is solid, with a conical

SHELL O.F. SHRAPNEL, 12 PR 12 CWT. AND 8 CWT MARK VIII.

FORGED STEEL.

SCALE ½.

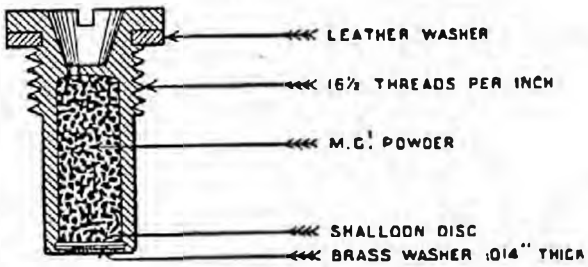




cup-shaped recess; the bottom of the cup is perforated with three small holes communicating, by loose powder, with the powder in the body of the primer. The bottom is closed by a thin annular disc of brass covered with shalloon.

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

Full size.



The 12-pr. and 14-pr. Q.F. Shrapnel Mark IX. (Plate XX.)—The body is made of forged steel with a shoulder, the base is left open and screw-threaded on its inside; a steel bush, threaded externally (left-handed) and recessed on its upper side for the tin cup containing the burster, closes the base and is kept from unscrewing by a steel fixing screw passing through the walls. A bronze disc rests upon the tin cup and into it is screwed a brass pipe; on top of the disc is placed another tin cup.

The shell is filled with mixed metal balls (7 parts lead, 1 part antimony), the interstices being filled with molten resin.

A gunmetal socket, threaded internally, screws into the head and is sweated on to the centre pipe.

A screw passing horizontally through the socket prevents the alluminium adapter, which is used in this shell, from unscrewing.

The burster consists of a perforated compressed pellet of powder. The flash from the fuze is conveyed to the burster by a number of compressed perforated powder pellets which fill the central tube.

The driving band is similar to that described for the Mark VIII.

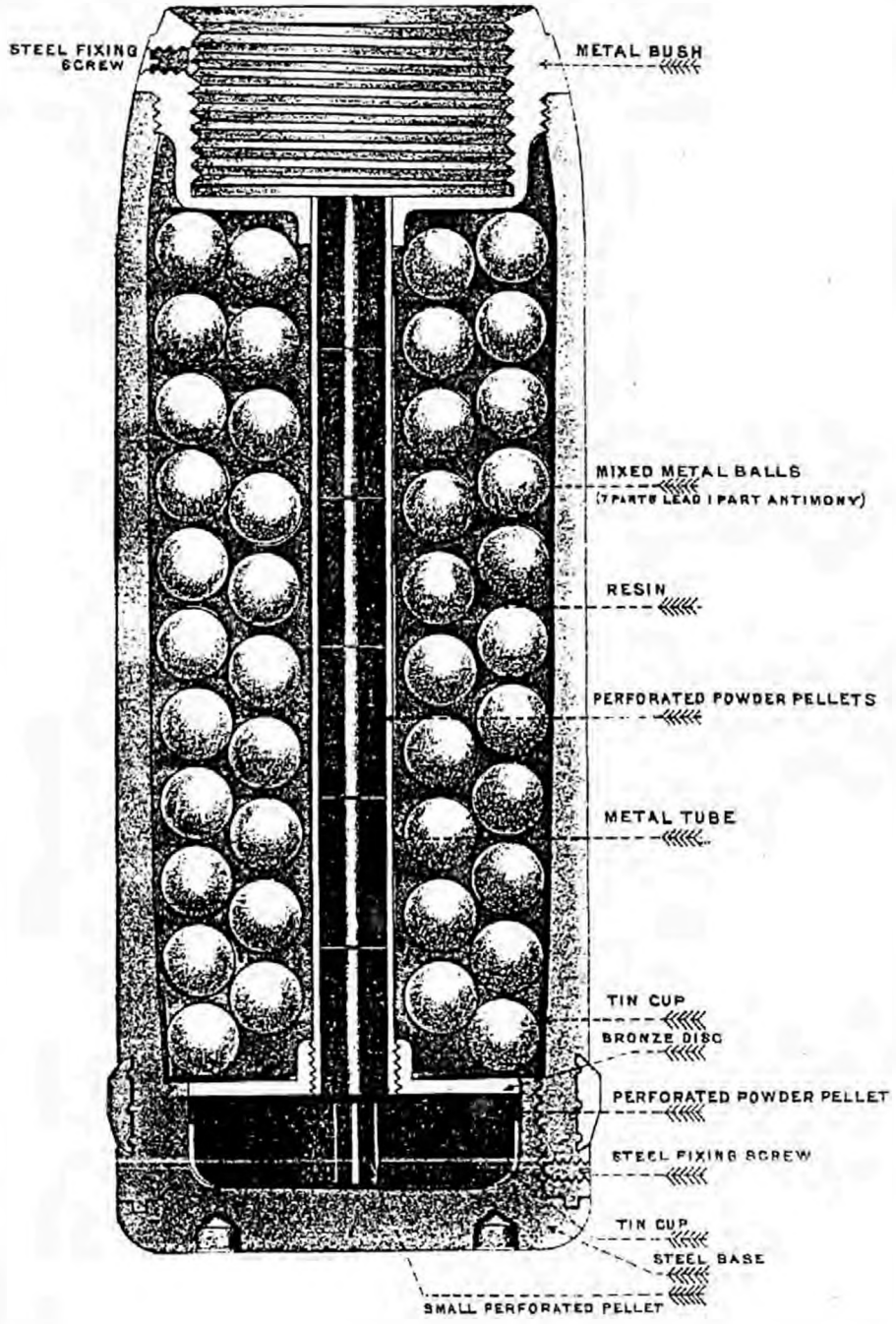
The weight of the shell empty is not stamped on the driving bands.

The 4-inch B.L. Mark VII. and VIII. Shrapnel Heavy Mark I. consists of a forged steel body and base, and a mild steel head forged separately. The body is recessed at the top to receive the head, and screwed internally at the bottom to receive the base.

The head is secured to the body by six steel screws, and six twisting pins, and is weakened by four saw cuts. It is screwed to receive a metal fuze socket, and is fitted with a wood block. The remainder of the shell is generally similar to that already described for the 12-pr. and 14-pr., except that the

SHELL Q.F. SHRAPNEL 12 PR AND 14 PR MARK IX.

FORGED STEEL.



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bursting charge consists of two perforated powder pellets. The weight of the shell is 31 lbs.

The shrapnel shell 4-inch light, which is similar in construction to the 12-pr. 12 and 8 cwt. shrapnel shell Mark VIII., is used for all other Marks of 4-inch B.L. or Q.F. guns. This shell weighs 25 lbs.

The later designs of shrapnel shell for the 9·2 and 12-inch guns are manufactured with solid bases; the walls of the shell are thick at the base, the metal being gradually reduced in steps to the front end of the body, to which is secured a thin cylinder which forms a junction between the body and the head.

The head, which is filled with wood, has in the top a 2-inch fuze socket screwed internally to take the time fuze (Plate XXVII.) which has a 2-inch gauge.

There are two kinds for each nature of gun, one having the head struck with a radius of 2 calibres and the other with a radius of 3¼ calibres in the case of the 12-inch and 3 calibres in the case of the 9·2-inch.

The bursting charge is contained in a tin cup at the base, the flash from the fuze passing down to it through an iron pipe. The shell is filled with steel balls.

Practice Projectiles are manufactured for all guns; they are made of iron cast solid, and are cast as near as possible to their final dimensions.

Projectiles sentenced to be used for practice, having base plugs, will, before being fired from Q.F. guns 12-pr. and above, have the keyhole filled with a wood plug to prevent the metal lids of Q.F. cartridges adhering to the base of the projectiles.

Practice projectiles are also supplied for use at "Loading Teachers." When they should not be used for any other purpose.

DISTINGUISHING MARKS ON PROJECTILES.

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

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

Steel common shell which can only be used in the the 12-pr. 12 and 8 cwt. guns are painted lead colour to distinguish them from those which are common to all 12-pr. and 14-pr. Q.F. guns.

Lyddite common shell are painted yellow to distinguish them from other projectiles, and all the distinguishing marks are in "black" excepting the "red" band denoting "Filled."

4·7-inch Lyddite shell and below are marked with "— " oz. exploder, monogram of station and date of filling; on the reverse

side is also stencilled a rectangle, denoting that the exploder is placed inside a waterproof cylinder; "D.M." indicating that the exploder is dry mixed picric powder contained in a "shalloon" bag; but if the exploder is contained in a Batiste waterproof bag, "II." is stencilled inside the rectangle instead of "D.M."

The letter "A" on top of the rectangle indicates that the waterproof cylinder is closed by an aluminium cap.

"K. C." underneath the rectangle denotes that "Kit Composition" was used.

Lyddite shell 6-inch and above filled before 1904 are marked as described above, but have in addition a black disc, denoting that an 8-dram primer of R.F.G.$_2$ powder is used with the exploder.

Lyddite shell 6-inch and above, filled on the "solid" system, have stencilled:—

Monogram of station and date of filling with 7-dram exploders, II.

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 with the word "fuzed." 3 and 6-pr. have the mark of the fuze and the word "Fuze" stencilled on them.

The nature of powder used for the bursting charges of filled shell is denoted by being stencilled on them as follows:—

"P" if pebble mixture is used.

"L G" if Large Grain is used.

"Q F" if Q.F.$_1$ powder is used.

The letter "N" on the shell means Naval Service.

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.

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.

The letter "H" stamped on the base of projectiles, and stencilled in white on the shoulder, signifies "Heavy."

Shells of the same nature are now being manufactured with heads of different radius, and, in order to readily distinguish the one from the other, the following marking has been adopted, viz.:—

1. Shells with 2-calibre radius heads will be marked as before; thus: I., II., &c.
2. Shells with (approximate) 4-calibre radius heads will have the letter "A" added to the mark; thus: IA., IIA., &c.
3. Shells that may be introduced with heads of greater radius than 4 calibres will have the letters "B," "C" added to the mark; thus: IB. (say) 6-calibre radius, IIC. (say) 8-calibre radius.

Driving Bands.

Driving bands are used to rotate projectiles, about their longer axis. They are made of copper, or an alloy of copper, larger in diameter than the bore of the gun; consequently, when the gun is fired, the copper is forced into the grooves of the rifling and cut into by the lands, thus giving rotation to the projectile during its travel along the bore.

The driving band should be as near the base of the projectile as possible, it being generally found that the more rearward position of the band gives the most accurate shooting. In practice, however, this is limited by the thickness of metal behind the band which is necessary to support the great strain thrown upon the shell, when the band is forced through the grooves, tending to tear off the base.

The "Vavasseur" driving band was the earliest type and was fitted on all projectiles. It is now only used for the 3 and 6-pr. Q.F.

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.

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 front part of the band is 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 (Fig. I.)

The "Gas-Check" driving band (Fg. III.) superseded the above type, for 6-inch and above, and, as its name implies, is 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. The Gas-check driving bands vary, according to the gun they are intended for, in the shape and size of the grave.

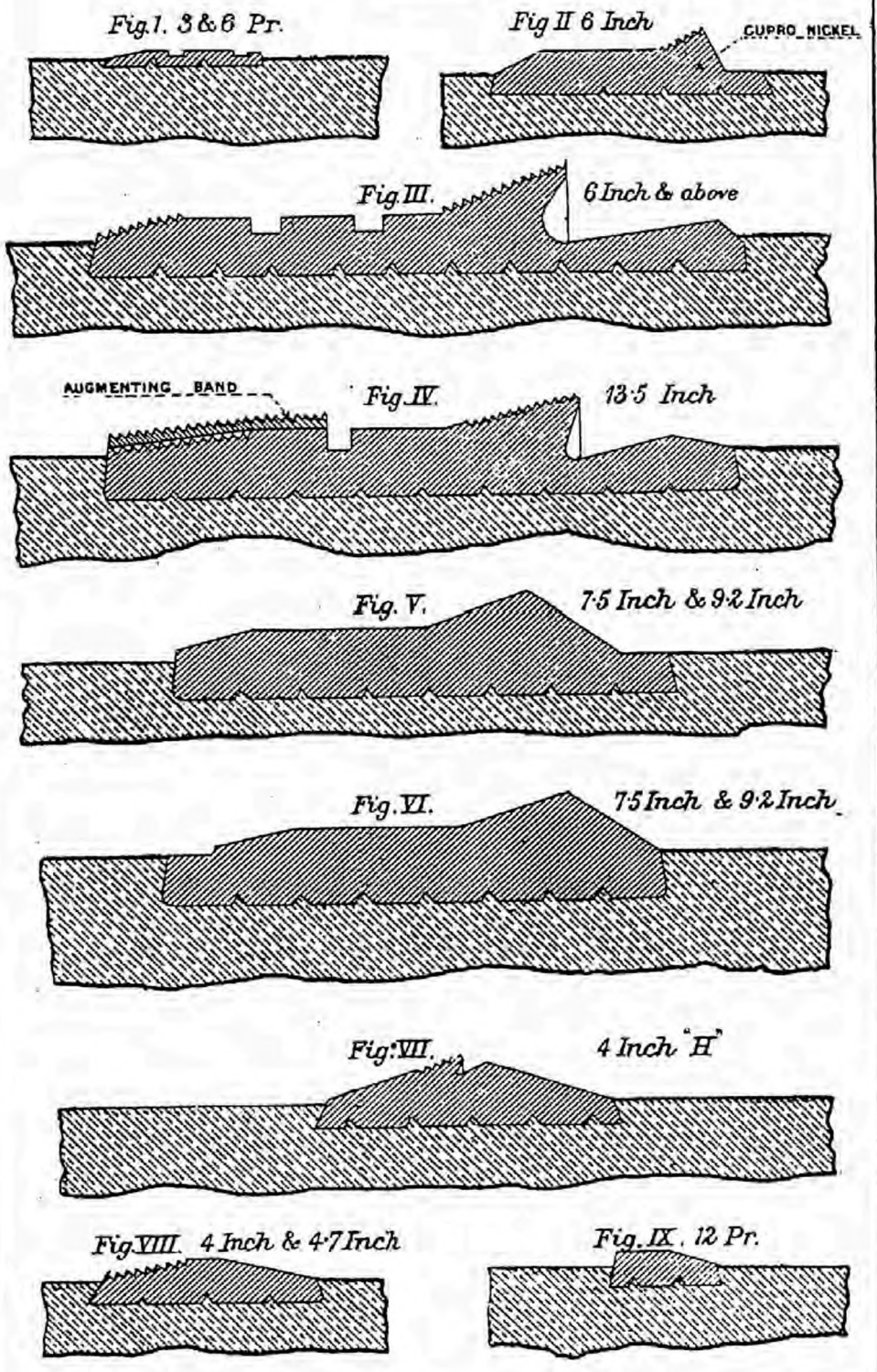
When the projectiles with this type of band are fired from the later 9·2-inch B.L. guns, they are fitted with an augmenting ring of copper in the grave of the Gas-check, which is fitted at the Naval Ordnance Depôts before issue.

Cupro-nickel bands (Fig. II.), composed of 95 parts of copper and 5 parts of nickel, were introduced for the 6-inch and 7·5 inch, but, in order to keep the ammunition for the 45 and 50 calibre guns interchangeable, the 7·5-inch projectiles have been rebanded with copper bands.

To face page 76.

TYPES OF DRIVING BANDS

FULL SIZE



The latest type of band (Fig. V.) for the 7·5-inch and 9·2-inch is the "Hump," made of pure copper, and known as the "Broad Copper Band."

It is, however, unsuitable for the "practice" shot, so the base of the shot is slightly reduced in diameter, and the groove placed slightly farther forward on the projectile to take the copper band (Fig. VI.).

"Narrow" copper driving bands are used for 12-pr. 4-inch and 4·7-inch (Fig. VIII.). They are similar to the "Broad" band, but have no hump.

