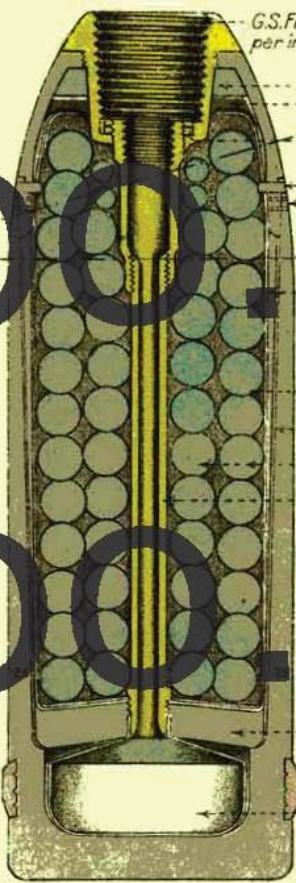
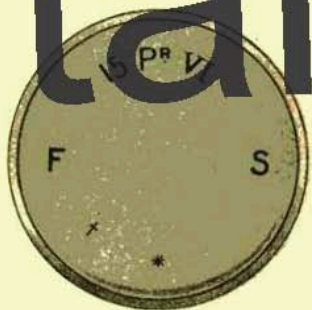


**SHELL, B.L. B.L.C. OR Q.F. SHRAPNEL 15 PR (MARK VI) L**  
**FORGED STEEL**  
 (§ 11.235.)

SCALE 1/2



G.S. fuze hole 14 083 threads per inch on axis right hand  
 Solder  
 Tin washer  
 3/4 M. or down brass nut locked by centre  
 and  
 twisting pins 1/34 dia brass screws 1/34 dia  
 Cylinders perforated with 5 holes per column 1/32 dia.  
 Resin  
 Brown paper  
 Mild metal balls 4 or 1/2 lb.  
 Gun-metal tube  
 Steel disc.  
 Copper band  
 Tin cup



PAN OF BASE

AVERAGE WEIGHT		lbs.	oz.
Shell empty with ball		3	3
Buried charge 15 PR			
of T. & P.			
Mean total weight		14	0

\* Contractors initials or recognised trade mark  
 † Date of manufacture

A primer is never used in shrapnel shell which have the fuze-hole of the 2-inch gauge, because fuzes of the 2-inch gauge have a much larger magazine, and give a more powerful flash than fuzes of the G.S. gauge.

*Means of preventing powder getting into the threads of the fuze-hole.*—In shell having a 2-inch fuze-hole, in some cases a shalloon disc is shellaced into the fuze-socket to prevent the powder working up; in the latest heavy shrapnel for N.S. a “Wad fuze-hole, 2-inch” is used instead of the shalloon disc.

The Q.F. 4.7-inch, Mark IV, shrapnel, has no primer; a “Wad, fuze-hole, G.S.” is used; it fits into a recess in the bottom of the fuze socket.

*Paint.*—

Shrapnel shell are painted black, except:—

- (a) those for the B.L. or B.L.C. 15-pr., which are lead-colour to distinguish them from the B.L. 12-pr. shrapnel.
- (b) the Mark II and III shrapnel for Q.F. 13- and 18-pr., which are lead-colour to distinguish them from the Mark I shrapnel.
- (c) 12-pr. shrapnel, suitable for Q.F. 12-pr., of 8 and 12 cwt. guns only (Naval Service).

All shrapnel have the nose painted red in addition to the red ring denoting filled. (See page 236.)

#### *Action of Shrapnel.*

The flash from the fuze passes down through the central tube, firing the primer, or perforated powder pellets in the shell which have them, and ignites the bursting charge of the shell, the explosion of which blows off the head (or where there is no separate head, blows out the socket and fuze) and so liberates the bullets.

#### *Types of Shrapnel Shell. Description of.*

The various shrapnel shell are here divided into types, illustrated in Plates XXIII to XXX.

In addition there are some of exceptional construction.

#### TYPE SHOWN ON PLATE XXIII.

The shrapnel shell for the B.L. 10-pr., B.L. or Q.F. 12-pr., B.L. or B.L.C., or Q.F. 15-pr. Marks I to VI, and the B.L. 30-pr., are alike in construction. The main feature of this type is a perforated tin cylinder to contain the bullets, intended to decrease the angle of opening.

Plate XXIII illustrates the shrapnel shell for the B.L., B.L.C., or Q.F. 15-pr., a short description of which is given below.

SHELL, B.L., B.L.C., OR Q.F. SHRAPNEL, 15-PR. (MARK VI) | L |.

The body is made of forged steel. The bursting charge is contained in a tin cup, above which rests a steel disc, into which the metal tube screws. This tube is in two parts screwed together, the upper part

enlarged, and threaded internally for the primer, and externally for a metal nut. The shell is lined with brown paper and fitted with a perforated tin cylinder which rests upon the steel disc. This cylinder is filled with mixed metal bullets; on top of the bullets is placed a flanged tin ring, and the top of the cylinder, which is fringed, is bent over and soldered to this ring. The space between the bullets is filled in with molten resin.

A short gunmetal socket screws into the head and is further secured by solder. This socket is threaded inside to the G.S. taper and pitch, and a flange formed on the inside at the bottom fits round the top of the central tube, to which it is secured by a locking nut screwed on the top of the tube, and prevented from working loose by four centre punch stabs.

The head is attached by means of brass screws and steel twisting pins, which are covered with solder. The twisting pins are in the top row and fasten the tin cylinder to the head.

#### TYPE SHOWN ON PLATE XXIV.

The shrapnel shell for the Q.F. 13- and 18-pr., and the Mark VII shrapnel for the B.L., B.L.C. or Q.F. 15-pr., are similar in construction, differing only in dimensions and type of driving band.

The main features are: They have no separate head nor shrapnel primer; they have the 2-inch fuze-hole, and the central pipe is filled up with powdered powder pellets for the purpose of increasing the angle of opening.

#### SHELL Q.F. SHRAPNEL, 13-PR., MARK III | I |.

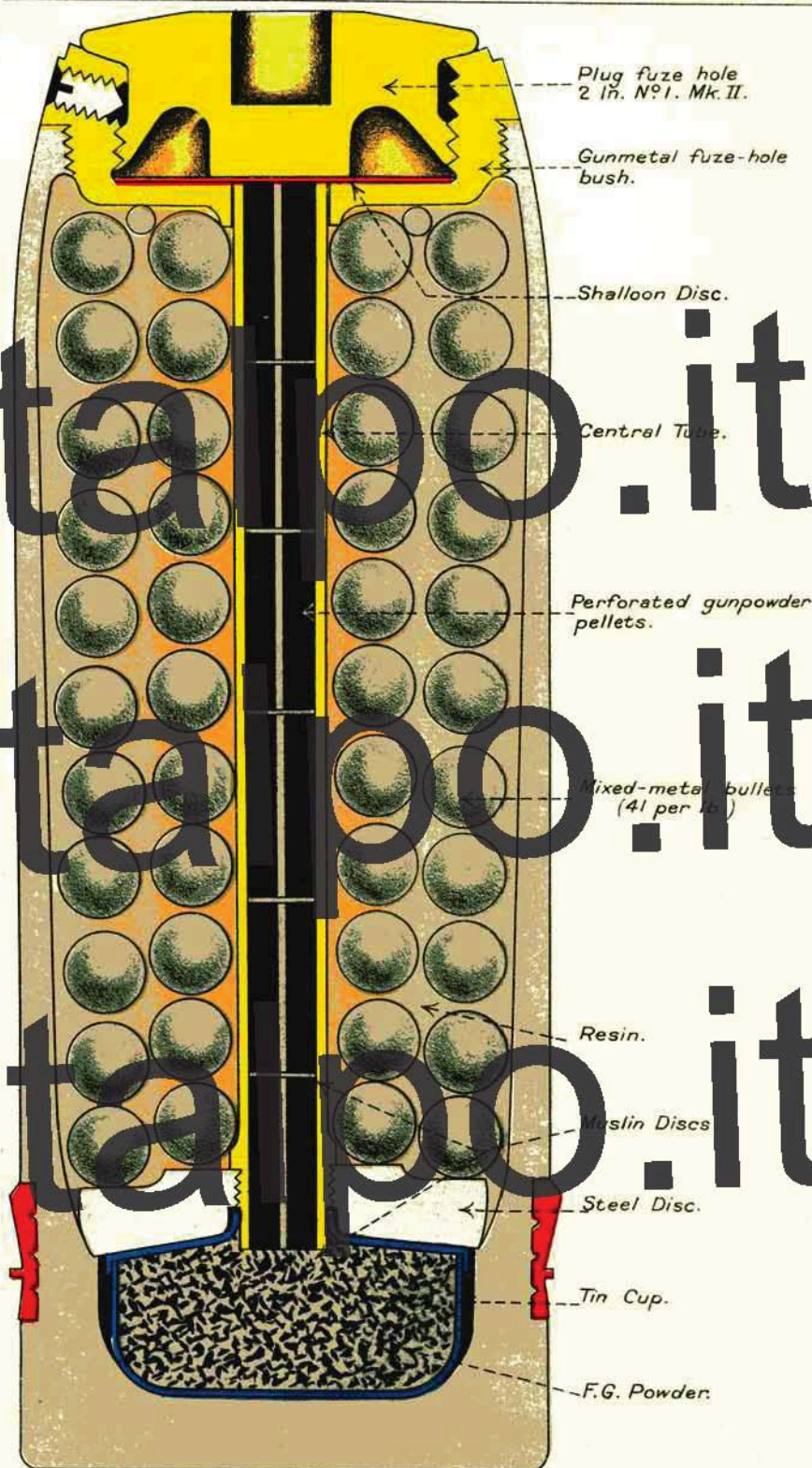
The body of the shell is of forged steel, oil-hardened, but the front portion is subsequently annealed, and is thereby enabled to open out slightly when the burster acts so as to allow the bullets to escape.

Its length is about 2.6 calibres; the walls near the base are thickened, forming a shoulder on which rests a steel disc; below the disc is placed a tin cup for the bursting charge. A hole is bored through the centre of this disc, and screwed into it is the lower end of a brass central pipe, which passes through the disc and projects into the mouth of the tin cup. The shell contains about 230 mixed metal bullets (4 parts lead, 1 part of antimony) 41 to the lb., the spaces between the bullets being filled up with resin. The front end of the shell is closed by a flanged gunmetal bush, or "Fuze socket," screwed in. The fuze socket is screw-threaded in the interior to the 2-inch gauge to take the T. and P., No. 80 fuze, a hole being bored through the bottom of the socket for the top of the central pipe. To prevent the resin working up into the fuze socket the top of the central pipe is soldered to the latter.

The shell is rotated by means of a copper driving band pressed into an undercut groove with waved ribs near the base. The driving band is of the special narrow type (No. 14. Plate XVI).

A projecting rim and a coning groove are formed on the band for the mouth of the cartridge case.

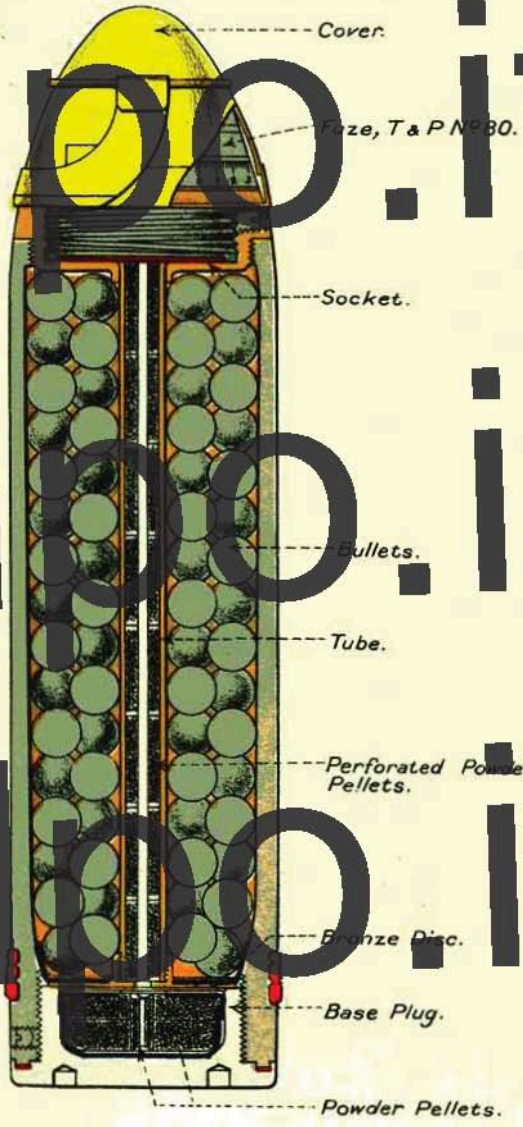
SHELL Q.F. SHRAPNEL, 13 PR. MARK III | L |



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SHELL, B.L. SHRAPNEL, 2.75 INCH, MARK I.

Scale = 1/2.



The bursting charge is  $1\frac{1}{4}$  oz. of F.G. powder which fills the tin cup, and the central pipe is filled with six perforated powder pellets; the bottom ends of the two lower powder pellets are covered with discs of muslin, and a disc of shalloon shellaced in the bottom of the fuze-hole socket prevents the F.G. powder working out of the tin cup.

The Plug, fuze-hole, 2-inch, No. 1, is used.

### TYPE SHOWN ON PLATE XXV.

This is a new type of shrapnel; its main features are—

1. It has no separate head.
2. It has a separate base which screws on.
3. It has the 2-inch fuze-hole gauge.
4. The bursting charge is in the form of compressed pellets of gunpowder.
5. It has no primer, the central tube being filled with powder pellets.

The B.L. 2.75-inch, and the Q.F. 12- and 14-pr., Mark IX shrapnel are manufactured to the above design.

The shrapnel shell for the B.L. 4-inch (heavy), is similar, but has a separate head attached to the body by rivets and twisting pins.

#### SHELL, B.L. SHRAPNEL, 2.75-INCH, MARK I | L |

The body and base are of forged steel; two holes are formed in the base to take the key when screwing it home and a small steel screw passing through the wall of the shell prevents the base from unscrewing. The tin cup fits into the front of the base; it is in two parts, and contains two flat powder pellets, with a central perforation in each; the central hole in the pellets is fitted with a small powder pellet, also perforated.

On the top of the pellets rests a tin disc with central hole and disc of paper shellaced to the under side.

On top of the tin cup, and resting on the base, is a bronze disc into which the central tube screws.

A small hole in the centre of the disc allows the flash to pass from the tube to the bursting charge. A disc of paper is shellaced to the underside of the disc.

Over the bronze disc is placed a flanged tin collar, intended to prevent the resin from working through into the base.

The shell is not lined with brown paper; it contains about 253 mixed metal bullets, 41 to the lb.

The fuze-socket is threaded to the 2-inch fuze-hole gauge and is soldered to the top of the central tube; it is fitted with a steel set-screw for securing the fuze in position.

The central tube contains eight perforated powder pellets; a disc of shalloon shellaced to the bottom of the fuze socket retains the powder pellets in position.

## TYPE SHOWN ON PLATE XXVI.

This is a new type of shrapnel fitted with tracers, intended for the attack of aircraft.

## TYPE OF SHRAPNEL SHOWN ON PLATE XXVII.

The shrapnel shell for the B.L. 60-pr., the Q.F. 4·5-inch howitzer, the Marks XI, XIa, XIII, XIIIa and XVaQ shell for the B.L. 6-inch gun, the Mark XVI shell for the B.L. or Q.F. 6-inch gun and howitzer, and the 6-inch howitzer (light) shrapnel are generally similar in construction.

They have the 2-inch fuze-hole gauge; the central tube has no primer, nor perforated powder pellets.

The 6-inch howitzer shrapnel has a wood block surrounding the central tube. (See Fig. 39.)

## SHELL, B.L. SHRAPNEL, 60-PR., MARK I | L |.

The body is made of forged steel and has a recess in the base to contain a bursting charge of  $4\frac{1}{2}$  ozs. of F.G. powder contained in a tin cup.

The bursting charge is covered with a steel disc resting on a shoulder in the interior of the shell. A hole is bored through the centre of this disc and screwed into it is the lower end of a brass central tube.

The shell is lined with brown paper and contains about 900 mixed metal bullets (35 to 37 to the lb.), the space between the bullets being filled up with molten resin.

The head is of steel and contains a wood block, below which is placed a felt wad; it is attached to the body by means of screws and twisting pins covered with solder.

The metal fuze-socket is screwed and soldered to the head; it is threaded to the 2-inch fuze-hole gauge and has a steel fixing screw for securing the No. 83 fuze, or the adapter 2-inch, when a No. 62 fuze is used.

## SHELL, B.L. SHRAPNEL, 6-INCH HOWITZER (LIGHT), MARK I | L |.

The 6-inch howitzer shrapnel differs from the above in dimensions, and in having a wood block surrounding the central tube so as to reduce the weight but not the length of the shell.

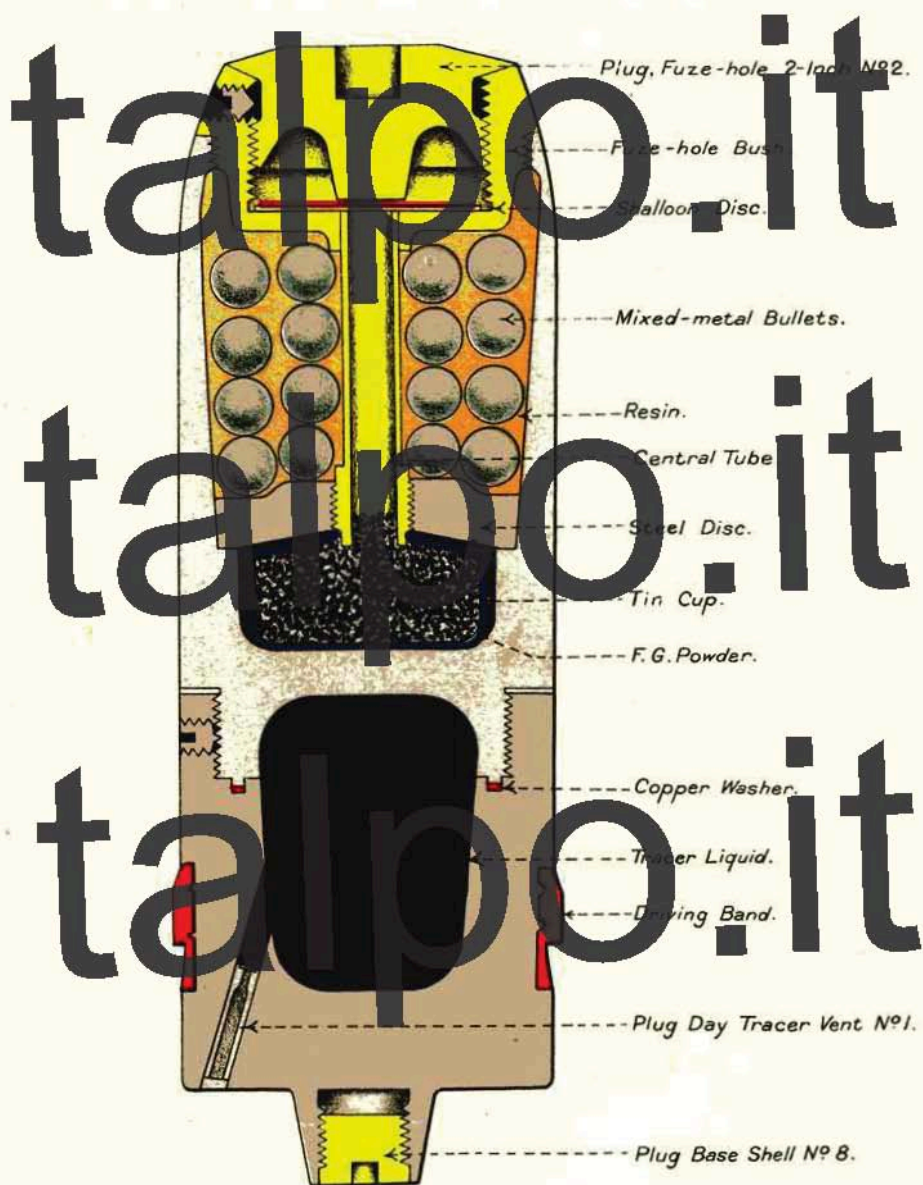
*First issue of Shrapnel Shell for Q.F. 4·5-inch Howitzer.*

The shrapnel shell that were first issued for the Q.F. 4·5-inch howitzer (§ 15434), differed from that shown on Plate XXVII as follows:—

The tin cup has no lid; the steel disc covering the bursting charge is tinned, and has soldered to its underside the flanged top of the tin cup as shown in Fig. 40.

SHELL, Q.F. SHRAPNEL, AND TRACER 3-INCH MARK I.

Scale = 2/3.





SHELL . B. L. SHRAPNEL . 60 PR MK I .

LAND SERVICE .

2 Inch Gauge

Shalloon Disc

Wood Block.  
Felt Washer

About 990 Bullets  
(35 to the lb) in Resin.

Brown Paper  
Lining

Forged Steel Body

F.G. Powder in  
Tin Cup.

Solder

Slots for  
Twisting Pins

Holes for  
Rivets

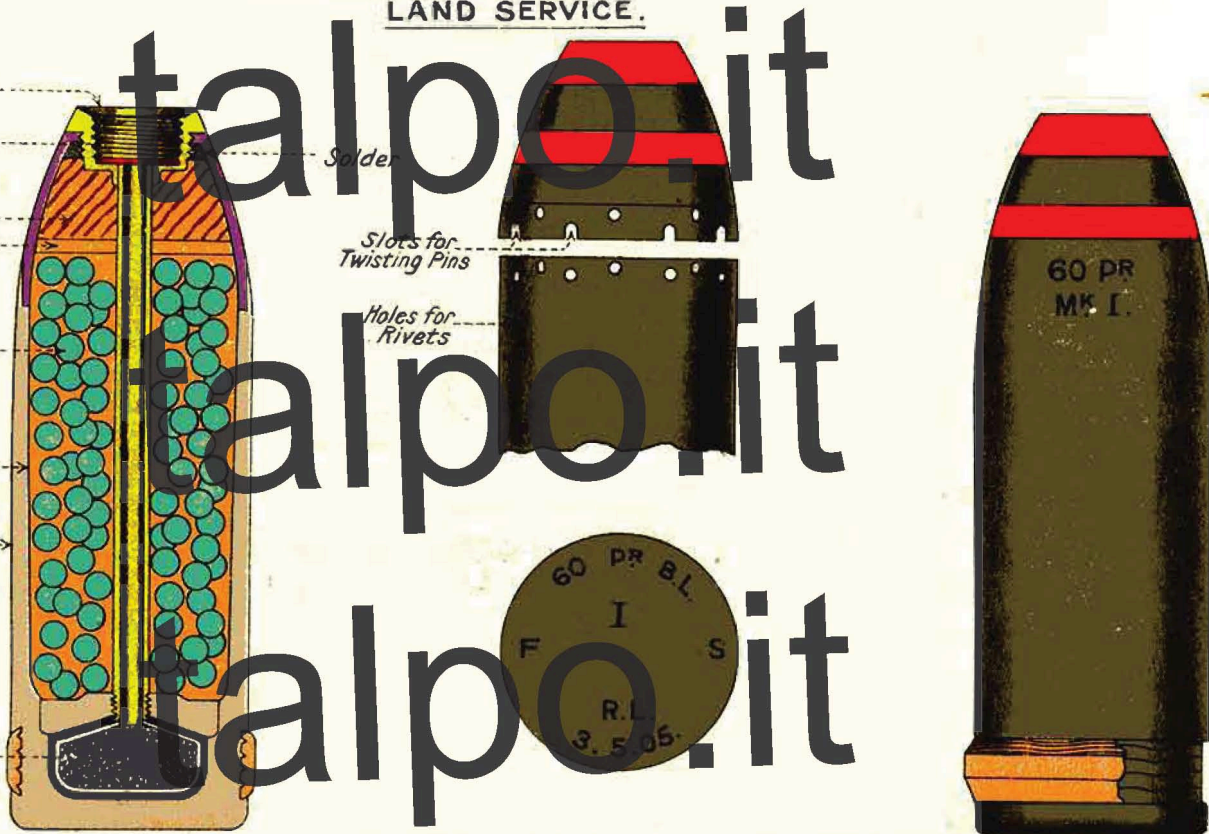


Fig. 39.

SHELL, B.L. SHRAPNEL, 6-INCH HOWITZER (LIGHT), MARK I | L | .

