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USER HANDBOOK

Anti-Aircraft Ammunition

1949

By Command of the Army Council

G. W. Simmers.

WAR OFFICE,
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NOTE: A decimal system is used for references.

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5.2 **FUZES**

5.22 **Time Fuzes**

5.223 Mechanical

5.2235 Escapeme[nt]

5.22352 Balan[ce] Arm

A fullpoint (.) is placed after the number of the Main Heading.

To locate a paragraph or sub-paragraph:

Find the Index entry.

Turn to the PAGE referred to in the Index entry.

Find on the left-hand side of the column the FULL NUMBER quoted in the Index, e.g. 5.22352 for "Balance Arm".

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3. THE CARTRIDGE

3.1 THE CARTRIDGE CASE

The metallic cartridge case is the distinguishing feature of a Q.F. gun, its chief function being to provide the means of obturation.

Brass is the usual metal employed but steel cases can also be used.

Cartridge cases follow a common design in the British service. The brass types are in one piece, solid drawn from a flat metal disc by a series of drawing and annealing operations. British steel cases are generally built up, the main components being the base and body.

The head of the cartridge case is enlarged to form a flange to position the case in loading and to provide a means of extraction after firing; it is bored centrally and usually threaded to take the primer. The body is tapered slightly to facilitate loading and extraction whilst the mouth is reduced in thickness to assist expansion when the propellant explodes in order to prevent gas escape.

When ballistic considerations require the chamber of a gun firing fixed Q.F. ammunition to be of considerably larger diameter than the bore, the case is necked towards the mouth.

With fixed Q.F. cases, the projectile is secured to the cartridge case by forcing the metal of the case near its mouth into one or more circular grooves round the wall of the projectile in rear of the driving band. These grooves are known as "Cannelures", and the forcing of the cartridge case into them is known as "Indenting". In some instances, the lip of the cartridge case is also rolled into a groove on the projectile made to receive it. This is known as "Coning".

Cartridge cases for separate loading may differ somewhat at the mouth according to the method used for closing the case for the retention and protection of the propellant. The cartridge may have a cannelure formed a short distance from the mouth to provide a seating for the lid. The lid, either of white metal or plastic material, is held in position either by bending over tangs formed in the mouth of the case or by coning the front of the case over the top of the lid. Where white metal lids are used, the metal acts as a decoppering agent and no foil is therefore necessary.

It is important that the joint between the projectile or lid and the cartridge case should be both water-tight and air-tight. This is achieved by assembling with wet cement or luting between the inside wall of the case and the outside of the projectile or lid. Wet cement (*e.g.*, R.D. cement) subsequently dries and hardens, giving a complete seal.

Cartridge cases are lacquered internally to prevent interaction between metal and propellant.

Brass cases occasionally develop cracks spontaneously after storage for some time. A crack near the base may be the means of putting the gun out of action and the *daily check of ready-use cases* is therefore *most important* and necessary. Short cracks near the mouth can be accepted as they cause little harm, but cracks elsewhere in the case should entail rejection. If a cracked case is loaded and fired, the propellant gases surge through the crack and erode the gun so severely that if a good case is subsequently loaded and fired it may collapse at the eroded spot through lack of support. As cases are reformed and used again, every effort should be made to remove all traces of the products of combustion remaining in the fired cases by washing as soon as possible after firing (see para. 9.622).

3.2 THE PRIMER

3.21 General

Primers are used in Q.F. guns to initiate the propellant charge.

They may be either percussion or electric and both contain three main elements; the cap, gas check and magazine in the case of percussion primers, and the bridge, gas seal and magazine for electric primers.

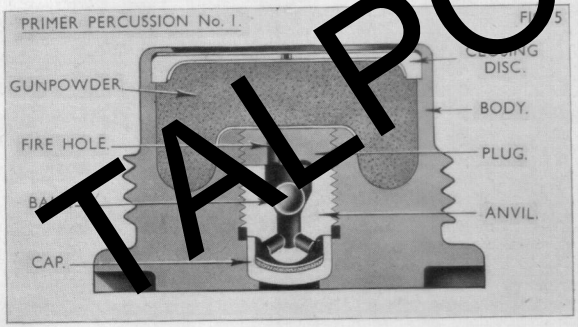
The igniferous initiator in the cap of the percussion primer and the gunpowder in the magazines of all primers, if allowed to become affected by damp, will cause misfires and hangfires.

With some primers and propellants an igniter is also used to reinforce the flash from the primer and ensure efficient ignition.

Primers can be repaired and used again.

Primers should invariably be removed from the cartridge case should it ever be necessary to use force to get the case into the breech of the gun. This particularly applies to any form of hammering, as not only might the primer cap be struck by accident but the shock might well damage it. The primer can be replaced once the case is fully home.

3.22 Percussion



3.221 Description

3.2211 Cap

This consists of a small copper shell containing about 1 grain of cap composition, covered with a tin foil disc and assembled with a fillet of waterproofing composition in the primer, with the open end close to an anvil and nearest the magazine. Either D.C.A. or Q.F. composition may be used. D.C.A. is somewhat more sensitive and provides more certainty in action, but experience has shown that if primers containing this composition are rammed home by a power rammer and subsequently unloaded there is a serious risk that they will function prematurely when next rammed into the gun. In fact, *a primer containing D.C.A. must NOT be power rammed a second time*, but should be removed when the round is unloaded and replaced by a new primer. (Primers containing D.C.A. ("A" composition) are not specifically marked but all primers containing Q.F. composition subsequent to August 1940, have the letter "Q" stamped on the base. Some of the packages for the "Q" primers also had the letter "Q" stamped on the ends, but this has since been discontinued.)

The cap composition is initiated by the cap being driven down on to the striker by the striker of the breech mechanism.

3.2212 Gas Check

The obturation or prevention of gas escape through or past the primer is of great importance as gas wash may cause serious damage to the breech mechanism.

Rearward escape of gas through the primer is prevented by a copper ball or cone which is contained in a central recess in the anvil and retained by a plug. This recess is connected by fire holes in the anvil to the cap and by fire holes in the plug to the magazine. This arrangement permits the flash from the cap to pass to the magazine, but the ball or cone is forced back on to a seating by the explosion of the primer magazine and thus seals the fire holes in the anvil.

3.2213 Magazine

The magazine may be formed in the body of the primer or it may be a separate component screwed on to the primer. Its length may vary within wide limits. It contains gunpowder, usually G.12.

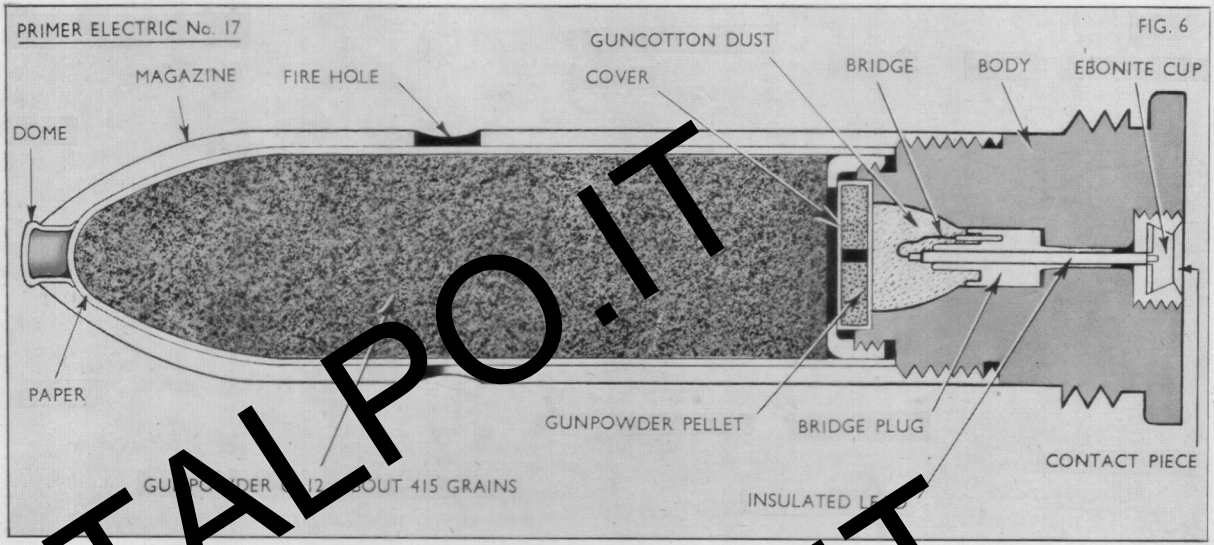
Integral magazines have a closing disc securely fixed to the body but weakened to provide an easy opening without fracturing, as debris in the bore might be troublesome.