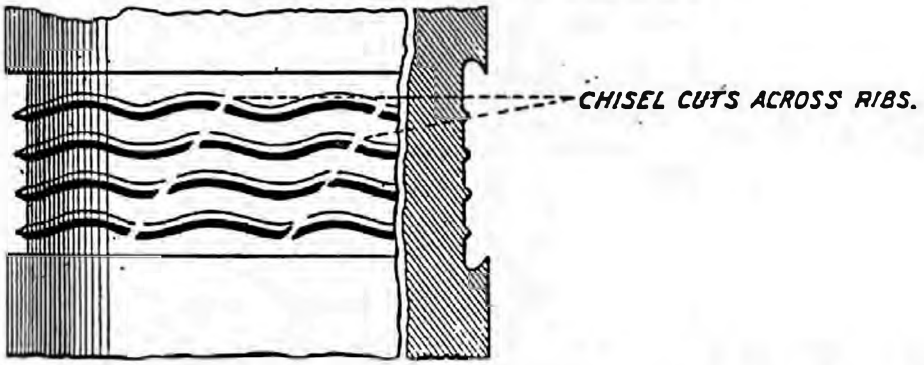
The copper driving band for the 4-inch "H" projectiles has a gas-check (Fig. VII.).

The groove in all projectiles for the driving band is 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.

The groove is also formed with waved ribs, which are continuous, except for diagonal chisel cuts across them in three places, to allow the air in the channels between the ribs to escape when the band is being pressed in.

Into this groove the band is forced by a powerful press and afterwards turned to exterior dimensions.

Method of attaching Driving Bands.



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 some of the driving bands, 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.

Band Augmenting B.L. 13·5-inch Projectile, Mark I.

When the 13·5-inch B.L. guns become so much worn that there is a tendency for the projectile to slip back on loading, a copper "augmenting band" (Fig. IV.) is used. Augmenting bands are never to be used in a new or comparatively new gun,

and they can easily be removed from any projectile to which they have been fitted. For placing the augmenting band in position, a steel tappet ring is supplied.

To fit the band, place the projectile on its base and slip the augmenting band on as far as it will go. Tap the augmenting band gently with the ring, until it comes into contact with the front of the driving band. The augmenting band is then in position.

They are only to be used with projectiles fitted with gas-check driving bands.

Rings Augmenting for B.L. 9·2-inch Projectiles with Gas-check Driving Bands.

In order to make the Service 9·2-inch projectiles fitted with gas-check driving bands range as near as possible to those fitted with the "Hump" band, it has been arranged to fit copper rings in the grave of the band in rear of the gas-check.

There are two designs of ring, one for projectiles having the bottom of the grave sloping up to the rear, and one for projectiles having the earlier form of this band with the bottom of the grave parallel.

Existing iron projectiles with gas-check bands *are not* to be fitted with these rings, but practice shot will be manufactured with the band in a different position and fitted with them for supply to ships where the Service projectiles are similarly fitted.

Where it can possibly be avoided, projectiles with gas-check bands and augmenting rings and those with "Hump" bands are not to be on board the same ship.

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.

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

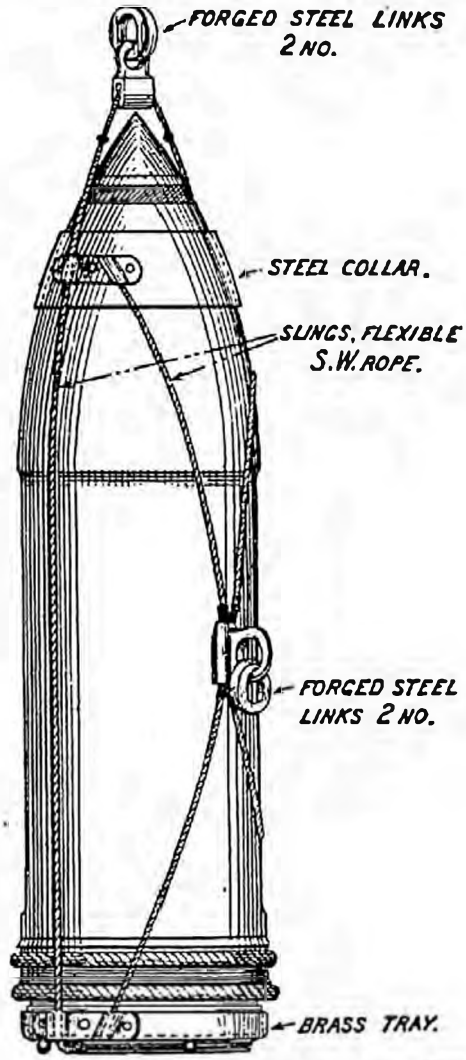
The bolts are made with a thread on the shank to screw into the hole in projectile, which is also threaded.

"Grabs" are supplied for lifting projectiles at the later 12-inch, 9·2-inch, and 7·5-inch B.L. guns.

When projectiles are being hoisted by "grabs" they are always to be in a horizontal position.

For lifting projectiles end on through scuttles, or for transporting horizontally, compound *slings* are supplied to 7·5-inch and above B.L. guns.

Compound Slings.



When using these slings the following precautions are to be observed:—

(*a*) The projectile should be triced up to the end-on position clear of a hatchway or other opening, so that if any failure occurs the projectile will not drop down the opening. If the horizontal sling is used when lowering a projectile through a series of hatches, care should be taken to prevent it swinging, and the lugs on the base plate catching the coamings of the hatch, as this is liable to displace the base plate sufficiently to allow the projectile to fall out.

(*b*) Where possible the projectile should be hanging by the centre sling, strop or bolt before taking the weight with the end-on sling, so as to reduce the strain on the latter.

(*c*) The slings should be kept in as dry a place as possible and carefully examined, both before and after use, to see that they are in good condition. They should be landed for examination after having been three years in the ship.

Projectile Gauges.

For B.L. and Q.F. guns, two ring gauges are supplied, one for the body and one for the driving band.

As long as there is a liability of different descriptions of driving bands being supplied, a gauge for each type of band will be supplied.

Projectiles should be gauged when first received, and those kept in bays of the shell room every 12 months; those which may be kept in deck racks or armoured lockers, every six months. They are always to be gauged before firing. Where projectiles are stowed with grummets on, the bands need not be gauged periodically, but bodies should be.

Shell are to be carefully examined when being 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 for each gun is supplied to each shell room.

At the same time as projectiles are gauged, the pressure plates of base fuzed shell are to be carefully examined, and if found damaged they are to be handled with great care, and a report of the same is at once to be made to the Gunnery Officer.

General Remarks on Stowage of Projectiles.

All projectiles are supplied and transported to a ship in bulk, excepting pointed shell for 4·7-inch and below, which are supplied in boxes.

All pointed shell, 6-inch and above, fitted with the Mark II. base percussion fuze No. 11, will be fitted with a fuze protector to protect base of fuze during transport.

All projectiles 4-inch and above are provided with rope grummets to protect the driving bands.

When receiving projectiles, where possible, the 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 into store when removed from the projectiles on board.

Before returning base-fuzed shell, a sufficient number of boxes and fuze protectors should be drawn, if required, and the shell should be put in the boxes or the fuze protectors put on, as the case may be, if possible, before removing the shell from the shell-room.

In returning base-fuzed shell without steel protecting plates, the shell are to be individually examined to see that the pressure plates of the fuzes have not been indented immediately prior to placing the fuze protectors on them, or, if boxes are used, immediately before placing them in their boxes. In no case are shell to be embarked or disembarked in canvas bags without having the fuze protectors in place.

Base-fuzed shell are never to be stowed in the bays base to point.

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.

When projectiles are stowed with their grummets on the sword matting packing will be dispensed with.

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.

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.

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."

Pointed shell 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 the Gunnery Officer.

CHAPTER X.

Fuzes.

The bursting charge of a shell is ignited by means of a fuze constructed so 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.

A decrease in atmospheric pressure increases the time of burning of time and percussion fuzes, the rough rule being that one inch fall of the barometer will give an increase of 1/30 to the time of burning.

The advantages of pointed shell with base percussion 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. Base percussion fuzes are supplied in the shell, with 2 per cent. spare.

Time, and time and percussion fuzes are used for shrapnel shell.

They are supplied separately and have to be fixed into the shell before loading, and in all cases a safety arrangement has to be removed before entering in B.L. or Q.F. guns.

Direct action impact percussion fuzes are used for lyddite shell.

They are supplied separately.

Fuzes are kept in the shell-room.

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 III. and IV.	3	Nose-fuzed common.	B.L., Q.F.	
Hotchkiss base percussion, Mark IV.	—	3- and 6-pr. cast steel common.	Q.F.	

Fuze.	No. of Fuze.	Nature of Shell.	Guns.	Remarks.
Base percussion, large, Marks I. to V.	11	Uncapped A.P. and pointed common for 6-inch and above.	B.L., Q.F.	
Base percussion, large, Marks I., II. and III.	15	Capped A.P. and common shell and may be used for uncapped A.P. and pointed common shell.	B.L., Q.F.	
Base percussion medium, Marks I. to VII.	12	Pointed common for 12-pr. to 4·7-inch.	B.L., Q.F.	
Direct action impact percussion, Mark IV.	13	Lyddite common for all guns using this shell.	B.L., Q.F.	

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.	
Time and percussion, Mark I.	63	Shrapnel shell for the 12-pr. and 4-inch.	Q.F.	This fuze supersedes the No. 56.
Time and percussion, Mark II.	62	Shrapnel shell for 4-inch B.L., Marks VII. and VIII.	B.L.	
Time fuze for heavy shrapnel.	30	Shrapnel shell for 12-inch B.L. 9·2, 7·5 and 6 inch.	B.L. and Q.F.	2-inch gauge.
Time fuze for heavy shrapnel.	26			G. S. gauge.

Fuze, Percussion, Direct Action, with Plug, No. 3, Mark IV. (Plate XXI.).

The direct action is an impact fuze, but it will act on graze provided the angle of incidence 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 gunmetal, 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 about 63 grains of F.G. gunpowder,

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.

The top edge of the body has two slots cut in it to take the projecting arms of the "Key, fuze, universal," by which it is screwed into the shell. The upper portion is bored out and screwed left-handed to take the screw plug for needle disc, screw collar, and safety plug. Below this the centre of the body is recessed for the detonator, and immediately under this recess is a fire-hole communicating with the blowing charge in the lower part. A paper disc prevents the powder working up the fire-hole.

The detonator is known as the R.L. cap and is made of copper, the top is cut out and the opening closed by a thin brass disc. It contains about 3½ grains of cap composition pressed, varnished, and covered by a tinfoil disc. The bottom is closed by a disc of copper pierced with four fire-holes, and secured in position by six lugs on the cap proper, bent down on it.

The screw plug for needle disc is threaded so as to screw into the body, and is recessed. It is slightly coned at the bottom, and has a hole through the centre. Two holes are drilled in the top so as to screw the plug into the fuze. The needle disc is of copper, with a single-pointed 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.

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 to take a key.

The safety plug screws into the top over the screw collar and prevents accidents in transport and storage. It must be removed at the moment of loading; for this purpose a slot is cut across the upper surface of it. The top is marked with an arrow and the word "unscrew," showing the direction to turn. The flat arm of the "Key, fuze, universal" will fit the slot in the safety plug.

The exterior of the fuze is lacquered, and the fuze is carefully waterproofed, by putting a little Pettman's cement on the threads of the plug for needle disc, edge of needle disc, screw collar and bottom plug before screwing them in, and finally painting the top of the fuze below the safety plug with the same cement, so as to completely cover the needle disc; the bottom of the fuze, also, is completely painted over.

The weight of the fuze, without safety plug, is about 5 oz., weight of plug, about 6 drs.

The fuze, being prepared by simply removing the safety plug, is quiescent in all its parts till direct impact takes place, or graze at such an angle that the nose of the shell enters the ground. Earth or water entering the head crushes in the needle disc, the needle pierces the detonator and fires it, the flash

passing through the fire-hole to the magazine and down into the shell through the bottom plug.

The head of the needle being some distance below the head of the fuze makes the fuze safe in loading.

No. 3, Mark III., differs from Mark IV. chiefly in the detonator and fire channel.

There are nine conical fire-holes filled with mealed powder; on the upper side the metal is recessed and fitted with a tinfoil disc, the 3½ grains of detonating composition covered by a thin brass disc, held in position by a copper washer, over which the metal is spun.

It also has a jagged needle, and the magazine contains about 75 grains of powder.

Base Percussion Fuzes.

Fuze, Percussion, Base, Large, No. 11, *Mark V.* (Plate XXII.).

The principal parts of the fuze are :—Body, steel protecting plate, pressure plate with spindle, detonator pellet, centrifugal bolt, retaining bolt, locking pellet with spiral spring, detonator plug with detonator, brass ball with retaining pellet and spring, phosphor bronze spring, and screwed cap.

The body is made of manganese bronze and is screw-threaded (nine threads per inch left-handed) for a length of 1·75 inches. Below the screwed part a flange is formed, which is coated with Mark III. luting, to make a gastight joint when screwed home into the base of the shell. The body is bored out to receive the percussion arrangement, and screw-threaded to take the screwed cap. The percussion chamber is coned towards the bottom and terminates in a small seating, sealed by a small brass ball.

A flash hole, bored radially through the body, forms a communication from the ball seating to the bottom of a vertical channel, filled with five perforated powder pellets, which in turn communicates with an annular groove formed in the upper part of the body.

This groove is filled with pressed pellet powder (about 110 grains), and is recessed on the underside to facilitate ignition.

A hole is bored in the body, a little above, and at right angles to the flash-hole, into which is placed a small retaining pellet with spiral spring. This pellet is pressed inwards by the action of its spring, and, bearing against the brass ball, keeps the latter on its seating.

In the base of the fuze, to one side and clear of the percussion chamber, a vertical hole is bored for the pressure plate spindle. The lower part of this hole is enlarged to take a gas check pressure plate, and below this it is screw-threaded for the steel protecting plate.

The detonator pellet is made of gunmetal, cylindrical in shape, the lower part being slightly tapered to fit the bottom of the percussion chamber. An angular flange on the lower end of the pellet which fits into an annular groove in the body assists in preventing the flash from the detonator, should it be prematurely fired, passing to the channel in the lower part of the body until the pellet is moved forward on graze or impact.

A groove is formed round the front edge of the pellet to support a phosphor bronze spiral spring, and in the centre it is bored out and screw-threaded, to take the detonator plug.

The detonator plug is made of gunmetal, screw-threaded, and recessed on the under-side to take the detonator; it is screwed into the front end of the pellet.

The detonator consists of a copper cap, pierced with four fire-holes. In the bottom of the cap, covering the fire-holes is placed a tinfoil disc, on to which is pressed $3\frac{1}{2}$ grains of detonating composition, this is varnished and covered with a brass disc and a copper washer. It is retained in position by six lugs on top of the cap which are burred over on to it. The detonator plug is prevented from working loose by being stabbed in the pellet in three places.

Leading from the detonator plug is a channel which is bored at first vertically, then diagonally through the pellet. This channel communicates with the lower part of the percussion chamber, just above the annular flange on the pellet. Passing through the detonator pellet at right angles to its longer axis, is a centrifugal bolt, one end of which is larger than the other; the small end fits in a recess in the body, and in this position the bolt masks the fire channel in the pellet. The centrifugal bolt has a hole bored through it, and when spun out by the rotary motion of the shell, there is a clear channel through the pellet and bolt. A small brass pin projecting from the head of the bolt into the pellet prevents the former from turning, and so ensures the flash hole or channel being clear when the centrifugal bolt moves out.