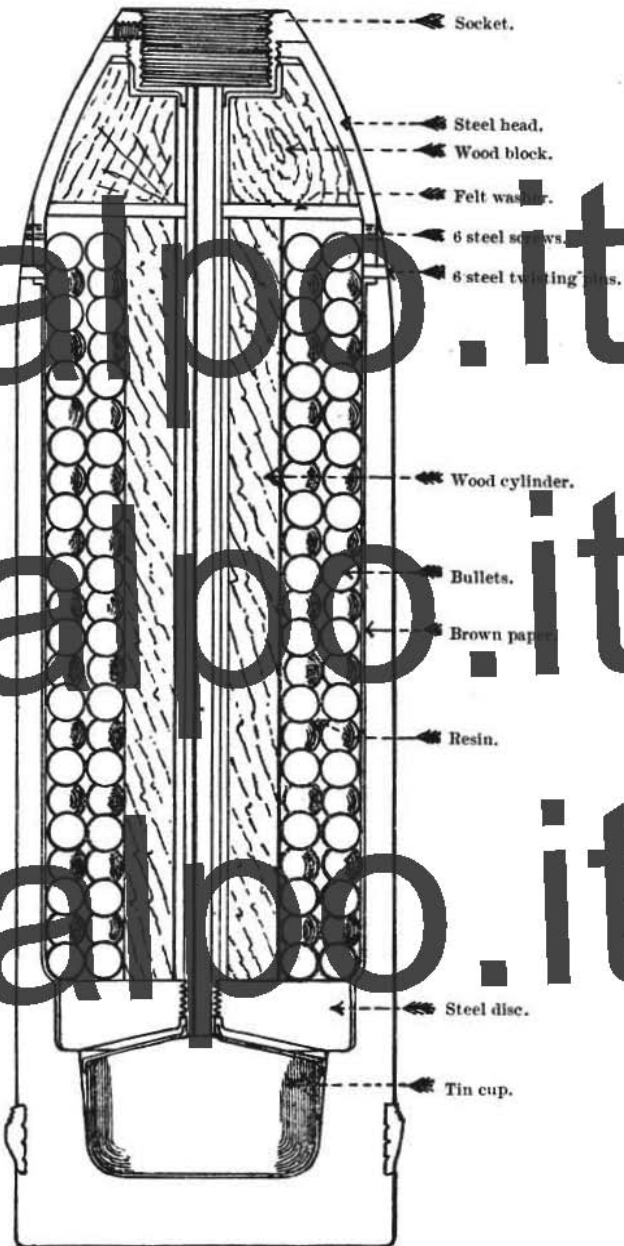
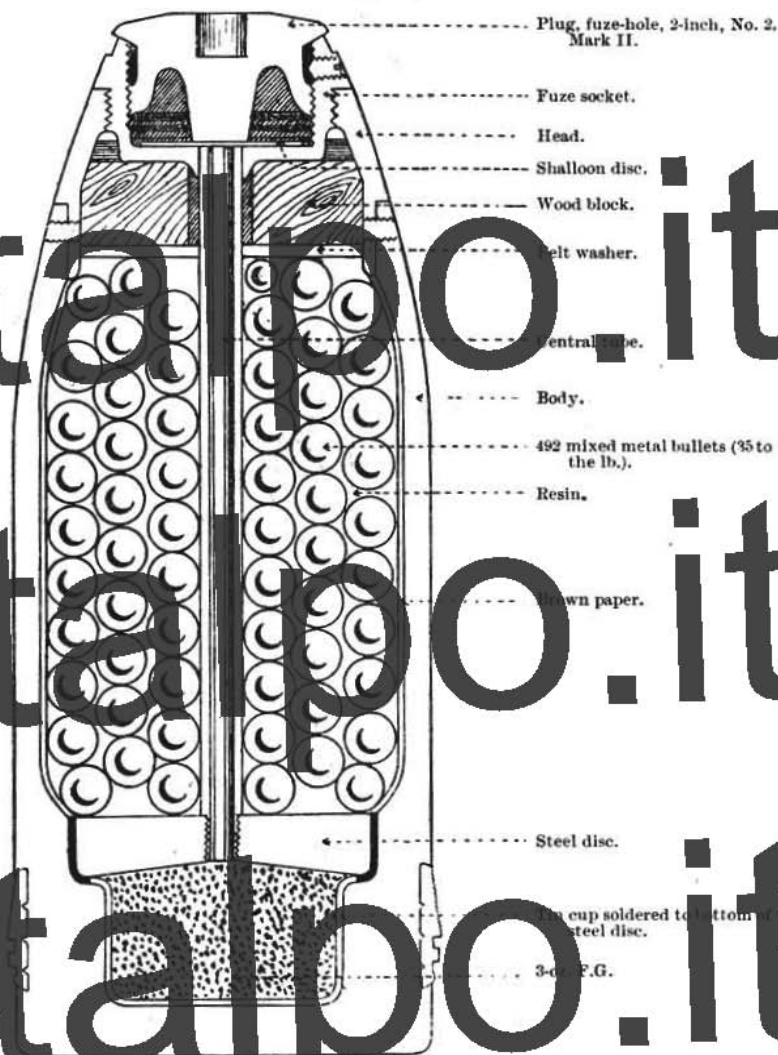
Scale  $\frac{1}{4}$ .

Fig. 40.  
SHELL, Q.F. SHRAPNEL, 4.5-INCH HOWITZER, MARK I,  
OLD TYPE.  
Scale  $\frac{1}{2}$ .



TYPE OF SHRAPNEL SHOWN ON PLATE XXVIII.

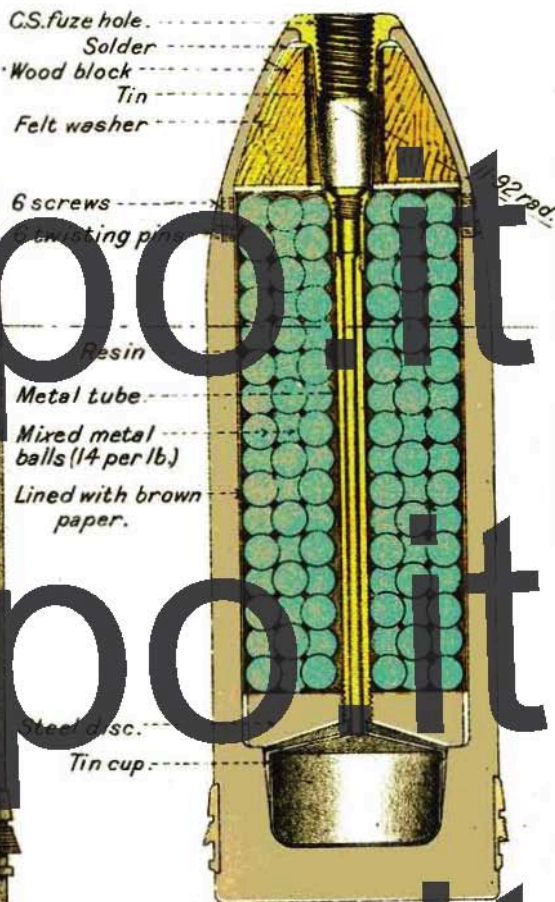
This class of shrapnel is generally known as the "*Composite socket type.*"

The shrapnel shell, Marks I to III, for the Q.F. 4-inch, Mark VI to VIII for the B.L. 4-inch; Marks III and IV for the B.L. 5-inch gun; and Marks IV to IX and Mark XII shrapnel, for the B.L. or Q.F. 6-inch gun and howitzer are of this type.

Plate XXVIII illustrates the Mark IX shrapnel shell for the B.L. or Q.F. 6-inch gun and howitzer.

SHELL, B.L. OR Q.F. SHRAPNEL 6 INCH GUN OR HOWITZER.

CAST STEEL, MARK IX | C |.



ELEVATION



PLAN OF BASE

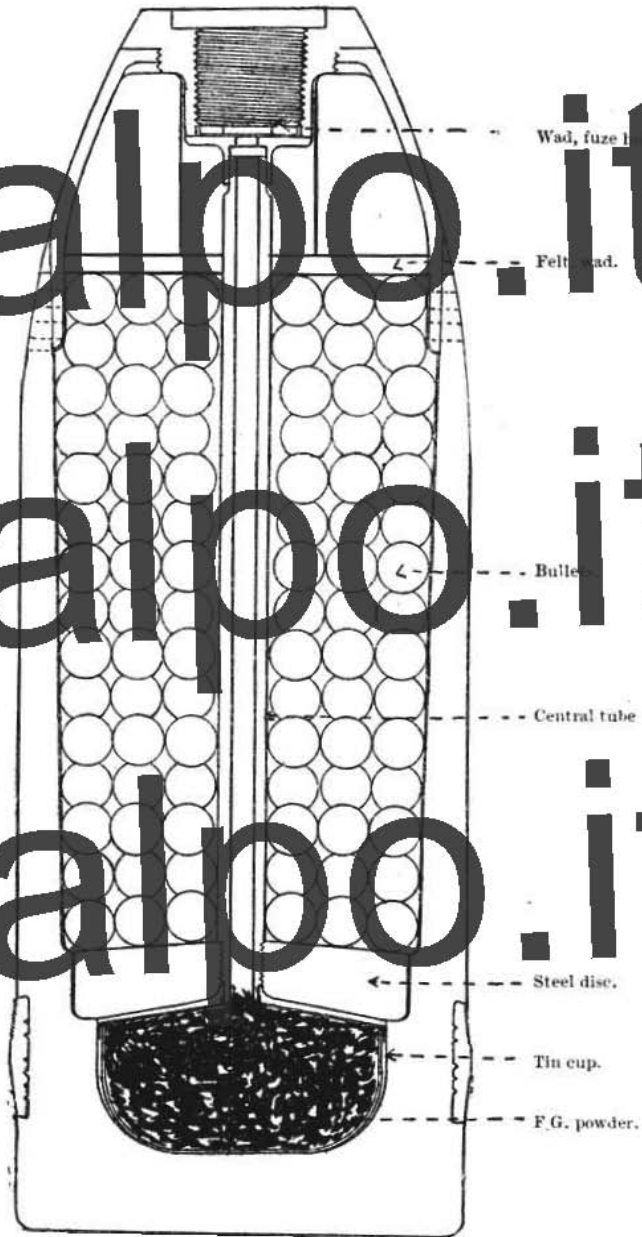
SECTION

AVERAGE WEIGHT OF SHELL	LB.	oz.
Empty with band.	98.	9
Bursting charge, R.F.G.		10½
Fuze T & P middle	1.	5
Mean total weight.	100.	8½

Manufacturers initials or recognised trade mark.

Fig. 41.

SHELL, Q.F. SHRAPNEL, 4.7-INCH, MARK IV.

Scale  $\frac{1}{2}$ .

## SHELL, Q.F. SHRAPNEL, 4·7-INCH, MARK V | L | .

*Mark V shrapnel for Q.F. 4·7-inch.*—The Mark V shrapnel differs from the Mark IV, in having the head screwed on instead of being attached by screws and twisting pins; the gunmetal fuze-hole bush is threaded to the 2-inch gauge. It contains 712 mixed metal bullets (35 to the lb.).

The first issue of the Mark V shrapnel had the steel disc covering the bursting charge pinned, and had soldered to it the tin cup as shown on Fig. 40.

## SHELL, B.L. SHRAPNEL, 7·5-INCH, MARK IIIA | N | .

This is a new type of shrapnel. The head is screwed on and secured by four steel screws, and is weakened by six saw-cuts, each  $\cdot 04$  inch wide, filled in with solder. The fuze-hole bush fits over the top of the central tube and is threaded internally to the 2-inch gauge.

There is no wood lining to the head; the bullets come right up to the bottom of the fuze-hole bush. The shell contains 407 2-oz. sand shot.

Fig.

## SHELL, B.L. SHRAPNEL, 7·5-INCH, MARK IIIA | N | .

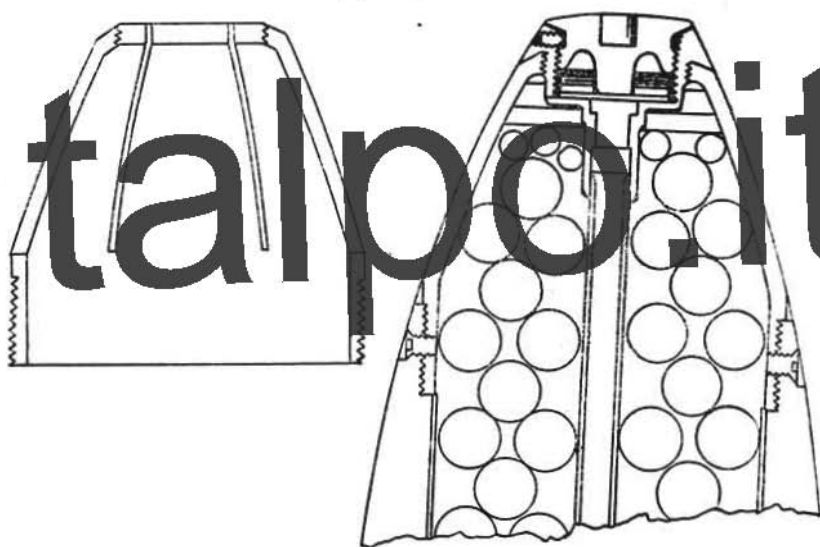
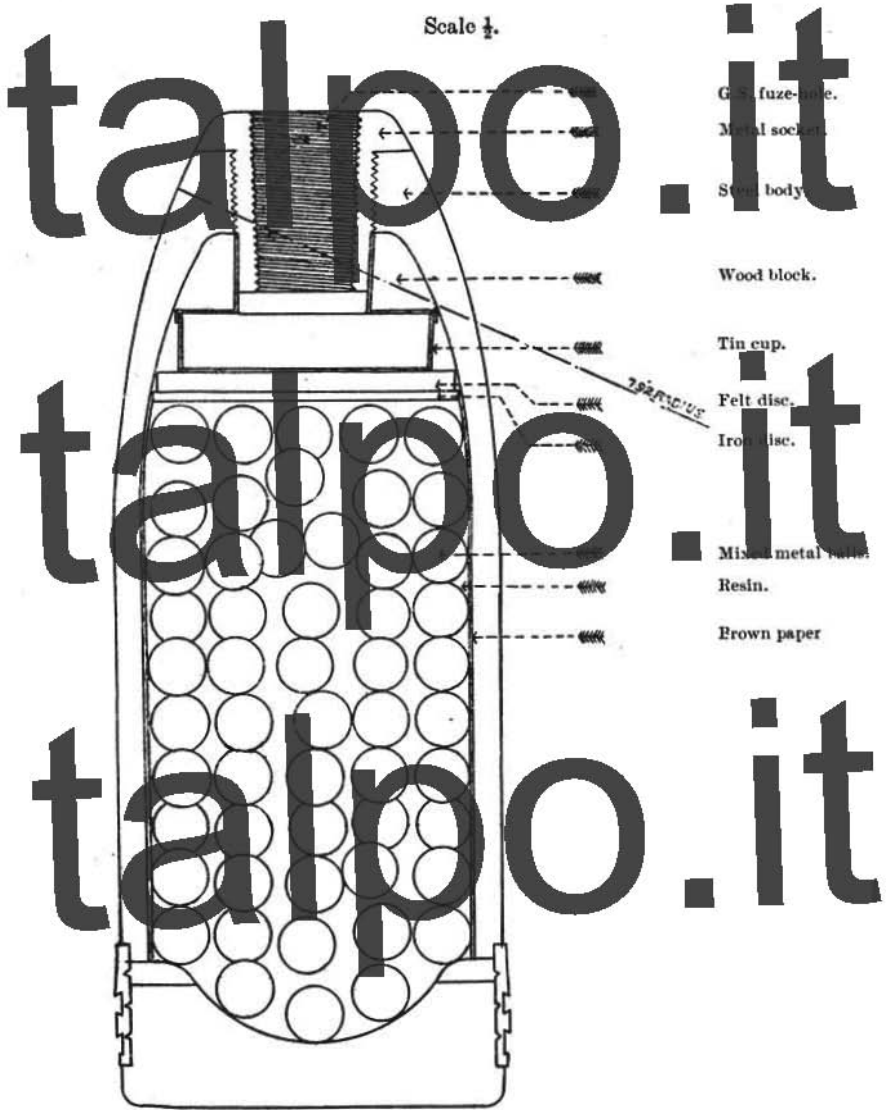


Fig. 43.

SHELL, B.L., Q.F. OR Q.F.C. SHRAPNEL, 1/4-INCH, FORGED STEEL, MARK V.

Scale 1/2.



Gas fuze-rod.  
Metal socket.  
Steel body.

Wood block.

Tin cup.

Felt disc.  
Iron disc.

Mixed metal  
Resin.

Brown paper

## SHELL, B.L. OR Q.F. SHRAPNEL, 4-INCH (HEAVY), MARK II | N | .

This shell has a compressed pellet burster and is similar in design to type shown on Plate XXV, but differs in having a separate head, with wood lining and felt washer, attached to the body by rivets and twisting pins.

It contains about 500 mixed metal bullets (35 to the lb.).

The central tube contains 9 perforated powder pellets.

The Mark I shell differs from the Mark II in having a slightly longer head, which is weakened by four saw-cuts.

## SHRAPNEL SHELL WITH BURSTING CHARGE IN THE HEAD.

The Shell, B.L. shrapnel, 4-inch, Marks IV, V and VI, are made of forged steel, and have the bursting charge contained in the head.

This shell has a body of forged steel tubing, head and body in one piece, and malleable cast iron or mild steel base. A flanged gun-metal bush screws into the nose, and is tapered to the G.S. pitch and taper being made long enough to take the short T. and P. fuze over the G.S. wad. A tin cup is placed inside the head to contain the bursting charge, the neck of the tin cup fitting over the lower portion of the bush, and the space between the projecting portion of the latter and the tin cup is filled by a wood block. A felt disc is placed next the tin cup, then a wrought-iron one, which presses on top of the bullets and prevents the resin from working up. The body is lined with brown paper, and the bullets inserted from the base, molten resin being afterwards run in amongst them. The base is then lightly attached by six steel shoring pins and two steel keys, the latter fitting into undercut slots in the body and base. They prevent the base being twisted off, but do not oppose any resistance to a direct blow from the front.

*Action.*—The explosion of the bursting charge slightly checks the velocity of the bullets, and acting through them blows off the base of the shell. The body then slides over them like a glove, the bullets continuing their course with a velocity slightly reduced.



## TYPE OF SHRAPNEL SHOWN ON PLATE XXIX.

Plate XXIX illustrates the old type of heavy shrapnel introduced for B.L. guns, 7·5-inch to 13·5-inch.

The main features are :—

- (1) They are made of cast steel.
- (2) The central tube is of iron, instead of brass or gunmetal, and is of larger diameter.
- (3) The fuze socket is lengthened so as to extend into the top of the central pipe, the upper part threaded to G.S. gauge, the lower part threaded to take the primer.
- (4) Sand shot (cast iron) are used instead of mixed metal bullets—2-oz. sand shot in the 7·5-inch and 9·2-inch, and 4-oz. in the 10-inch, 12-inch and 13·5-inch.

### SHELL, B.L. SHRAPNEL, 9·2-INCH, MARK VIII | I |.

The shell is made of cast steel about 2·5 calibres in length, the walls near the base are thickened so as to form a shoulder, on which rests a steel diaphragm, beneath which is the powder chamber.

The bursting charge is contained in a tin cup, which is cored at the top to facilitate unloading, and the neck of which fits on to the bottom of the wrought-iron pipe. The use of this cup is to guard against possible prematures from the roughness of the interior of the shell, and to prevent loss of powder. The bottom of the pipe has asbestos wrapped round it and is covered with Pettman cement in order to make a tight joint with the tin cup and so prevent resin working in among the powder. The diaphragm, which rests upon the shoulder of the powder chamber, is of steel and into it is screwed a piece of 1-inch gas pipe, smoothed and beveled inside. The interior of the shell is lined with brown paper, and contains 638 2-oz. sand shot, the interstices are filled up with melted resin and covered with a felt washer.

The head is of steel, fitted with a wood block, and is attached to the body by a row of rivets and a row of twisting pins covered with solder.

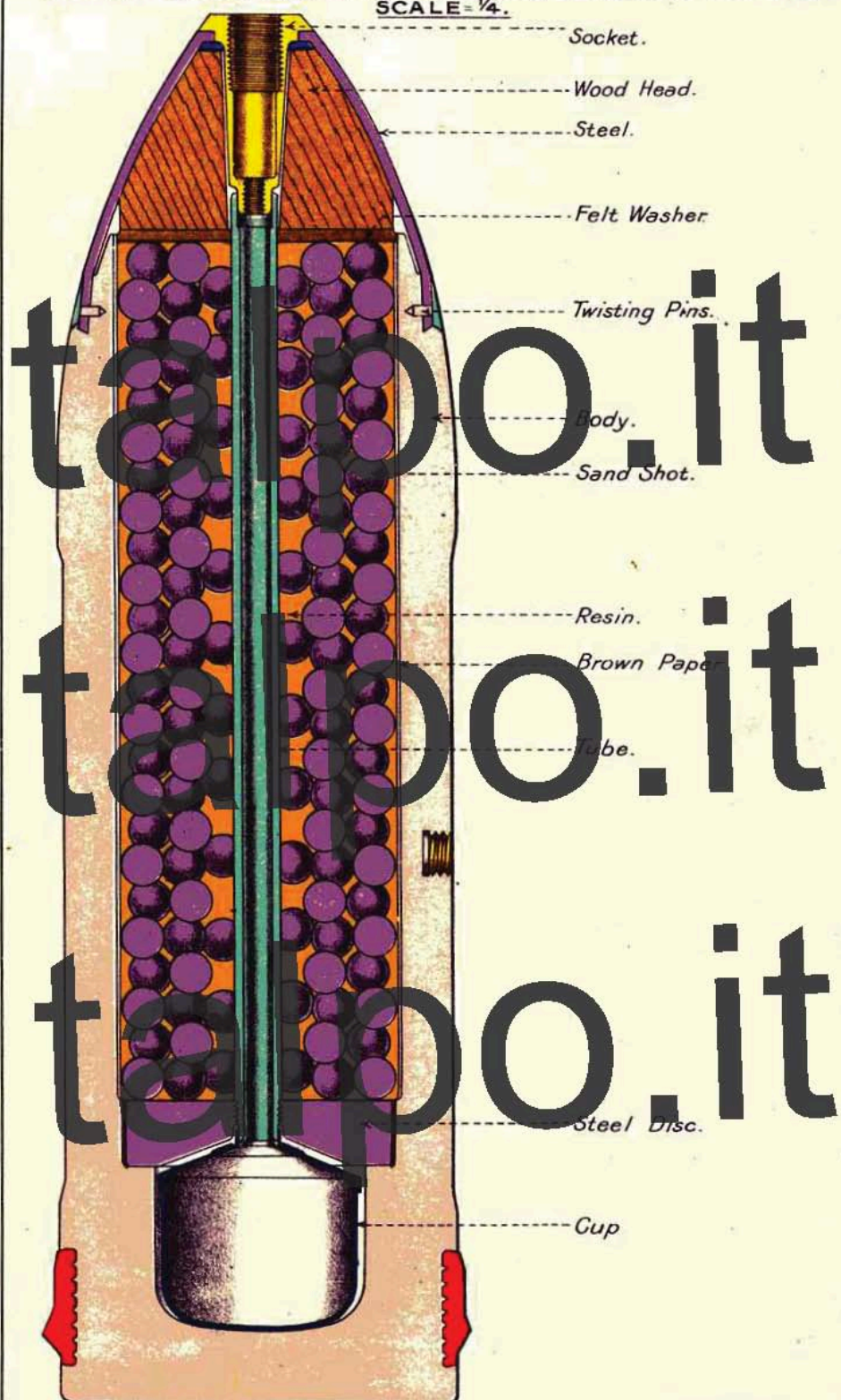
The head is fitted with a metal fuze-socket; the upper part of this socket is screw-threaded to the "G.S. gauge," the lower part threaded to receive the "Primer, shrapnel, shell."

There is no attachment between the gunmetal socket and the wrought-iron tube; but the end of the latter is slightly recessed to receive the socket, which is carefully turned to fit it.

The shell is rotated by means of the "Hump" pattern of driving band which is pressed into an undercut groove near the base

SHELL, B.L. SHRAPNEL, 9.2 INCH, CAST STEEL, MARK VIII.

SCALE = 1/4.



Socket.

Wood Head.

Steel.

Felt Washer.

Twisting Pins.

Body.

Sand Shot.

Resin.

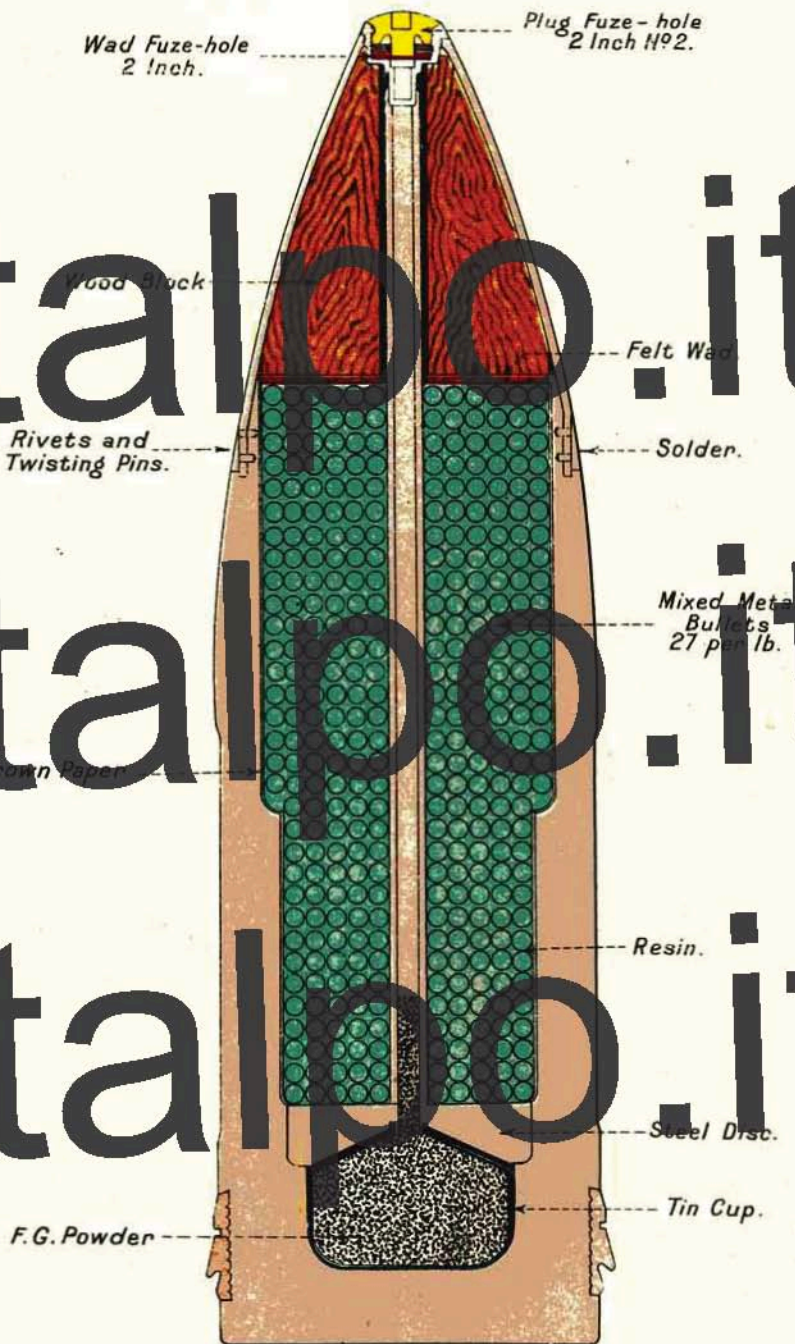
Brown Paper

Tube.

Steel Disc.

Cup

SHELL B.L. SHRAPNEL 12 INCH HEAVY, MARK II<sup>A</sup> /N/



## TYPE OF SHRAPNEL SHOWN ON PLATE XXX.

Plate XXX illustrates the new type of heavy shrapnel introduced for B.L., 7.5-inch to 15-inch, for Naval Service.

They differ from the old type of heavy shrapnel in the following particulars:—

- (1) The fuze-socket is threaded to the 2-inch gauge.
- (2) No shrapnel primer is used.
- (3) A "Wad, fuze-hole, 2-inch," is used to prevent the powder working up into the threads of the fuze-hole.
- (4) Latest marks are now filled with mixed metal bullets, 27 to the lb.; the earlier marks were filled with sand and shot. The B.L. 12-inch, Mark I" shrapnel, had 12-oz. steel balls.
- (5) The 12-inch, 13.5-inch and 15-inch shell have "stepped walls," to give greater capacity for bullets.