The separate magazine is provided with fire holes, and a liner prevents escape of the powder, the liner being also varnished with shellac varnish as a protection against damp. Some of these magazines have a fire hole at the forward end and to prevent accidental perforation of the liner by the propellant, this hole is covered by a white metal "dome", the white metal of which also acts as a decoppering agent.

3.222 Action

The striker of the firing mechanism is driven on to the cap (or cap holder) and the composition is nipped on the anvil. The flame passes through the fire holes in anvil and plug, past the ball or cone and ignites the gunpowder in the magazine. The resultant explosion forces the ball or cone back on to its seating preventing internal gas escape and passes through the closing disc or fire holes to ignite the propellant charge. In primers without a ball or cone sealing device, the cap is forced rearwardly on to the face of the breech block, where it is supported and serves to prevent gas escape.

3.23 Electric



3.231 Description

3.2311 Bridge

The bridge consists of a short length of iridio platinum wire, both ends of which are secured to the bridge plug, one to a copper wire running down the insulated centre of the body to a contact piece and the other to an earthed pole piece.

Guncotton dust surrounds the bridge, and a perforated powder pellet is held to the plug by a crewed cover.

3.2312 Gas Seal

Obturation through the primer is secured by the copper bridge plug which is shaped at the rear to wedge in the correspondingly shaped opening in the body. It is also provided with a gas check lip at the front to act as an obturator.

3.2313 Magazine

The separate magazine contains gunpowder (G.12) and is provided with a number of fire holes or vents. The front vent of the magazine is closed with a white metal dome to prevent intrusion of stick propellant. There is a lip to prevent escape of the powder.

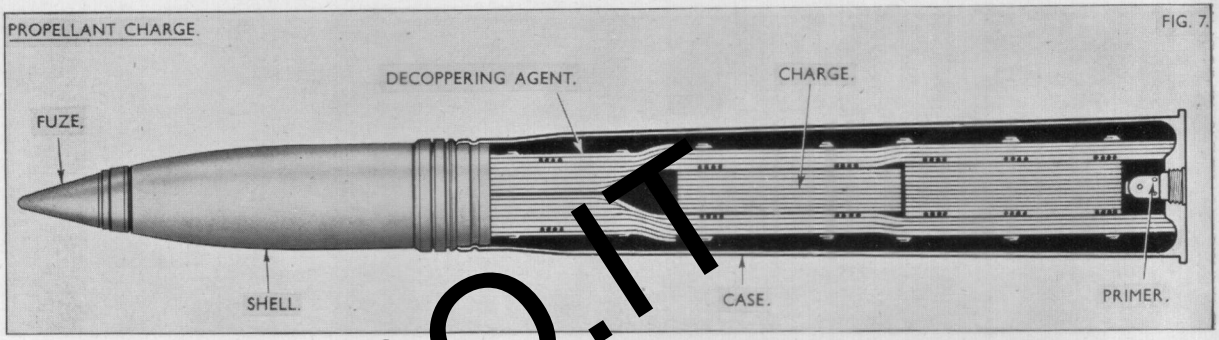
3.2 Action

The firing pin of the breech mechanism makes contact with the contact piece, and when a firing current is passed through the insulated copper wire the bridge fuses, ignites the guncotton yarn, the pellet and gunpowder in the magazine. The explosion of the primer magazine forces the bridge plug back into the coned opening and outwards at the front gas check lip to prevent internal gas escape. The flame from the magazine ignites the propellant charge.

3.3 THE IGNITER

This consists of a silloon bag containing gunpowder. It is placed round or in front of the primer in certain cartridges and assists the ignition of the propellant charge.

3.4 THE PROPELLANT CHARGE



See Appendix E.

The propellant charge may be made up of *cords* or sticks or it may be in granulated form as *grains*.

When cords are used, they are tied in bundles with silk sewing, cotton sewing or shalloon braid, and arranged to fit over and around the primer.

With a granular propellant, the charge is filled loose into the case. If there is considerable free space in the case of a fixed Q.F. round, the propellant may be confined to the rear of the case by means of a leather board cap shellacked into position and supported by a distance piece (*e.g.*, a cardboard tube) between the cap and the base of the projectile.

3.5 THE DECOPPERING CHARGE

Tinfoil or leadfoil is incorporated in the charge, when necessary, to counteract coppering of the bore. Special decoppering charges, containing an extra amount of foil, may be used for cleaning a badly coppered gun, although such charges are not a normal service issue.

Where white metal lids are used to close separate loading Q.F. cartridge cases, the white metal of the lid acts as a decoppering agent and no foil is necessary. Similarly the white metal domes of some primers assist the decoppering action although additional tin or lead foil is still required in these cases.

4. THE PROJECTILE

4.1 GENERAL

4.11 Body

The bodies of all projectile are manufactured from steel or iron, the type of which depends upon the use to which the projectile is put.

The external contour of the projectile is mainly cylindrical, but may be tapered (streamlined) at the rear and is provided with an ogival or radiused head to reduce air resistance in flight. The cylindrical portion is provided with a circumferential groove or grooves to accommodate the driving band or bands.

4.12 Base

The bases of practice projectiles and shrapnel shell are usually plain.

With H.E. shell a rolled steel plate is used as a protection against propellant gases reacting on the H.E. filling and causing a premature.

Some projectiles have recesses in the base to take tracers and/or shell ignite[illegible].

4.13 Driving Band

The metal used is usually copper although various alloys of copper and nickel as well as sintered iron are also used.

The driving band serves the purpose of sealing the propellant gases behind the projectile, imparting a spin that continues throughout the flight of the shell and of centring the projectile in the bore of the gun.

The rotation or spinning of the shell enables an elongated projectile to be used.

The centring is seldom well done except in the case of projectiles with forward as well as rear driving bands.

More than one driving band is often used for high velocity guns and the functions of sealing, driving and centring are variously shared by the bands according to the design.

4.14 Head

The head is ogival, that is to say, the parallel sides of the projectile are curved inwards forwardly of the shoulder to form a point. Some projectiles are more pointed than others and the actual shape is expressed according to the radius of the curve or ogive expressed in calibres and referred to as the "calibre radius head" or "CRH".