In a small hole bored in the body, between the upper part of the recess for pressure plate spindle and the percussion chamber, is a small retaining bolt. The inner end of this retaining bolt bears against the enlarged head of the centrifugal bolt in the pellet: the outer end is recessed to allow it to move outwards round the small part of pressure plate spindle when this has been moved forward on discharge, thus releasing the bolt in the pellet.

The pressure plate and spindle are made of copper in one piece. The plate is formed with a gas-checked lip which fits into an undercut recess formed in the body. The spindle is about 1·75 inches in length; near its upper end it is reduced in diameter, so as to give a clearance for the recess in the small retaining bolt, when the spindle has been moved forward on discharge. When placed in position the pressure plate spindle

prevents the bolts from moving outwards, and thus keeps the detonator pellet in place.

The protecting plate is made of steel and is screw-threaded and recessed to fit over the pressure plate; it has four holes bored through it, to allow the pressure of the gas on firing to act on the pressure plate, and is prevented from unscrewing by being stabbed in three places.

To prevent any rebound or setting back of the detonator pellet on impact or graze, after it has been carried on to the needle, and so masking the flash from the detonator to the powder channel, a small locking pellet with spiral spring is inserted in the detonator pellet. When the detonator pellet moves forward, the locking pellet is pushed out by its spring into the recess in the body, vacated by the small end of the centrifugal bolt. A small screw pin, projecting from the body of the fuze, engages in a groove in the detonating pellet, thus preventing it from turning during flight.

The phosphor bronze spring resting in the groove in the front end of the detonating pellet, prevents the latter from moving forward on to the needle during flight.

The screwed cap is of bronze, flanged to fit over the end of the fuze body. The boss on the underside of the cap is screw-threaded to screw into the body of the fuze, and has a steel needle snapped into it, which comes directly in front of the detonator. The flange of the screwed cap is pierced with six holes to allow the flash from the powder ring, in the annular recess to pass into the shell; these holes are closed by a paper washer shellaced to the underside of the flange. The cap is prevented from unscrewing by a set screw. There are two elongated holes in the base of the fuze to take the key, "base fuze and plug."

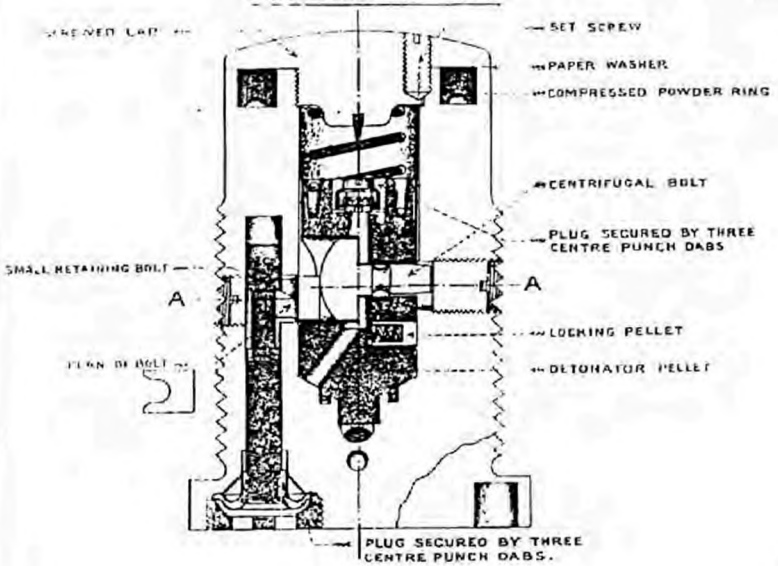
It is stamped on the base with an arrow indicating the direction for screwing it into the shell, the lot number, manufacturer's initials, date of manufacture number, and numeral of fuze.

Action.—On discharge, the gas, acting through the holes in the protecting plate, forces the pressure plate in, carrying forward the spindle and thus freeing the small retaining bolt. The rotary motion of the shell causes the retaining bolt for pea ball, centrifugal and small retaining bolts to fly outwards, leaving the detonating pellet free to move forward, which it does on graze or impact, compressing the phosphor bronze spring. The locking pellet, by the action of its spring, is forced into the body, and prevents any rebound action. The ball now being free rolls outwards, unmasking the flash-hole. The detonator coming into contact with the needle, is ignited, the flash passing through the detonator pellet and flash-hole, ignites the perforated powder pellets, which in turn ignite the powder ring. The flash then passes through the fire-holes into the shell and bursts it.

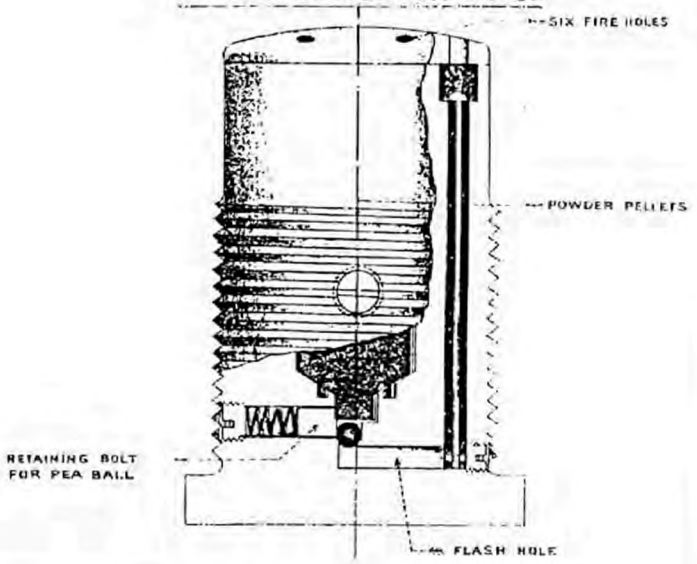
FUZE, PERCUSSION, BASE, LARGE Nº II. MARK V.

FULL SIZE.

SECTION AT B.B.

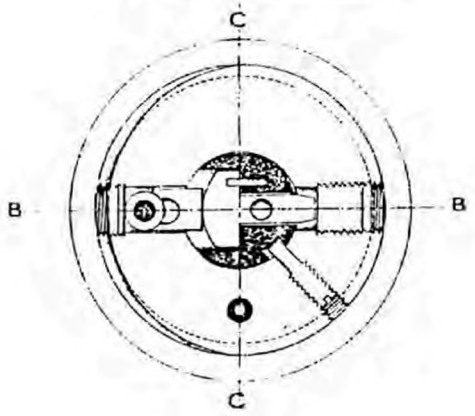


PART SECTION AT C.C.



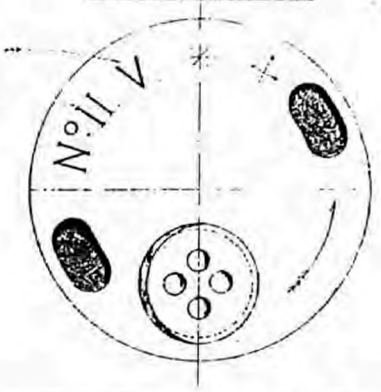
* MANUFACTURER'S INITIALS OR RECOGNISED TRADE MARK.

SECTION AT A.A



† LOT NUMBER.

PLAN OF BASE.



Base Percussion, Large, No. 11, *Mark IV.* (Plate XXIII.).

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.

The body is made of manganese bronze and is screw-threaded (nine threads per inch left-handed) for a length of 1·65 inches the remainder above the screwed part being left plain; it has a flange below the screwed part which is coated with Mark III. luting to make a gas-tight joint with the shell. The interior is bored out to receive the needle pellet, and threaded at the top to receive the screwed cap ; a hole is bored in the base through which passes the pressure plate spindle, the base being recessed to take the pressure plate and steel protecting disc. A hole is bored through the side of the body, and is closed by a brass screw plug, the end of which is reduced in diameter, and on it fits a fine brass spiral spring, this keeps the bolt in position till acted upon by centrifugal force ; a recess is also made in the opposite side of the body in which the small end of the centrifugal bolt engages ; two elongated holes are made in the base for screwing it into the shell. It is stamped on the base with similar information to that on the Mark V.

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 its axis, in which fits the centrifugal bolt, and another along its axis, from the top, in which works the nut of pressure plate spindle, this hole being reduced in diameter at the bottom of the pellet for the spindle to pass through. The upper part is threaded to receive the needle plug, which is prevented from unscrewing by the metal of the pellet being spun over it. There is a small groove in the side of the pellet, into which a screw projects from the side of the body, preventing the pellet from turning during flight.

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 recess inside the body. A hole is bored through it from top to bottom, the upper surface on one side of the hole being recessed for the nut on the spindle to grip, this locks the bolt, and makes the fuze perfectly safe till set in action.

The protecting plate is made of steel, slightly countersunk on the upper part, having 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, the metal of the body being spun over to secure it.

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.

The pressure plate spindle is threaded at both ends, one end screws into the boss on the pressure plate, 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.

The screwed cap is in two parts, screwed together and prevented from unscrewing by a locking screw, the two parts together forming a magazine holding a pressed pellet of R.F.G.^{2} powder with a hole through the centre, a disc of muslin is shellaced between the powder and the upper part of cap to prevent the powder working through the four fire-holes, through which the flash passes into the shell. A recess is made in the under side to receive the R.L. cap, 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.

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.

The Mark III. fuze is in every way similar to the Mark IV., except that the centrifugal bolt does 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.

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*.

The Mark I. fuze differed from the Mark II. in 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 is added, and it is called Mark I**.

Fuze, Percussion, Base, Large, No. 15, Mark III.

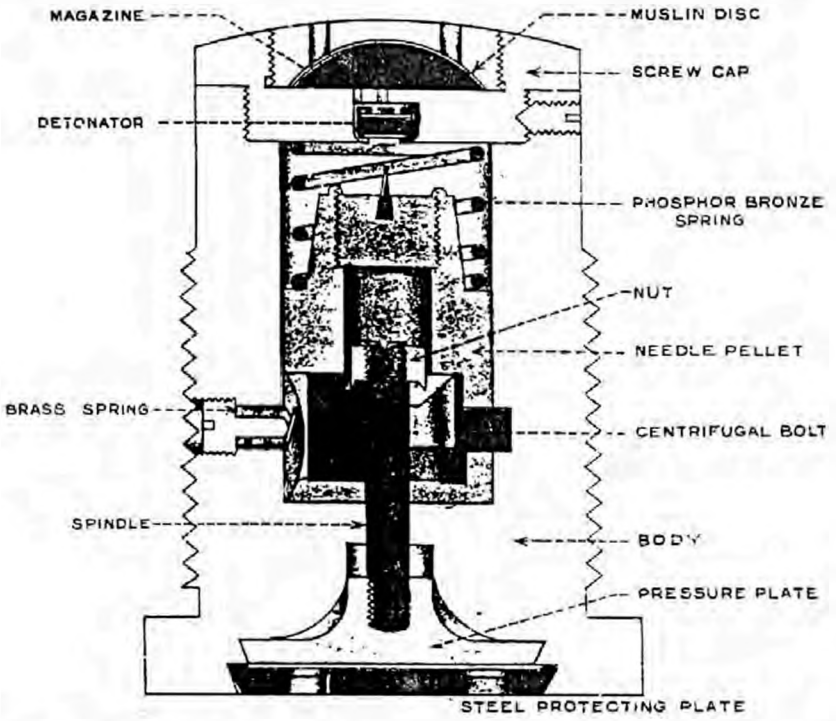
This fuze is identical with the No. 11, Mark V. (Plate XII.), except that it is made of aluminium bronze. It is for use with capped A.P. and common shell only, but could be used with uncapped A.P. and pointed common shell.

The Mark II. Fuze (Plate XXIII.) is similar to the No. 11, Mark IV., excepting the following:—

1. It is made of aluminium bronze.
2. The fuze is slightly longer.

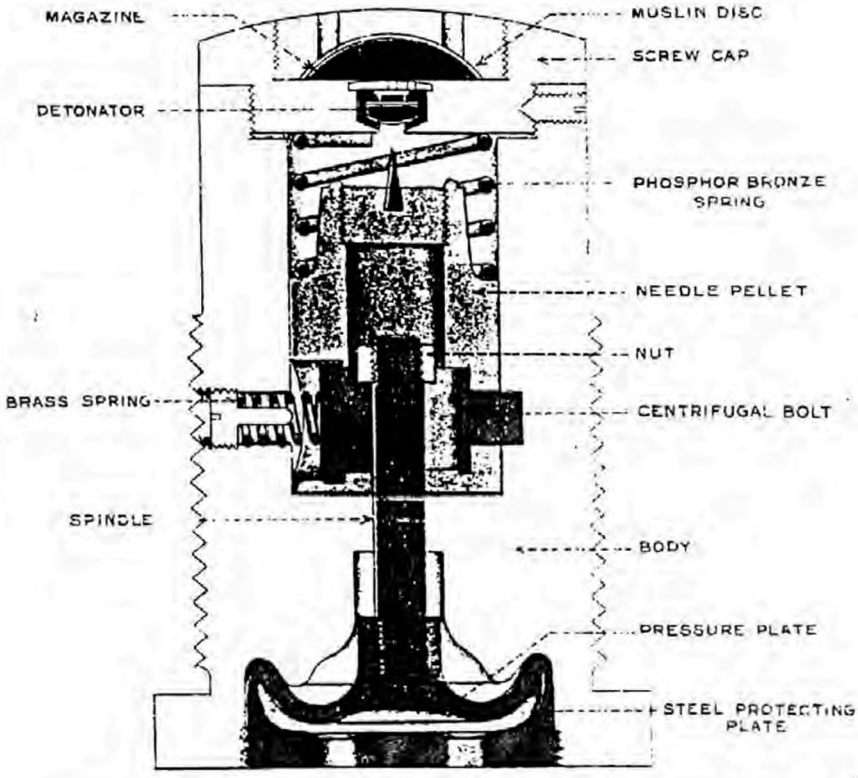
FUZE, BASE, PERCUSSION LARGE No11 MARK IV.

FULL SIZE.



FUZE, BASE, PERCUSSION LARGE No15 MARK II.

FULL SIZE.



3. The pressure plate is of an improved design, having a lip to form a gas check.
4. A modified form of steel protecting plate, having four instead of eight perforations.
5. An improved form of locking nut, which locks the bolt more securely.
6. The detonator is placed in position from the top of the screwed cap, and retained in position by a brass disc with six fire holes.

The Mark I. fuze is of aluminium bronze, and with this exception is identical with the No. 11, Mark IV.

Fuze, Percussion, Base, Medium, No. 12, Mark VII.

This fuze is similar in construction and action to the base percussion, large, No. 11, Mark V., but is smaller, and screwed outside 12 threads per inch instead of nine.

The Mark VI. Fuze (Plate XXIV.) is similar to the base percussion, large, No. 15, Mark II., except as follows :—

1. It is made of manganese bronze.
2. The pellet carries a detonator instead of a needle plug.
3. A needle plate with steel needle, is placed between the detonating pellet and screw cap, containing the magazine.
4. There are two safety bolts which pass through holes in the needle plate, and screw into the front end of the detonating pellet. These safety bolts have enlarged heads, and seal the passage between the detonator and magazine, until graze or impact, when the detonating pellet carries them forward.

The Mark V. Fuze is similar to the Large, No. 15, Mark II., except that it is made of manganese bronze.

The Mark IV. Fuze is similar to the Large, No. 11, Mark IV., except that it has an enlarged head on the heavy end of the centrifugal bolt.

The Mark III. Fuze is similar to the Large, No. 11, Mark IV.

The Mark II. Fuze is similar to the Large, No. 11, Mark III.