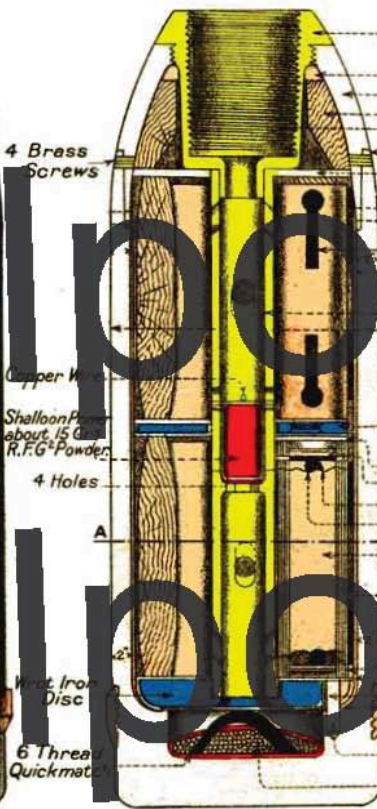
For particulars of number and size of bullets, weight of burster and other details of all Service shrapnel, see Table 19 overleaf.

**SHELL B.L., STAR, 10-PR. (MARK II.) | L**

**STEEL.**

(NOTE MARK III HAS NO PRIMER IN THE CENTRAL TUBE)  
**MEAN TOTAL WEIGHT, FUZED 6 LB.15 OZ.**

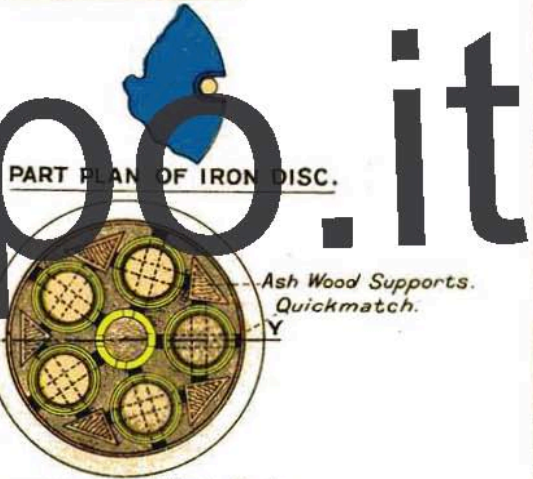
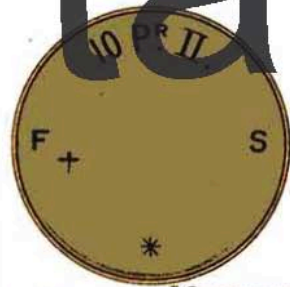
Scale  $\frac{1}{2}$ .



- G.S. Fuze Hole.
- Solder.
- Steel Head.
- Wood Block.
- 7 Hole .08 dia.
- Joint made with Pettman Cement.
- Felt Washer.
- 4 Twisting Pins.
- 4 Thread Quickmatch.
- Interior of Shell lacquered & lined with brown paper.
- Metal Tube perforated with 12 holes.
- Felt Washer.
- Iron Disc 2.125 dia. perforated with 5 holes.
- Felt Washer & Band stitched together.
- Star Composition.
- Priming Composition.
- Surface roughened after A pressing.
- Star Composition pressed.
- Sheet Brass .005 thick 3 turns rolled to centre of walls of brown paper cylinder.
- White Fine Paper Disc.
- Felt Washer.
- Brown Paper.
- Felt Washer .05 thick slipped up between shell & Disc.
- Steel Pin.
- 3 drams R.E.G.<sup>2</sup> Powder in Shalloon Bag.

**SECTION AT X.Y.**

**ELEVATION.**



**PART PLAN OF IRON DISC.**

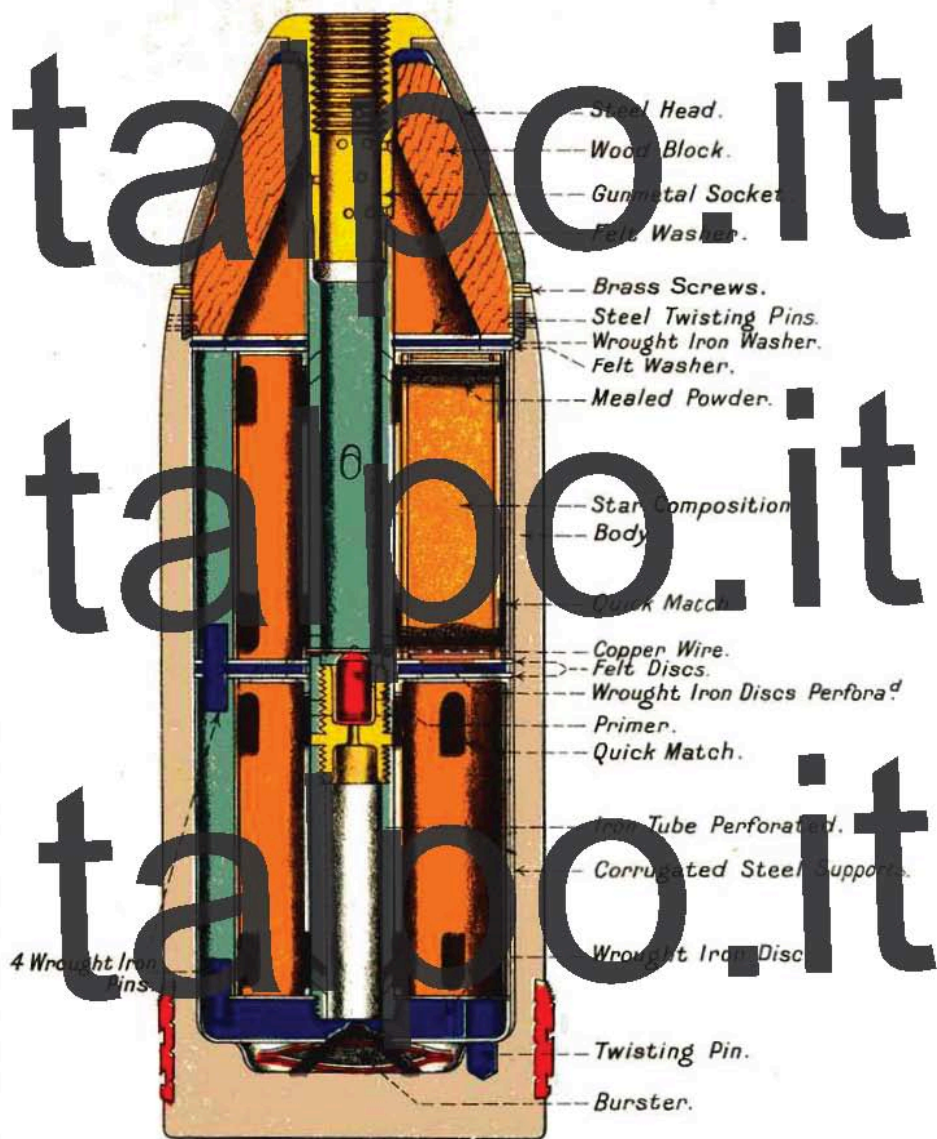
**SECTION AT A.A.**

† or 'C' if made of <sup>\*</sup>Contractors Initials or recognised Trade Mark.  
 cast steel

**PLAN OF BASE.**

SHELL, B. L. STAR 6 INCH, HOWITZER, MARK I. | L |

SCALE = 1/3



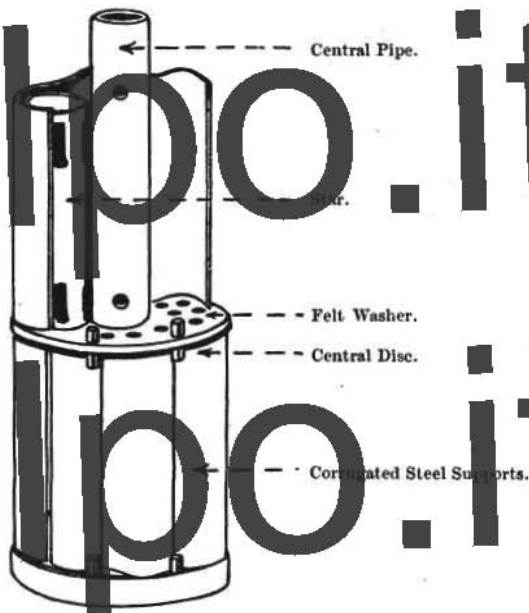
4 Wrought Iron Pins

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The figure shows the interior arrangement of the shell with one of the upper corrugated steel supports removed, showing two of the stars in position; the pins projecting upwards from the bottom disc, and from both sides of the central disc, lock the corrugated steel supports and prevent them from turning.

The shell weighs about 58 lbs.

Fig. 45.



#### STAR SHELL FOR B.L. 5-INCH AND 5'4-INCH HOWITZERS

The star shell for the B.L. 5'4-inch and 5-inch howitzers differ from the above in having wood wedges instead of corrugated steel supports, and the central tube is in one piece and has no powder primer.

The 5-inch has 8 stars, the 5'4-inch 10 stars.

SHELL, Q.F. STAR, 13-PR., MARK II | L | .

The shell is made of steel recessed in the base to receive a bursting charge of  $3\frac{1}{4}$  drams of R.F.G.<sup>2</sup> powder contained in a shalloon bag primed with quickmatch. A metal central pipe perforated with 12 holes is screwed into a flat covered wrought-iron disc resting over the bursting charge.

The interior of the shell is velrilled and lined with brown paper; it contains 10 stars in two tiers of five; a perforated iron disc covered with felt separates the tiers. The iron disc is supported by wood

wedges placed between the stars, and is prevented from turning by means of two projections or feathers fitting into two featherways cut down the inside of the shell.

The head is lined with wood, and is attached to the body by four brass screws and four steel twisting pins. A felt wad is placed between the wood block and the top tier of stars. A gunmetal fuze-hole bush is fitted to the head, threaded internally to the G.S. gauge to take the No. 25 time fuze.

*Star Shell for Q.F., 18-pr.*

The star shell for the Q.F., 18-pr., is similar to the Q.F., 13-pr. star shell described above, differing only in weight and dimensions. (See Table 20.)

*Star Shell for Q.F., 2.95-inch.*

*Star shell.*—The Mark II star shell is made of forged steel, and is similar to the 13-pr., Q.F. star shell, but has a bursting charge of 3 drams of R.F.G.<sup>2</sup> powder and 5 per cent. oxide of iron, and is fitted with the plain type of driving band.

The Mark I star shell differed from Mark II in having a gunmetal head attached by brass screws and steel twisting pins; the tiers of stars were not separated by a perforated iron disc, and the bursting charge was 1 dram of R.F.G.<sup>2</sup> powder.



TABLE NO. 20.—Shell, B.L. and Q.F. Star.

Para. in List of Changes.	Nature of Gun or Howitzer.	Mark of Shell.	Type of Band.	Length in Inches.	Diameter.		Number of Stars.	Bursting R.F.G. <sup>2</sup>	Total Weight.		Remarks.
					Band or Body.	Driving Band.			Drams.	Lb.	
11025	10-pr. B.L. ...	I	12	8-31	2-73	2-85	10	1	6	Wood wedges; 15 grain primer in central tube.	
11278	Do. ...	II	12	8-31	2-73	2-85	10	3	6		
12804	Do. ...	III	12	8-31	2-73	2-85	10	3	6		
13812	Do. ...	III	12	8-31	2-73	2-85	10	3	6	Wood wedges; no primer in central tube.	
13811	13-pr. Q.F. ...	I	13	8-44	2-99	3-09	10	3½	7½	Wood wedges.	
	Do. ...	II	14	8-44	2-99	3-09	10	3½	7½	No cannellure around shell.	
13811	18-pr. Q.F. ...	I	13	10-32	3-28	3-39	10	3	10½	Wood wedges.	
	Do. ...	II	14	10-32	3-28	3-39	10	3	10½	No cannellure around shell.	
13350	15-pr. B.L., B.L.C., or Q.F.	I	12	8-07½	2-98	3-08	10	3	9	Wood wedges.	
10898	2-95-inch Q.F. ...	I	4	8-78	2-04	3-017	9	3	8½	Do.	
11979		II	4	8-78	2-04	3-017	9	3	8½	Do.	
13384		Do. ...	II	4	8-78	2-04	3-017	10	3	8½	Do.
11318	5-inch Howitzer ...	II	4	14-87	4-95	5-115	8	2	30	Do.	
	Do. ...	III	10	14-87	4-95	5-115	8	2	30	Do.	
	5-4-inch Howitzer (India)	II	4	16-33	5-35	5-115	10	2	39½	Do.	
10410	6-inch Howitzer ...	I	4	16-69	5-37	6-12	2	10	58½	With corrugated steel supports in lieu of wood wedges; 70-grain primer in central tube.	
11071											

NOTE.—Star Composition: Nitrate of Baryta, 108 parts; Nitrate of Potash, 73 parts; Magnesium Powder, 98 parts.

## SECTION (D). LYDDITE AND H.E. SHELL.

*General remarks on Common Lyddite ; Methods of Filling and Marking ; Exploders Picric Powder and Trotyl ; Description of types of Filled Lyddite ; A.P. Lyddite and H.E. Shell.*

Lyddite shell are intended to detonate.

If detonation takes place the shell is torn into a large number of comparatively small fragments.

These fragments are projected over a comparatively large area in all directions and do not all go forward with the remaining velocity of the shell, as do the fragments of a powder-filled shell.

The fragments would be very effective against personnel, but as they have little energy, they are not very effective against material except in the vicinity of the detonation, where an intense shattering effect is obtained.

There is no incendiary effect, and the effect of the fumes is small.

A lyddite shell is vastly superior to a gunpowder-filled shell for the attack of earthworks, magazines, etc., being about four times as powerful.

To obtain the maximum effect, lyddite must be detonated well inside, and not on the surface of the target, hence a delay action is desirable.

When used against "Heavily armoured ships," or against "Earthworks," a fuze giving a short delay is best.

Against "Torpedo craft" instantaneous action is essential, otherwise the shell will have passed through before detonating.

Detonation is indicated by the bursting shell spreading its fragments over a large area, giving an all-round effect, and by the smoke being black to grey, or even nearly white.

The latter appearance is due to the steam produced, which shows up more clearly under certain atmospheric conditions.

Yellow smoke denotes simple explosion, and the effect is not so great as regards the spread of fragments.

The proportion of yellow smoke to that of black, grey or white, may therefore be taken as a guide to the nature of the explosion.

## COMMON LYDDITE.

The premature explosion of a common lyddite shell in the gun would be so disastrous that, in designing these shell, every precaution is taken to prevent such an accident, hence:

- (1) They are made of forged steel.
- (2) As these shell take a large bursting charge, it is not considered desirable to have any opening in the base ; they are therefore forged with solid bases to prevent any chance of gas getting into the shell.
- (3) To prevent gas getting through a possible flaw, a recess is turned in the base, so that the interior metal may be examined for piping. This recess is filled in with a plate steel disc screwed in and riveted. Flaws are most likely to exist in the centre of a forging.

For future manufacture this steel plate will be of larger diameter more effectively to cover the base of the shell.

Early issues had no steel plate, and this type will still be met with.

- (4) As picric acid easily forms dangerous picrates with metallic bases, the interior of the shell is coated with copal varnish to prevent the formation of picrate of iron; the exterior, painted with a special yellow paint (containing no lead) to prevent formation of picrates; the fuze-hole bush, fuze-hole plug, &c., are made of a leadless alloy.

*Steel base plates.*—The introduction of the steel base plate advanced the numeral of lyddite shell for all natures.

Earlier marks of shell, when passing through Ordnance factories, will be fitted with a steel base plate, and will have a star added to their numeral.

The introduction of the large steel base plate again advanced the numeral of the shell.

*Coned walls.*—Lyddite shell first issued had "parallel walls" (*i.e.*, walls of uniform thickness). The walls in nearly all natures are now tapered, being thicker at the base and thinner near the shoulder. This design of shell is stronger, and has a greater capacity.

For example:—

	Lyddite
6-inch, Mark VI shell (parallel walls) ..	10 lb. 4 oz.
6-inch, Mark VII shell (tapered walls) ..	13 lb. 6½ oz.
Increase ..	3 lb. 2½ oz.

*Tracer shell.*—The base of common lyddite fitted for "Internal night tracer," is thicker, and has a boss formed in the interior as shown in Plate XXXVI.

#### METHOD OF FILLING.

There are three methods:—

(1) "*Long central cavity filling.*"—A long central cavity is left in the lyddite for the long exploder or "Picric powder." The original method for all natures up to B.L. 10-inch is still retained for B.L. 60-pr., 5-inch, 5·4-inch and Q.F. 4·5-inch howitzers.

(2) *Solid filling.*—There is no central cavity, but a small place is left on the top of the lyddite in the nose of the shell.

The first issues, B.L. 6-inch and up, had this space filled with "7-dram exploders" of picric powder. Later issues with "Exploder pellets"; 12-pr. to 4·7-inch have the space in the nose filled with exploders of trotyl.

(Solid filling with exploder pellets is the latest method of filling for B.L. 2·75-inch and 9·2-inch and up.)

(3) *Solid filling with short cavity in the top of lyddite.*—Q.F. 3-pr.

*Notes on the Methods of Filling Lyddite Common.*

The first lyddite shells were filled up to the bottom of the fuze-hole bush and had a long central cavity; the exploder consisted of granulated picric powder in a shalloon bag.

Various changes have been made and details introduced; they took place in the following order:—

(1) A waterproof-paper cylinder was introduced to take the above-mentioned shalloon bag. Shell fitted with exploders enclosed in this waterproof cylinder are marked with a rectangle stencilled on the side of the shell. The cylinder had a paper cap.

(2) Dry mixed picric powder was next introduced; this was indicated by the letters D.M. stencilled in the rectangle.

(3) An aluminium cap was introduced instead of the paper cap; the letter A is marked above the rectangle. The aluminium cap is perforated with a number of small holes; these are closed by a disc of paper shellaced to the inside of the cap.

(4) An asbestos paper tube, closed at the bottom, was introduced; it is placed into the lyddite before it solidifies, and the lyddite sets round it and sticks to it. At the same time as the above asbestos tube was adopted, the method of filling was changed as follows:—

The shell is not filled right up to the fuze-hole, as had been the procedure up to that time; a space is thus left beneath the fuze-hole, which space is left empty. To prevent lyddite dust getting into the fuze-hole threads, the surface of the lyddite is covered with a thin layer ( $\frac{1}{10}$ -inch thick) of "composition beeswax," originally known as "kit composition."

The asbestos tube prevents friction between the metal "former" (the tool used to form the cavity) and the lyddite; the tube being left in the shell prevents the walls of the cavity from breaking away.

The K.C. stencilled below the rectangle indicates both asbestos tube and "composition beeswax."

(5) "Solid filling" was introduced in November, 1904, for shell 6-inch and upwards.

In this method the space above the lyddite is filled with 7-dram exploders; these consist of dry mixed picric powder in small seamless bags; no "composition beeswax" is used.

(6) The shalloon bag in the long exploder was done away with and a batiste bag introduced; such exploders are known as Mark II.

Shell that were first issued with Mark II exploders were stencilled on the body with a rectangle and the numeral "II" inside the rectangle, the markings "A" and "D.M." being omitted.

(7) Shell that were originally filled up to the bottom of the fuze-hole bush with lyddite, when refitted with a Mark II exploder, had the letters "K.C." omitted, so as to distinguish them from shell with an asbestos tube and "composition beeswax."

The letters "K.C." were also omitted on lyddite shell for B.L. 60-pr. and Q.F. 4.5-inch howitzer, as all shell for the above natures have "composition beeswax" on top of the lyddite.

(8) Solid filling was introduced in November, 1909, for B.L. and Q.F. guns 12-pr. to 4-inch, and the shell fitted with small exploder bags of batiste containing *tri-nitro-toluene* (or trotyl) instead of picric powder.

Shell so filled are marked as follows:—

"EXPLODERS, T.N.T."

← T.N.T. in bags.

(9) Existing shell for B.L. and Q.F. guns 12-pr. to 4.7-inch, are converted as follows:—

The picric powder exploder is removed, the cylindrical cavity filled up with compressed pellets of T.N.T. and the cavity in the nose of the shell filled up with exploders of T.N.T. in bags.

Shell so converted are marked as follows:—

EXPLDRS T.N.T.

6½ Oz.

— Weight of pellets

← T.N.T. in bags.

(10) B.L., Q.F. or Q.F.D. 4-inch (light) and Q.F. 4.7-inch shell originally filled up to bottom of fuze-hole bush and fitted with a long exploder, when converted, will have the cavity filled up with pellets of trotyl only, there being no space for T.N.T. in bags in the nose.

(11) Exploder pellets introduced for solid-filled shell, 6-inch and up, instead of 7-dram exploders. (Introduced 30-5-10.)

Compressed pellets of picric powder are inserted into a batiste bag resting on the top of the lyddite. One or more 7-dram exploders are used to fill up the space in the nose of the shell after the bag has been choked.

Shell so filled have stencilled on the body:—

“EXPLODER PELLETS.”

- (12) *New marking on lyddite shell having central cavity.*—The rectangle denoting waterproof paper cylinder is now dispensed with, and all shell when filled on the above method are stencilled as under:—

	FRONT.	REVERSE.
W.	= Monogram of filling station.	
27.2.12	= Date of filling.	
4½ oz.	= Weight of exploder.	N. = If Naval Service.
Expldr. =	Mark of exploder. If Mark I exploder is used the letters D.M. shall be appended to numeral.	If an asbestos tube and “composition beeswax” are present
II	if the picric powder is dry mixed.	
Lot 24	Lot No. of picric acid.	

- (13) *Method of filling for shell taking No. 10 D.A. Impact fuze, with composition exploding (i.e., 3-pr.).* In this method the shell is filled to within a short distance of the fuze-hole bush.

A short asbestos paper cylinder is then inserted by means of a “former” into the lyddite before its solidifies; this cylinder takes an exploder of T.N.T. in a batiste bag.

The space in the nose of the shell is filled with “composition beeswax.”

Shell so filled are marked as follows:—

“EXPLODER T.N.T. (or TROTYL).”

S. P. R. S.

## EXPLODERS FOR LYDDITE SHELL.

*Long cylindrical exploder.*—The latest Mark is Mark III; it consists of a cylindrical bag of vulcanized cashmere filled with dry mixed picric powder; the mouth is choked with silk sewing.

It is inserted, choke end down, into a waterproof paper cylinder closed with a perforated aluminium cap secured with shellac. The paper cylinder is fitted with a lifting bracket of silk sewing.

The Mark II exploder was made of “batiste” (a waterproof cotton fabric) which had a tendency to rot.

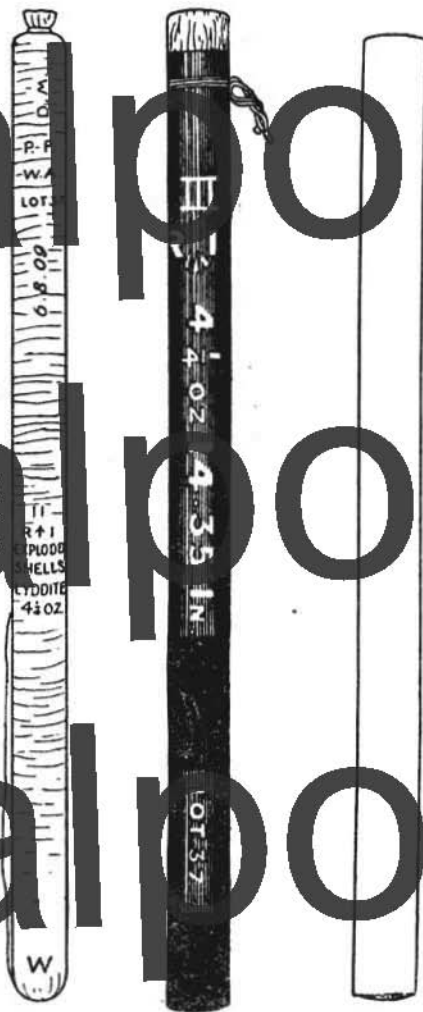
The Mark I was made of balloon; the first issues were filled with granulated picric powder.

On the left of fig. 46 is shown the batiste, or vulcanized cashmere bag filled with picric powder; in the centre is the exploder complete; on the right is the asbestos paper tube (open at the top) which is inserted into the lyddite before it has solidified, and into which the exploder is placed.

Stencilled on the bag, and also on the waterproof paper cylinder, are particulars of the mark, weight and length of the exploder, also the lot No. of P.P. used.

*Long exploders fitted with powder primer.*—With shell above 5-inch, issued prior to November, 1904, filled with a central cavity, a primer of 8 drams black gunpowder (R.F.G.<sup>2</sup>) is included in the exploder

Fig. 46.

Scale  $\frac{1}{2}$ .

on top of the picric powder, and in a separate bag of shalloon (see Fig. 47); its presence is indicated by a black disc "●" stencilled on the opposite side of the shell to the rectangle, and also on the waterproof paper cylinder.

*Exploders for central cavity.*—The lengths of these varies of course with the length of the shell in which they are used.

Fig. 47.

EXPLODER COMPLETE.

EXPLODER WITH CAP REMOVED.

Scale  $\frac{1}{2}$ .

NOTE.—The 8-dram primer is not used with shell 5-inch and below.



The following table gives the various long exploders in the Service :—

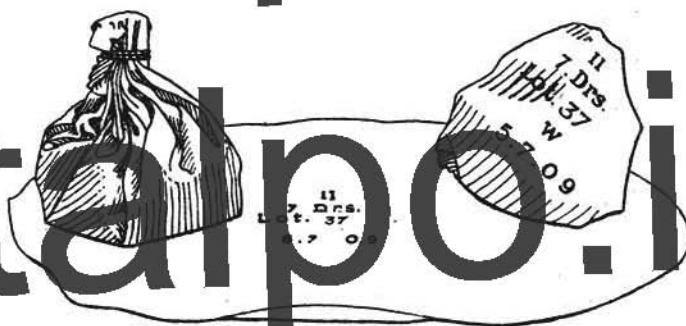
TABLE NO. 21.