Prior to 1945, if the CRH exceeded two, it was indicated by the addition of a letter to the mark of the projectile according to the following code:

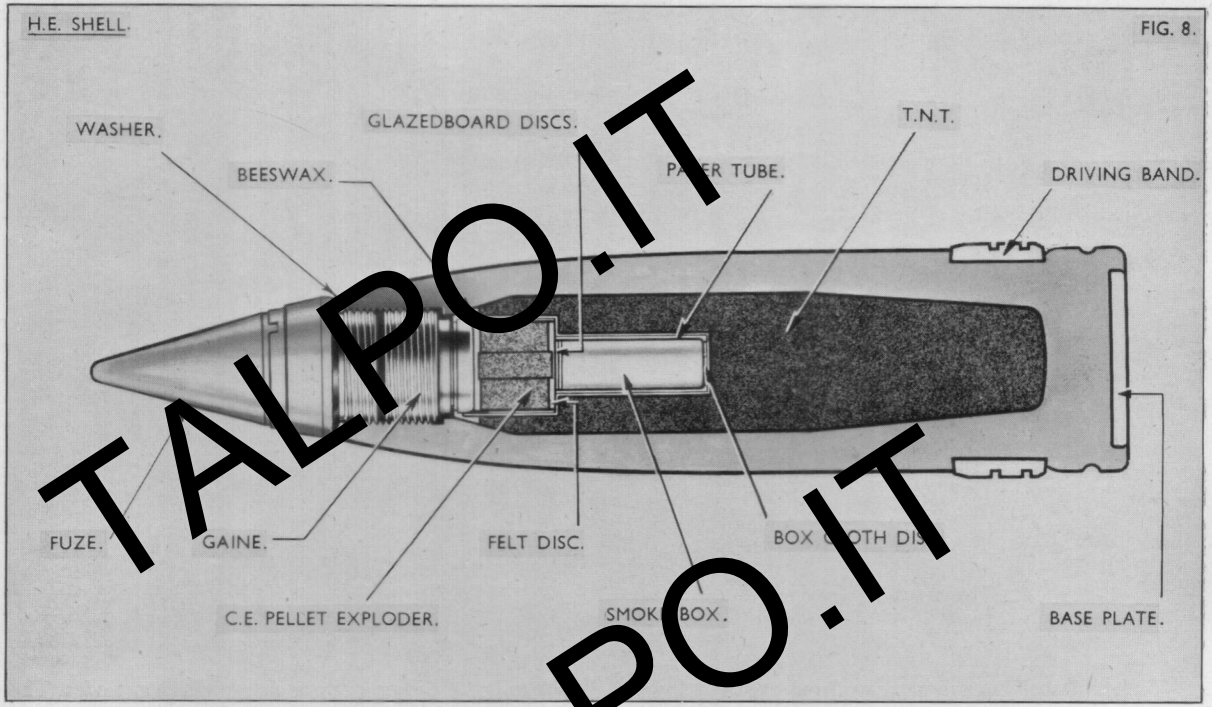
CRH	*Code letter*
From 2 to 4	A
„ 4 to 6	B
„ 6 to 8	C
„ 8 to 10	D

The radius referred to above includes the fuze and/or ballistic cap when fitted.

4.2 THE SHELL

4.21 High Explosive

H.E. SHELL. FIG. 8.



The high explosive shell is forged to form a cavity for the explosive, the mouth being screwed to take the fuze.

The interior is varnished, the explosive poured or pressed into position, a central cavity being left to receive a smoke box or exploder while the upper surface of a filling is topped with a waterproofing material.

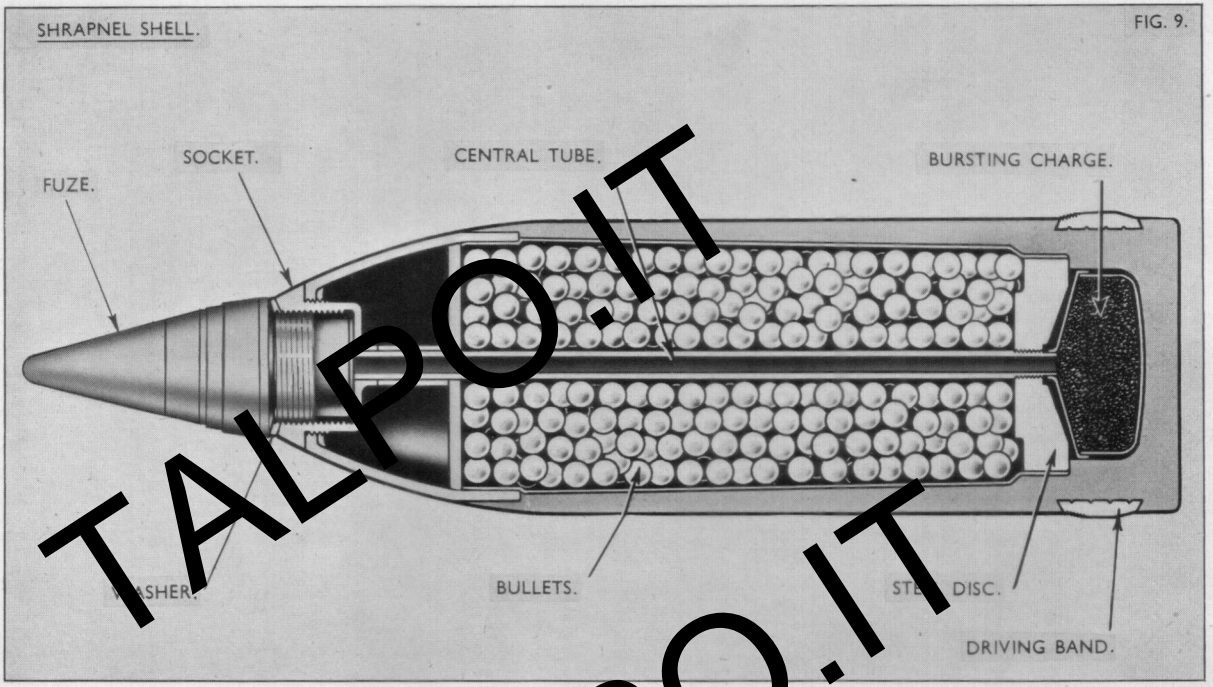
The *smoke box* contains red phosphorus and gives off a white puff of smoke to indicate the point of burst. Many shell are not fitted with a smoke box as the distinctive *black* smoke produced as the result of the *detonation of the T.N.T. or R.D.X.* filling is sufficient. A distinctive *red* burst can be obtained by the introduction of a *red dye in the H.E.* filling, such shell, however because of the reduction in the H.E. content are only semi-lethal.

Shell fuzed with percussion or proximity fuzes for use in the A.A. role are also fitted with a self-destroying element designed to burst the shell after a given time of flight. This is essential in order to avoid functioning on reaching the ground should the aircraft target have been missed. The self-destruction element is in the nature of a secondary fuze and may be electrical, mechanical or combustion type. The simplest form consists of a shell igniter in the base of the shell to ensure self-destruction after a fixed time of flight.

When the fuze or gaine functions the exploder picks up the detonating wave from the C.E. pellet or magazine, amplifies it and detonates the main filling. When the self-destruction device functions the shell is generally exploded only by the ignition of the filling by a powder magazine.

Details of Methods of Filling are shown in Appendix 5.

4.22 Shrapnel



Shrapnel shell have a separate head attached by a short screw thread or by set screws and twisting pins and an internal fillet of solder. A recess in the base is fitted with a tin cup charged with gunpowder, and above this a thick steel disc with a central hole rests on a ledge. A central tube connects the fuze hole bush with the tin cup. The space between the central tube and the inside wall of the shell is filled with lead alloy bullets embedded in resin. The fuze hole bush is threaded to receive the fuze and screws into the nose of the shell and is soldered to the tube.