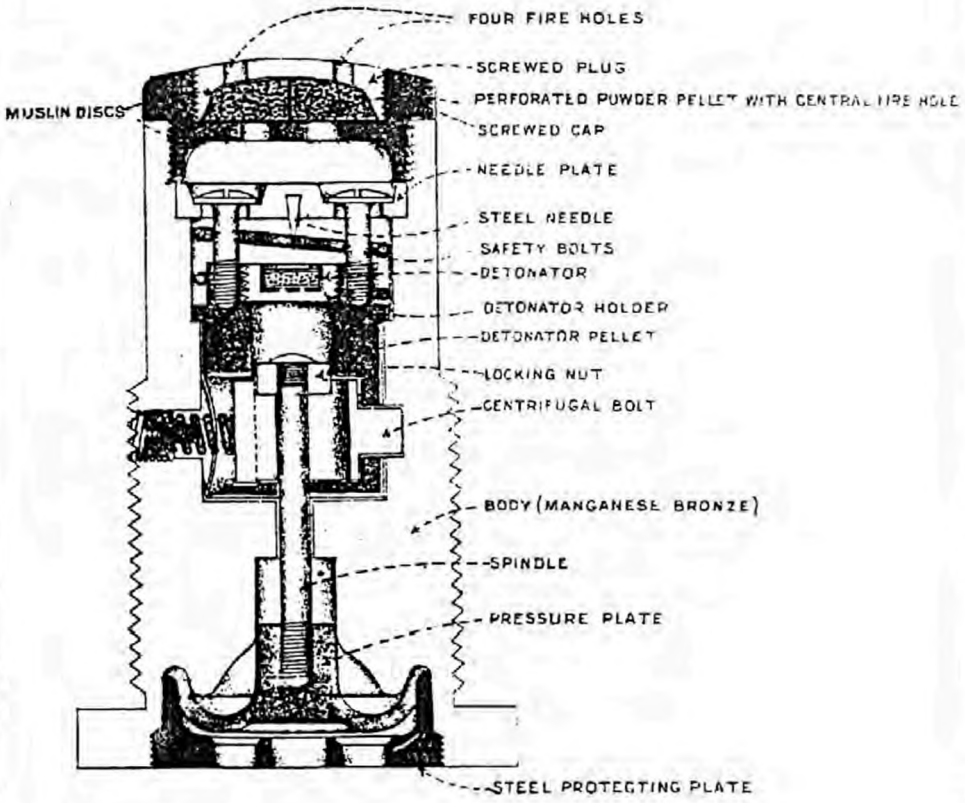
Note on Base Percussion Fuzes.

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.

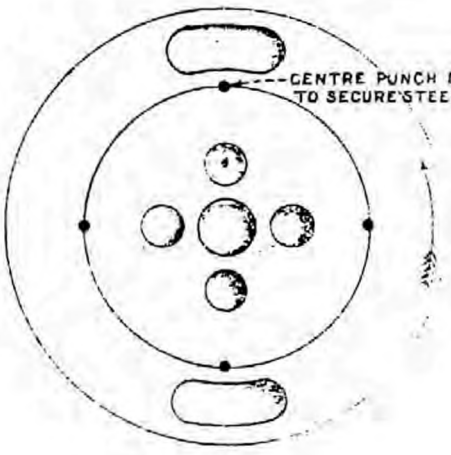
Base percussion fuzes, large and medium, which have worked loose, *and this may be expected to occur*, are to be screwed up with the "base fuze and plug key." No other

BASE PERCUSSION FUZE

Nº 12 MARK VI.



PLAN OF BASE



FULL SIZE

implement is to be used on any account whatever. Care is to be taken to see that large or medium base percussion fuzes are always screwed hard up before firing. This is always to be done at the same time that the projectiles are gauged before firing.

Fuzes before being screwed into shells will be lubricated with thin luting (half Mark III. luting, half mineral jelly) on the screw threads, and unthinned luting under the flange. They should be screwed hard home.

Before issue the top and bottom of the fuze are painted red with Pettman cement.

Fuzes, percussion, base, large, No. 11 and medium, No. 12, which become unserviceable as such, will be used as plugs when required, in salt-filled or empty shells.

The fuzes will be prepared for this use by removing the magazine plug and detonator, breaking the needle, and stamping the word "empty" on the base.

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.

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 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 operations 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.

Direct Action Impact Fuze.

This fuze is used in all lyddite shell.

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 Gunnery 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 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.

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. 63, Mark I.
T. and P., No. 56, Mark IV.
T. and P., No. 62, Mark II.

Time and Percussion, No. 63, Mark I. (Plate XXV.).

This fuze is used for the shrapnel of the 4-inch and 12-pr. Q.F., and consists of the following parts:—Body, percussion pellet with steel needle and centrifugal bolt, spiral spring, detonator plug,

safety pellet, brass ball, bottom plug, two composition rings, dome, brass washer, cap, two safety pins, a felt washer below each time ring, and a leather washer. The body, composition rings, percussion pellet, detonator plug, bottom plug and cap, are made of gunmetal. The dome, washer, ball, safety pellet, and spring are made of brass.

The time safety pin is made of phosphor bronze wire, and the percussion safety pin of split copper wire.

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 making the joint tight.

Above this again the body terminates in a stem, the top of which is threaded to receive the cap, and has two grooves cut in it to receive the feathers on the brass washer.

Two brass pins are secured into the stem, which engage with slots in the upper composition ring and prevent it turning.

In the enlarged diameter of the body will be found the safety pin of the percussion arrangement and a hole for the projection on the key, by which the fuze is screwed into the shell.

The percussion safety pin has a whipcord loop coloured black.

There are two time rings which contain the fuze composition. Each ring has a channel, running nearly all round its under surface, which is lined with asbestos paper, and rings of vegetable paper are shellaced to the lower surface of each.

The lower ring is barrel-shaped and milled, 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. 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.

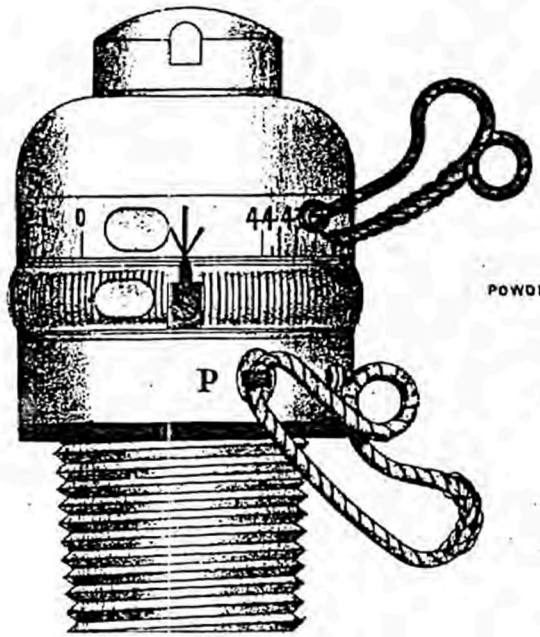
The upper ring is pinned to the stem so that it cannot turn. It is cylindrical in shape and graduated from 0 to 44 divisions (half divisions being shown by dots), and has an external gas escape, similar to the lower ring.

It is also marked with an arrow. When this is opposite the setting mark the fuze is set at safety, as the fire-hole in the body is covered by solid metal and not by fuze composition.

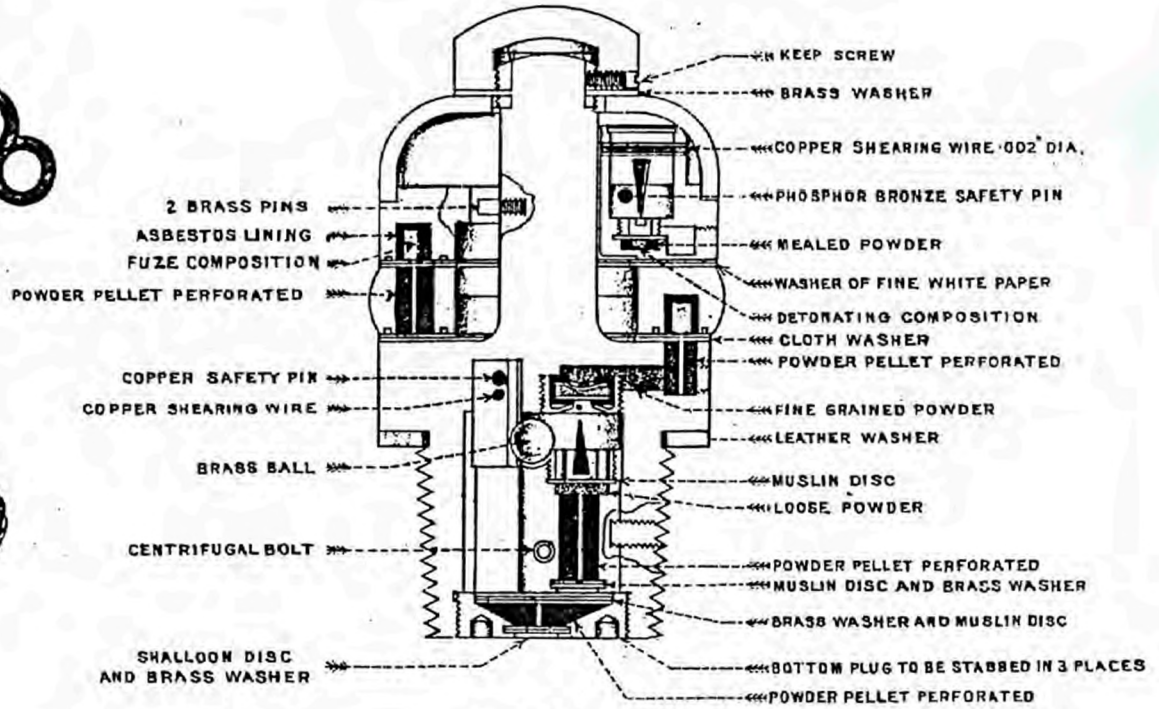
A cloth washer is secured by shellac to the top of the body, and another to the top of the bottom ring, a hole being pierced

FUZE T. AND P. Nº 63 MARK I.

FULL SIZE.



ELEVATION.



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To face page 93.

On graze or impact, the pellet moves forward, compressing the spiral spring, and the needle, striking the detonator, fires the fuze, the flash passing through the bottom plug into the shell, and so bursts it.

T. and P. Fuze, No. 56, Mark IV.

This fuze is similar to the No. 63, Mark I., but differs as follows:—It is not a quick-setting fuze, the dome and composition ring being secured by an hexagonal nut, which has to be eased to set the fuze, and afterwards tightened.

There is only one time ring, round the exterior of which are divisions marked and numbered up to 18. The divisions are further sub-divided by unnumbered lines into quarters.

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 from the burning composition ring, part of the gas also escaping into the dome.

The time detonator consists of 0·2 grains of cap composition surrounded by mealed powder. A certain number of these fuzes have been fitted with new detonators containing more composition. Fuzes so modified will have a star (*) added to the numeral.

A calfskin washer is shellaced to the face of the body.

The percussion pellet is filled with loose F.G. powder instead of a powder pellet, and shalloon instead of muslin is used for the discs.

The time of burning at rest is 13 seconds, and the weight of the fuze about 13 ozs.

T. and P. Fuze, No. 62, Mark II.

This fuze is used for the shrapnel shell of the 4-inch B.L. "H." only, but could be used for all heavy shrapnel shell having G.S. fuze-hole (Plate XXVI.).

It is similar to the T. and P. Fuze, No. 63, Mark I., but the body above the screw-threaded portion is larger in diameter, the stem being hollow for lightness.

The upper ring is graduated from 0 to 60 divisions.

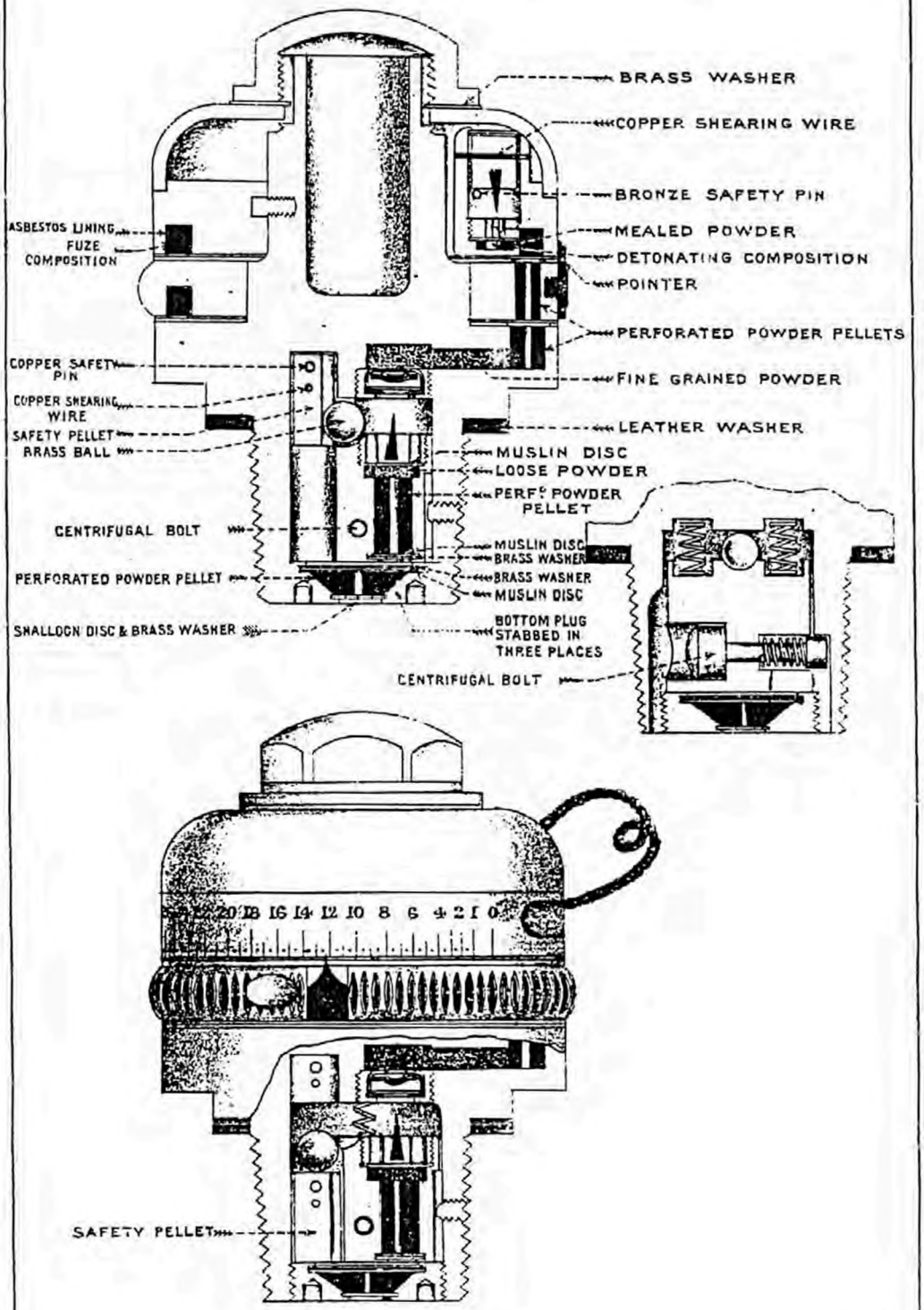
A hexagonal nut is used to clamp the dome and composition rings, instead of a round cap secured by a steel set screw.

The percussion pellet has two brass spiral springs to prevent rebound action.

This fuze, having a G.S. gauge, screws into an aluminium adapter in the head of shell with 2-inch fuze-hole.

The time of burning at rest is 30 seconds, and the weight of the fuze 1 lb. $9\frac{3}{4}$ ozs.

FUZE T. AND P. Nº 62 MARK II.



The time fuze, No. 30 (Plate XXVII.) is used in the shrapnel shell for the 6-inch and above guns, and consists of the following parts:—Body, composition ring, cap, detonator pellet with detonator, stirrup spring, needle plug with needle, bottom plug and safety pin. All parts are made of gunmetal except the safety pin which is phosphor bronze.