Exploders, Lyddite Shell.	—	In Vulcanized Cashmere Bag and Paper Cylinder.
5 ozs., with primer, 17·5-inch. (Mark III)	C	B.L. or Q.F. 6-inch shells, formerly taking 5½ ozs. exploder.
4½ ozs., with primer, 16·1-inch. (Mark III)	C	B.L. howitzers, 5·4-inch and above; B.L. or Q.F. gun shells, 6-inch and above; and R.M.L. 10-inch (except shells formerly taking 5½ ozs. or 4 ozs. exploders).
4 ozs., without primer, 14·35-inch. (Mark III)	L	B.L. 5-inch howitzer, and 60-pr. Marks II to III shells.
4 ozs., 14·35-inch. (Mark III)	C	Q.F. 4·7-inch, Marks I to II** shells.
3 ozs., 12·5-inch. (Mark III)	C	B.L. or B.L.C. 5-inch gun; and Q.F. 4·7-inch, Marks III to IV* shells.
3 ozs., 11·4-inch. (Mark III)	C	B.L. 9·2-inch, B.L. or Q.F. 6-inch; Q.F. 4·7-inch, Mark I; B.L. 6-inch howitzer, 5-inch howitzer, and R.M.L. 10-inch shells formerly taking 4 ozs. exploder.
3½ ozs., 10·75-inch. (Mark III)	L	B.L. 60-pr., Marks I and I*, and 30-pr. shells.
3 ozs., 9-inch. (Mark III)...	N	B.L., Q.F., or Q.F.C. 4-inch shell.
2 ozs., 6·25-inch. (Mark II)	N	Q.F. 12 and 14-pr. shell. (In batiste bag)

## 7-DRAM EXPLODERS.

Fig. 48.

Scale ½.



7-DRAM EXPLODERS.

The above figure shows "7-dram exploders," Mark III, one empty and two filled.

The exploder is merely a small seamless bag of vulcanized cashmere filled with dry mixed picric powder and tied with silk sewing. The

bag is made seamless because picric powder is very fine, and if there were any seams in the bag, it would work out and so get into the threads of the fuze-hole.

The Mark II, 7-dram exploder, was made of batiste. The Mark I exploders were made of oiled silk, which were apt to stick together and get torn when removed for inspection.

### BAGS, PELLET EXPLODERS, LYDDITE SHELL | C | .

No. 1. *Mark II | C |*.—Vulcanized cashmere; for shell with exploders of picric powder pellets, except B.L. 9·2-inch (heavy), Marks IV to V\* and 2·75-inch.

No. 2. *Mark II | C |*.—Vulcanized cashmere; for shell with exploders of picric powder pellets, B.L. 9·2-inch (heavy), Marks IV to V\* and all shell formerly fitted with 7-dram exploders.

No. 3. *Mark II | C |*.—Vulcanized cashmere; for shell with exploders of picric powder pellets B.L. 2·75-inch.

The Mark I bags differ from the Mark II, in being made of batiste.

### EXPLODERS FOR A.P. LYDDITE SHELL.

(See Page 210.)

*Exploder bag, 4-oz., Mark II.*—The exploder bag is made of vulcanized cashmere and contains 4 ozs. of D.M. picric powder; the mouth of the bag is choked with silk sewing.

It is fitted with a silk sewing loop.

The Mark I was made of batiste.

### TABLE No. 23.

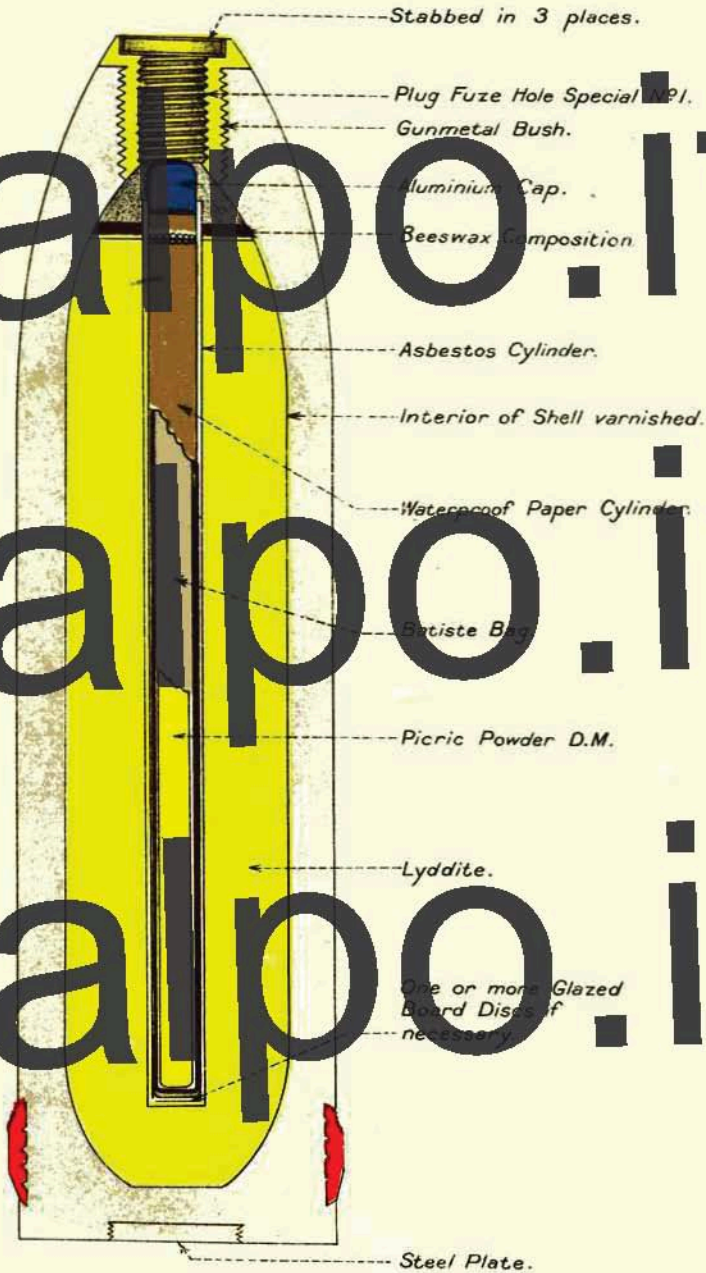
### EXPLODERS, T.N.T. (OR TROTYL).

5½ ozs. T.N.T. (Mark I) ...	L	Q.F. 4·7-inch, Marks II and II* shell, formerly taking 4 ozs. picric powder exploder.
5½ ozs. T.N.T. (Mark I) ...	L	Q.F. 4·7-inch, Marks III to IV shell, formerly taking 3½ ozs. picric powder exploder.
3½ ozs. T.N.T. (Mark I) ...	N	B.L., Q.F. or Q.F.C. 4-inch shell, formerly taking 3 ozs. picric powder exploder.
2½ ozs. T.N.T. (Mark I) ...	N	Q.F. 12 and 14-pr. shell, formerly taking 2 ozs. picric powder exploder.
3 drams T.N.T. (Mark I) ...	N	In waterproof bag; Q.F. 4·7-inch, B.L., Q.F. or Q.F.C. 4-inch, and Q.F. 12 and 14-pr., and Q.F. 3-pr.
Bag, T.N.T. ... ..	C	In waterproof bag; Q.F. 4·7-inch, B.L., Q.F. or Q.F.C. 4-inch, Q.F. 12 and 14-pr., and Q.F. 3-pr.
(Various weights.)		

The exploders are made up, in the case of the first four named, in the form of compressed pellets of T.N.T., enclosed in white fine paper wrappers, and fitted with a lifting becket of silk sewing.

The 3-drams T.N.T. is made up similarly to the 7-dram picric powder exploder (see Fig. 48), but contains T.N.T. in crystalline form.

**SHELL B.L. 60 PR COMMON LYDDITE MARK III.  
FORGED STEEL.**



talpo.it  
talpo.it  
talpo.it

The "Exploders, bag, T.N.T." are made up in different sizes to suit the various natures of shell, and consist of T.N.T. in crystalline form, enclosed in small bags of vulcanized cashmere or waterproofed batiste.

Shells filled prior to 6/03 will not require the two last-mentioned exploders when converted to T.N.T. filling as described on page 201, as all these shells are filled up to the bottom of the fuze-hole bush.

For special fuze-hole plugs used with lyddite shell, see page 254.

#### PACKAGES FOR EXPLODERS, LYDDITE SHELL.

Up to 16·1 inches in length they can be packed in "*Box, exploders, Lyddite.*"

Above 16 inches in length they can be packed in "*Case, powder, metal-lined, whole*" (see page 118), or "*Cylinder No. 6.*"

##### *Box, Exploders, Lyddite.*

*Box, exploders, Lyddite, Mark I | C |*.—The box is of deal with elm ends, painted yellow; the lid is secured by brass screws working in nuts let into the top of the box. It is fitted with a tinned copper lining which has a luting groove formed round the top. Into this the flange of a tinned copper lid is pressed so as to make an air-tight joint; cleats with handles are attached to each end of the box. The box is provided with packing pieces of varnished wood for use with different size exploders.

*Mark I* differs in dimensions and the nuts for screws securing lid; a felt wad over the exploders is also used.

##### *Cylinder No. 6, Mark I | C |*

The cylinder is made of tin and is issued for the use of Inspecting Ordnance Officers. The cylinder, which is painted yellow, is provided with a lid having a groove on the inside, which is filled with luting and secured by a tape band and shellac; it is intended for the carriage of "exploders" when a small number is required for replacing those taken for moisture test. At forts, &c., where no laboratory exists, the cylinder may be used for packing the exploders removed from shell for moisture test.

For transport purposes, three of these cylinders are packed in a "*Cylinder, ammunition, half-barrel.*"

#### TYPES OF FILLED LYDDITE SHELLS, DESCRIPTION OF.

(Type shown on Plate XXXIII.)

##### SHELL, B.L. 60-PR. COMMON LYDDITE, MARK III | L |.

The shell is made of F.S. nearly 4 calibres long; the head is struck with a radius of 2 calibres, the point being truncated and fitted with a gunmetal bush which is tapped to the G.S. fuze-hole gauge. A steel plate is screwed into the centre of the base and the shell is rotated by the plain type of driving band.

The interior of the shell is varnished with copal varnish and is filled nearly to the top with melted picric acid, a long central cavity being left in the lyddite for the exploder; this cavity is lined with an asbestos paper tube.

The top surface of the lyddite is covered with a thin layer of "composition beeswax"  $\frac{1}{10}$ -inch thick, as shown in the plate.

The exploder is described on page 202; before it is inserted into the asbestos tube one or more glazed board discs may be inserted so as to adjust the depth of the cavity.

The Plug, fuze-hole, special, No. 1, Mark III, with a leather washer under the flange, is screwed into the fuze-hole bush and is prevented from unscrewing by the raised lip on the plug being stabbed into the bush of the shell in three places.

*Type of Lyddite shown in Plate XXXIV.*

Plate XXXIV. illustrates a "solid-filled" shell (without a steel base plate) fitted with "7-dram exploders."

B.L. and Q.F. 6-inch to 15 5/8-inch have been filled with "7-dram exploders."

In this type of filling no cylindrical cavity is left in the lyddite, but a slight space is left at the top. The surface of the lyddite is *not* covered with "composition beeswax."

The space in the nose of the shell is then filled with exploders, each consisting of 7 drams of picric powder (*see* page 205); the 6-inch generally taking 12 to 15, the 7 1/2-inch and up generally 8 to 10, but these numbers may be increased if necessary.

*Type of Lyddite shown in Plate XXXV.*

This is the latest method of filling for B.L. 2.75 and 9.2-inch and up.

B.L. and Q.F. 6- and 7.5-inch shell have also been filled on this system.

In this type the shell is filled with lyddite in the same manner as above, but the space in the nose is filled with a number of compressed pellets of picric powder (about 20 in the B.L. 2.75-inch, 30 in all other natures).

The pellets are inserted into a burlap or vulcanized cashmere bag resting on top of the lyddite, one or two "7-dram exploders" being used to fill up the slight space in the nose of the shell after the bag has been closed.

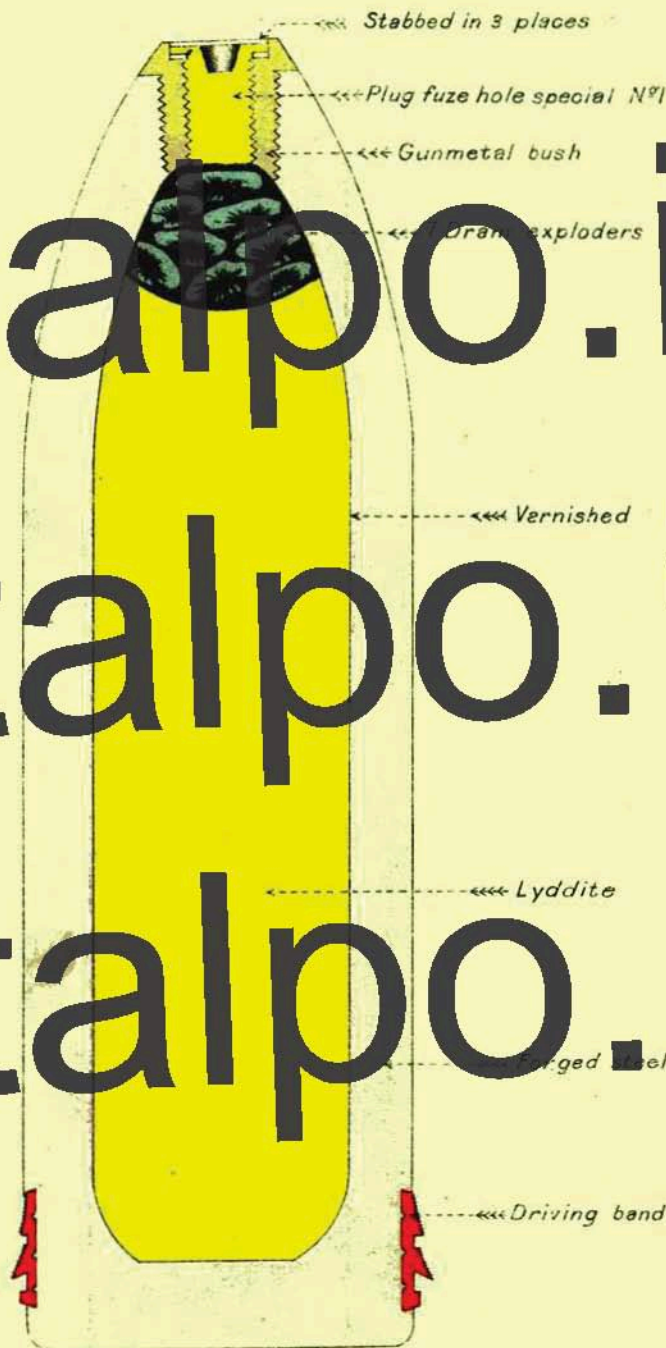
For description of "Bags, pellets, exploders," *see* page 206.

SHELL, B.L. COMMON LYDDITE, 6-INCH GUN, MARK XII. A.Q.N.T.  
| N |.

This is a 4-calibre head shell, with tapered walls, large base-plate, and is prepared to take a "night tracer."

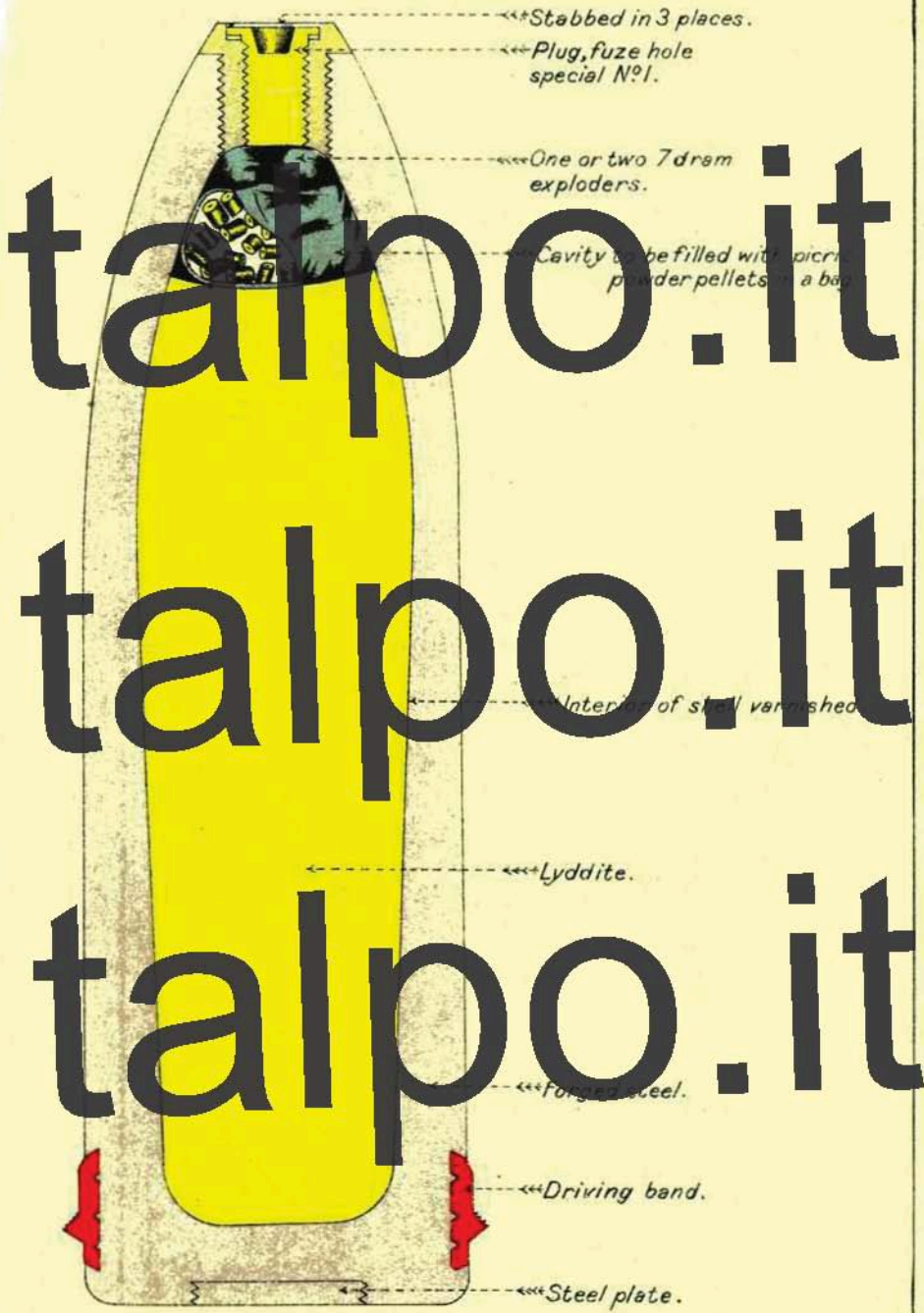
The letter "Q" after the numeral denotes that the shell is of stronger design, introduced for B.L. 6-inch, Mark XII gun.

SHELL B.L.Q.F. OR Q.F. C. COMMON LYDDITE,  
6 INCH GUN, MARK IV.  
FORGED STEEL.



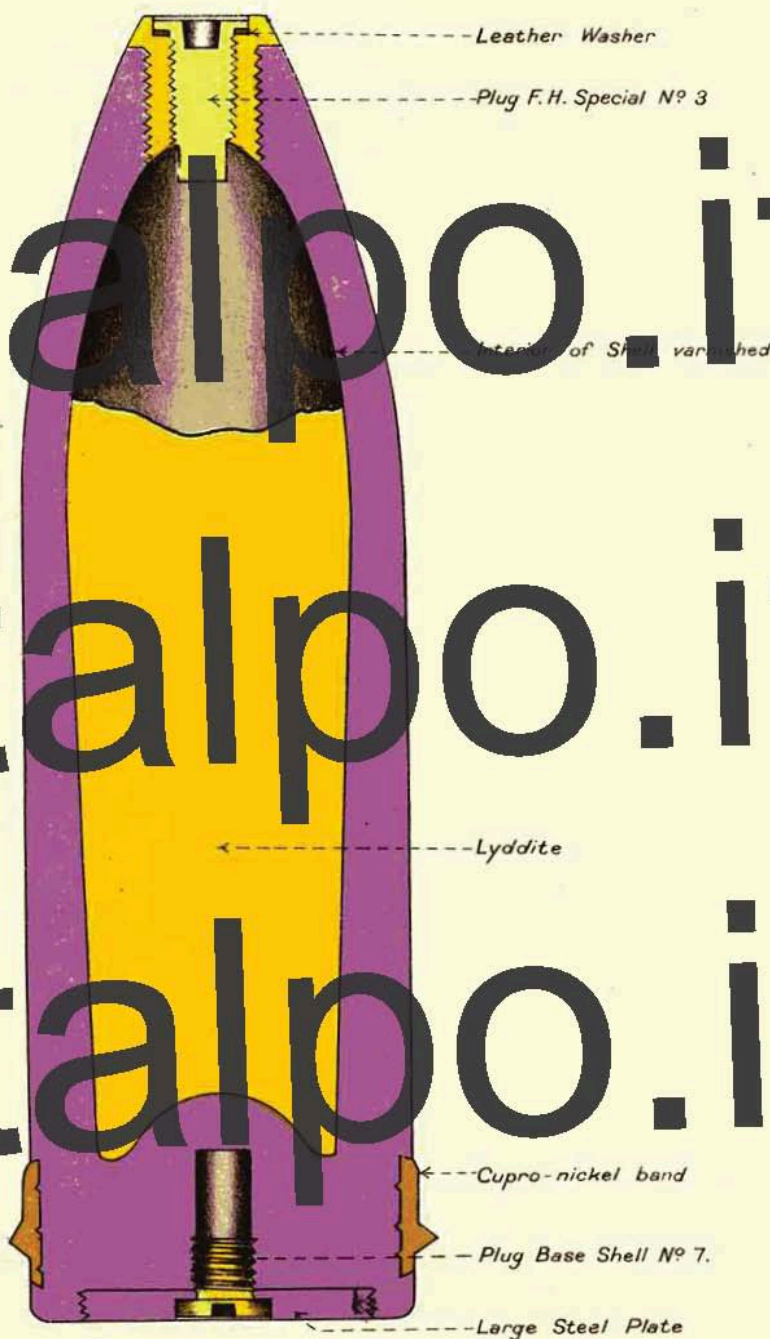
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SHELL B.L.COMMON LYDDITE.  
6 INCH GUN MARK VII<sup>A</sup>.



Note: Typical method of filling adopted for 6" and upwards on 26/10.

**SHELL B.L. COMMON LYDDITE**  
**6 INCH GUN MARK XII A.Q.N.T.**





SHELL Q. F. COMMON LYDDITE, 12 AND 14 PR. MK IV.

Scale = 2/3.



SHELL. Q.F. COMMON LYDDITE 3 PR MARK V.N.T.

FULL SIZE.



Composition Beeswax.

Asbestos Paper

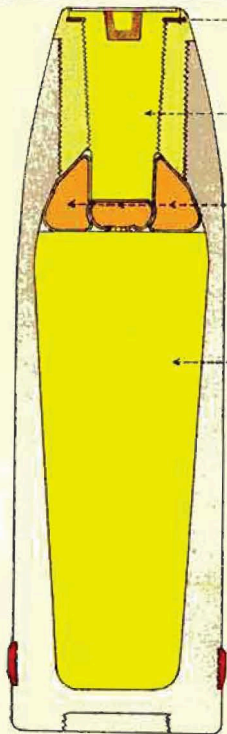
3 Drs. Trotyl.

Lyddite

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SHELL.Q.F.,LYDDITE COMMON 12 & 14 PR. M<sup>K</sup> III.

SHELL.Q.F.,LYDDITE COMMON 12 & 14 PR. M<sup>K</sup> II.



Leather Washer.

Plug Fuze Hole Special N<sup>o</sup> 3.

Water proof Bags filled with Tri-nitro-toluene Powder (Crystalline) to pass a 30 mesh.

Lyddite.



PLAN OF EXPLDER.



Leather Washer.

Plug Fuze Hole Special N<sup>o</sup> 3.

Waterproof Bags filled with Tri-nitro-toluene Powder (Crystalline) to pass a 30 mesh. Disc of white cardboard .02 thick.

Kit composition.

Abestos paper tube .013 thick.

Tri-nitro-toluene .85 oz. pellets, compressed under 10 tons per sq in.

Fine white paper. 3 thicknesses.

Lyddite.

Disc of white cardboard .02 thick.

One or more glazed board discs if necessary.



PLAN OF EXPLDER.

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In Plate XXXVII the latest mark of shell for the Q.F. 12- and 14-pr. is shown. Owing to the increased thickness of the base for the tracer this shell takes a much smaller charge of lyddite than earlier marks.

*Type of Lyddite shown on Plate XXXVIII.*

Plate XXXVIII illustrates the method of filling Q.F. 3-pr. shell.

The shell is nearly filled with molten picric acid, which is then allowed to solidify. A small quantity of molten picric acid is then poured in and a short "former," carrying an asbestos cylinder, is inserted.

This forms a short cylindrical cavity and displaces sufficient acid to fill the shell nearly to the fuze-hole bush. After the acid has solidified the former is removed and the space in the nose filled with "composition beeswax."

The exploder, 3 grams of T.N.T. in a vulcanized cashmere bag, is inserted into the asbestos cylinder, choke down.

Fuze, D.A. Impact, No. 19A, or Plug, fuze-hole, special, No. 4A, is used with this shell.

*Type of Lyddite shown on Plate XXXIX.*

Plate XXXIX illustrates an earlier method of filling for Q.F. 3-pr., 12- and 14-pr., 6-inch B.L. or Q.F. (heavy); B.L., Q.F. or Q.F.C. 4-inch (light) and Q.F. 4 7/8-inch.

The above shell are filled on the *solid system*, the space in the nose of the shell being filled with exploders of T.N.T., instead of picric powder.

*Conversion of shell filled with cylindrical cavity to take pellets and exploders of T.N.T.*—The first issues of the above lyddite shell, *i.e.*, those filled with a cylindrical cavity, are being converted as follows:—The cylindrical exploder of picric powder is removed, the cavity inside the asbestos tube is then filled with pellets of compressed T.N.T., covered with three thicknesses of fine white paper, discs of fine cardboard being placed on top and underneath the pellets. The space in the nose of the shell above the kit composition is filled with bags of batiste or vulcanized cashmere containing T.N.T.

ARMOUR-PIERCING SHELL. (LYDDITE FILLED.)

Armour-piercing shell filled with lyddite have been introduced for B.L. guns, 6-inch to 15-inch.

They may be either cast or forged.

They are fitted with the latest type of cap. The cavity is lined with a container of aluminium; the base is closed by a large adapter, and is threaded to take a special gas-sealing arrangement (plate cover) to prevent the gas from the charge getting into the shell.

SHELL, B.L. ARMOUR-PIERCING, WITH CAP, 9·2-INCH, MARK VIIA  
| L |.

(With Aluminium Container.)

(Plate XL.)