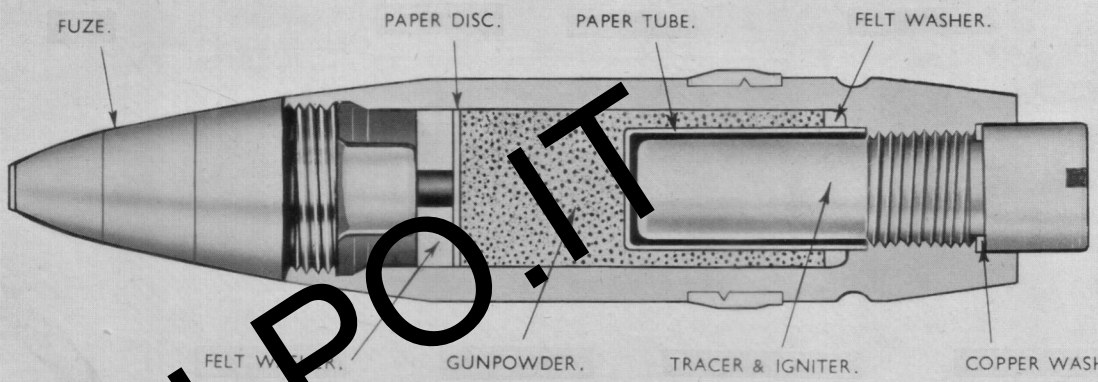
The explosion of the fuze sends a flame down the tube to ignite the gunpowder charge which explodes. The steel disc is forced forward, carrying the bullets, resin, central tube, head of shell, with fuze hole bush and fuze, clear of the shell body. The components are thus separated and follow generally the path of the trajectory. The bullets, acting under centrifugal force, spread out to form a cone. The shell body is not broken up by the explosion.

A.A. shrapnel is fitted with a time fuze, but if this fails to burst in the air there is little risk of the shell bursting on graze.

Shrapnel is not at present in use in the British service.

4.23 Practice Projectiles

PRACTICE PROJECTILE, T., Q.F., 40 mm. FIG. 10.



Practice projectiles are of the ordinary H.E. type except that the bursting charge is either gunpowder, a gunpowder composition or an inert substance known as "H.E. Substitute" or H.E.S.

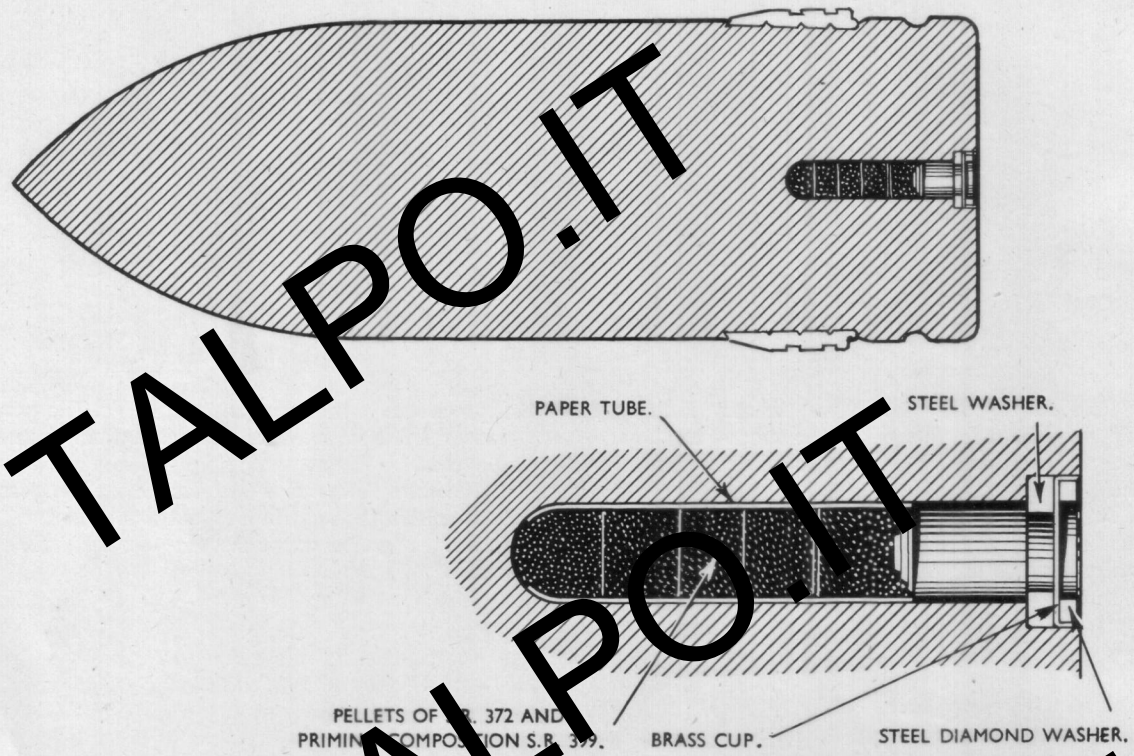
Practice projectiles for the larger calibres normally consist of an empty "H.E." shell, filled H.E.S. except for a cavity beneath the fuze which is filled by a powder pellet over one or more magnesium pellets. The powder produces white smoke and the magnesium ensures a visible flash.

The term "Innocuous" to designate these practice shell is misleading and, in fact dangerous, as the shell may contain gunpowder either in the fuze, shell or tracer.

4.3 SHOT

SHOT, A.P. Q.F., 3·7 INCH GUN MARK 3T — FIG. 11.

METHOD OF FILLING TRACER CAVITY TYPE L.54.



4.31 General

The term "shot" applies to projectiles containing no explosive as the main filling or bursting charge.

4.32 Piercing

4.321 General

These are provided for use in the secondary anti-tank or anti-ship role.

Penetration of armour by shot causes damage in proportion to the remaining forward and rotational velocity of the shot and the confinement of space beyond the armour of the target. Additional damage is also inflicted by the projection of the "plug" of armour ahead of the shot, occasional break-up of the shot during penetration, flaking of the armour and by concussion.

Most shot are fitted with tracers.

4.322 A.P. (Armour Piercing)

A.P. shot are of forged steel and pointed, the radius of the head being usually less than two calibres as a more pointed head tends to break upon impact. The head is hardened to penetrate the target but the hardness decreases progressively towards the base in order to allow increased toughness to the body and thus reduce the incidence of break up.

4.323 S.A.P. (Semi Armour Piercing)

S.A.P. shot are not so strong as A.P. and are only suitable for use against the lighter armoured portions of targets.

4.324 A.P.C. (Armour Piercing, Capped)

A.P.C. shot are A.P. shot fitted with a penetrative cap of hardened alloy steel whose function is to assist the point of the shot at the moment of impact and help its entry into the armour. The cap increases the maximum penetrative performance of the shot considerably.

4.325 A.P.C.B.C. (Armour Piercing, Capped, Ballistic Cap)

A.P.C.B.C. shot are A.P.C. shot fitted with a ballistic cap. This latter is a light hollow pointed cap fitted over the penetrative cap. It increases the radius of the head and allows a better shaped penetrative cap to be used without any loss of ballistics.

4.33 Practice

This is similar to S.A.P. shot but of a lower grade steel.

4.34 Proof

This consists of a solid cylinder of steel, fitted with the standard driving band. It is used for proof of guns and mountings and is designed to withstand the high chamber pressures used at gun proof.

4.35 Paper

This usually consists of two or more portions. They are made of paper cylinders, closed at the ends with strawboard discs and filled with diamond grit or iron filings. The rear portion has a "driving band", or skirt, also of board, formed at the rear.

Paper shot are used at proof of mountings to simulate firing stresses.

5 FUZES, GAINES, TRACERS AND IGNITERS

5.1 GENERAL

5.11 General

Fuzes, gaines, tracers and igniters are conveniently considered together as the components of the projectile that between them ensure the initiation of the bursting charge at the desired time and place, and, in the case of tracers, provide a visible indication of the trajectory.

5.12 Explosive Devices

5.121 General

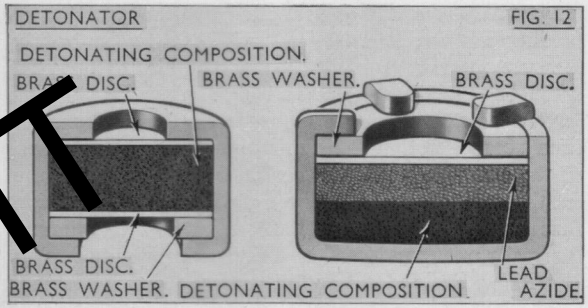
Explosives forming the explosive train in the various components of the projectile are generally contained in either a detonator shell, magazine, chamber, channel or bag.