The bottom part of the body is screw-threaded on the exterior to the 2-inch gauge, and hollowed out to form the magazine, which contains F.G. powder, the lower part being threaded to take the bottom plug. This plug has a central fire-hole, and is closed by a muslin disc and brass washer.

An inclined hole, filled with powder, through the body forms a communication between the magazine and composition ring; the position of this hole being indicated on the outside by a black notch, which is the setting mark of the fuze.

The upper part of the body is reduced in diameter to form the stem, the exterior of which is threaded to take the cap, and the interior hollowed out to receive the stirrup spring and detonator pellet, and at the bottom the needle plug with needle.

Radial holes are bored from this chamber to convey the flash from the detonator to the composition ring.

The detonator pellet, which carries the detonator on its under side, is supported over the needle by a brass stirrup spring which rests on the top of the stem, and also by a safety pin which passes through the pellet and cap.

The cap screws on the stem and is secured by a set-screw.

The composition ring, which is cone-shaped on the exterior, is hollowed out on its under surface to take the composition, a hole being bored at the commencement of the composition towards the centre to convey the flash from the radial holes in the body to the ring. This hole contains a powder pellet.

A felt washer is placed between the ring and body, and a steel spring washer between the ring and the cap which keeps the former from moving after adjustment.

The ring is graduated in divisions from 0 to 44, half divisions being shown by dots.

The arrangement for gas escape is similar to that described in the T. and P. No. 63.

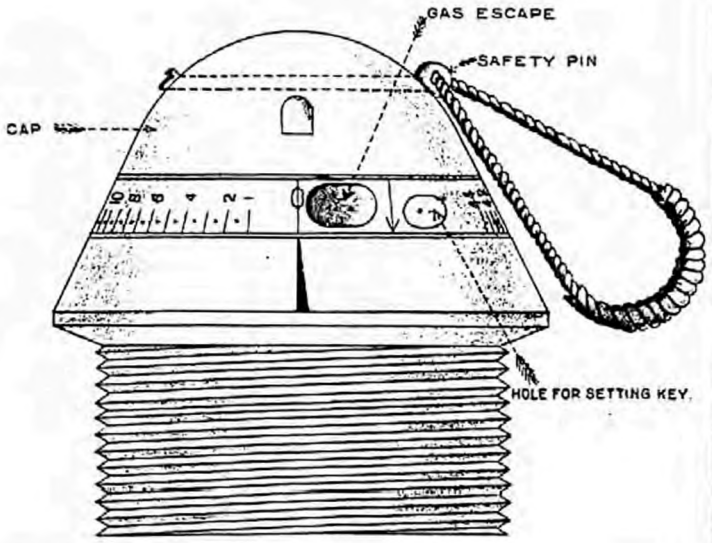
When an arrow on the time ring is in line with the setting mark the fuze is safe.

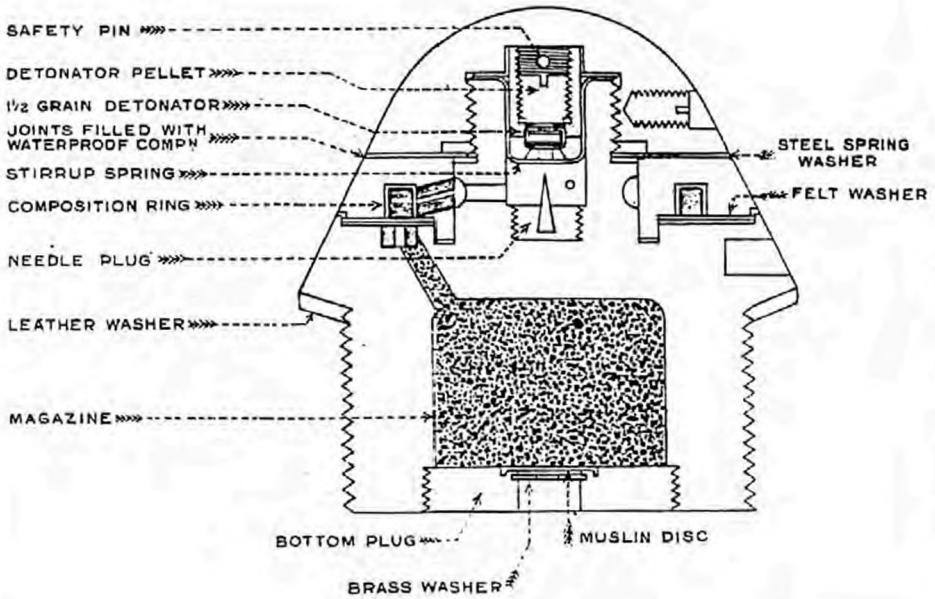
Action.—The time ring is adjusted by a key; the safety pin pulled out at the moment of loading.

On firing, the supporting arms of the stirrup are straightened out and the detonator pellet sets back on the needle, which fires the detonator, the flash passing by the radial hole in the stem

TIME FUZE Nº 30.

FULL SIZE.





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to the powder pellet at the commencement of the composition ring, which burns round to the setting mark, down the inclined hole to the magazine and thence to the shell.

The fuze weighs 1 lb. 11 ozs. and burns 8·3 seconds at rest.

T. and P. fuzes, are supplied in tin cylinders. One fuze wrapped in brown paper being in each.

Labels gummed on the outside of the cylinders show the nature and mark of fuze, lot number, date of manufacture, time of burning at rest, and instructions for opening the cylinder. The directions for closing and the packer's label are found inside the tin cylinders, which are supplied in wooden cases and should not be opened till the fuze is actually required for use.

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 where necessary, turn round the composition rings or ring until the number indicating the required length is opposite the pointer on the body, and screw the nut hard down.

A special key 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.

Two short burning time fuzes have been introduced for use with shrapnel in 12-inch, 9·2-inch, 7·5-inch and 6-inch guns. They are numbered 26 and 30. The former is suitable for fuze hole of G. S. gauge and the latter for the new 2-inch fuze hole.

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.

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.
4. Projectile not being properly rammed home.

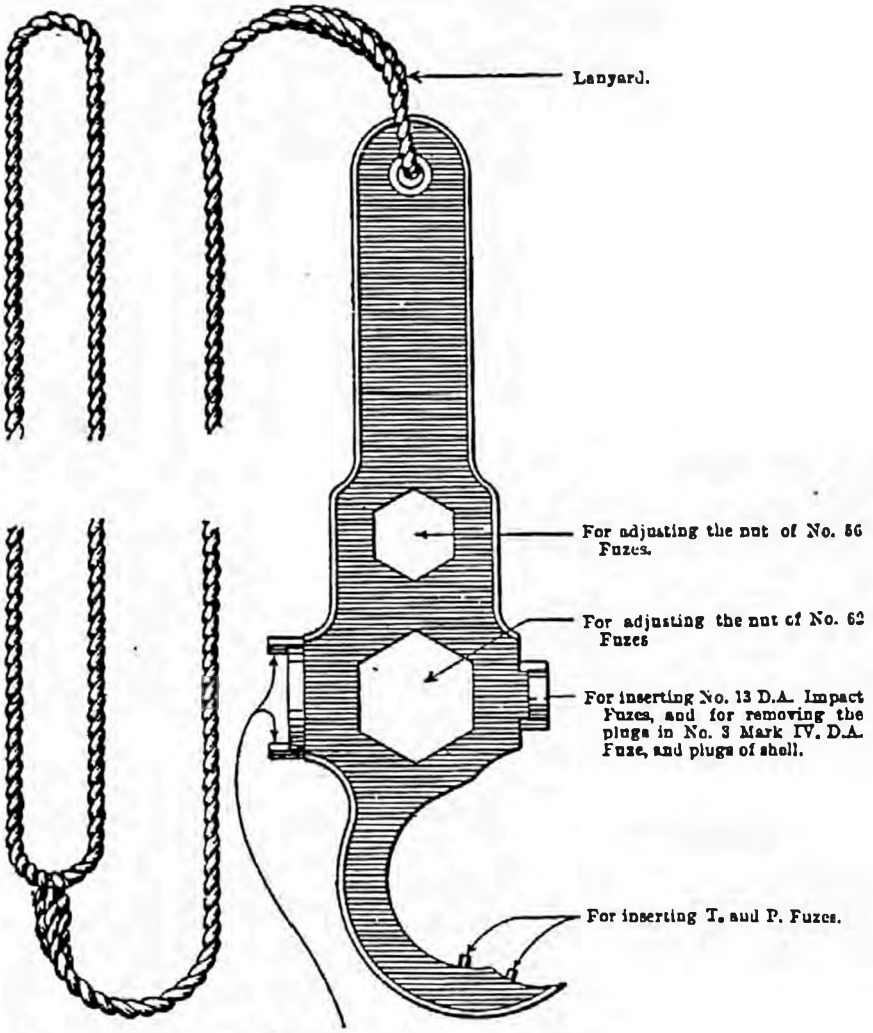
Fuze Implements.

The following keys and implements are supplied for fixing and removing fuzes and for adjusting them :—

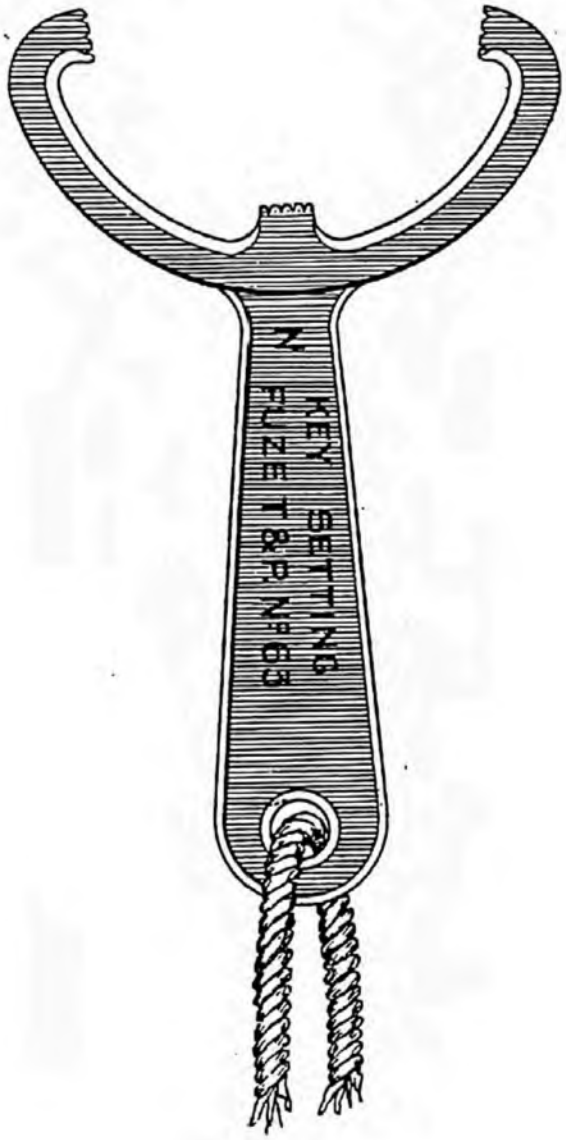
Universal Fuze Key.—The woodcut shows the Mark III. key and the use of the several parts :—

Universal Fuze Key, Mark III.

Scale ½.



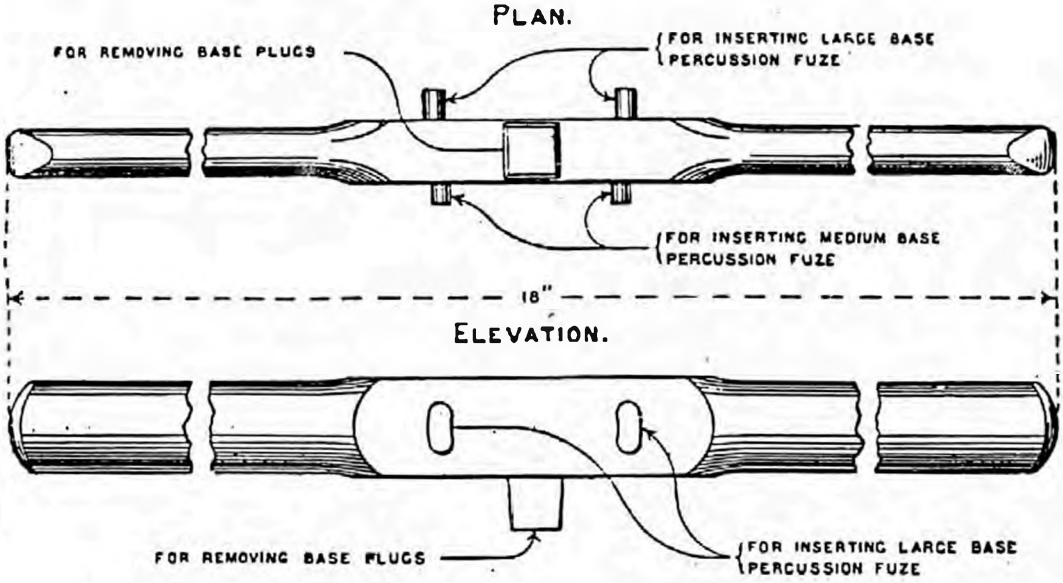
KEY SETTING FUZE, T. AND P. No. 63, MARK I.



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.

Scale ½.



CHAPTER XI.

Aiming Rifle, Machine Gun, and Small Arm Ammunition.

Cartridge, Aiming Rifle, 1-inch. Electric Mark V (Plate XXVIII.) consists of the case, electric primer, charge, wads, and bullet.

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 primer consists of a brass tube with an enlarged head; it is threaded near the head, so as to screw into the case, the head fitting into a recess. The tube is bored out, the metal being thinned at the front end.

Fitting in the tube is a brass contact pin, which is insulated with ebonite plugs, the front plug being coned to suit the coned seating in the primer. An iridio-platinum wire bridge resistance (1 to 1·5 ohms) is soldered, with pure tin, to the point of the contact pin and front edge of the body, the bridge being surrounded with gun-cotton dust or cotton powder, and the primer is closed with a card wad shellaced in. Two slots are cut in the head for the key removing and inserting primer.

A vulcanite fibre washer makes the primer gas-tight when the latter is screwed into the case.

The charge is 400 grains of R.F.G.^{2} powder; on top of which there is a grease-proof wad, then a felt wad lubricated with pure beeswax, and finally a white cardboard wad.

The bullet is made from an alloy of 12 parts lead, 1 part tin. It has three cannelures round it filled with beeswax, and the base is hollowed out. The bullet is partly covered with a patch of fine white paper, which is lubricated with beeswax at the base after being crimped over.

The bullet weighs 9 ozs. 408 grains. It is firmly pressed into the case, which is then reduced at the mouth by coning to hold the bullet tightly.