The shell is generally similar to the Mark V shell described on page 169. The head is fitted with the latest type of cap, struck with a radius of nearly 4 calibres.

The interior of the shell is varnished and fitted with an aluminium container, also varnished internally.

The base is closed by a large adapter screwed in; this adapter is bored out and threaded to take the No. 16 large base fuze and screw-threaded on its outer edge to take the "Plate cover."

The shell is filled nearly to the base with lyddite, in which a short cavity is formed; this cavity is lined with an asbestos paper tube, fitted with an exploder bag, containing ½ ozs. of picric powder, inserted choke-end first. The space between the lyddite and the adapter is filled with composition beeswax."

After insertion of the fuze, the key slots in the adapter are filled with steel plugs, and the key slots in the fuze are partially filled with luting and metal plugs.

A "Plate, gas-check, copper," is placed over the base of the fuze and adapter, and is held in position by the "Plate cover."

The plate covers in two parts, *i.e.*, a perforated steel plate and a steel locking ring; the latter screws on to the base of the adapter and is prevented from unscrewing by a steel set-screw.

The shell is painted yellow with 2 white rings denoting A.P., and, when fitted, the "Plate-cover" is painted red.

A.P. shells filled with lyddite are issued *plugged* to both Land and Naval Services.

If these shells are plugged, the "Plug, base, shell, No. 6," is used.

*Plates, Gas-check, Copper.*

These are issued in three sizes, *viz.* :—

Large, for B.L. 9·2-inch.

Medium, for B.L. 12-inch to 15-inch.

Small, for B.L. 18-inch.

They are flat discs of pure copper, shaped to fit into the "Pressure, plate recess," and the partially filled key slots in the No. 16 base fuze.

With A.P. lyddite shells taking the medium and small "Plate, gas-check, copper," a smaller "Plate cover" is used, and the locking screw is inserted vertically, instead of radially, in the shell.

HIGH EXPLOSIVE SHELL.

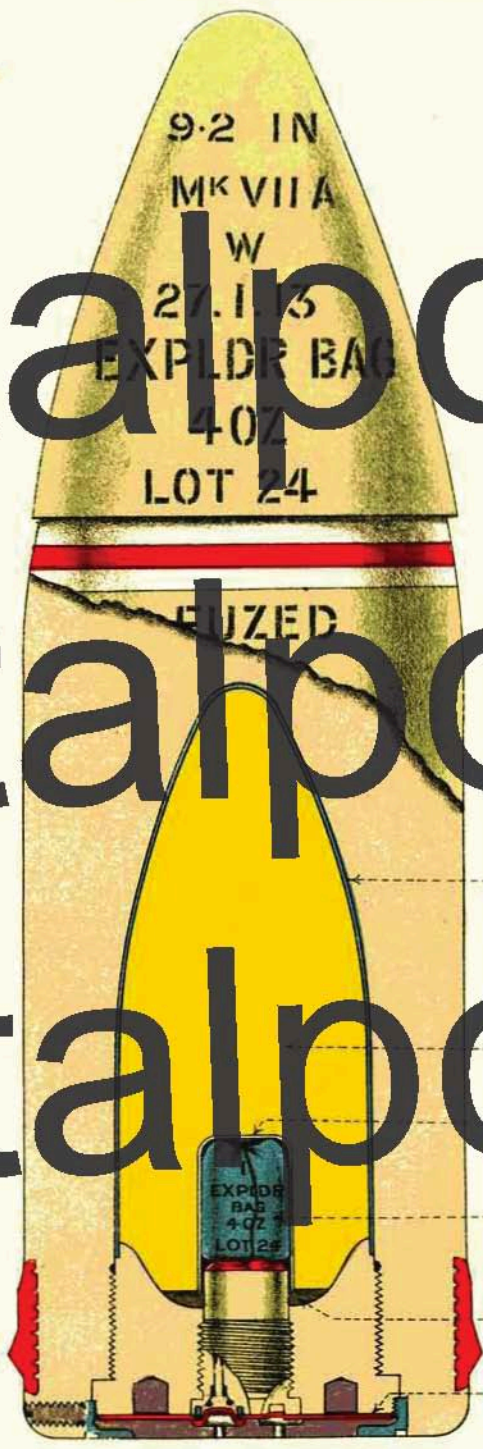
Shells which take a bursting charge of "Composition exploding" are painted yellow in the same way as lyddite shells; they are distinguished by a red band round the centre, and are known as "High explosive shell."

This nature of projectile is used with the Q.F. 3-inch, anti-airship gun.

SHELL, B.L. ARMOUR-PIERCING WITH CAP.  
9.2 INCH. MARK VIIA [L].

9.2 IN  
MK VIIA  
W  
27.1 1/3  
EXPLDR BAG  
4 OZ  
LOT 24

FUZED



Aluminium  
Container

Lyddite

Asbestos Cylinder

Batiste Bag  
with 4 oz of  
Picric Powder.

Composition Beeswax.

Plate, Gas-check Copper.

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## SHELL, Q.F., HIGH EXPLOSIVE AND TRACER, 3-INCH, MARK II | C |.

The shell is made of forged steel, 3 calibres in length; the head struck with a radius of 2 calibres.

In the centre of the base is screwed a tracer socket with fixing screw for the night tracer.

The lower part of the body, which forms the day tracer, is filled with a black liquid (turpentine and aniline dye).

A small conical hole is bored through the base of the shell, and is fitted with a steel plug. (Plug, day tracer, vent.)

This plug is pierced with a central hole closed on the inside by a brass disc soldered on. On firing the pressure blows this disc in, so unmasking the hole.

The front of the shell is threaded internally for a "gunmetal container," a small groove being formed for a copper washer intended to seal the joint between the container and the body.

The front of the container is closed by a gunmetal fuze-socket secured by a steel locking screw.

The fuze-socket is bored out and threaded to the G.S. gauge to take the No. 44 D.A. fuze.

The shell is rotated by a special type of band, prepared so that the cartridge case can be attached to it by coning.

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TABLE No. 23.—Shell, B.L., B.L.C., Q.F., or Q.F.C. Common Lyddite.

Para. in List of Changes	Nature of Gun.	Mark of Shell.	Serial No. of Shell.	Type of Band.	Length in inches.	Diameter.		Bursting charge, including Exploders. Lbs. ozs.	Nature and weight of Exploders.	Weight filled. Lbs.	Remarks.
						Head or Body.	Driving Band.				
15566	3-pr. Q.F. ... ..	I	N	4	8.59	1.842	1.992	4 1/8	T.N.T. 1/2 or 3/4 dram and bags	3 5/8	For No. 19 fuze.
16480	Do. ... ..	II	N	4	8.59	1.842	1.992	4 1/8	T.N.T., drama	3 5/8	For No. 19A fuze.
16480	Do. ... ..	III Int	N	4	*8.59	1.842	1.992	4 1/8	Do.	3 1/2	* Over tracer holder = 7.35 inches. Fitted for external night tracer. For No. 19A fuze.



	Do. ...	IV	N	4	6-59	1-842	1-902	0	4 $\frac{1}{8}$	Do.	3 $\frac{5}{8}$	Same as Mark II except Same as Mark III except	That these Marks are fitted with a larger base plate.
	Do. ...	VNT	N	4	6-59	1-842	1-902	0	4 $\frac{1}{8}$	Do.	3 $\frac{1}{2}$		
16298	2.75-inch B.L. ...	I	L	12	11-53	2-73	2-845	1	6 $\frac{1}{2}$	Explosion pellets	12 $\frac{1}{2}$		
13652	12 and 14-pr. Q.F. ...	I	N	12	9-57	2-98	3-095	1	1 $\frac{1}{2}$	2 oz., long, picric powder	12 $\frac{1}{2}$		
15443	Do. ...	II	N	2	9-57	2-98	3-095	1	1 $\frac{1}{2}$	T.N.T., 5 drams and bags	12 $\frac{1}{2}$	Base plate,	
15450	Do. ...	III	C	2	9-57	2-98	3-095	1		Do.	12 $\frac{1}{2}$	Base plate and tapered cavity.	
	Do. ...	IVNT	C	2	9-57	2-98	3-095	1	12 $\frac{1}{2}$	T.N.T., 5 drams	12 $\frac{1}{2}$	For internal night tracer.	
	Do. ...	V	C	12	9-57	2-98	3-095	1	5	T.N.T., 3 drams and bags	12 $\frac{1}{2}$	Same as Mark III, but has large base plate	

TABLE NO. 23.—Shell, B.L., B.L.C., Q.F., or Q.F.C., Common Lyddite—continued.

Para. in List of Changes	Nature of Gun.	Mark of Shell.	Type	Length in inches	Diameter.		Bursting charge, including Exploders.	Natural Weight of Exploders.	Weight filled.	Remarks.
					Base or Driving Body.	Base.				
15443	30-pr. B.L. ... ..	I	S I	4 14-22	3-98	4-11	3 14½	3½ ozs., long, picric powder	30	
	Do. ... ..	II	S I	4 14-22	3-98	4-11	3 14½	Do.	30	
	Do. ... ..	III	S I	10 14-22	3-98	4-1	3 14½	Do.	30	
	Do. ... ..	IV	S I	10 14-22	3-98	4-1	3 14½	Do.	30	Base plate.

8784	4-inch B.L., Q.F., or Q.F.C. Light (except for B.L., Marks VII to VIII* and Q.F. Marks IV and V guns)	I	N	3	12.3	3.97	4.115	3	3½	3 ozs., long, picric powder	25	
9957	Do.	II	N	10	12.3	3.97	4.105	3	3½	Do.	25	Groove for driving band undercut.
11193	Do.	III	C	0	12.45	3.97	4.105	3	3	Do.	25	Waved ribs in groove for driving band.
15073	Do.	IV	C	10	12.25	3.97	4.105	3	2⅞	T.N.T., 3 drams and bags	25	Tapered cavity. Base plate.
16446	Do.	VNT	C	10	11.93	3.97	4.105	3	0	Do.	25	For internal night tracer.
	Do.	VI	C	10	12.25	3.97	4.105	3	2⅞	Do.	25	Large base plate. Otherwise same as Mark IV.
16445 } 14461 }	4-inch B.L. or Q.F. Heavy (for B.L., Marks VII to VIII*, and Q.F., Mark IV guns)	I	N	11	14.25	3.97	4.23	3	2	3 ozs., long, picric powder	31	
16445 } 15443 }	Do.	II	N	11	14.25	3.97	4.23	3	2	T.N.T., 3 drams and bags	31	Base plate.
16453	Do.	III	N	11	16.19	3.97	4.23	5	0	Do.	31	Tapered cavity.
16455	Do. (Also for Q.F., Mark V gun)	IVNT	N	11	15.16	3.97	4.23	4	3	Do.	31	For internal night tracer.
	B.L. Marks VII to VIII*, and Q.F., Mark IV guns	V	N	11	16.19	3.97	4.23	5	0	Do.	31	Large base plate; otherwise the same as Mark III.
	B.L., Marks VII to VIII*, and Q.F., Marks IV and V guns	VINT	N	11	14.98	3.97	4.23	3	15½	Do.	31	For internal night tracer. Strengthened walls.

TABLE No. 23.—Shell, B.L., B.L.C., Q.F., or Q.F.C. Common Lyddite—continued.

Para. in List of Changes	Nature of Gun.	Mark of Shell.	Type	Length in Inches	Diameter. Band or Body.	Diameter. Driving Band.	Bursting charge, including Exploders lbs. oz.	Name and Weight of Exploders.	Weight filled.	Remarks.
15434	4.5-inch Q.F. Howitzer Do. Do.	I II III	L L L	15-2 4 15-12 4 15-12	4.46 4.46 4.46	4.62 4.62 4.62	6 2 6 1 6 1	3 lbs. oz. long, picric powder Do. Do.	35 35 35	Base plate. Thicker walls than Mark I Large base plate,

8479	4.7-inch Q.F.	...	I	N	3	17.06	4.7	4.819	7	5	4 ozs., long, picric powder	46 $\frac{1}{8}$	
9957	Do.	...	II	C	4	17.06	4.7	4.819	7	5	Do.	46 $\frac{3}{8}$	Groove for driving band undercut.
11193	Do.	...	III	C	4	16.365	4.7	4.819	6	10	3 $\frac{1}{2}$ ozs., long, picric powder	46 $\frac{3}{8}$	Waved ribs in groove for driving bands. Thicker walls.
12036	Do.	...	IV	C	10	16.365	4.7	4.819	6	10	Do.	46 $\frac{3}{8}$	Plain driving band intro- duced.
15449	Do.	...	V	C	10	16.36	4.7	4.815	13 $\frac{1}{8}$	0	I.N.P., 3 drams and bags	45	Tapered cavity. Base plate.
16446	Do.	...	VI <sup>INT</sup>	C	10	15.81	4.7	4.815	6	5 $\frac{1}{2}$	Do.	45	For internal night tracer.
	Do.	...	VII	C	10	16.36	4.7	4.815	6	13 $\frac{3}{8}$	Do.	45	Large base plate; other- wise same as Mark V.
8463	5-inch B.L. Howitzer		I	L	2	15.00	4.97	5.11	4	14	5 $\frac{1}{2}$ ozs., long, picric powder, without water- proof paper cylinder	50 $\frac{3}{8}$	This shell was originally filled with gunpowder § 8231.
9347	Do.		II	L	2	18.225	4.97	5.115	9	15	Do.	50	Longer shell. Thinner walls.
9957	Do.		III	L	4	18.225	4.97	5.115	9	15	4 $\frac{1}{2}$ ozs., long, picric powder	50	Groove for driving band undercut.
11318	Do.		IV	L	1	18.215	4.97	5.115	9	15	Do.	50	Plain driving band intro- duced.
	Do.		V	L	10	18.2	4.97	5.115	9	15	Do.	50	Base plate.

TABLE No. 23.—Shell, B.L., B.L.C., Q.F., or Q.F.C. Common Lyddite—continued.

Para. in List of Changes	Nature of Gun.	Mark of Shell.	Type of Shell.	Length in inches.	Diameter.		Bursting charge, including Exploders lbs., oza.	Nature and Weight of Exploders.	Weight filled. Lbs.	Remarks.	
					Body.	Drum.					
15443	5-4-inch B.L. Howitzer	I	S I	4	19-44	5-36	5-515	12 10	4 1/2 ozs., long, picric powder	60	Base plate.
	Do.	II	S I	4	19-44	5-36	5-515	12 10	Do.	60	
	Do.	III	S I	4	19-44	5-36	5-515	12 10	Do.	60	
13169	60-pr. B.L. ...	I	L	10	15-48	4-97	5-125	4 0	3 1/2 ozs., long, picric powder	60	

13169	Do. ... ..	II	L	10	19-05	4-97	5-125	8	0	4½ ozs., long, picric powder	60	Longer shell. Thinner walls. Greater capacity for burstor.
15443	Do. ... ..	III	L	10	19-05	4-97	5-125	8	0	Do.	60	Base plate.
8479	6-inch B.L. or Q.F....	I	N	5	21-81	5-97	6-33	13	12	5½ ozs. long, picric powder without water- proof paper cylinder	102½	
9957	Do.	II	C	5	21-81	5-97	6-33	13	12	4½ ozs., long, picric powder	102½	Groove for driving band undercut.
9980	Do.	III	C	5	20-57	5-97	6-33	10	6	Do.	101 <sup>2</sup> / <sub>16</sub>	Shorter and lighter.
11234	Do.	IV	C	5	20-57	5-97	6-33	10	6	Do.	101 <sup>2</sup> / <sub>16</sub>	Waved ribs in groove for driving band.
12267	Do.	V	N	7	20-57	5-97	6-33	10	6	7 drams, changed to exploder pellets	101 <sup>2</sup> / <sub>16</sub>	Cupro - nickel driving band.
15443	Do.	VI	L	5	20-57	5-97	6-33	10	6	Do.	101 <sup>2</sup> / <sub>16</sub>	Base plate.
15458	6-inch B.L., Marks VII, VIII, XI and XI* guns	VII	N	7	21-53	5-97	6-33	13	6½	Do.	100	Cupro - nickel driving band. Base plate. Tapered cavity.
15008	Do.	VIIA	N	7	22-89	5-97	6-33	13	5	Exploder pellets	100	Base plate. Tapered cavity.
15448	6-inch B.L. or Q.F. guns	VIII	L	5	21-53	5-97	6-33	13	6½	Do.	100	Differs from Mark VII only in the driving band.
	6-inch B.L., Marks VII and XI to XII guns	IXA QNT	N	7	21-53	5-97	6-33	10	5	Do.	100	For internal night tracer.

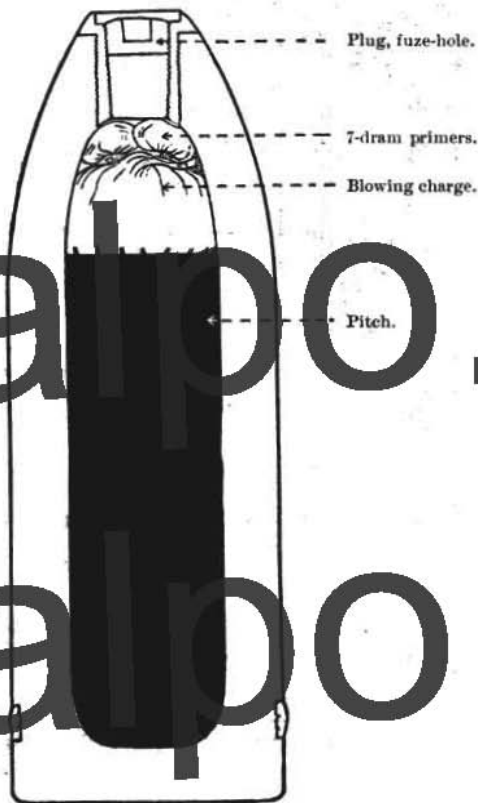
TABLE No. 23.—Shell, B.L., B.L.C., Q.F., or Q.F.C. Common Lyddite—continued.

Para. in List of Changes	Nature of Gun.	Mark of Shell.	Serial No. or vice	Type Band.	Length in Inches	Diameter. Band or Body.	Bursting charge, including Explosives.	Net weight of Explosives.	Weight filled.	Remarks.	
	6-inch B.L., Marks VII, VIII, XI and XI* guns Do.	X  XA	N  N	7  7	21.53  22.59	5.97  5.97	6.33  6.33	8 6½  9	50 grams T.N.T.  Do.	100  100	Large base plate; otherwise the same as Mark VII.  Large base plate; otherwise the same as Mark VIIA.
	6-inch B.L. or Q.F. guns	XI	L	5	21.53	5.97	6.33	13 6½	Do.	100	Large base plate; otherwise the same as Mark VIII.
	6-inch B.L., Marks VII and XI to XII guns	XIIAQNT	N	7	21.4	5.97	6.33	10 15	Do.	100	For internal night tracer. Large base plate; otherwise the same as Mark IXAQNT.



Fig. 53.

## PRACTICE SHELL FILLED WITH PITCH AND POWDER.



## SHELL FILLED WITH SMOKE-PRODUCING COMPOSITION.

A new design of practice shell has been introduced for the Q.F. 4.5-inch howitzer.

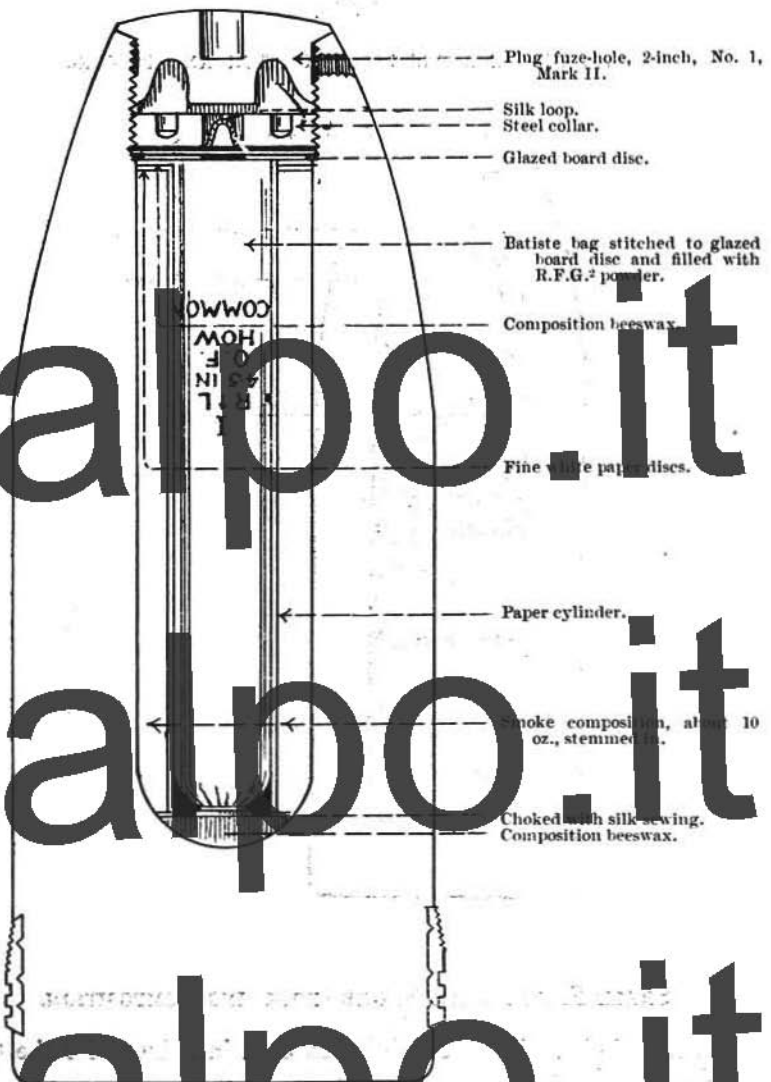
The shell is intended to represent shrapnel.

## SHELL, Q.F. COMMON, 4.5-INCH HOWITZER, MARK I | L | .

The shell is made of cast iron. It is prepared to take fuzes or plugs of the 2-inch gauge, and is filled with smoke-producing composition stemmed in around a central burster of R.F.G.<sup>2</sup> powder contained in a batiste bag, which is enclosed in a paper cylinder and is removable.

The shell is issued plugged, and is painted black with two yellow bands around the body. The "Plug, fuze-hole, 2-inch, No. 1, Mark II," is used. The fuze used is the T. and P. No. 82.

Fig. 54.



## SECTION (C). MARKINGS ON PROJECTILES.

(See also *Regulations for Army Ordnance Services.*)

## PAINT MARKS.

(1) *Tips* :—

Shot (except case)—To have white tips. Capped shot to have the cap painted white.

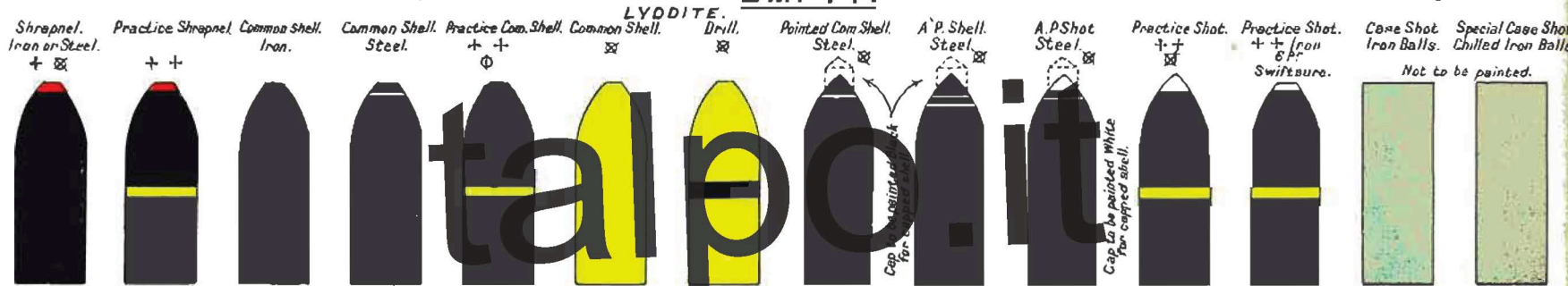
Common shell (except lyddite)—To have black tips.

Shrapnel shell—To have red tips.

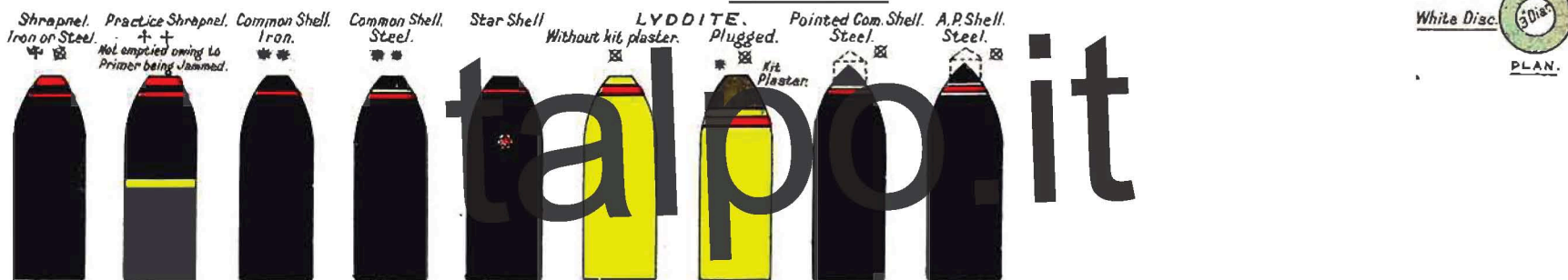
(2) *Ends* :—

Case shot containing chilled-iron balls—To have a white disc painted on the end.