The explosive may be loose, pressed *in situ*, or in the form of pellets. In this latter form a separate container is not always necessary.

5.122 Pellets

These are formed of pre-pressed explosive, both C.E. and powder pellets being used.

Powder pellets are sometimes perforated, in which case they serve to reinforce flash, or they may be solid and in this form constitute a delay.



5.123 Detonators and Caps

These are either igniferous or disruptive according to whether they are required to ignite powder or detonate C.E. respectively.

Small igniferous detonators are also termed "Caps".

Detonators and caps consist of small copper cups containing the explosive, closed by a thin metal disc and a brass washer secured by turning over the lip of the cup.

Ignition is by impact with a needle, striker or anvil, or by passing an electric current through a filament in contact with the explosive.

5.124 Magazine

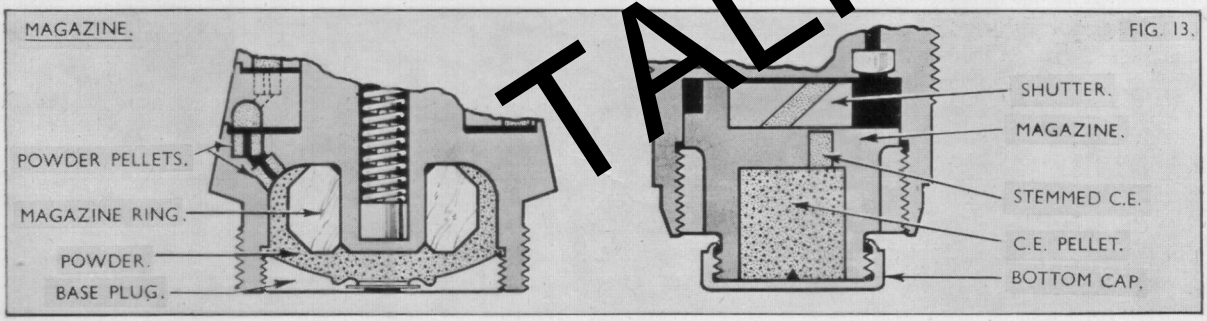
This can be formed either in the body of the fuze, gaine, primer, etc., or can be a separate container secured to the body.

It may be either igniferous or detonating according to whether it is filled with powder to produce flash or with C.E. to detonate an H.E. charge respectively.

5.125 Channels

These connecting links may contain loose powder, compressed powder, pellets of powder or C.E., or may be empty and merely serve the purpose of flash direction.

Channels filled C.E. or similar high explosive are used to ensure substantial continuity of the detonating train.



5.13 Mechanical Devices

5.131 General

The ultimate object of the mechanical devices is to ensure that the detonator is struck at the desired instant.

Premature action is prevented by various forms of holding and locking devices, and as a further safety measure, masking devices can be incorporated to block the detonating train to an H.E. bursting charge.

A component is said to be "armed" when it is in such a condition that there is nothing to prevent initiation of the bursting charge, either on a disturbance of the existing state of motion or rest (*e.g.*, impact of a percussion fuze or movement of a blind) or on the functioning (normally or prematurely) of a time or proximity device.

Although freedom from premature action is essential for both safety and operational reasons at all stages handling, loading and projection until well clear of the muzzle, the projectile must be fully armed on approaching the target.

The various devices in use will be described according to their principle function as holding, masking and firing after considering the forces used to operate them.

5.132 Forces

5.1321 General

All components of fuzes, gaines, tracers, etc., are either fixed relatively to the projectile or are free to move within certain limits. The movement of the free components, controlled or restrained as necessary by friction and/or springs, depends principally upon the forces arising from acceleration, deceleration and spin, although it is also affected by "side-slap" to an extent depending mainly upon the state of wear of the gun.

Some or all of these forces are utilized to effect correct operation as well as in various safety devices.

5.1322 Acceleration and Deceleration

The acceleration of the projectile and fixed components tends to leave the free components behind. If the acceleration is moderate, the loose parts "creep back", and if violent, "set back". Conversely, deceleration causes "creep forward" and "set forward".

Violent acceleration occurs at the instant of firing the gun, and comparatively moderate acceleration with the subsequent forcing of the projectile up the bore of the gun.

Moderate deceleration continues from the moment the projectile leaves the muzzle until it becomes violent on impact. Violent and momentary deceleration also occurs with a worn Q.F. gun with appreciable free run-up when the driving band first takes up the rifling.

5.1323 Spin

Centrifugal force, resulting from the rotation of the shell, acts in a plane at right angles to the line of flight to force the free components outwards from the centre of the shell.

Centrifugal force is not normally intended to be effective until the shell has left the bore of the gun as the free components are expected to be held in their original positions by frictional forces proportional to the set back forces in the gun.

5.1324 Side-Slap

Forces acting in a plane roughly at right angles to the axis of the bore are also set up owing to inadequate centring of the projectile. This causes the shoulder of the projectile to hit against the bore of the gun. These forces, however, are only appreciable with a well worn gun, and in this case, the excessive hammering is known as "side-slap".

5.133 Firing Devices

5.1331 Striker, Firing Pin or Needle and Anvil

A striker, firing pin or needle is a rod of metal with a pointed end to impinge on the detonator. The American term "firing pin" is synonymous with "striker" and the distinction between a striker and needle is that of size only, the needle being smaller.

An anvil is a steel block with a nipple projecting from the centre.

Initiation of a detonator is by impact with a striker or anvil nipple. The striker may be forced on to the detonator (Fig. 19) or the detonator (in a weighted holder or "pellet") on to a striker (Fig. 14) or anvil (Fig. 32). Striker and detonator are kept apart by a holding device. Additional and interlocking holding devices can also be incorporated.

5.1332 Hammer

See Fig. 15.

This is usually a rod with an enlarged head and is mounted in front of the striker and used to "hammer" the striker on to the detonator.

The hammer is often used with very sensitive fuzes designed to function on aircraft fabric or skin.

The sensitivity of the fuze can be reduced by having a thin diaphragm stretched in the fuze head above the hammer. The shape of the hammer head and thickness of the diaphragm are somewhat critical. If such a fuze is too sensitive it may function on impact with raindrops.

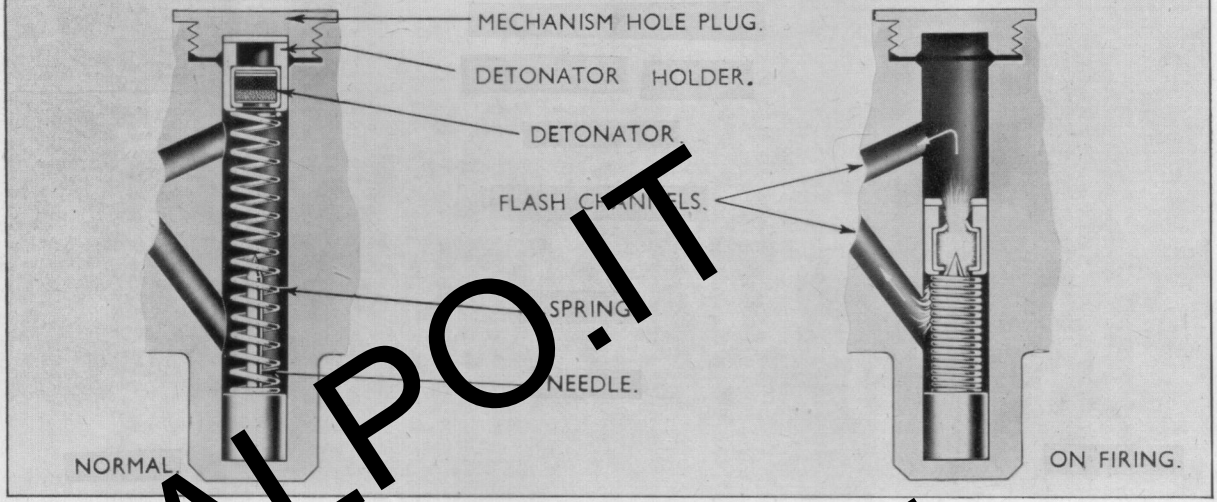
In some cases, the hammer and striker are combined in one piece and the combined hammer and striker is then termed a "hammer".