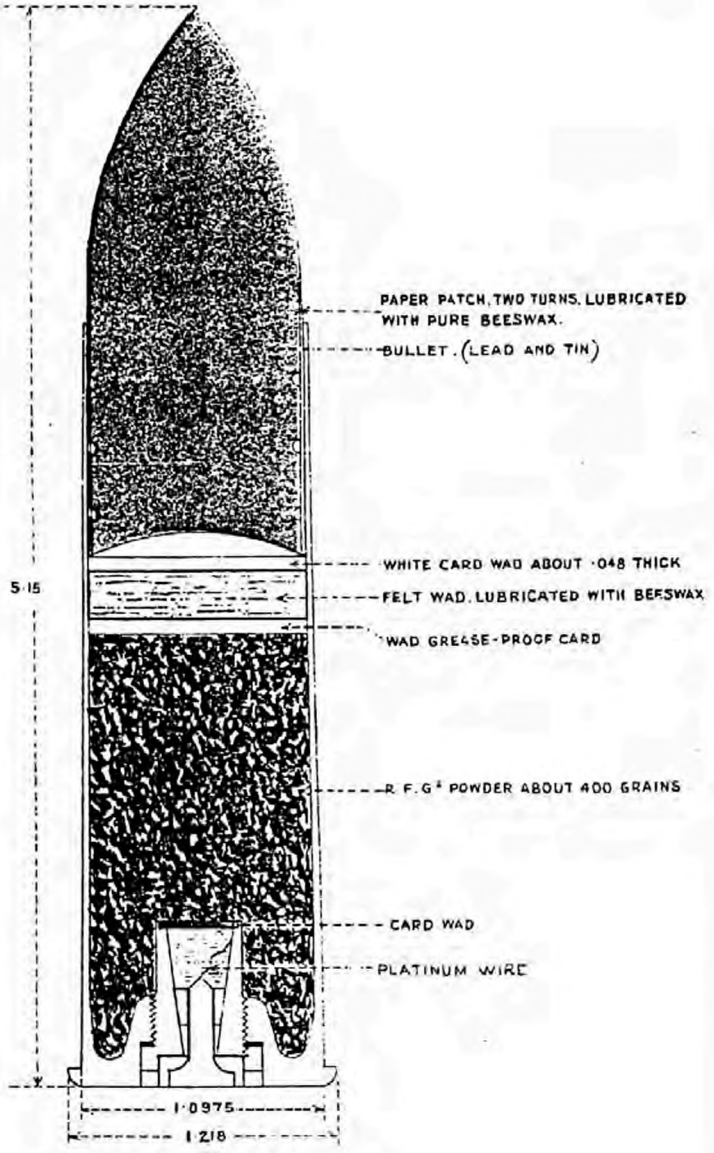
The cartridge is stamped on the base with the numeral and manufacturer's initials.

The Mark IV. cartridge is very similar in construction to the Mark V., except that the primer is not screwed in, there is no vulcanite fibre washer, and no paper round the bullet, which is secured into the case by three indents into the rear cannelure.

In order to facilitate identification of the pattern of primer in the Mark IV. cartridges, the letters "M" or "KN" will be

CARTRIDGE, AIMING RIFLE, 1 INCH, ELECTRIC, MARK V.

FULL SIZE.



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found stamped on the cartridge, and printed on the wrapper, after the numeral, to indicate that the primers are of the Morris, or Kings Norton Company's pattern respectively.

The cartridges are packed, 96 in an S.A.A. box, in bundles of 12.

The distinguishing mark on the box of this ammunition is a black diamond, connected at the angles to a skeleton black diamond.

Used in all 1-inch aiming rifles fired by electricity.

Fired cases are to be cleaned as described for cleaning Q.F. fired cases.

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.

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.

The charge is 38 grains of size 3 cordite.

On top of the charge is a millboard wad, paraffin waxed.

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.

The cartridges are packed in bundles of ten; 680 rounds in an S.A.A. box.

The distinguishing mark is a red triangle with the letter "C" in white inside it.

Cartridge, S.A., Ball, ·303-inch, Cordite, Mark VI., 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 $3\frac{1}{4}$ cordite in 60 strands. A single glazed-board wad is placed over the cordite.

The bullet consists of a pellet (98 per cent. lead, 2 per cent. antimony) enclosed in a cupro-nickel envelope, and weighs

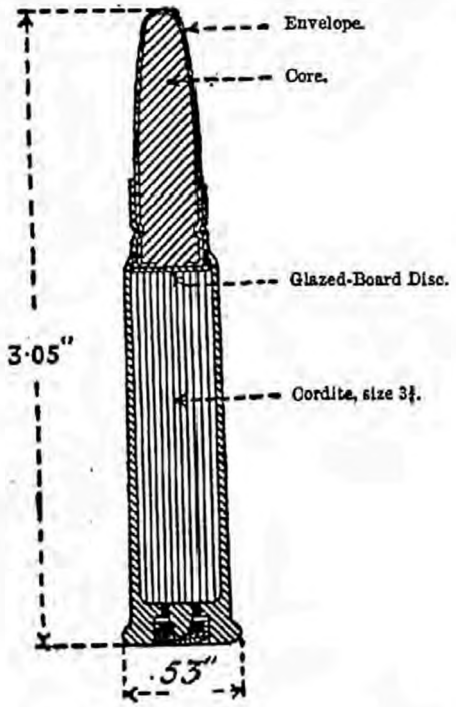
215 grains. The envelope is solid-drawn from an alloy of about 80 per cent. of copper to 20 per cent. of nickel. The pellet is secured in the envelope by the edge of the latter being turned over the pellet. The bullet is coated near its base with beeswax and has a cannelure. It is secured into the case by the latter being coned and indented in three places into the cannelure.

The base of the cartridge is marked with the year of manufacture, numeral of the cartridge, and the manufacturer's initials. Those cartridges supplied by contract will have two broad arrows stamped on the base. Cartridges of R.L. manufacture will, as hitherto, be stamped R ⅄ L.

The Mark II. cartridge differs from the Mark VI. in the bullet, which has the envelope thicker at the nose, and ·5 per cent. of iron was used in its alloy.

All other Marks are obsolete.

·303-*inch Ball Ammunition, Mark VI.*

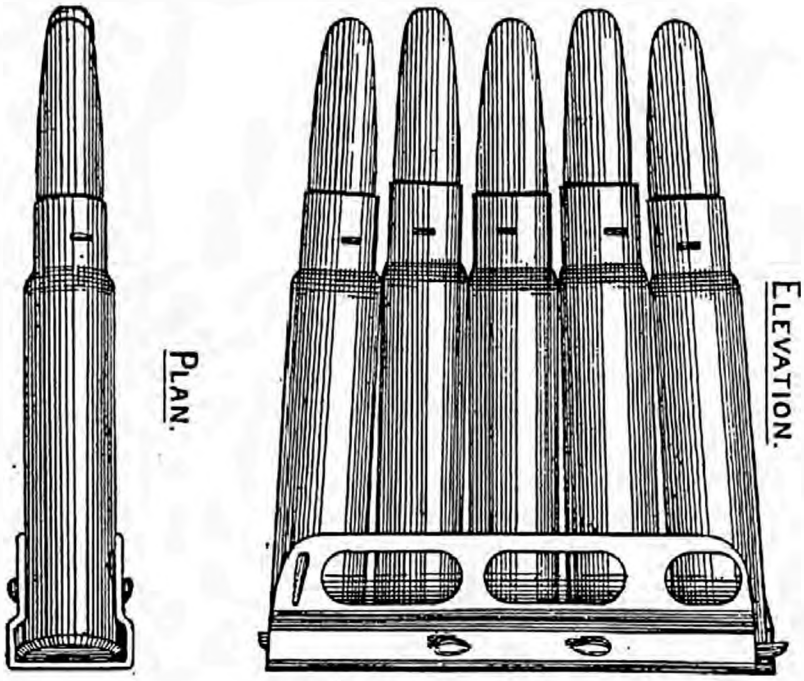


The ·303-inch cartridges are made up in packets of 10 and stowed :—

1,100 rounds in S.A.A. box whole, or,
500 „ „ „ „ half, „
1,200 „ „ ¼ M.L. case, for boat service.

The distinguishing mark for ·303-inch cordite ball ammunition, is a red rectangle with a bar across the centre, and the word "Cordite" above and below it.

When ·303 cartridges are supplied in "chargers" the whole S.A.A. box, or ¼ M.L. case will contain 840 rounds, each charger holding five rounds, and four chargers stowed in a leather-board box, the S.A.A. box or ¼ M.L. case thus holding 168 chargers in 42 leather-board boxes.



The Mark II. charger differs from Mark I. in having a spring stop at each end, and in being strengthened by having three ridges on the base.

The distinguishing mark for this ammunition in chargers is the same as ·303-inch ball, 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 word "chargers" will be printed diagonally across in black letters.

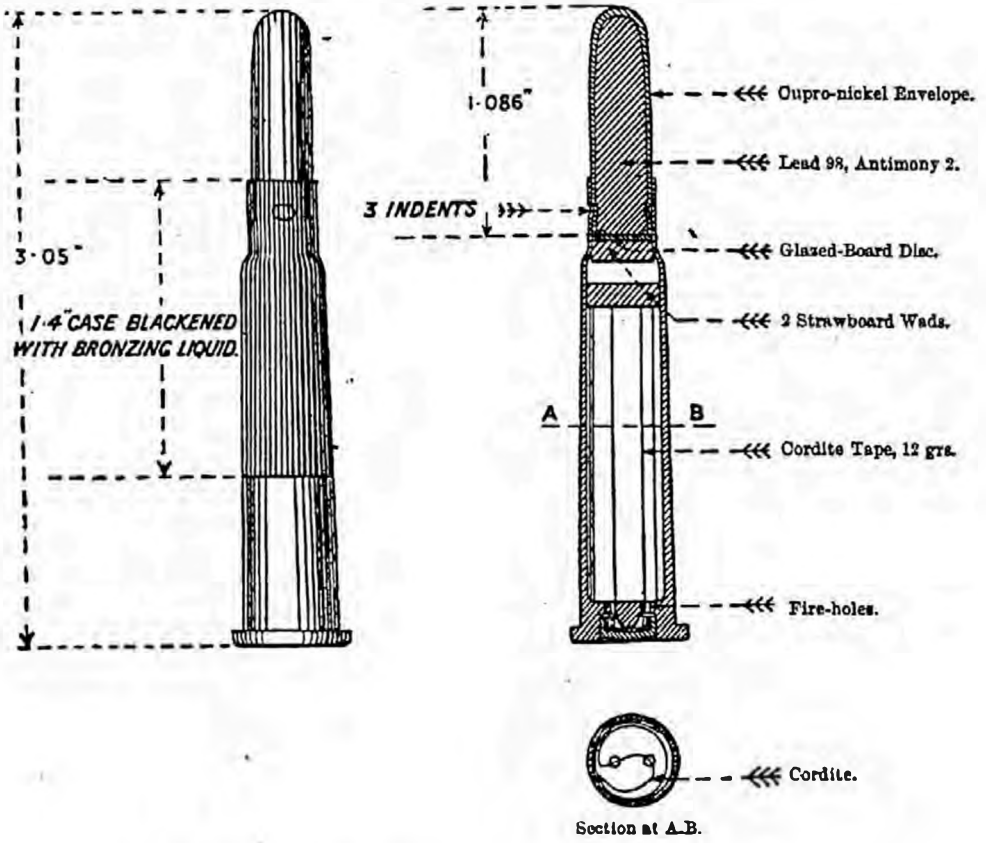
Cartridge, Ball, S.A., ·303-inch, Cordite, Short Range, Practice, Mark II., consists of a case, cap, charge, wads, and bullet.

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 a similar construction to the Mark II. Service bullet, but is slightly shorter, more rounded at the point, and weighs 188 grains. It is lubricated at the base, and secured into the case by being coned and indented similarly to the Service ·303 cartridges.



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.

This ammunition is used at certain Coastguard ranges.

The Mark V. Blank Cartridge, ·303-inch. consist of a Service case crimped at the mouth to retain the charge of 10 grains of size 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, the wrong numeral being cancelled by having a ring stamped on the base, over it.

On the base of the cartridges is the letter "C."

The Mark VI. Blank Cartridges without Bullet, are those which were originally fitted with mock bullets, but have since had them removed. They are now identical to the Mark V. and are packed in bundles of 10 in blue paper; 1,450 rounds in a quarter metal-lined case; or 3,400 rounds in a half metal-lined case.

Cartridge, S.A., Dummy Drill, ·303-inch Rifles, Mark III., consists of an empty Service case without cap. The bullet is of boxwood, dyed red, which is secured to the case by coning and three indents. Two holes are drilled through the case at right angles to each other.

Cartridge, S.A., Dummy Drill, Mark II., consists of an empty Service case without cap. A hollow brass bullet, or the envelope of the Service bullet, is secured in the case by coning and indenting the case into the cannelure as in the Service cartridge. The exterior of the cartridge is tinned all over to distinguish it.

Mark I. dummy drill cartridge differed from Mark II. in the bullet not being so securely fastened to the case.

These cartridges are issued loose in a packing-case as required.

The distinguishing mark on the wrapper and box is a black rectangle with a black bar across the centre, and the letter D in black on the outside.

Cartridge, Aiming-Tube, C.F., Mark II., is supplied to enable rifle practice to be carried on in confined spaces and without the expense entailed by using Service cartridges.

The case is of solid-drawn brass with the cap chamber and anvil formed in the base. Two fire-holes in the latter, as shown in the cut, communicate from the brass cap to the powder charge.

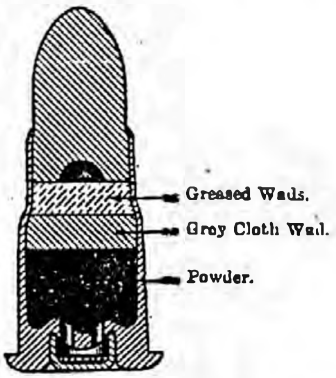
The charge is 3¼ grains. Curtis and Harvey's Diamond No. 2.

The bullet is of 12 parts lead and one part tin, and weighs 37 grains.

The base of the bullet is slightly recessed to which is fastened two wads, that next the bullet being greased, and the other of grey cloth.

Mark II.

Scale, $\frac{2}{1}$.



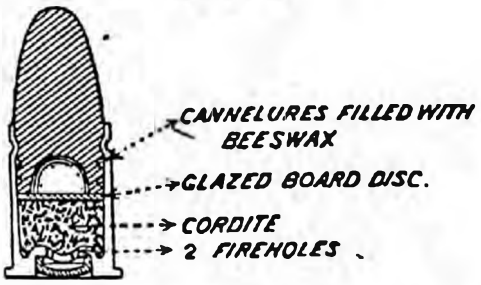
Supplied, 100 in a cardboard box, 9,100 rounds in a quarter metal-lined case.

The distinguishing mark on the wrapper or box is a black circle with a black dot in the centre, between the letters C and F, denoting central fire.

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 $7\frac{1}{2}$ grains of size 1 cordite on the top of which is placed a glazed-board disc.

The bullet, of 12 parts lead and 1 part tin, weighs 265 grains. It has a cavity formed in the base and three cannelures round the body, these cannelures are filled with beeswax, and the bullet is secured in the case by choking the latter into the front cannelure.

Full Size.



Packed six in a packet, in brown paper wrappers, and are issued 828 rounds in a half S.A.A. box.

The distinguishing mark is a red ring and cross-bar with letter "C" in red above and below the bar, which is printed on both wrapper and box.

Fired cartridge cases of all S.A. ammunition are to be returned into store in any convenient package.

Plate XXIX. shows the distinguishing marks for all S.A. ammunition.

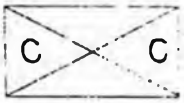
The following table shows how each of the S.A. cartridges are stowed for Naval Service :—

Ammunition.	How Stowed.	Number of Cartridges.	Description of Box.	Distinguishing Mark on Box.
Electric aiming 1-inch.	Packets of 12	96	S.A.A. box, whole.	Black diamond connected at the angles to a skeleton black diamond.
·45-inch M.G. ball, G.G. chamber.	Packets of 10	680	" "	Red triangle with letter "C" in it in white.
·303-inch ammunition.	" "	1,100	" "	Red and white rectangle with the word "Cordite."
		500	S.A.A. box, half.	
		1,200	Quarter metal-lined case.	
·303-inch in chargers.	5 in a charger	840	" " S.A.A. box, whole.	Red and white rectangle with the word "Cordite" above and below the line, and the word "chargers" printed diagonally across in black.
·303-inch blank.	Packets of 10	3,400	Half metal-lined case.	Blue labels, printing in red.
		1,450	Quarter metal-lined case.	
Aiming tube C.F.	Cardboard box containing 100.	9,100	" "	Black ring with black centre.
Webley pistol, Mark II.	Packets of 6	828	S.A.A. box, half.	Red ring with cross-bar and letter "C" above and below the bar.