## EMPTY.



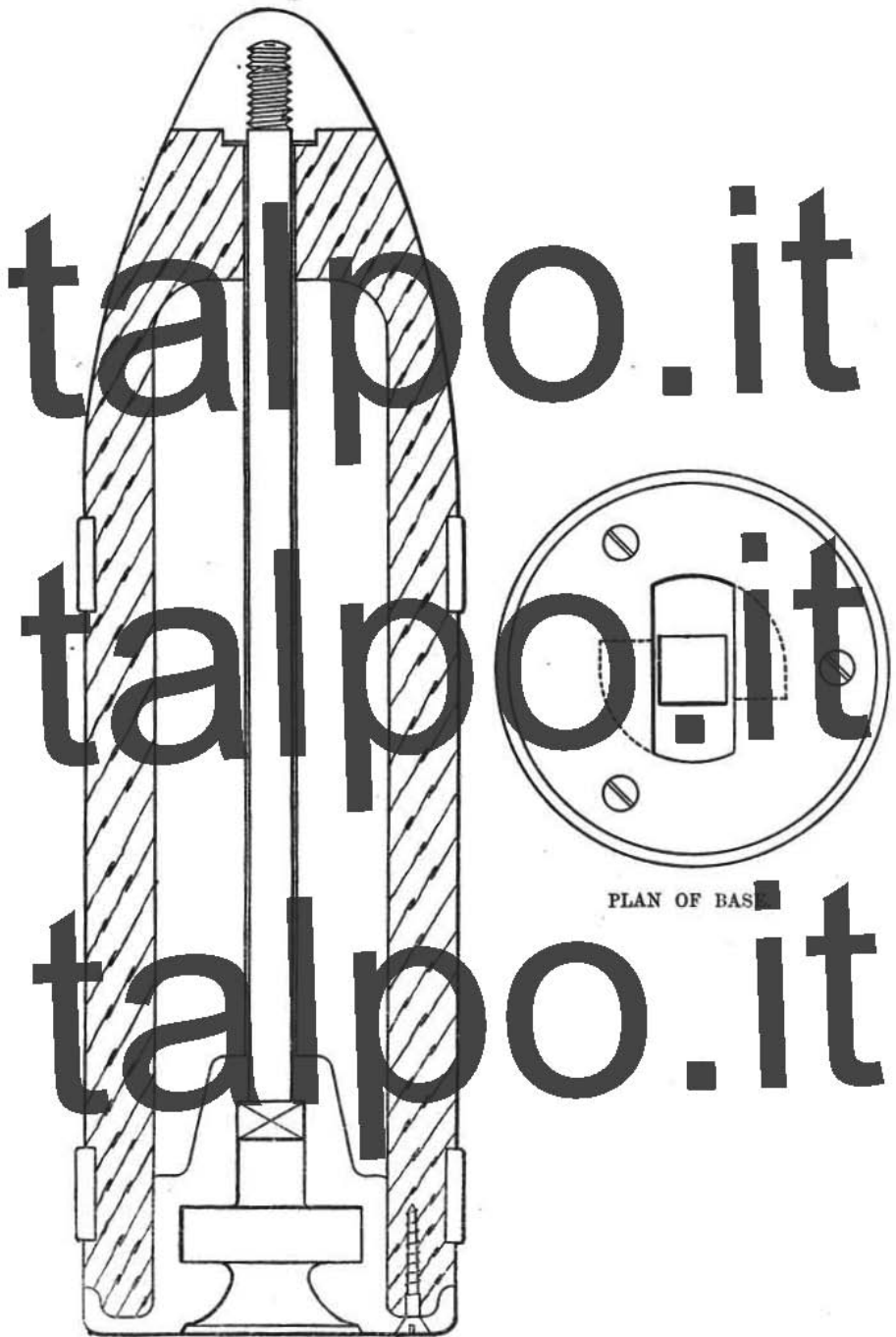
## FILLED.



- R.B.L. Projectiles coated with lead are not to be painted over the lead coating, except as provided for base and shoulder.  
 Naval Projectiles suitable only for use with Q. F. 12 Pr. 12 and 8 cwt. Guns to be painted lead colour.  
 Projectiles fitted with a Dupro Nickel driving band have a white band  $\frac{1}{2}$  in width immediately above the driving band.
- + 15 Pr Shrapnel shell body to be painted lead, and plug Black.
  - + 13 Pr and 18 Pr Mark II Shrapnel shell bodies to be painted lead colour.
  - ⊕ Pointed common shell for Practice will be similarly marked.
  - \* Kit Plaster required with No 1 Mark II plug only.
  - + + Practice projectiles (except those referred to in footnote \*\*), width of Yellow band to be 2 inches for 6 inch and over, and 1 inch for under 6 inch (3 Pr).
  - \*\* Common Practice shell filled with Pitch and Powder or with smoke producing mixture to represent shrapnel will have in addition two yellow bands. The bands will be 1 inch wide and 1 inch apart for 6 inch shell, and  $\frac{1}{2}$  inch wide and  $\frac{1}{2}$  inch apart for shell below 6 inch.
  - ⊗ Projectiles B.L. 12 inch and 13.5 inch will be stencilled ⊗ in 3 places equally spaced round the projectiles to indicate centre of gravity when filled.

Fig. 60.

DRILL SHELL FOR Q.F. GUNS.



bridge being formed across the recess for the extractor to engage with when withdrawing the shell. They are fitted with two gunmetal bands—one near the base, the other at the shoulder. The base end of the shell is turned down and screwed to take a gunmetal ring which projects over the side and prevents injury to the gun in loading. A groove is formed round the junction of this gunmetal ring and the body to take a rope grummet which prevents the shell jamming when rammed home.

The shell are fitted with a hole in the side at the centre of gravity to take the "Bolt, eye, lifting."

In future manufacture of drill shell for Land Service the eye bolt lifting hole will be dispensed with.

A common-pointed shell weighted with salt, and stencilled near the point with the word "DRILL," is used for drill purposes with the B.L., 9.45-inch howitzer.

Drill shell for the 4.7-inch, 4-inch and 6-inch Q.F. guns (see also Shell, B.L. or Q.F. drill, 6-inch) also the 5-inch B.L.C. are made of wood brought up to weight of the Service projectile by a lead core. They are fitted with a bolt which passes through the centre of the shell; the front end of this bolt screws into a gunmetal nut which forms the point of the shell.

The base is of gunmetal, having a recess in which is formed a slot to receive the "T" shaped projection of the extractor. Two bands of copper are fitted to the shell; the rear band is sufficiently large to prevent the shell being rammed home too far.

#### *Shell, Q.F. Drill, 12-pr. Mark II.*

The drill shell for the 12-pr., Q.F., is made of gunmetal of the same diameter and weight as the Service projectile, except that instead of being fitted with a driving-band the diameter is increased near the base to prevent the shell being rammed home too far. The base of the shell is closed by a plug recessed to receive the hook of the extractor.

## SECTION (J)—CAUSES OF BLINDS AND PREMATURES.

### BLINDS.

The fact of a fuzed shell failing to burst may be generally attributed to some fault in the manufacture of the fuze, or in its preparation, but it may also be due to the shell not being properly filled, a damp bursting charge, damp exploder, or a dirty shrapnel primer. "Graze" percussion fuzes will cause blinds if the shell is not sufficiently checked. The most trying conditions for a fuze of this description are a heavy shell with a high velocity and a small angle of incidence, since a heavy body moving at a high rate of speed is more difficult to check than a light one.

To sum up, we may divide the probable causes of blinds into two classes :—



**Due to Shell.**

- (1) Empty, or shell not properly filled.
- (2) Damp bursting charge.
- (3) 7-dram primers omitted.
- (4) With shrapnel, a dirty or defective shrapnel primer.
- (5) With lyddite, damp or defective exploders.

*Due to Fuzes.*

- (1) Fuze not properly prepared.
- (2) Fuze used in a gun for which it was never intended.
- (3) Defective fuze.
- (4) With graze fuzes, angle of descent too slight, and shell not sufficiently checked on graze.

**PREMATURES.**

Premature explosions are even more serious than blind shells, and it is difficult to over-rate the importance of getting rid of them, especially with high explosive shells.

A premature may be due to a weak shell breaking up in the gun, or to the penetration of gas into the shell through a flaw. It may also be due to the ignition of the bursting charge due to the distortion of the shell, or from friction or shock of discharge.

Distortion may be due to (a) oil in the bore; (b) weakness of the shell walls :—

- (a) The oil collects in front of the driving band as the projectile travels up the bore and, as it cannot escape, forces in the walls of the shell.
- (b) The walls of the shell being unable on firing to withstand the pressure acting on the base, bulge outwards.

These two forms of distortion are termed "set in" and "set down" respectively.

It appears to be conclusively proved that prematures may occur from shell not being properly filled, and also from the great friction due to the rotation of the shell and the powder setting back on shock of discharge.

For this reason the insides of shells are either vulvilled or varnished, to give them a smooth surface.

As an additional precaution, bursting bags to contain the charge are used with practically all powder-filled common and armour-piercing shells except the smallest. The necessity for these bags has been demonstrated on several occasions when shells have been fired without them.

With time fuzes, apart from defects of manufacture, a premature may occur in metal fuzes from the time ring not being clamped down, when the flash of the burning composition could travel round the underside of the ring.

With graze percussion fuzes a rebound action may be set up by the shock of discharge, which might throw the detonator against the needle. To check this action, a spiral spring is placed in all modern fuzes between the pellet and the body of the fuze.

There is also the fact that a very light shell may be checked by an irregularity in the bore of the gun, sufficiently to set the fuze in action.

With direct action fuzes prematures are less likely, and the cause, if one does occur, is more obscure. Placing a disc of tin foil under the detonating composition was found to have a great effect in preventing prematures.

Base fuzes have introduced additional causes for prematures from failures due to a weak fuze, or from the penetration of gas into the shell between the fuze and the body of the shell, or between the pressure plate and the fuze body.

To sum up, the probable causes of prematures may be divided into two classes:—

*Due to Shell.*

- (1) Bad lacquer.
- (2) Grit in shell.
- (3) Bursting bag omitted.
- (4) Insufficient & rusty tin cup.
- (5) Weak or defective shell.
- (6) Shell not properly rammed home.
- (7) Obstruction in the bore.
- (8) Oil in the bore.

*Due to Fuze.*

- (1) Fuze not properly prepared.
- (2) Fuze used in a gun for which it was never intended.
- (3) Defective fuze.
- (4) Penetration of gas through or over the fuze.

SECTION (K).—STORES USED IN CONNECTION WITH SHELL.

BAGS, BURSTER.

*Bags, burster* are used with common, common-pointed, and A.P. shells 4-inch and above.

For *common shell* they are made of dowlas. Common shell filled through the base have the tip, while those filled through the nose have the neck and shoulder of the bag made of shalloon. Shalloon is used to lessen the resistance to the penetration of the flash from the fuze.

With heavy natures, "collar cloth" is employed at the shoulder of the bag to form a cushion for the powder as it sets back on the shock of discharge.

The burster bags for *common-pointed shell* are also made of dowlas, with a neck and shoulder of shalloon.

For *armour-piercing shell* the burster bags are made entirely of "lasting cloth," a material much closer in texture than dowlas, the object being to prevent the bursting charge, if dusty, from working through the bag.

The burster bags for A.P. shell were formerly made of dowlas, and such bags will still be met with.

Burster bags for shell filled with "pitch and powder" are made of shalloon.

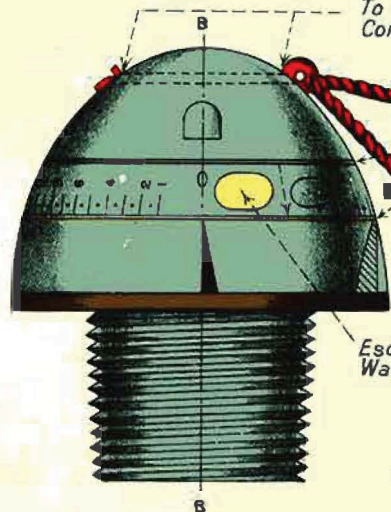
Burster bags for iron or steel shells or different marks of shell of the same calibre are not interchangeable, as the capacities of shells of different material may vary considerably. The bags have the numeral, nature of shell, and contractor's mark on them.

FUZE, TIME, 15 SECONDS, Nº25, MARK IV.

SCALE = 1/4

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To be filled with Waterproof Composition



ELEVATION.

Escape Hole to be Waterproofed

Body

Cap



SECTION AT B.B.

- Detonator Pellet.
- Safety Pin.
- Stirrup Spring.
- Steel Keep Screw.
- Detonator.
- Steel Spring Washer.
- Time Ring.
- Needle Plug.
- Fuse Composition.
- Leather Washer.
- Perforated Powder Pellet.
- Loose Powder.
- Muslin Disc.
- Base Plug.
- Brass Disc.

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## (E). TIME FUZES.

Time fuzes are used in the Land Service, generally for star shell only. (See page 112.)

In the Naval Service time fuzes are used with shrapnel shell from B.L. guns, 12-inch and above, when firing at short ranges. (See page 112.)

The following *time fuzes* will be met with :—

Land Service	{ No. 25.
	{ No. 24.
Naval Service	No. 30.

## TIME FUZES USED IN LAND SERVICE.

FUZE, TIME, 15 SECONDS, No. 25, MARK IV | I.

(Plate III.)

The fuze, time, 15 seconds, No. 25, consists of the following parts—Body, bottom plug, time ring, needle plug with steel needle, lighting pellet with R.L. cap and stirrup spring, safety pin, steel washer, cap and set-screw.

The *body* is made of aluminium; the lower part is threaded to the G.S. gauge. Above the screw-threaded portion it is enlarged, forming a shoulder under which is placed a leather washer.

The top part of the body is reduced in diameter and screwed to receive the cap. The body is bored out from the bottom to take a charge of about 45 grains of R.F.G. powder, and is closed by a bottom plug with a central flash hole. This hole is covered on the inside of the plug by a muslin disc and a disc of brass over which the metal of the plug is spun.

The body is bored out from the top, forming a lighting chamber in the stem; in the bottom of this chamber is screwed a small needle plug of brass, having a steel needle on its upper face. Three flash-holes are bored through the stem, communicating from the lighting chamber into an annular groove cut round the exterior of the bottom of the stem. One of these holes is primed with a small pellet of gun-powder.

A setting mark on the body indicates the position of a small hole containing a perforated powder pellet which communicates with a fire channel leading to the magazine of the fuze.

The *time ring* is made of aluminium, and is graduated from 0 to 44.

On the underside of the ring a flange is formed, which fits into a groove cut in the face of the body round the bottom of the stem. The composition channel is driven with fuze composition, and then covered with a washer of vegetable paper. At the beginning of the fuze composition there is a gas escape hole closed by an aluminium disc, and another hole bored through to the inner circumference of the ring is intended to allow the flash from the holes in the stem to ignite the composition at the spot where it begins to burn. A cloth washer is shellaced to the top of the fuze body, on which rests the time ring.

The spaces between the cap, time ring and body, also set-screw recess of cap and gas escape hole disc in the ring, are waterproofed with a composition of beeswax, mineral jelly and French chalk.

*Lighting pellet.*—The lighting pellet is made of gunmetal and is supported in the top of the lighting chamber by means of a brass stirrup spring, the upper arms of which rest on two slots cut away on the top of the stem. The lighting pellet is bored out and contains a very small R.L. cap which is retained in position by means of a screw plug. A steel spring washer is placed on top of the time ring; the ring itself is then clamped by means of a cap of aluminium screwed on to the top of the stem and secured by a steel set-screw.

As the stirrup spring is of very weak construction the lighting pellet is secured in a safe position until the moment of loading by means of a phosphor-bronze safety pin which passes through the cap and the lighting pellet.

*Action.*—The fuze is set by means of the special key by turning round the ring until the graduation ordered is opposite the setting mark. At the moment of setting the safety pin is withdrawn, leaving the lighting pellet supported by means of the stirrup spring only.

On shock of discharge the pellet sets back, straightening out the arms of the stirrup spring, and carries its detonator on to the point of the needle. The flash from the exploding detonator passes through the holes in the stem and round the groove to the powder pellet at the commencement of the composition. The ring burns round until it comes to the pellet of powder in the body at the setting mark, which fires the magazine of the fuze and the shell.

This fuze was originally intended for use with the star shell for the B.L. 10-pr. but its use has now been extended to all B.L. and Q.F. guns and howitzers for use with star shell.

#### *Mark III Fuze.*

Mark III fuzes differ from the Mark IV in the bottom of the composition groove in the time ring being square instead of round, and in the groove having an asbestos lining.

#### *Mark II Fuze.*

The Mark II fuzes differ from Mark III in not being waterproofed.

#### *Mark I Fuze.*

Mark I fuzes differ from Mark II as follows:—

- (1) The underside of the time ring is flat (instead of being provided with a lip and recess).
- (2) The magazine channel is placed at a different angle.
- (3) The aperture in the bottom plug is smaller.
- (4) The external contour of the fuze is slightly different.

FUZE, TIME, SENSITIVE MIDDLE, NO. 24, MARK I | L | .

(See Plate LII.)

This fuze can still be used with star and shrapnel shell with the B.L., 6-inch and 5.4-inch howitzers.

It will become obsolete when existing stock is expended.

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FUZE TIME SENSITIVE MIDDLE N° 24 MARK I.

§ 5638.

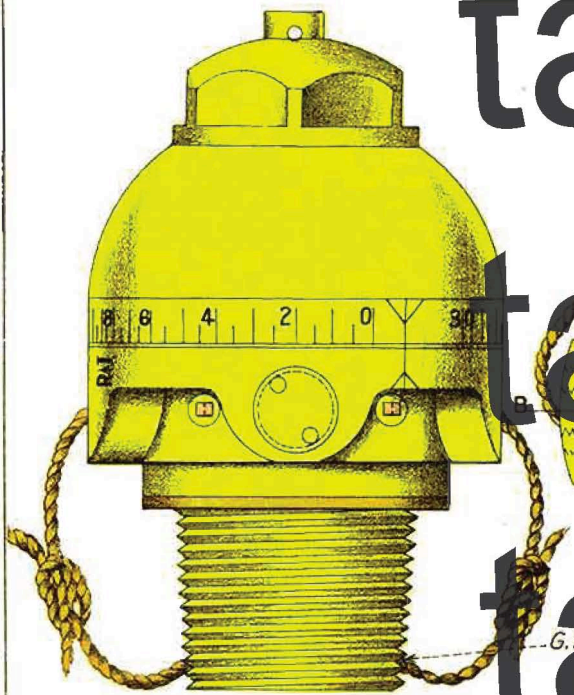
SCALE  $\frac{1}{16}$ .

WEIGHT 1 LB. 10 OZ.

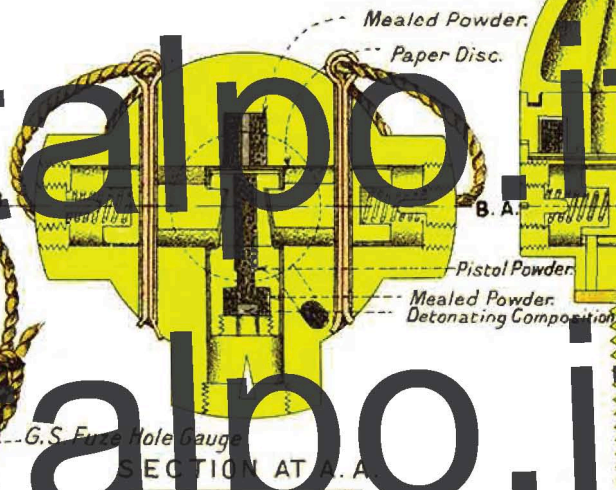
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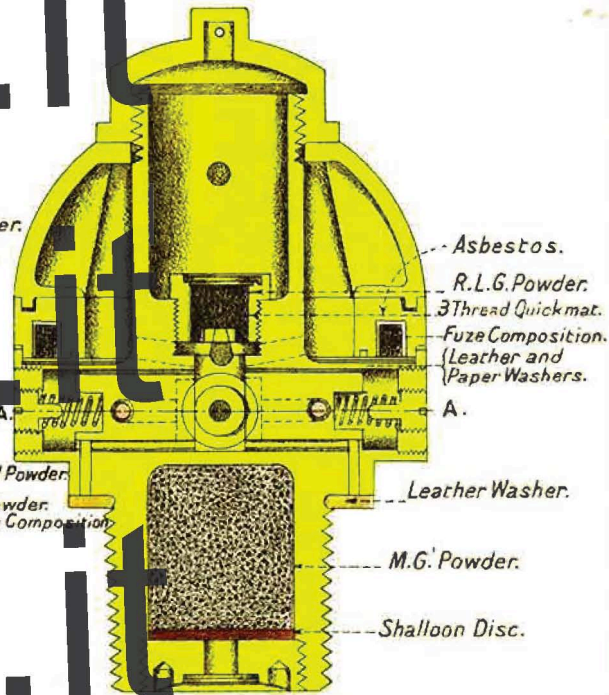
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ELEVATION SET AT "SAFETY."



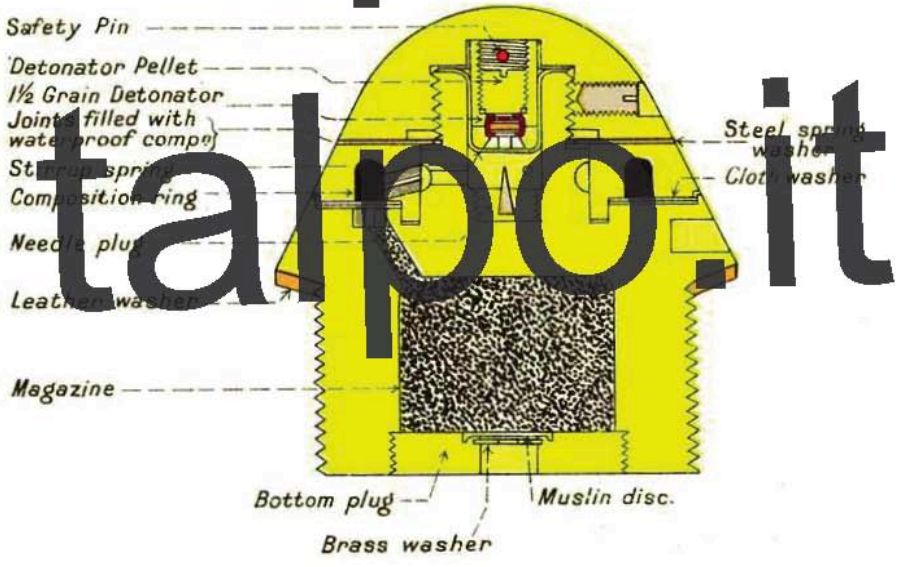
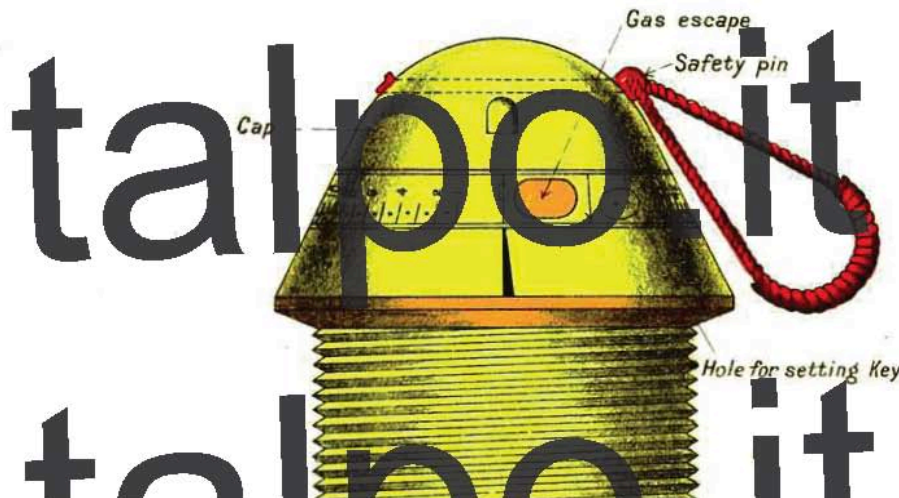
SECTION AT A. A.



SECTION AT B. B.

TIME, FUZE N° 30. MARK II /N/.

FULL SIZE.



*Action.*—The action of the fuze does not depend upon the shock of discharge, but immediately the shell begins to rotate, the retaining bolts, acted upon by centrifugal force, fly outwards, compressing the spiral springs and releasing the lighting pellet, which, acted upon by the same force, also flies outwards against the needle, firing the detonator, the flash passing through the body of the pellet to the axial magazine; thence it passes out through the fire holes in the bottom of the stem and ignites the time ring. The ring burns round until it reaches the channel opposite the setting mark, when the magazine of the fuze is fired, so bursting the charge of the shell.

#### TIME FUZES USED IN NAVAL SERVICE.

Fuze, Time, No. 30, MARK II, N | .

(Plate LIII.)

This fuze is used with shrapnel shell having the 2-inch gauge, for B.L. 12-inch and above, when firing at short ranges.

The fuze is identical in construction with the Fuze, time, No. 25, Mark IV, but is made of metal instead of aluminium, is larger, and is threaded to the 2-inch gauge.

#### *Mark I Fuze.*

The Mark I fuze differs from the Mark II in the channel for the composition in the time ring being square instead of rounded at the bottom.

The channel is also lined with asbestos.

TABLE NO. 29.—*Time Fuzes used in Land Service.*

The Fuzes shown in Italics are Obsolete for future manufacture.

Fuzes.	Marks.	Paragraph in List of Changes.	Time of Burning in seconds.	Used with.	
<i>Sensitive, middle, No. 24...</i>	I	5083	14-8 to 15-8	B.L., 6-inch, 30-cwt. howitzer	
		5082		B.L., 6-inch, 25-cwt. howitzer	
		7046		B.L., 5.4-inch howitzer	
		7231			
		8417			
15 seconds, No. 25	I	12392	15	B.L., 10-pr. howitzer	
		13333		B.L., 6-inch, 30-cwt. howitzer	
		13352		B.L., 6-inch, 25-cwt. howitzer	
		14066		B.L., 5-inch howitzer	
		15760		B.L.C., 15-pr.	
	II				Q.F., 18-pr.
					Q.F., 15-pr.
					Q.F., 13-pr.
					Q.F., 2.6-inch
No. 30	I	14872	8-5	B.L., 13.8-inch, V	
		16658		B.L., 12-inch	

*Time Fuzes used in Naval Service.*

For star shell, but when stock of fuzes is exhausted, to be replaced by No. 25.  
For shrapnel shell, but when stock of fuzes is exhausted, to be replaced by No. 54.

For star shell.

For shrapnel shell having 2-inch fuze hole at short ranges.

## (F). TIME AND PERCUSSION FUZES.

Time and percussion fuzes are here, for convenience, divided into three groups, namely :—

(1) The *small* type of T. and P. fuze with the G.S. gauge (1-inch).

Fuze, T. and P. No. 60,	two time rings,	burns at rest	20 sec.
" " No. 63,	" "	" "	20·1 "
" " No. 65 and 65A	" "	" "	20·1 "
" " No. 56,	single time ring	" "	13 "

(2) The *large* type of T. and P. fuze with the G.S. gauge.

Fuze, T. and P. No. 62,	two time rings,	burns at rest	35 sec.
" " No. 64,	" "	" "	30 "
" " No. 66,	" "	" "	34 "
" " No. 54,	single time ring,	" "	16 "

(3) T. and P. fuzes having the 2-inch fuze-hole gauge.

Fuze, T. and P. No. 80,	two time rings,	burns at rest	22 sec.
" " No. 81,	" "	" "	30·25 "
" " No. 82,	" "	" "	40 "
" " No. 83,	" "	" "	30 "
" " No. 84,	" "	" "	30 "

For nature of gun with which the above fuzes are used, see Table of Fuzes, page 334 to 338.