5.1333 Striker Spring

See Fig. 21.

The striker spring consists of a spiral spring surrounding the striker and used to drive the striker down on to the detonator when released by a trigger. This spring is kept in compression until released and must not be confused with the striker spring used as a holding device (see para. 5.1342).

FUZE No. 199 (ACTION ON SHOCK OF DISCHARGE). FIG. 14.



5.1334 Pellet

This is a metal weight, usually cylindrical in shape and can be used to house a detonator and carry it on to a striker or anvil (*e.g.* the detonator holder in Fuze No. 199, Fig. 14).

5.134 Holding Devices

5.1341 Shear Wire

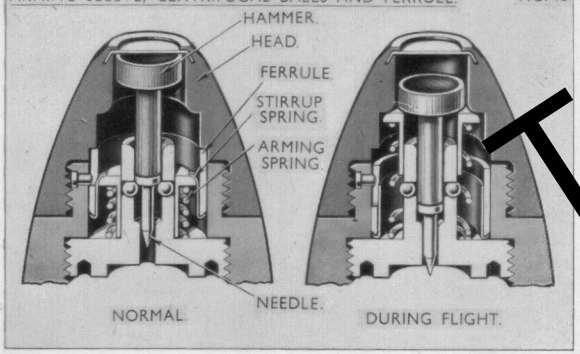
This simple device consists of a short length of wire inserted in radial holes in register in two concentric sleeves. If sufficient force is available the wire will be sheared and the sleeves freed.

5.1342 Striker Spring and Spring Disc

The striker spring consists of a spiral spring surrounding the striker to keep the striker separated from the detonator until overcome by a superior force (*e.g.*, impact with the target).

The same function is performed by a corrugated spring disc in the centre of which is fixed a needle.

ARMING SLEEVE, CENTRIFUGAL BALLS AND FERRULE. FIG. 15



5.1343 Centrifugal Balls, Segments, etc., and Arming Sleeves

This combination depends for operation on two forces operating at right angles.

Number of balls, segments, etc., are retained under a flange of the striker by an arming sleeve. Movement of the arming sleeve due to, say, creep forward, uncovers the balls, etc., which are then free to fly out under centrifugal force clear the striker.

5.1344 Stirrup Spring

This consists of a thin metal cylinder with lugs turned over at each end and in opposite directions. The lugs can be used to lock two concentric sleeves together and rest at opposite ends of each sleeve. One of the sleeves is fixed and the other kept against a lug by a spring. The lugs are designed to be straightened out by one of the forces described (para. 5.132) and thus allow the moving sleeve to be freed under action of the spring.

5.1345 Ferrule

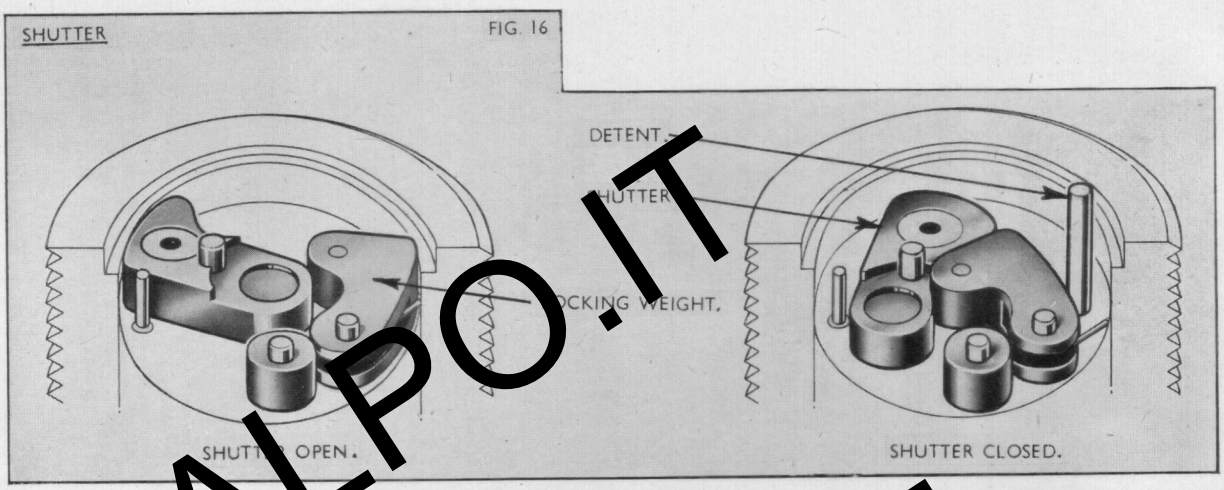
This is simply a sleeve or collar and is usually used to denote the outer or holding sleeve used in conjunction with a stirrup spring to hold the moving (*e.g.*, arming) sleeve.

5.1346 Detent

This is a form of latch, consisting of a small metal cylinder or block working in a hole usually in the fuze body and covering a spiral spring under compression. The spring is used to keep the detent in a hole in a moving component and thus lock it. The detent spring may be designed to be overcome by any of the forces described (para. 5.132) to withdraw the detent and thus unlock the moving part.

A second hole can be arranged in the moving part so as to lock it in an alternative position.

5.135 Masking Devices or Shutters



These consist essentially of sliding or rotating blocks of metal which, in the shut or safe position block the channel leading to the magazine to provide safety from premature firing. In some cases the shutter consists of a number of sliding leaves.

In the open or armed position, the detonator is connected to the magazine by channels in the shutter. In some cases, the striker and detonator are above the shutter and the shutter channels filled with C.E. In other cases the striker only is above the shutter, the detonator being housed in the shutter and therefore only under the striker in the armed position.

Shutters are kept in the closed position by a spring, either operating directly or through an interlocking device.

The shutter opens under centrifugal force. During the passage of the shell up the bore of the gun, centrifugal force has also to overcome friction between the shutter and fuze body due to set-back of the former, and, under ideal conditions, this may be sufficient to prevent the shutter opening until the shell leaves the muzzle.

5.136 Assemblies

Examples of typical assemblies of strikers, detonators and associated holding devices with current nomenclatures are given on the next page. They are classified according to the force used to operate the striker and examples are given of components embodying particular assemblies.