DISTINGUISHING MARKS FOR AMMUNITION S A BOXES.

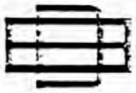
Devices of the colours and forms shown are used to distinguish packages of the several descriptions of S.A. and M.G. ammunition mentioned, the device will be printed on the wrapper of each bundle of ammunition and on descriptive label and distinguishing label of each package

AIMING RIFLE
1 INCH ELECTRIC.



CARTRIDGE S.A. BALL
·303 INCH, CORDITE, SHORT
RANGE PRACTICE.

M.G. BALL 45 INCH
CORDITE.



CARTRIDGE. S A
DUMMY DRILL
MAGAZINE RIFLE.

S.A. BALL 303 INCH
CORDITE

AIMING TUBE
0 23 INCH. POWDER

S.A. BALL 303 INCH
IN CHARGERS

S A BALL, PISTOL
WEBLEY, CORDITE

185. Weller & Green Ltd. London

CHAPTER XII.

Fireworks.

Rocket, Sound, ½-lb., Mark III., consists of a case made of brown paper rolled into a cylinder and filled with rocket composition, which consists of 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 a piece of safety fuze passes to the composition inside. The recess in the bottom outside the choke is primed with mealed powder, damped with a solution of isinglass and methylated spirit and sprinkled with F.G. powder while damp.

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 quick-match 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 the rocket a small paper cylinder is secured, with a small steel tongue at its upper end for attaching 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 to fit into.

The rockets are painted black, and have a label on the outside giving directions as to firing, &c.

They are supplied in half metal-lined cases, 25 in a case.

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. They are supplied in quarter metal-lined cases containing 50 in each.

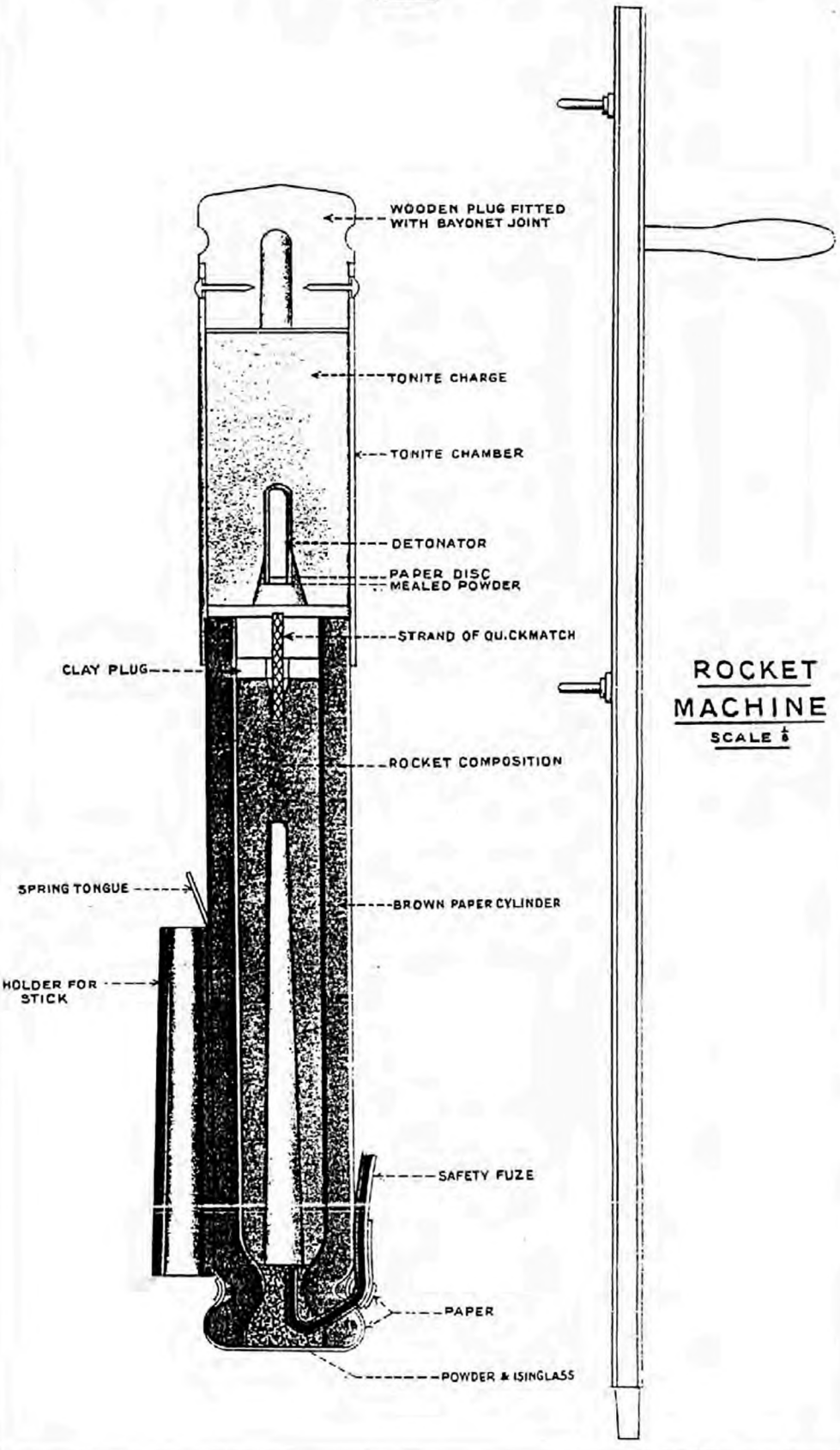
The tonite detonator is a copper tube, closed at one end, containing a fulminating composition (fulminate of mercury, chlorate of potash, and gun-cotton) strongly pressed in. It is primed with mealed powder, a disc of paper being placed between the meal powder and composition.

They are supplied in tin cylinders, five in a cylinder, packed in cork.

A rocket machine is supplied for firing the sound rocket (*see* Plate XXX.), 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.

ROCKET SOUND, ½ LB. MARK III.

½ SIZE



2852 Weller & Graham Ltd Litho London

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; 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 a port-fire or any available means of ignition, keeping the rocket machine in an upright position.

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 quick-match, 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.

The Mark II. Sound Signal Rocket differs from the Mark III. in having a 2-oz. primer of dry gun-cotton 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 gun-cotton primer has been inserted. This rocket will supersede the Mark III. when the stock of the latter is used up.

The 1-*lb. Signal Rocket, Mark III.*, has a case made of brown paper, rolled into a cylinder. The composition is driven in by hand, and the conical hollow is made by a former placed in temporarily.

A light paper case is attached to the head, terminating in a cone; this contains 28 stars and some mealed powder which serves to open the case and scatter the 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.

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-ft. rope tail.

The rockets are supplied in the firework boxes, which are to be kept in the shell-room, and the night signal box and boats' magazines are completed from them.

Each rocket is packed in a tin cylinder, the lid of which is secured by a tape band.

The action of a rocket is as follows:—When in flight the burning rocket composition gives off a large quantity of 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 again 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 by 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 straight 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.

The Long Light G.S. Mark III. is supplied on special demand for illuminating purposes; it burns about 5 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 filled 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.*

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.

Lights, Long, blue, green, and red, Mark III., 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 III.

The red and blue lights burn 2 minutes, the green a minute and a half, and are supplied one in a tin cylinder.

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.

The "Tear-off" bands of the tin cylinders are painted the same colour as the light contained in the cylinder.

All signal lights and other fireworks which have been removed from their cases and not used are to be carefully examined before being restowed, and they are not to be handled in bulk, *i.e.*, packing them together in bags for transmission below.

Cartridges, Signal, Very, Marks II. and III., are issued for signalling purposes and contain a single green, red, or white pellet. The cartridge consists of a brass case, rolled for Mark II., solid-drawn for Mark III., lined with brown paper which projects beyond the mouth. The case is provided with a percussion cap, and the charge consists of 65 grains of R.F.G.^{3} powder. Above the charge is the pellet, which is made of composition wound round with quickmatch.

The portion of the lining, which projects beyond the case, is painted the same colour as that given by the pellet in 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.

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.

Very's lights are stowed in the small-arm magazine.

Very's light pistols are to be examined every six months, and the pull-off of the trigger tested. When not cocked a pressure of from 7 to 10 lbs. should be necessary to compress the trigger spring.

The Portfire, Common, consists of a cylinder about 16 inches long, and rather more than ½ inch diameter. It is made of stout brown paper pasted, rolled, and when dry, turned in at one end to form a bottom. The case or cylinder is filled with portfire composition.

The top has a small hole bored in the composition, and is primed with mealed powder to make it light easily. They burn from 12 to 15 minutes, and are generally lit by slow match, or any other handy means such as a short quill friction tube.

It is used for incendiary purposes. A portfire holder is supplied.

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 shaking it.

Slow Match is made of pure hemp slightly twisted and boiled in a ley of water and wood ashes. It may equally well be made by boiling in a solution of 8 oz. saltpetre to one gallon of water.

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, 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 it is practically instantaneous when confined.

Safety Fuze 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.

It can be easily ignited by a portfire, 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.

The cartridges are issued 25 in a tin cylinder.

The safety fuze is issued in tin cylinders.

Firework Boxes.

Signal rockets, portfires, and tin cylinders containing lights, are packed in firework boxes; large and small.

These boxes will pack the following stores:—

Stores.	Large Box.	Small Box.
Lights, long	24	8
„ short	24	16
Portfires, common	14	10
Rockets, signal (1 lb.)	24	12

The lids are screwed down by a metal-lined key.

Firework boxes are stowed in the shell-room, and the various boxes on deck and elsewhere are replenished from them.

These are:—

Boats' magazines, night signal box, and sea boat's 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 short 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.

A sea boat's box is supplied for each sea boat.

Sea boat's box contains :—

4 short lights.
1 Very's pistol.
10 Very's lights, 5 green and 5 red.

The Gunner is responsible, and will report to the Captain on proceeding to sea, that a sea boat's box is in each sea boat. Every evening at sea he will satisfy himself that they are there and report as before.

The list of stores and stowage of the magazines for the different classes of boats, are given below :—

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.
2 universal keys.
1 metal key, Mark IV.
204 rounds of pistol ammunition in a leather pouch.
2 trigger lanyards.
1 fuze scale.
1 bandolier for tubes.

BOAT'S MAGAZINE.

For Boats armed with 3-pr. Q.F. or 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.

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-buoys.

The latest pattern of night life-buoy is shown in the woodcut, and the buoy itself requires no explanation.

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 watertight.

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.

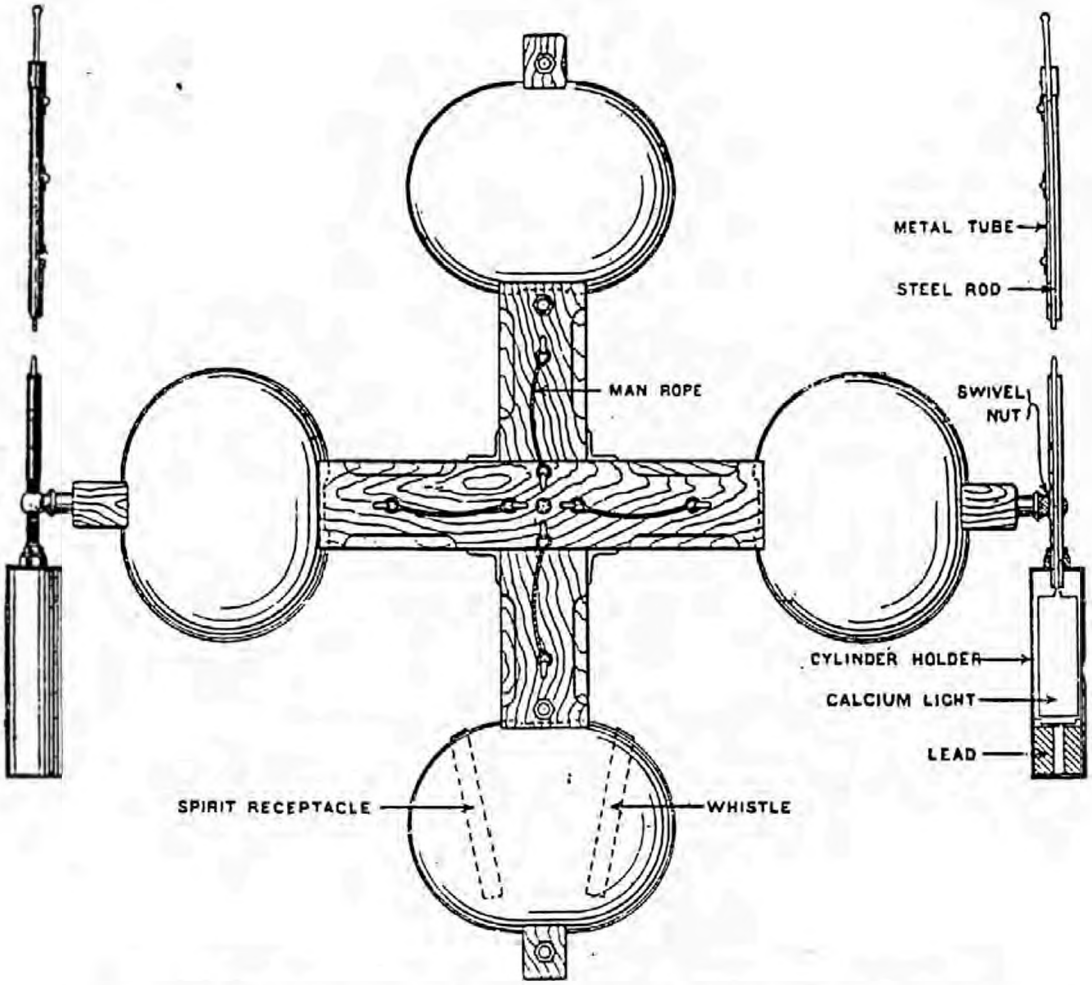
The calcium light is entered in the holder when unscrewed from the tube, and a steel rod with a knob at the top screws into the stopper of the light.

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 $\frac{1}{12}$.



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 and gunnery 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.

When the ship is in dry dock, the buoys are to be lashed or unshipped.

Lights are supplied 10 for each buoy but not to exceed 20 per ship, and 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.

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 XIII.

Tables of Ammunition for each Gun.

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, each having an igniter of 8 oz. S.F.G.[2] powder.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 1,250 lbs.—

Armour-piercing shell	Weight of burster,	5	per cent.
Pointed common, cast steel	,,	6·7	,,
Nose-fuzed common, steel	,,	6·8	,,
Shrapnel.			
Practice shot.			

Fuzes.—

For all pointed shell	Base percussion, large.
,, nose-fuzed common	Direct action, No. 3.
Shrapnel	T. and P., No. 62.

Cases for Charges.—Cylindrical "P." for cordite.

12-*inch B.L., Mark XI.*

Nominal Weight of Gun.—67 tons.

Full Charge.—Cordite, 307 lbs. size 45 M.D. made up in quarters, each having an igniter of 16 oz. S.F.G.[2] powder in eight compartments.

Tubes.—Electric, V.S. electric wireless, large. *Percussion*, V.S. percussion, large.

Projectiles.—Approximate weight, 850 lbs.—

Armour-piercing shell	Weight of burster,	2·1	per cent.
Capped common shell	,,	9·4	,,
Lyddite	,,	13·0	,,
Shrapnel shell.			
Practice shot.			

Fuzes.—

For armour-piercing capped shell	Base percussion, large, No. 15.
,, capped common shell	,, ,, ,, 15.
,, lyddite shell	Direct action, impact.
,, shrapnel shell	Time No. 30.

Cases for Charges.—Cylindrical "L."

Cartridge Cases.—

12-*inch B.L., Mark X.*

Nominal Weight of Gun.—58 tons.