(1) SMALL T. AND P. FUZES OF G.S. GAUGE	No. 60.
	" 63
	" 65 and 65A
	" 56.

The above-mentioned T. and P. fuzes are similar in construction, differing only in minor details hereafter described.

The No. 56 fuze is fitted with only one time ring.

The No. 65A fuze is an entirely new fuze; the No. 65 is a fuze which has been converted from old T. and P. No. 56, 60, or 63 fuzes.

The No. 65A fuze is here described in detail.

FUZE, T. AND P. No. 65A, Model I | C | .

(Plate LV.)

*Parts.*—The fuze consists of the following parts.—Body, percussion pellet with needle plug and retaining bolt, spiral spring, detonator plug, safety pellet, brass ball, bottom plug, two time rings, dome, washer and nut.

*Description.*—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 are situated 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.

*Time rings.*—There are two time rings which contain the fuze composition. Each ring has a channel running nearly all round its under surface, 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 straight 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 with 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 marked with an arrow, and when this is opposite the setting mark the fuze is set as safely as the fire-hole in the body is covered by solid metal and not by fuze composition.

A cloth wad is secured by shellac to the top of the body, and another to the top of the bottom ring, a hole being pierced through each to allow the powder pellet in the fuze body and in the composition ring exposed.

*Lighting chamber.*—On the upper side of the upper ring, at the beginning of the composition there is a small chamber containing the lighting arrangement, which consists of a gunmetal hammer having a steel needle, suspended by a thin copper shearing wire over 35 grains of cap composition; this cap composition is surrounded by mecke powder, and covered by a thin brass disc which is kept in position by a small screw collar. This collar has a side groove cut away so as to form a channel for the flash to pass from the time detonator to the composition at the beginning of the ring. The top of the chamber is closed by a brass disc, the metal being spun over to retain it in position. A strong safety pin of phosphor-bronze wire passes through the ring from the outside, and underneath the hammer, which it supports. The letter "T" is stamped on the ring near the entrance of the safety pin.

*Closing pellet.*—When the safety pin is withdrawn, a small brass pellet with spiral spring behind it, closes the hole.

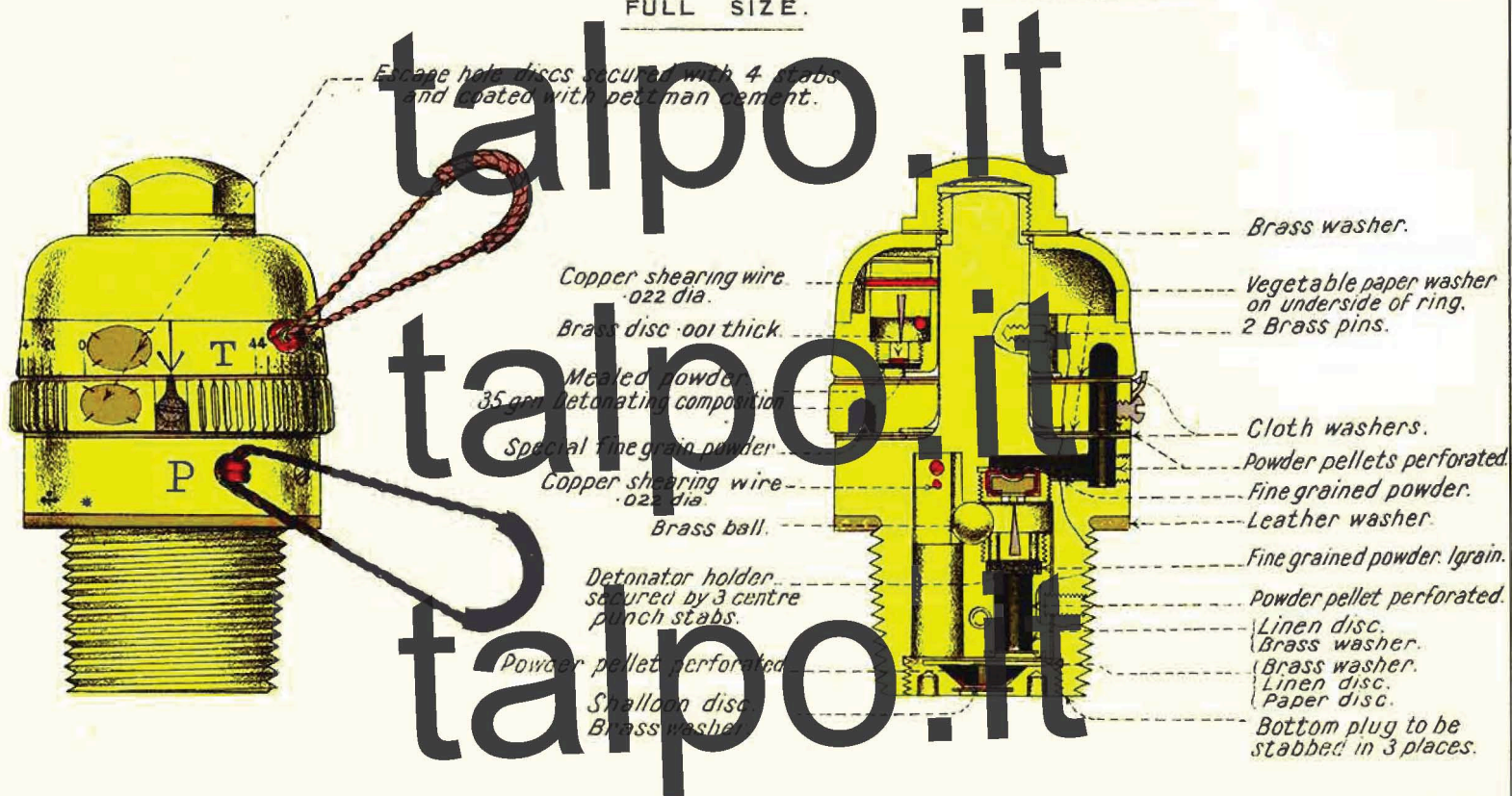
*Dome.*—The dome is made of brass; it fits over the upper ring and covers the lighting arrangement.

*Washer.*—Placed on top of the dome is a washer of sheet brass having two feathers which fit into grooves in the top part of the stem.



# FUZE, TIME & PERCUSSION, No 65.A. MARK I | L | METAL.

FULL SIZE.



*Nut.*—The nut, which is hexagonal, screws on to the top of the stem and clamps the dome and time rings in position.

*Percussion arrangement.*—The percussion arrangement consists of a percussion pellet with steel needle, retaining bolt with spring, safety pellet, safety ball, detonator plug with R.L. cap, spiral creep spring and bottom plug.

*Percussion pellet.*—The percussion pellet is made of metal, cylindrical in shape, having a slot cut down one side for the safety pellet and ball to fall into; there is also a small groove cut down the body of the pellet into which projects a small pin in the fuze body to prevent the pellet from twisting round.

A hole is bored through the pellet, the top part of which is threaded to receive the needle plug with a hardened steel needle with six fire holes round it. Underneath the needle plug is a recess containing one grain of F. C. powder and a perforated pellet of powder retained in position in the pellet by a brass washer and a muslin disc.

*Creep spring.*—A small recess is made on the underside of the body and a corresponding one on the top of the pellet, into which fits the spiral spring, intended to prevent the pellet moving forward in flight.

*Retaining bolt.*—The retaining bolt passes transversely through the percussion pellet, its small end projecting into a recess in the body, in which position it is kept by a small spiral spring. The other end of the bolt is heavier, and flies outward when the shell rotates, a slot being formed in the body into which this end can move.

*Safety pellet.*—The safety pellet is suspended in the body above the slotted out portion of the percussion pellet by means of a thin copper shearing wire, and by a safety pin passing through the body and the pellet. The letter "P" is stamped on the body near the entrance of this pin.

*Closing pellet.*—A small brass pellet, with a spiral spring behind it, closes the safety pin hole when the latter is withdrawn.

*Safety pellet and ball.*—The safety pellet retains in position a small brass ball lying on an inclined recess cut away on the top face of the pellet. The ball prevents any forward movement of the percussion pellet as long as it is kept in position by the safety pellet.

*Detonator plug.*—The detonator plug is a small cylinder of metal screwed on the exterior to fit into the body at the end of the horizontal powder channel, and immediately above the needle of the percussion pellet. It is recessed to receive the R.L. cap, and has a central fire hole.

*Bottom plug.*—The bottom plug is a short cylinder of metal, threaded externally to screw into the bottom of the fuze. It has a cavity filled by a perforated pellet of gunpowder covered on the top by a disc of paper and a disc of muslin, secured by a brass washer. The hole at the bottom is closed by a brass washer and shallon disc, the base of the fuze and plug being waterproofed by a coating of Pettman's cement, and the bottom plug stabbed in three places to prevent it unscrewing.

*Action of time portion.*—The fuze is set by unclamping the nut by means of the "Key No. 5," and turning round the lower time

ring until the graduation ordered is opposite the pointer on the body. The nut is then clamped securely. At the moment of loading the "T" pin is withdrawn and the closing pellet closes up the hole occupied by the pin and so prevents the gas on discharge getting into the fuze. On the shock of discharge the hammer in the lighting chamber sets back, shearing its suspending wire, and fires the detonating composition in the bottom of the lighting chamber and ignites the top ring, the brass disc being blown out to allow the gas to escape. The top ring burns round the reverse way to which the shell is rotating until it comes to the powder pellet at the beginning of the lower ring, which is then fired, blowing out the brass disc, and igniting the lower ring. The lower ring burns back the opposite way to the top until it comes to the pellet of powder in the body; this is fired, and ignites the powder in the horizontal channel, firing the percussion detonator and the bursting charge of the shell.

*Action of percussion part.*—At the moment of loading the "P" pin is withdrawn, the closing pellet closing the hole occupied by the pin. On shock of discharge the safety pellet sets back to the bottom of the slot in the percussion pellet, shearing its suspending wire, the brass ball following it on the first motion of rotation. The spiral spring prevents the percussion pellet rebounding, and the anti-boring pin prevents the pellet from turning.

Owing to the rotary motion of the shell the heavy end of the retaining bolt overpowers the spring and withdraws the smaller end from the recess, so that the percussion pellet is free to move forward, which on graze or impact, compressing the spiral spring; the needle striking the percussion detonator fires the fuze.

FUZE, T. AND P. NO. 65, MARKS I AND II.

Fuze, T. and P. No. 65, Marks I and II, are similar in design to the above, but are conversions from old No. 56, 60 and 63 fuzes.

The Mark II differs from the Mark I in the upper time ring, which is graduated in a slightly different manner.

FUZE, T. AND P. NO. 63, MARK I.

(Plate LV.)

The fuze is, in construction, generally similar to the Fuze, T. and P. No. 65, Mark I, but is a quick-setting fuze; the cap on the stem is circular and is not unclamped before nor clamped up after setting. It differs from the No. 65, Mark I, in the following particulars:—

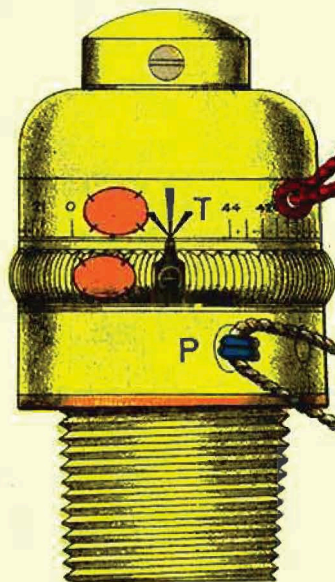
The composition channels in the time rings are lined with asbestos paper.

The lower ring is milled in a different manner. The cap securing the dome is fixed in position by a steel set-screw.

This fuze is set by means of a special key (Key, No. 14, see page 343), shaped to fit the milling of the lower ring.

**FUZE, TIME & PERCUSSION, No 63, MARK I | C | METAL.**

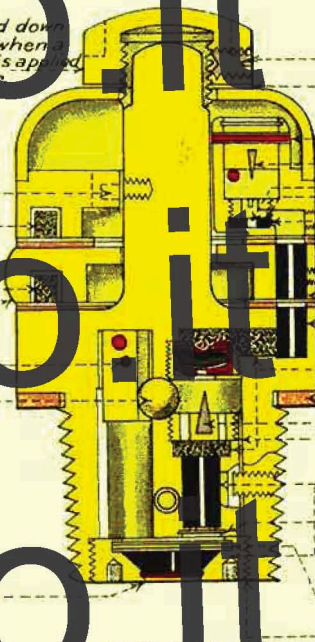
**FULL SIZE.**



**ELEVATION.**  
**SET AT SAFETY.**

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The Cap is to be screwed down  
so that the Ring will turn when  
a weight of 24 ozs. or 2 lbs. is applied  
at the end of a 3 in. lever.

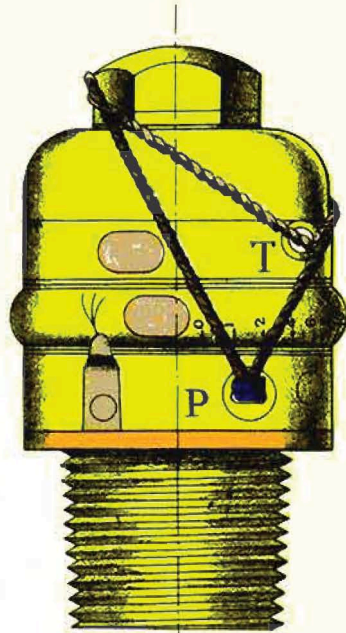


**SECTION**

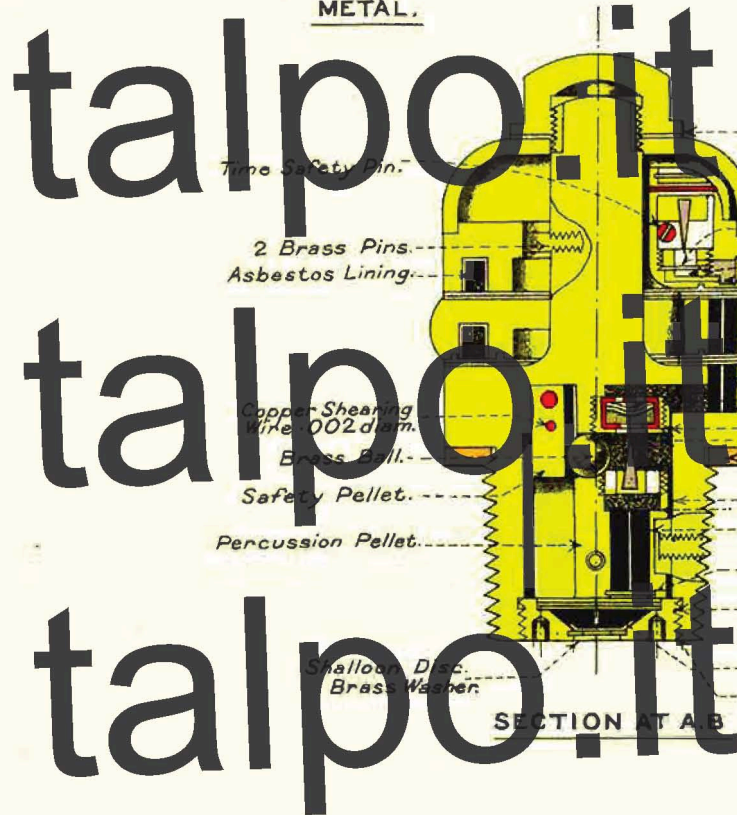
- 2 Brass Pins.
- Asbestos Lining.
- Powder Ring Milled.
- Copper Shearing Wire.
- Brass Brass.
- Shallow Disc.
- Brass Washer.
- Steel Set Screw.
- Brass Washer.
- Copper Shearing Wire.
- Steel Needle.
- Detonating Compo Mealed Powder.
- Brass Disc.
- Cupro Nickel Pointer (Vegetable Paper Washer on Cloth Washer. (underside of Ring)
- Brass Screw.
- Powder Pellets perforated.
- Fine Grained Powder.
- Leather Washer.
- Steel Needle.
- Muslin Disc.
- Powder Pellets perforated.
- (Muslin Disc. Brass Washer.
- (Brass Washer Muslin Disc. Paper "
- Bottom Plug to be stabbed in 3 places.

# FUZE T AND P Nº 60 MARK II. C

METAL.



ELEVATION.  
FUZE SET AT SAFETY



Time Safety Pin.

2 Brass Pins.  
Asbestos Lining.

Copper Shearing Wire .002 diam.  
Brass Ball.

Safety Pellet.

Percussion Pellet.

Shallow Disc.  
Brass Washer.

SECTION AT A-B

Brass Washer.

Copper Shearing Wire .002 thick.

Brass Disc .002 thick.

Detonating Composition.

Mealed Powder.

Calf Skin Washer  
Washer of Fine White Paper.  
Tablet " " "

Powder Pellet perforated.

" " "

Fine Grained Powder.

Detonator (Copper)

Needle (Steel)

Leather Washer.

Muslin Disc.

Loose Powder.

Pellet of Powder perforated.

Muslin Disc.  
Brass Washer.

" "

Muslin Disc.  
Paper "

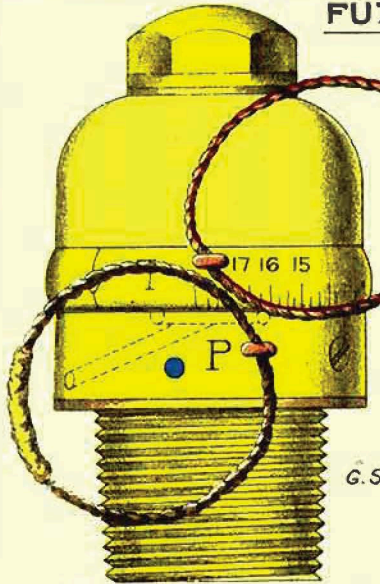
Powder Pellet perforated.

Bottom Plug to be stabbed  
in three places.

# FUZE TIME AND PERCUSSION NO 56 MARK IV C.

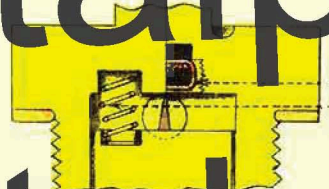
METAL, 1 IN A TIN CYLINDER.

Scale 1/1  
\$7716



ELEVATION.

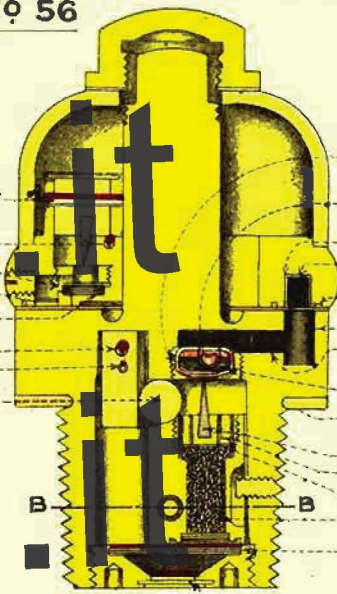
G.S. Fuze Hole Gauge.



PART SECTION AT A A.



PLAN OF PELLET.



SECTION AT A A.



SECTION AT B B.

- Copper Shearing Wire .022 diam.
- Copper Safety Pin .065 diam.
- Brass Disc .001 thick.
- Detonating Composition:  
Mealed Powder.
- Copper Safety Pin .065 diam.
- Copper Shearing Wire .022 diam.
- Metal Ball

Brass Washer .02 thick.

- (Copper Detonator diam. 30 thickness 147)
- Tin Foil Disc.
- Asbestos Lining.
- Powder Composition.
- Calf Skin Washer.
- Powder Pellet perforated F.G. Powder.
- Brass Disc .005 thick.
- Leather Washer.
- Steel Needle.
- 6 Fire Holes .075 diam.
- Paper Disc.
- F.G. Powder.
- Brass Washer .015 thick
- Shalloon Disc and Paper Disc.
- Shalloon Disc and Brass Washer .015 thick.

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## FUZE, T. AND P. NO. 60, MARK II | L | .

(Plate LVI.)

The Fuze, T. and P. No. 60, Mark II, differs from the No. 65 fuze as follows :—

- (1) The lower, instead of the upper time ring, is graduated.
- (2) The setting pointer is attached to the body of the fuze instead of to the lower ring.
- (3) The composition channels are lined with asbestos paper.
- (4) Calf-skin washers are used under the time rings instead of cloth washers.
- (5) The time detonator in the upper time ring contains  $\cdot 2$  grains instead of  $\cdot 35$  grains of composition.

## FUZE, T. AND P. NO. 60, MARK I | L | .

*Fuze, T. and P. No. 60, Mark I*, differs from Mark II in having a blackened notch instead of a pointer. In the first issues of Mark I the graduations showed the odd numbers.

*Fuzes, T. and P. No. 60, Marks I\* and II\**.—A certain number of Marks I and II, T. and P. fuzes, No. 60, have been issued with  $\cdot 35$  instead of  $\cdot 2$  grains of detonating composition in the Time portion; such fuzes will be distinguished by a (\*) added to their numeral.

*Fuzes, T. and P. No. 60c, Marks I and II*, are conversions from Nos. 56, 57, and 61 (single ring) fuzes. No more of No. 60c will be made.

They have the old numeral, lot number, and date of filling based out and new substituted.

## FUZE, T. AND P. NO. 56, MARK IV | C | .

(Plate LVII.)

*T. and P. No. 56*.—This fuze differs from the T. and P. No. 60 in having a *single*, barrel-shaped, time ring with lighting arrangement graduated from 0 to 15 and subdivided to read in quarters. The gas from the burning composition escapes into the dome through a hole bored into the ring from the inner side, near the commencement, and through another at the top. A groove is cut in the top face of the body close to the stem and halfway round it, and a hole is bored through the body into this groove at an angle reverse to the spin of the rifling, for the gas to escape from the dome.

The percussion pellet is filled with F.G. powder instead of having a perforated pellet of gunpowder.

Shalloon is used in place of muslin for the discs. Time of burning at rest, 13 sec. :—

There are no earlier Marks of this fuze.

*Fuze, T. and P. No. 56, Mark IV.\**.—Certain lots of No. 56 fuzes have been re-fitted with  $\cdot 35$  grains instead of  $\cdot 2$  of detonating composition for the time portion, and are distinguished by having a (\*) added to their numeral.

- (2) LARGE T. AND P. FUZES OF G.S. GAUGE
- |   |         |
|---|---------|
| } | No. 66. |
|   | „ 62.   |
|   | „ 54.   |
|   | „ 64.   |

The Nos. 66, 62 and 54, T. and P. fuzes, are similar in construction ; the No. 54 is fitted with only one, instead of two, time rings.

The No. 64 fuze is entirely different in design from the above, and is described in detail.

#### FUZE, T. AND P. NO. 66, MARK I.

(Plate LVIII.)

This fuze is similar in mechanism to the T. and P. No. 65A ; but the body above the screw-threaded portion is larger in diameter, the stem being hollow (for lightness) and thickened at the base to ensure the centering of the lower time ring. The upper ring is graduated from 0 to 60. The percussion part only differs from that already described in having two, instead of one spiral creep spring in front of the percussion pellet.

#### FUZE, T. AND P. NO. 62, MARK II | L | .

(Plate LIX.)

This fuze is very similar to the No. 66, differing from it in the lower time ring which is barrel-shaped and milled in a different manner.

The composition channels in the time rings are lined with asbestos paper.

The fuze composition in the rings is a mixture of black and brown mealed powder instead of P.G.

The fuze burns about a second longer than the No. 66.

#### FUZE, T. AND P. NO. 62, MARK I.

A few T. and P. No. 62 Mark I fuzes have been issued ; they differ from the Mark II in the time rings, both of which are graduated, and both rings are capable of being moved in setting the fuze. The upper ring is graduated up to 30 ; the lower ring from 30 to 60.

The lower ring is fitted with a spring pawl, which, in the operation of setting the fuze, acts as follows :—For graduations up to 30, the pawl secures the lower ring to the body, so the upper ring is the only one which is moved ; for graduations *above* 30, the pawl no longer keeps the lower ring fixed, but secures it to the upper ring, so that the rings move round together. (See Fig. 87.)

#### FUZE, T. AND P. MIDDLE NO. 54, MARK III.

(Plate LX.)