Force	Striker	Detonator	Holding Device	Component
Set back on firing the gun	Fixed *Needle* fixed to *Needle Pellet*	Moving *Detonator* in *Detonator Holder*	Spring between *Needle* Pellet and detonator holder	Fuzes 199 223
	Fixed *Needle*	Moving *Detonator* in *Pellet*	*Stirrup Spring*	Fuze 80/44
	Fixed *Needle Plug*	Moving *Detonator* attached to *Pellet*	*Stirrup Spring*	
	Fixed *Anvil*	Moving *Cap* in *Cap Holder*	*Stirrup Spring*	T & I 12
Action of striker *Spring*	Moving *Striker*. (Collar at top of striker to retain striker spring. Collar at base to rest on *Pillar* and *Centrifugal Safety Catch*)	Fixed *Detonator*	Cam of striker rests on pillar and centrifugal safety catch. Rotation of striker cam off pillar prevented by *Striker Lever* being locked by *Hand Centre*	Fuzes 206 207 208 211
	Moving *Striker*. (Collar near centre of striker. Top of collar rests on *Striker Spring* and bottom rests on *Safety Plate*)	Fixed *Detonator*	Collar of striker rests on one toe of centrifugal safety plate, the other toe being held by slot in centrifugal *Firing Arm*. Rotation of firing arm to free safety plate prevented by engagement with both *Timing Disc* and *Set Back Pin*	Fuze 214
	Moving Striker. (Top of striker slotted to admit toe of *Striker Bolt*)	Fixed *Detonator*	Slot in striker engaged by one toe of striker bolt. *Striker Bolt Spring* rotates bolt to free striker as soon as a second toe of bolt can slip into slot in *Bottom Crown* on rotation of latter	Fuze 209
Explosion of fuze magazine	Moving *Needle*. (Lower part flanged for *Disc*)	*Detonator* fixed to centrifugal shutter	Needle held in corrugated spring disc	Gaine No. 8
Direct Impact with target	Moving *Striker*. (Top of striker bored for *Shearing* Wire and bottom reduced in diameter for *Centrifugal Half-Collars*)	Fixed *Detonator*	Striker secured by shearing wire and locked by centrifugal half-collars, latter retained by *Arming Ring* and *Ferrule*	Fuze 80
	Striker moving in *Guide Bush*. *Striker Spring* between striker head and top of guide bush. *Arming Sleeve* and *Arming Spring* between bottom of guide bush and fuze body	*Detonator* fixed in centrifugal shutter	Striker kept off detonator by striker spring and locked by segments, the latter retained by arming sleeve and spring	Fuzes 117 230
Direct Impact with target via *Hammer*	Moving *Hammer* and *Needle* (upper end of needle flanged to accommodate centrifugal balls)	*Fixed Detonator*	Hammer and needle retained by *balls* kept in holes in Striker Guide by *Arming Sleeve* and *Stirrup Spring* retaining the arming sleeve	Fuzes 223 250 251 255
Set Forward on impact with target	Fixed *Needle*	Moving *Inertia Pellet* containing *Detonator*	*Detent* operated by setback and holding *Centrifugal Bolt* in inertia pellet, latter also held by *Creep Spring*	Fuzes 501 502

5.2 FUZES

5.21 General

The fuze, in conjunction with the exploding system, ensures the *correct functioning* of the bursting charge, either after a set time (Time), on nearing the target (Proximity) or on impact with the target (Percussion).

Although particular types of fuzes are considered separately, one or more types may be combined into a single fuze (*e.g.*, Time and Percussion).

Fuzes are normally placed either in the nose or base of the shell.

With nose fuzes, the fuze body is shaped externally to conform to the shell contour and with base fuzes the body is cylindrical for entry into the shell cavity.

All fuzes (with associated [illegible] igniferous), embody devices to ensure:

Safety in handling, both before and during loading.

Bore and muzzle safety immediately after firing.

Arming after leaving the muzzle.

Firing of magazine and initiation of bursting charge.

The above devices are housed in the fuze body and have been described in detail (paras 5.12 and 5.13).

For time fuzes, the fuze body also contains the time element, and for proximity fuzes, the proximity element.

5.22 Time Fuzes

5.221 General

Time fuzes are set for time before loading by rotation of a moving portion of the fuze against the fixed fuze body by means of a fuze key or fuze setting machine. Graduations are provided to enable the setting to be checked.

The time element may be either of the combustion or mechanical type.

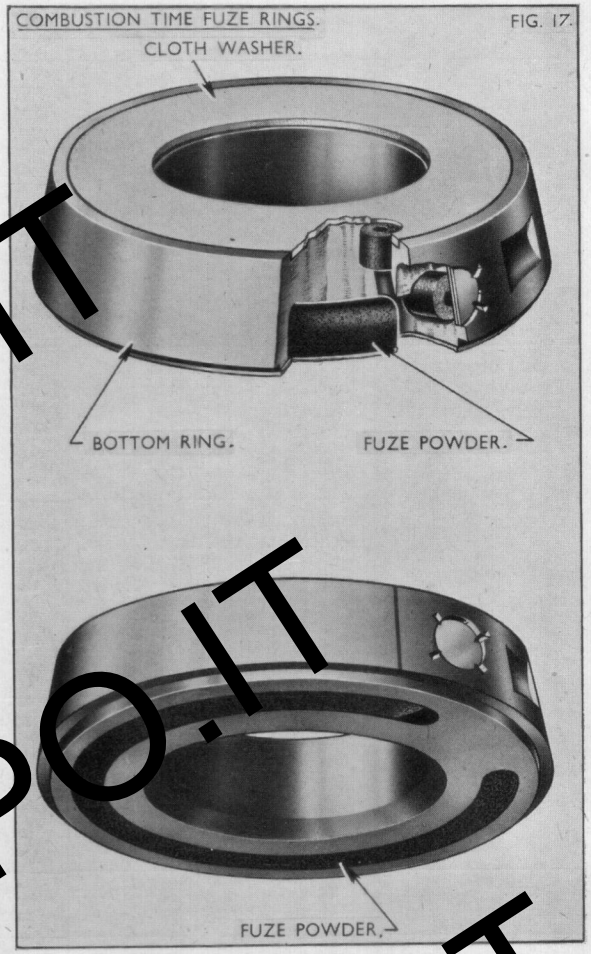
The bottom portion of the fuze body generally forms a platform upon which the moving part rotates for setting the time of functioning. With British fuzes, the fixed part is either graduated in arbitrary fuze lengths for reading against an indicator on the moving part, or else the moving portion is made to operate a fuze length indicator on the fixed part. In addition, both fixed and moving parts generally have slots for the engagement by the pawls of fuze keys or the older fuze setting machines. Such slots are not required by the latest fuze setting machines which grip the fuze by means of knife rings.

The moving portion must be tight enough to prevent movement in handling, transport, loading and firing, and yet sufficiently loose to permit setting by the fuze key or fuze setting machine. The maintenance of the correct stiffness or *tension* is important.

5.222 Combustion

These fuzes embody a train of compressed powder which burns through until the time as set has expired. The flash then fires a magazine.

COMBUSTION TIME FUZE RINGS. FIG. 17.

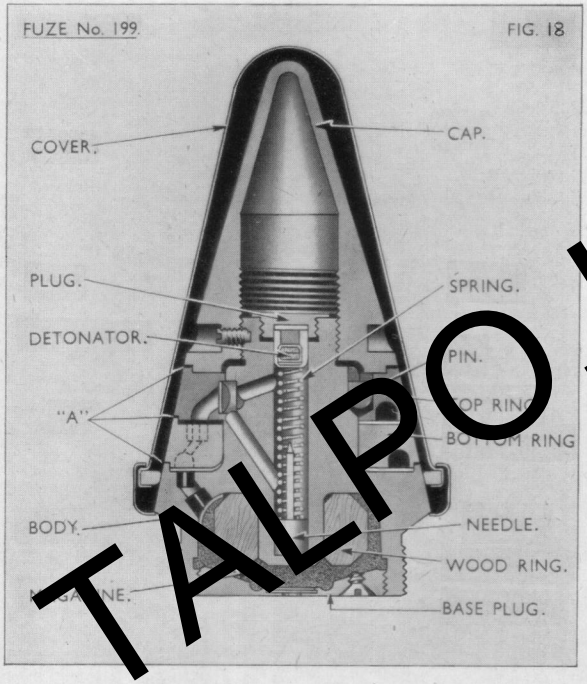


The powder is generally contained in circumferential grooves in adjacent time rings, the powder burning in one ring until it can ignite the powder in the other, depending upon the relative position of the two rings as determined by the setting.