Full Charge.—*Cordite*, 260 lbs. size 45 M.D., made up in quarters, each having an igniter of 16 oz. S.F.G.[2] in eight compartments.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 850 lbs.—

Armour-piercing capped shell	Weight of burster, 2·5 per cent.
Pointed common shell	,, ,, 9·5 ,,
Lyddite shell	,, ,, 13·0 ,,
Shrapnel.	
Practice shot.	

Fuzes.—

For armour-piercing capped shell	Base percussion, large, No. 15.
,, common pointed shell	,, ,, ,, ,, 11.
,, lyddite shell	Direct action, impact.
,, shrapnel	Time No. 30.

Case for Charges.—Cylindrical "Q" (being superseded by cylindrical "N").

Cartridge Case.—K.A. duck case No. 39.

12-*inch B.L., Mark IX.*

Nominal Weight of Gun.—50 tons.

Full Charge.—*Cordite*, 254 lbs. size 45 M.D., for K.E. VII. class, or 246 lbs. size 45 M.D., for "Duncan" class; made up in quarters, each having an igniter of 16 oz. S.F.G.[2] in eight compartments.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 850 lbs.—

Armour-piercing capped shell	Weight of burster, 2·5 per cent.
Lyddite shell	,, ,, 13·0 ,,
Pointed common shell	,, ,, 9·5 ,,
Shrapnel.	
Practice shot.	

Fuzes.—

For armour-piercing capped shell - - - Base percussion, large, No. 15.
„ common pointed shell - „ „ „ „ 11.
„ lyddite shell - - Direct action, impact.
„ shrapnel shell - - Time No. 30.

Case for Charges.—Cylindrical "Q" or rectangular "I."

Cartridge Case.—Canvas bag, or K.A. duck case No. 39.

12-*inch B.L., Mark VIII.*

Nominal Weight of Gun.—46 tons.

Full Charge.—Cordite, 200 lbs. size 45 M.D. Made up in halves and quarters, each having an igniter of 8 oz. S.F.G.[2] in eight compartments.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion,* V.S. percussion.

Projectile.—Approximate weight, 850 lbs.—

Armour-piercing capped shell - - -	Weight of burster,	2·5 per cent.
Pointed common shell -	„ „	9·5 „
Lyddite shell - -	„ „	13·0 „
Shrapnel shell.		
Practice shot.		

Fuzes.—

For armour-piercing capped shell - - - Base percussion, large, No. 15.
„ common pointed shell - „ „ „ „ 11.
„ lyddite shell - - Direct action, impact.
„ shrapnel shell - - Time No. 30.

Case for Charges.—Cylindrical "R."

Cartridge Case.—Clarkson's case No. 32.

10-*inch B.L.*

Nominal Weight of Gun.—29 tons.

Full Charge.—Cordite, 80 lbs. size 16 M.D. Made up in halves and quarters, each having an igniter of 8 oz. S.F.G.[2]

Tubes.—Electric, V.S. "P." electric wireless. *Percussion,* V.S. percussion.

Projectile.—Approximate weight, 500 lbs.—

Armour-piercing shell -	Weight of burster,	5 per cent.
Pointed common „ -	„	7·5 „
Practice shot.		

Fuze.—All pointed shell - Base percussion, large, No. 11.

Case for Charges.—Rectangular J.

Cartridge Case.—Clarkson's No. 34.

9·2-*inch B.L., Mark XI.*

Nominal Weight of Gun.—28 tons.

Full Charge.—*Cordite*, 130½ lbs. size 37 M.D., made up in halves and quarters, each having an igniter of 8 oz. S.F.G.[2] in eight compartments.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 380 lbs.

Armour-piercing capped shell - - - -	Weight of burster,	2·5 per cent.
Common pointed - -	„ „	8 „
Lyddite common - -	„ „	10·5 „
Shrapnel.		
Practice shot.		

Fuzes.—

For armour-piercing capped shell - - - -	Base percussion, large, No. 15.
„ pointed common shell -	„ „ „ „ 11.
„ lyddite „ „ -	Direct action, impact.
„ shrapnel - -	Time No. 26 or 30.

Cases for Charges.—Rectangular "N." or "S."

Cartridge Cases.—K.A. duck case No. 40.

9·2-*inch B.L., Mark X.*

Nominal Weight of Gun.—28 tons.

Full Charge.—*Cordite*, 120 lbs. size 37 M.D., made up in halves and quarters, each having an igniter of 8 oz. S.F.G.[2] in eight compartments.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 380 lbs.—

Armour-piercing capped shell - - - -	Weight of burster,	2·5 per cent.
Pointed common shell -	„ „	7·9 „
Lyddite „ „ -	„ „	10·5 „
Shrapnel.		
Practice shot.		

Fuzes.

For armour-piercing capped shell - - -	- Base percussion, large, No. 15.
Pointed common shell	- „ „ „ „ 11.
Lyddite - - -	- Direct action, impact.
Shrapnel - - -	- Time No. 26 or 30.

Case for Charges.—Rectangular "N." or "S."

Cartridge Case.—K.A. duck case No. 40.

7·5-inch B.L., Mark I., II. or V.

Nominal Weight of Gun.—15 tons.

Full Charge.—Cordite, 61¾ lbs. size 26 M.D., made up in halves and quarters, each having an igniter of 6 oz. S.F.G.[2] in four compartments.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 200 lbs.—

Armour-piercing capped shell - - -	- Weight of burster,	2·5	per cent.
Pointed common capped shell - - -	„ „	8·125	„
Lyddite common shell -	„ „	9·86	„
Shrapnel.			
Practice shot.			

Fuzes.—

For armour-piercing capped shell -	- Base percussion, large, No. 15.
„ pointed common shell -	„ „ „ 11.
„ lyddite „ „	- Direct action, impact.
„ shrapnel - -	- Time No. 26 or 30.

Cases for Charges.—Rectangular "O."

Cartridge Cases.—K.A. duck case No. 41.

6-inch B.L., Mark XI.

Nominal Weight of Gun.—9 tons.

Full Charge.—Cordite, 33 lbs. size 26 M.D., made up in two-thirds and one-third, with an igniter each end of 2 oz. S.F.G.[2] in four compartments.

Blank Charge.—7 lbs. L.G. powder.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 100 lbs.—

Armour-piercing capped shell	-	- Weight of burster, 2·5 per cent.
Common pointed shell	-	„ „ 8·7 „
Lyddite common shell	-	„ „ 10·7 „
Shrapnel.		
Practice shot.		

Fuzes.—

For armour-piercing capped shell	-	- Base percussion, large, No. 15.
„ common pointed shell	-	„ „ „ „ 11.
„ lyddite shell	-	- Direct action, impact.
„ shrapnel	-	- Time No. 26 or 30.

Cases for Cordite.—"F." or "T."

Cases for Blank—"A."

Cartridge Cases.—No. 42, K.A. duck case.

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

Nominal Weight of Gun.—7 tons.

Full Charges.—*Cordite*, 20 lbs. size 20 Mark I., or 23 lbs. size 16 M.D., made up in halves, and 29 lbs. size 26 M.D., made up in one-third and two-thirds laced together, with an igniter each end of 2 oz. S.F.G.[2]

Blank Charge.—7 lbs. L.G. powder.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectiles.—Approximate weight, 100 lbs.—

Armour-piercing capped shell	- -	- Weight of burster, 2·5 per cent.
Pointed common shell	-	„ „ 8·7 „
Lyddite „ „	-	„ „ 10·5 „
Shrapnel.		
Practice shot.		

Fuzes.—

For armour-piercing capped shell	- -	- Base percussion, large, No. 15.
Common pointed shell	-	„ „ „ „ 11.
Lyddite	- -	- Direct action, impact.
Shrapnel	- -	- Time No. 26 or 30.

Cases for Charges.—"B" for 20-lb. or 23-lb. charges.
"F" or "T" for 29-lb. or 33-lb. charges.
"A" for blank.

Cartridge Cases.—No. 30, K.A. duck case.
„ 42, „ „ „
„ 31, Clarkson.

4-inch B.L., Mark VII

Nominal Weight of Gun.—42 cwt.

Full Charge.—*Cordite*, 9 lbs. 15 oz. size 19 M.D., made up whole, with an igniter of 1 oz. S.F.G.^{2} at each end, and divided into four compartments.

Blank Charge.—3 lbs. L.G. powder.

Tubes.—*Electric*, V.S. electric wireless, large, Mark I.
Percussion, V.S. percussion, large, Mark I.

Projectiles.—Approximate weight, 31 lbs.—
Common pointed - Weight of burster, 7·05 per cent.
Lyddite - - „ „ 7·05 „
Shrapnel.
Practice shot.

Fuzes.—

For common pointed shell - - - Base percussion, medium, No. 12.
„ lyddite shell - - Direct action, impact.
„ shrapnel shell - T. and P., No. 62, Mark II.

Case for Charges.—Rectangular "R."

Case for Blank.—"A."

Cartridge Case.—No. 43, K.A. duck case.

4-inch B.L., Mark VIII.

Nominal Weight of Gun.—26 cwt.

Full Charge—Cordite, 5 lbs. 4 oz. size 16 M.D., made up whole, with an igniter of 1 oz. S.F.G.^{2} at each end, and divided into four compartments.

Blank Charge.—3 lbs. L.G. powder.

Tubes.—*Electric*, V.S. "P." electric wireless, large, Mark I.
Percussion, V.S. percussion, large, Mark I.

Projectiles.—Approximate weight, 31 lbs.—

Common pointed shell	-	Weight of burster, 7·05 per cent.
Lyddite shell	- -	„ „ 10·5 „
Shrapnel.		
Practice shot.		

Fuzes.—

For common pointed shell - - -	Base percussion, medium, No. 12.
For lyddite shell -	Direct action, impact.
„ shrapnel shell -	T. and P., No. 62, Mark II.

Case for Charges.—Rectangular "R."

Case for Blank.—"A."

Cartridge Case.—No. 43, K.A. duck case.

6-*inch Q.F.*

Nominal Weight of Gun.—7 tons.

Full Charge.—*Cordite*, Mark I., 13¼ lbs. size 30, with igniter of 1¼ ozs. S.F.G.[2]

Blank Charge.—7 lbs. L.G. powder.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 100 lbs.—

Armour-piercing capped shell	-	Weight of burster, 2·5 per cent.
Pointed common shell	-	„ „ 8·7 „
Lyddite „ „	-	„ „ 10·5 „
Shrapnel.		
Practice shot.		

Fuzes.—

For armour-piercing capped shell - - -	Base percussion, large, No. 15.
Common pointed shell -	„ „ „ „ 11.
Lyddite shell - -	Direct action, impact.
Shrapnel - - -	Time No. 26 or 30.

Case for Charges.—6-inch outfit box.

Cartridge Case.—Canvas bag.

4·7-*inch Q.F.*

Nominal Weight of Gun.—42 cwt.

Full Charge.—*Cordite*, Mark I., 5 lbs. 7 oz. size 20, with igniter of 1¼ oz. S.F.G.[2]

Blank Charge.—3 lbs. L.G. powder.

Tubes.—Electric. V.S. "P." electric wireless. *Percussion,* V.S. percussion.

Projectile.—Approximate weight, 45 lbs.—

Pointed common shell - Weight of burster, 9·4 per cent.
Lyddite „ „ - „ „ 10 „
Shrapnel.
Practice shot.

Fuzes.—

For common pointed shell - Base percussion, medium.
Lyddite shell - - Direct action, impact.
Shrapnel - - - T. and P., No. 62, Mark II.

Cases for Charges.—4·7 outfit box.

Cartridge Cases.—Canvas bag.

4-inch Q.F.

Nominal Weight of Gun.—26 cwt.

Full Charge.—Cordite, Mark I., 3 lbs. 9 oz. size 15, with igniter of 1¼ oz. S.F.G.[2]

Blank Charge.—3 lbs. L.G. powder.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion,* V.S. percussion.

Projectiles.—Approximate weight, 25 lbs.—

Pointed common shell - Weight of burster, 8 per cent.
Lyddite „ „ - „ „ 12·9 „
Shrapnel.
Practice shot.

Fuzes.—

For pointed common shell - Base percussion, medium.
„ lyddite „ „ - Direct action, impact.
Shrapnel - - T. and P., No. 62, Mark II.

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, 2 lbs. 12⅛ oz. size 11 M.D., with igniter of 10 drs. S.F.G.[2]

Blank Charge.—1½ lbs. L.G.

Tubes.—Electric, V.S. "P." electric wireless. *Percussion,* V.S. percussion.

Projectiles.—Approximate weight, 12·5 lbs.—

Pointed common shell - Weight of burster, 9·5 per cent.
Lyddite shell - - „ „ 7·5 „
Shrapnel shell.
Practice shot.

Fuzes.—
For pointed common - - Base percussion, medium.
Lyddite - - - Direct action, impact.
Shrapnel - - - T. and P., No. 63.

Case for Charges.—12-pr. 18 cwt. outfit boxes.
Half metal-lined case for blank charges.

Cartridge Case.—Canvas bag.

12-*pr. Q.F.*, 12 *cwt.*

Nominal Weight of Gun.—12 cwt.

Full Charge.—*Cordite*, Mark I., 1 lb. 15 oz. size 15, with igniter of 1¼ oz. S.F.G.[2], or 2 lbs. size 11 M.D., with igniter of 10 drs. of S.F.G.[2]

Blank Charge.—1½ lbs. L.G. powder.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 12·5 lbs.—
Pointed, common - Weight of burster, 9·5 per cent.
Lyddite „ - „ „ 7·5 „
Shrapnel.
Practice shot.

Fuzes.—
For pointed common - Base percussion, medium.
Lyddite „ - - Direct action, impact.
Shrapnel - - - T. and P., No. 63.

Cases for Charges.—12-pr. 12 cwt. outfit box.
Half metal-lined case for blank charges.

Cartridge Case.—Canvas bag.

12-*pr. Q.F.*, 8 *cwt.*

Nominal Weight of Gun.—8 cwt.

Full Charge.—*Cordite.*—Mark I., 13¾ ozs. size 10, with igniter of 1¼ ozs. S.F.G.[2]

Blank Charge.—1½ lbs. L.G. powder.

Tubes.—*Electric*, V.S. "P." electric wireless. *Percussion*, V.S. percussion.

Projectile.—Approximate weight, 12·5 lbs.—
Pointed common shell - Weight of burster, 9·5 per cent.
Shrapnel shell.
Practice shot.

Fuzes.—
For pointed common - - Base percussion, medium.
Shrapnel - - - T. and P., No. 63 or 56.

Case for Charges.—12-pr. 8 cwt. outfit box.
Half metal-lined case for blank charges.

Cartridge Case.—Canvas bag.

Q.F. 6-pr. and 3-pr.

Detail.	Hotchkiss.		Vickers.
	6-pr.	3-pr.	3-pr.
Nominal weight of gun - -	8 cwt.	5 cwt.	6 cwt.
Full charge, Cordite, size 5 - -	$7\frac{3}{4}$ oz.	$6\frac{7}{8}$ oz.	—
„ „ „ M.D., size $4\frac{1}{4}$ -	$8\frac{111}{116}$ „	$7\frac{1}{4}$ „	—
„ „ „ M.D., size 8 -	—	—	$13\frac{6}{16}$ oz.
Practice „ „ M.D., size $4\frac{1}{4}$ -	—	—	$6\frac{14}{16}$ „
Blank „ L.G. Powder - -	15 oz.	11 oz.	11 oz.
Projectiles:—			
Steel shell - } Approximate	} 6 lbs.	$3\frac{5}{16}$ lbs.	$3\frac{5}{16}$ lbs.
Practice shot - } weight			
Weight of burster - - -	4·17 per cent.	4 per cent.	4 per cent.

Fuze.—Hotchkiss base percussion.

Case for Charges.—Ammunition boxes.

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