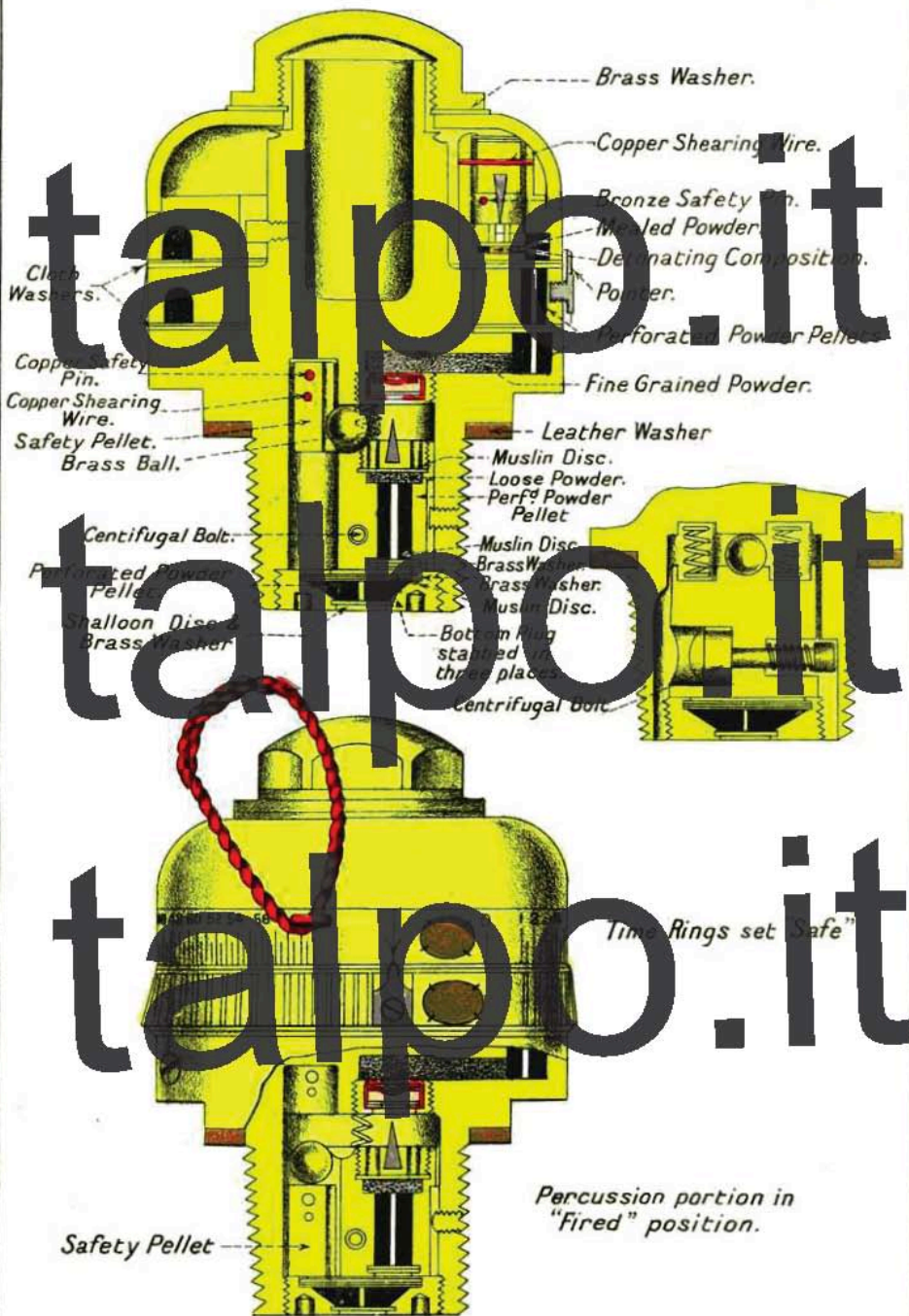
This is a single ring fuze of the same size as No. 62, but in construction and action it is similar to the T. and P., No. 56, Mark IV,



7

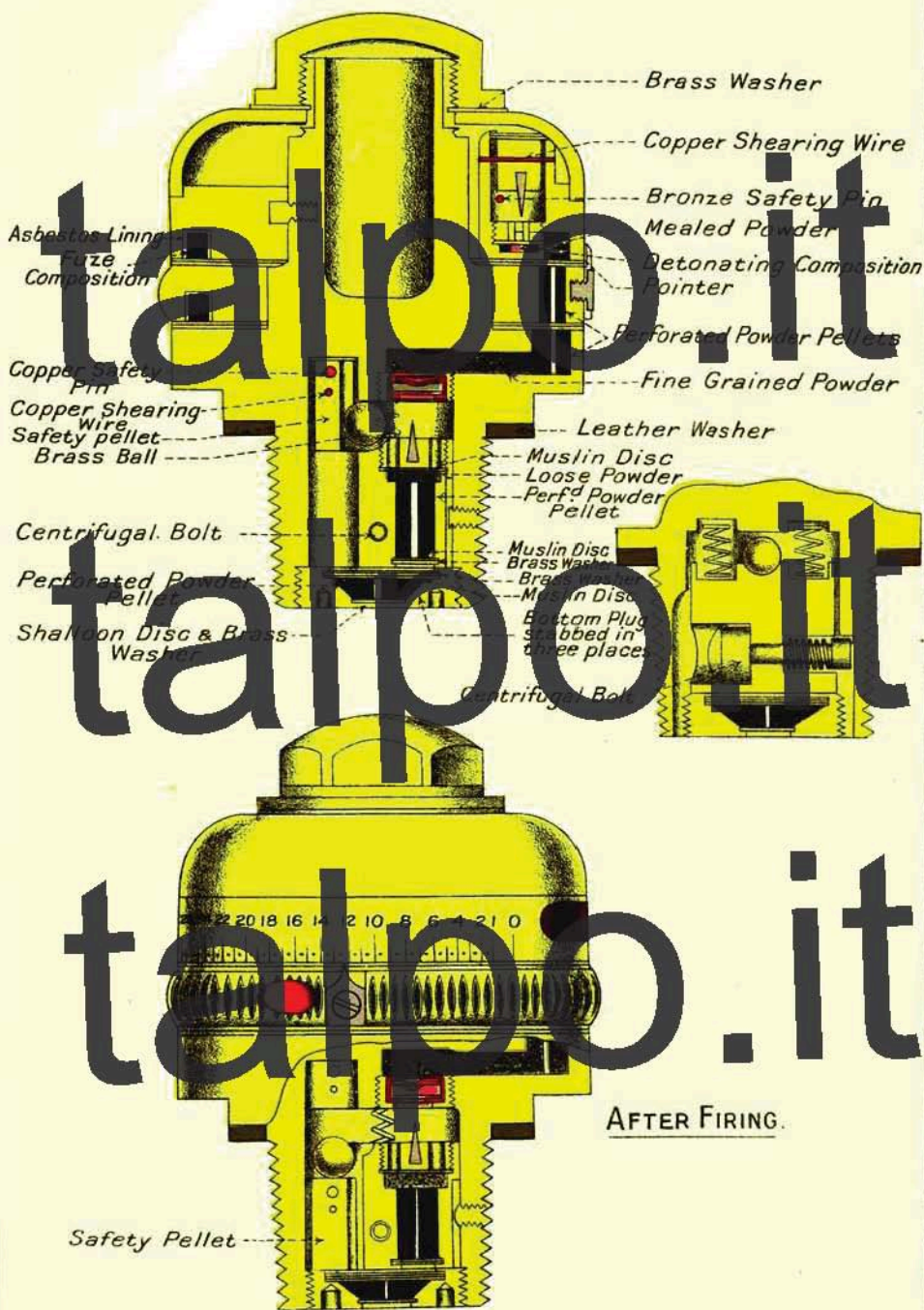
**FUZE T AND P. N°66 MARK I.**

**FULL SIZE.**



FUZE T AND P. N°62 MARK II.

FULL SIZE.



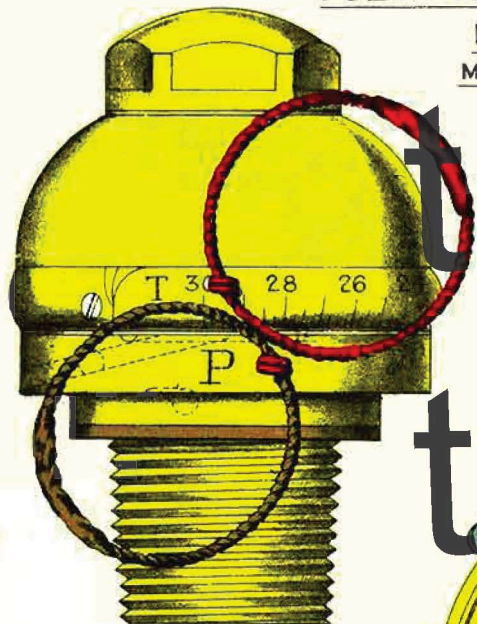
**FUZE TIME AND PERCUSSION MIDDLE**

**№ 54 MARK III C.**

**METAL, 1 IN A TIN CYLINDER.**

8912

FULL SIZE



Safety Point  
ELEVATION.

Copper Shearing Wire

Copper Safety Pin

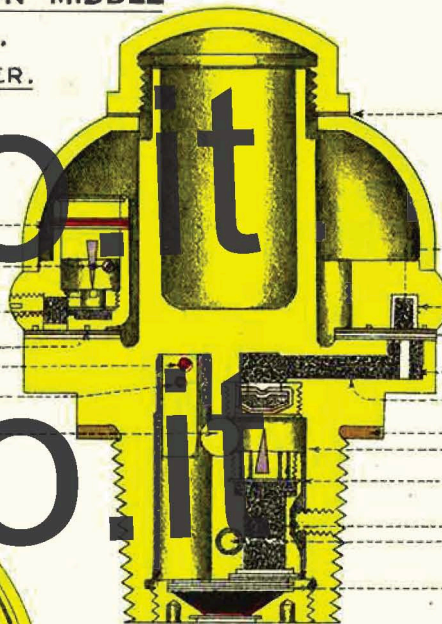
Mealed Powder

Detonating Composition

Copper Safety Pin

Copper Shearing Wire

Metal Ball



Brass Washer

Powder Composition

Asbestos Lining

(Calf Skin Washer

Washer of Fine White Paper

Tablet

Powder Pellet perforated

F.C. Powder

Leather Washer

Brass Disc

Paper Disc

F.C. Powder

Centrifugal Bolt

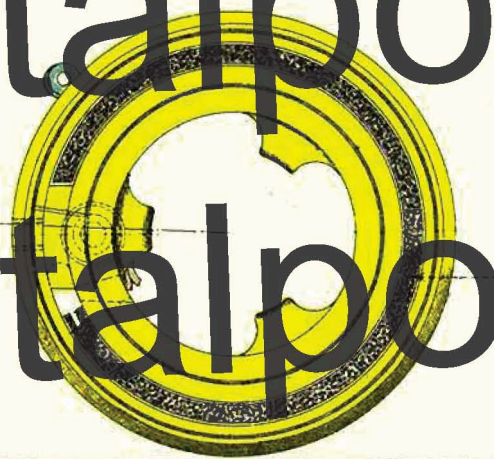
(Brass Washer

Shalloon Disc

and Paper Disc

SECTION.

Powder Composition



except in marking and length of composition; the stem is hollow and the ring is graduated up to 30 divisions.

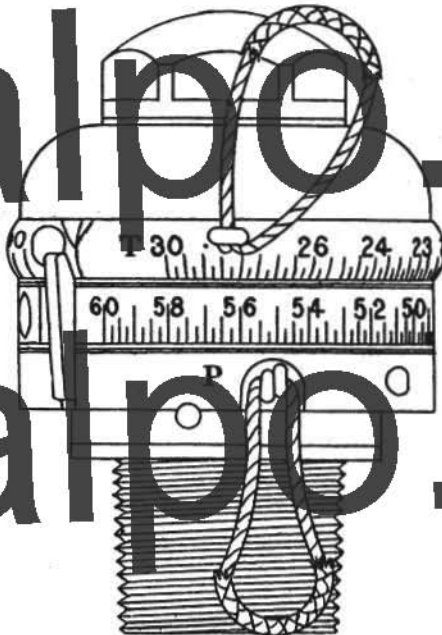
*Fuze, T. and P. No. 54, Mark III\*.*—Certain lots of No. 54 fuzes have been re-fitted with .35 grains instead of .2 of detonating composition for the time portion, and are distinguished by having a (\*) added to their numeral.

No more No. 54 or 62 fuzes will be manufactured.

Fig. 87.

FUZE, T. AND P. NO. 62, MARK I.

Scale  $\frac{1}{2}$ .



FUZE, T. AND P. NO. 64, MARK II | C | .

State XI.

This fuze is used with shrapnel shell having the G.S. gauge, Naval Service—B.L. and Q.F. 6-inch to 9-inch.

Land Service—Q.F. 4-7-inch and 6-inch, B.L. and B.L.C., 6-inch to 10-inch.

*Parts.*—It consists of the following parts:—Body, bottom plug, percussion pellet with creep spring, detonator, and screw plug, stirrup spring, brass ferrule with safety pin, centrifugal bolt, two steel needle plugs, two time rings, lighting pellet with detonator and stirrup spring, safety pillar, safety pin and clamping nut.

*Body.*—The body is made of metal; externally it resembles that of the Fuze, T. and P. No. 66; the upper part of the stem is bored out to take the lighting arrangement of the time portion of the fuze; the lower part of the body is bored out to take the percussion arrangement, and fitted with a central steel needle plug.

*Percussion pellet.*—The percussion pellet is made of brass, cylindrical in shape, with a flanged base; this flange supports the phosphor-bronze creep spring; it has grooves cut round its circumference to allow the flash from the time rings to reach the powder in the bottom plug. The pellet is bored out to take a detonator, which is held in position by a detonator plug screwed into position beneath it; this plug has a central hole containing a perforated powder pellet.

*Stirrup spring.*—Fitting over the front end of the pellet is a small brass stirrup spring with two projecting arms, intended to support the ferrule.

*Ferrule.*—The ferrule is a short brass tube; it is supported by the arms of the stirrup spring, and projects beyond the front of the pellet, and so prevents any forward movement of the latter towards the needle point.

The ferrule is further supported by a safety pin passing through it and the body of the fuze.

*Centrifugal bolt.*—In addition to the above safety arrangements, there is a centrifugal bolt placed into a radial recess in the fuze body; the inner end of this bolt projects in front of the pellet and so prevents it moving forward on to the needle, until the bolt has been spun out of the way by the rotary motion of the shell. The centrifugal bolt is held in the safe position by the upper part of the ferrule projecting into a slot cut in the bolt.

*Creep spring.*—A phosphor-bronze creep spring, resting on the flange of the pellet, prevents any rebound action and creeping forward of the pellet during flight.

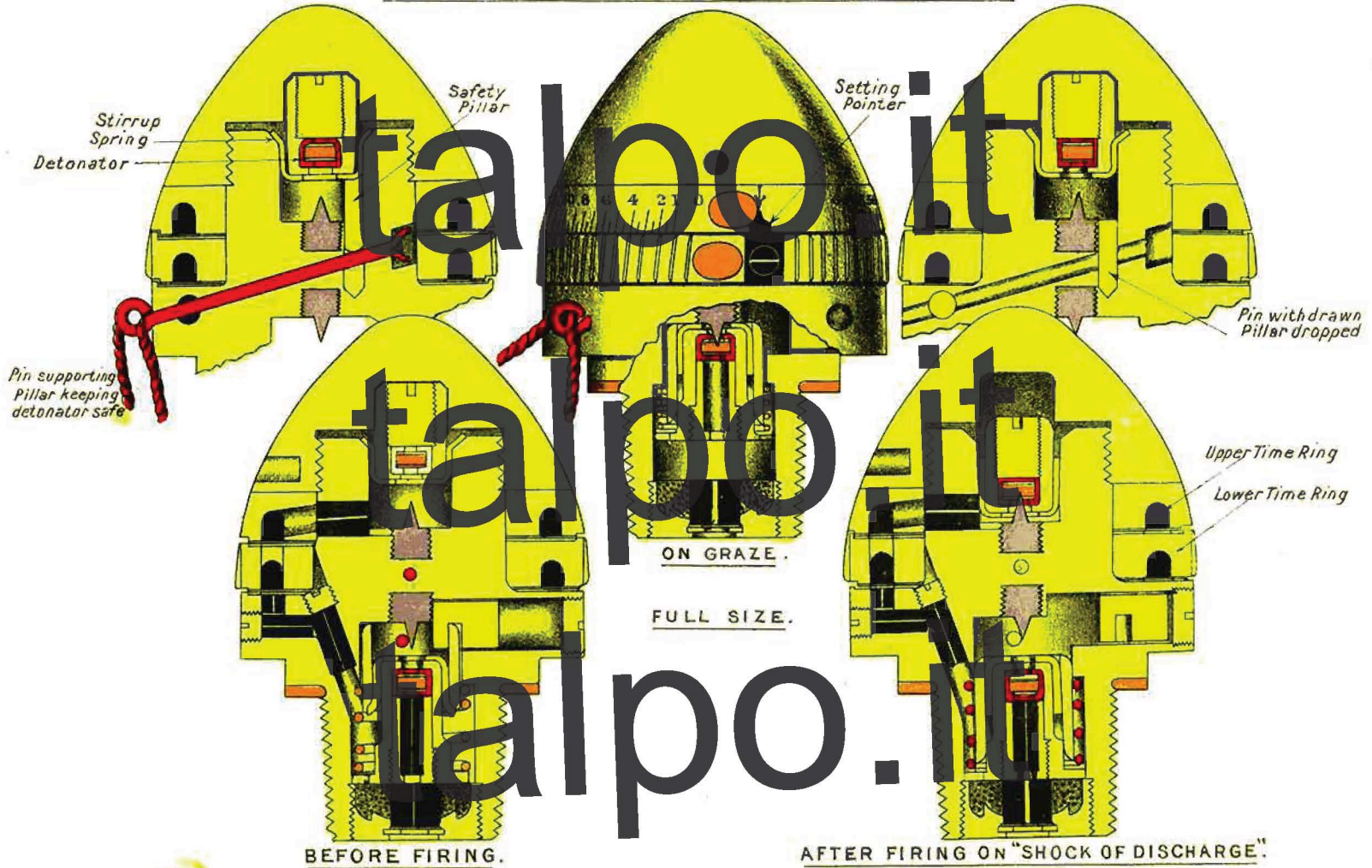
*Bottom plug.*—The lower part of the body is closed by a gunmetal bottom plug; this plug supports the percussion pellet; its upper surface is grooved and filled with loose gunpowder communicating with a central perforated powder pellet. The plug has a flash hole closed by a muslin disc and a brass washer spun in; a disc of paper and a disc of muslin are also shellaced to the upper face of the plug to retain the powder in position.

*Cloth washer.*—Shellaced to the flat portion of the body is a cloth washer; a small hole in this washer leaves exposed a perforated powder pellet communicating by means of two other perforated powder pellets with the percussion chamber.

*Lower time ring.*—Resting on this washer is the lower time ring, which is movable; it is of gunmetal, milled on the exterior and fitted with a blackened cupro-nickel pointer. On the underside a channel is cut nearly all the way round, which is varnished, and driven with fuze composition (special black powder) and then covered with a washer of vegetable paper. At the beginning of the composition in the ring is a vertical hole containing a perforated powder pellet, to communicate with the composition in the upper ring. The gas escape hole is similar to that of the No. 66 fuze, but is fitted with a small pellet of gunpowder contained in an asbestos cup; the brass disc closing the hole is stabbed in four places.

*Upper time ring.*—Resting on a cloth washer shellaced to the top of the lower ring is the upper time ring; it is graduated from 0 to 60,

FUZE, TIME AND PERCUSSION N° 64 MARK II.



sub-divided to read in quarters; it has a composition channel, and gas escape hole similar to the lower ring.

At the beginning of the composition a small hole is bored through to the inner circumference of the ring; this hole is in direct communication with another hole (fitted with a perforated powder pellet), bored through the stem into the lighting chamber.

The top ring is fixed to the stem by two metal pins fitting into slots cut down the stem and the inner circumference of the ring.

*Lighting pellet.*—The lighting pellet is made of delta metal bored out to take a detonator and screw plug; it is held in position in the top of the lighting chamber, directly over the needle plug, by means of a brass stirrup spring with two projecting arms, which fit into a recess bevelled off round the top of the stem.

*Safety pillar.*—In the event of the supporting arms of the stirrup spring being broken, the lighting pellet is prevented from coming in contact with the needle plug by means of a brass safety pillar. This pillar is supported over a vertical hole in the fuze body by means of a safety pin, and projects up into the lighting chamber beyond the point of the needle.

*Safety pin.*—The safety pin is of phosphor bronze, and passes diagonally through the body of the fuze, the ends being splayed out into a groove to retain it in position; it is fitted with a becket of scarlet cord. A closing pellet is provided to close the hole on the removal of the pin.

*Cap.*—The time rings are clamped by a metal nut or cap, recessed to fit over the top of the lighting pellet. A hole in the side of the cap is intended to take the special tommy for loosening or tightening the cap before and after setting the fuze.

*Action of time portion.*—The fuze having been set at the required graduation and the cap tightened by means of the setting tommy, at the last moment of loading the safety pin is withdrawn, leaving the safety pillar free to fall into its recess clear of the lighting pellet. On discharge, the lighting pellet sets back, straightening the arms of the stirrup spring, and carries its detonator on to the needle. The flash from the detonator fires the powder pellet in the flash hole in the stem, igniting the top time ring, and blows out the covering disc of the gas escape hole. The top ring burns round until it comes to the pellet of powder at the beginning of the composition in the lower ring; this pellet is ignited, blows out the gas escape hole disc and ignites the lower ring, which burns back in the opposite direction until it reaches the pellets of gunpowder in the body, thus firing the powder in the magazine of the fuze and the bursting charge of the shell.

*Action of percussion portion.*—At the moment of loading the "P" pin is withdrawn, the closing pellet closing the hole from which the pin has been removed. On shock of discharge the brass ferrule sets back, straightening the arms of the stirrup spring, unmasking the front of the pellet, and withdraws itself from the slot in the centrifugal bolt. As soon as the shell starts to rotate the centrifugal bolt is spun out into its recess by the rotary motion of the shell, clear of the front of the pellet; the spiral spring prevents the pellet creeping forward during flight.

On graze or impact the pellet is dashed violently forward on to the needle, compressing the creep spring. The flash from the exploding detonator fires the powder pellet in the percussion pellet, the powder in the magazine of the fuze, and the bursting charge of the shell.

*Mark I fuze.*

The Mark I fuze, T. and P., No. 64, differs from the Mark II in the following particulars:—

- (a) The gas escape powder pellet in the lower time ring has no asbestos cup.  
 (b) The shape and direction of gas escape hole in the lower time ring differ; in Mark I the hole is circular, and leads out at an angle against the spin of the shell; in Mark II the hole is oval, and leads out almost at right angles to the axis of the fuze.

(3) STANDARD FUZES OF 2-INCH GAUGE

No. 79.
" 80.
" 82.
" 83.
" 84.

FUZE, T. AND P., NO. 80, MARK V | L |

(Plate LXII)

*Use.*—At present with B.L., 7 $\frac{1}{2}$ -inch and Q.F., 13-pr., 18-pr., and 4-inch Mark IV guns.

*Parts.*—The fuze consists of the following parts:—Body, bottom plug, percussion holder with steel needle, brass washer and cap, percussion pellet with detonator, detonator plug, stirrup spring, ferrule, creep spring, two time rings, lighting pellet with time detonator and screw-plug, stirrup spring, cap and set-screw and fuze cover.

*Body.*—The body is made of aluminium, the lower part screw-threaded on the exterior to the 2-inch gauge. Above the screwed portion the body is of larger diameter forming a flange to which is screwed a brass ring, the lower edge of this ring is tinned to facilitate the soldering on of the brass fuze cover.

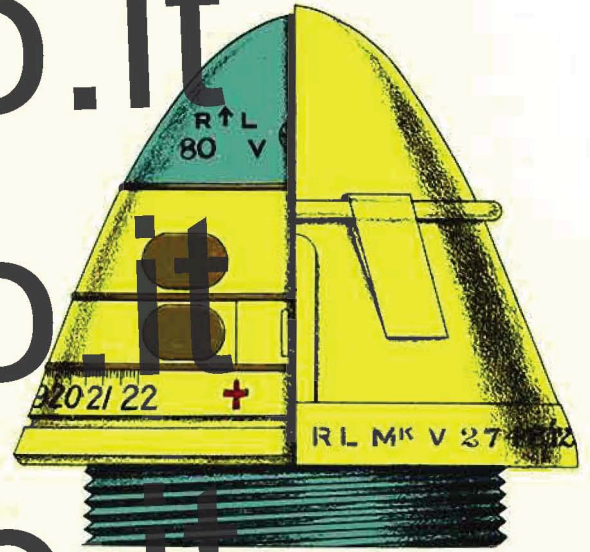
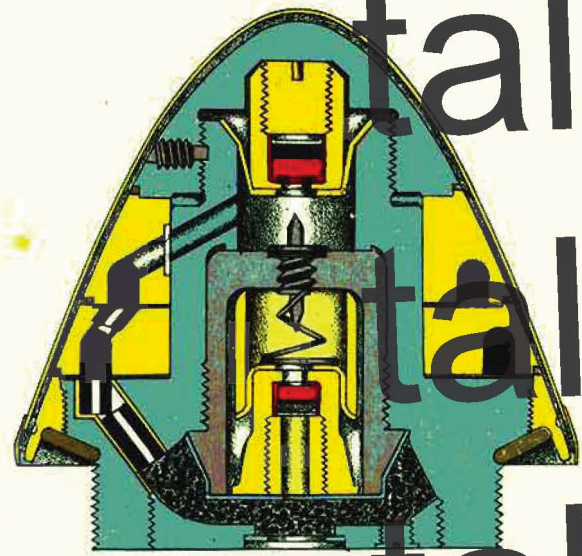
The body is bored out to form three chambers of different diameters; the lower chamber forms the magazine and is screw-threaded to take the bottom plug.

*Graduations.*—The brass ring on the body of the fuze is graduated from 0 to 22, reading in tenths. Near the "0" graduation a small vertical hole is bored in the top of the fuze body, into which is placed a perforated powder pellet which communicates with the magazine by means of a small channel filled with powder.

The hole and the channel are fitted with brass linings to prevent the powder coming in contact with the aluminium body.

A steel percussion holder is screwed into the centre of the body, and in its front end is a double-pointed needle; the lower point of





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the needle projects into the percussion chamber, while the upper point is intended to fire the time portion of the fuze.

*Percussion pellet.*—The percussion pellet is made of brass, cylindrical in shape, reduced in diameter at the front end, and bored out to take a special detonator, which is held in position by a detonator plug screwed into position beneath it. This plug has a central hole for the flash from the detonator to pass to the magazine.

*Detonator.*—The detonator consists of a small copper cup with a central hole closed by a copper disc. It contains about  $1\frac{1}{4}$  grains of detonating composition, and also a small pellet of gunpowder; these are retained in position by another covering disc of copper.

*Stirrup spring.*—Fitting over the front end of the percussion pellet is a small stirrup spring with two projecting arms which support the ferrule.

*The ferrule* is a short brass tube which projects beyond the pellet, and so prevents its forward movement on to the needle.

*A steel spiral spring* is placed around the lower point of the needle and in front of the pellet; it prevents any rebound action, and prevents "creeping."

*The holder is closed* by a brass washer, a disc of muslin, and a cap of brass with a central flash hole fitting tightly over the lower part of the holder.

*Bottom plug.*—The bottom plug is made of aluminium and has a small hole for the purpose of filling the magazine; this hole is closed by a screw plug.

The magazine of the fuze is filled with F.G. powder; the flash hole in the bottom plug is closed by a lining disc and aluminium washer spun in.

*Lower time ring.*—Shellaced to the top face of the body is a cloth washer having a small hole which leaves the powder pellet at the "0" graduation exposed. Resting on this washer is the lower time ring, which is made of brass and fits round the stem, and is free to turn. On the underside of the ring a channel is cut which is driven with fuze composition (special F.G. powder), and the bottom of the ring covered with a washer of vegetable paper. At the beginning of the composition there is a small hole bored through to the top face of the ring, containing a perforated powder pellet; at the same place there is also a gas escape hole bored through to the exterior. A perforated pellet of powder is placed into this hole and the hole closed by a disc of aluminium retained in position by the metal of the ring being stabbed over the disc in four places. The beginning of the composition is indicated on the ring by a setting mark; there is also a metal stud attached to the ring to engage with the key or fuze setter in setting the fuze. The top face of the lower ring has shellaced to it a cloth washer, a small hole being left in the washer to leave the powder pellet in the ring exposed.

*Top time ring.*—The top ring is also made of brass; it is smaller in diameter than the lower; it has a composition channel and gas escape hole similar to the lower ring, but at the beginning of the composition a small hole is bored through to the inner circumference which is filled with mealed powder and closed by a patch of special