Two rings are usually employed, the upper ring being fixed by pinning to the stem of the fuze body, and the other movable, or "free" to rotate on the stem. The under surface of both rings is grooved for almost the entire circumference, the grooves being charged with fuze powder under compression.

The upper ring has a radial channel from one end of the powder groove to pick up the flash from the detonator, the channel containing a perforated powder pellet to facilitate this function. A second channel to the outside of the ring forms a gas escape, being fitted with a small closing disc to provide a watertight cover, and a perforated powder pellet to blow the disc clear when ignited.

The lower ring differs only in having a vertical channel (instead of a radial channel) to pick up the flame from the powder grooves in the upper ring.



The central stem or body contains the detonator, needle and magazine.

Cloth washers are placed below the two rings to ensure a tight joint.

Both rings are secured by a cap which is screwed on to the stem of the fuze and bears down on to the rings to secure the necessary tension.

5.223 Mechanical

5.2231 General

These fuzes depend for their action on a clockwork mechanism consisting of a train of wheels, driven either by a spring or by centrifugal weights, and controlled by an escapement.

At the end of the time as set, the mechanism releases a lever which allows a striker to be driven on to a detonator to fire a magazine.

The following are typical mechanisms:

Type	Drive	Fuzes
Thiel (German)	Spring wound up during manufacture	206, 207, 208, 211
Junghans (German)	Spring assisted centrifugal weights	214
Tavaro (Swiss)	Spring partially wound up by fuze setting	209

The interior of the fuze body is usually bored out from both top and bottom to leave a diaphragm, the upper boring accommodating the "clock" and the bottom forming a magazine and containing the detonator.

The Thiel and Junghans clocks are secured to the diaphragm by screws inserted from underneath and enclosed by a dome which is in turn retained by a screwed collar or sleeve which engages the interior threads of the body. The dome is covered by a ballistic cap, or both dome and cap may be combined. The bottom of the dome is flanged, and between this flange and the bottom of the sleeve is a wire tensioning ring. The tension is varied by adjustment of the sleeve and the fuze set by rotation of the dome.

The Tavaro clock is enclosed in a cylinder secured to the inside of the body. The top of the cylinder has four saw cuts to enable the cylinder to grip the top of the clock frame, and this device, combined with the pressure of the moving cap on the securing washer above the cylinder and clock frame, provides the tension. The top of the clock is covered by a fixed cap secured to the body, and above this is the moving cap for fuze setting.

The clock of the fuze is very similar to an alarm clock, and will be considered in detail under the headings of Frame, Drive, Gear Train, Escapement and Timing.

5.2232 Frame

This consists of an assembly of flat plates, one above the other, secured by bolts, dowels and distance pieces. The plates form platforms upon which are mounted the various components and in which holes are drilled as bearings for the shafts or *arbors* of the various wheels.

The plates are identified either by being numbered "outwards" from the drive, or from the bottom, or by being described as "bottom", "train", "panel", "top", etc.

5.2233 Drive

5.22331 General

The drive may be either spring, centrifugal or a combination of both.

5.22332 Spring

A main spring consisting of a coiled steel spring is housed in a "barrel" or flat round box, and mounted on an arbor.

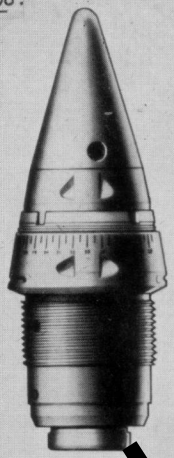
The outer end of the spring is secured to the barrel and the inner end to the centre or barrel arbor.

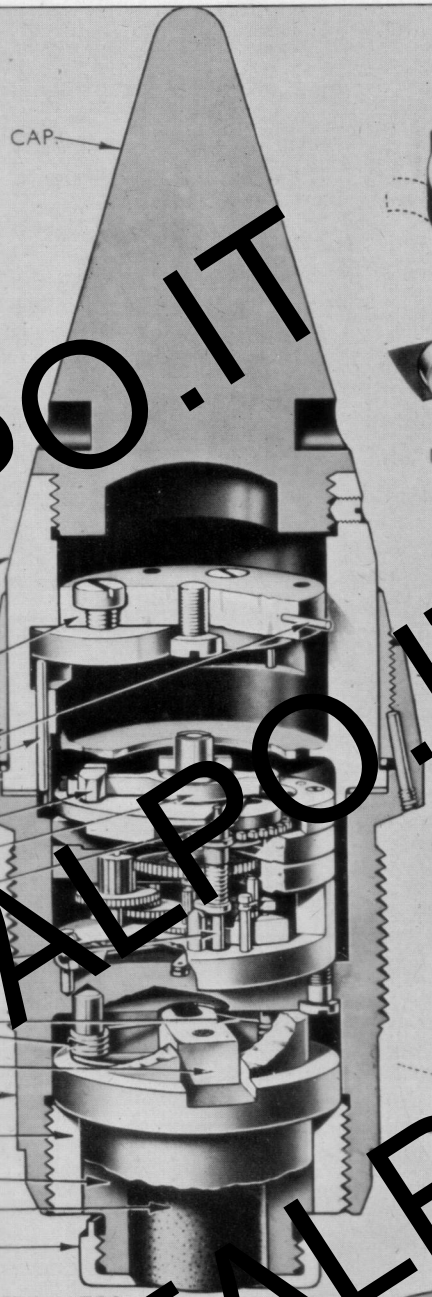
With the Thiel clock, the spring is wound up during manufacture by rotation of the barrel by a winding key engaging teeth on the periphery of the barrel.

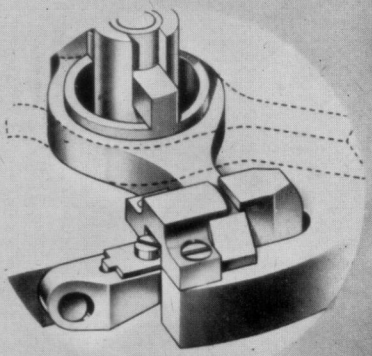
With the Tavaro mechanism the spring is further wound by rotation of the barrel arbor when setting the fuze.

FUZE 208.

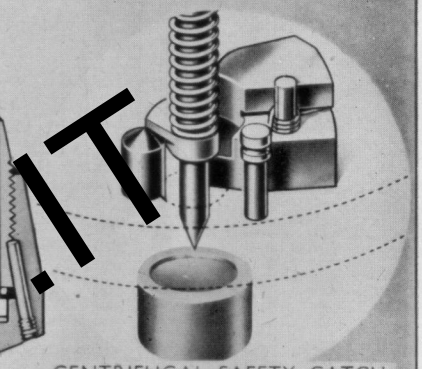
FIG. 19.



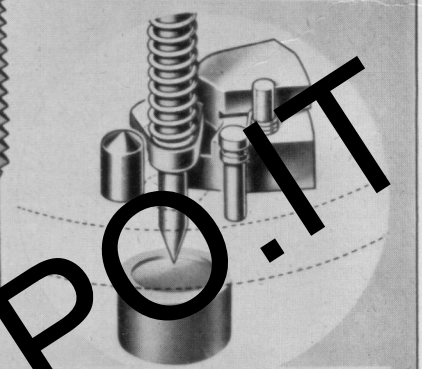




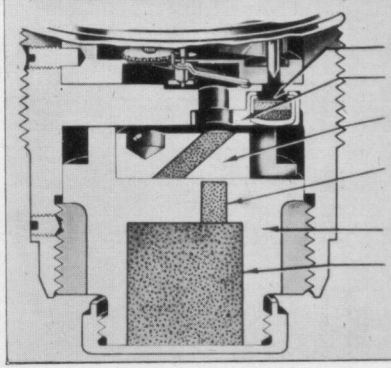
MUZZLE SAFETY BRIDGE.

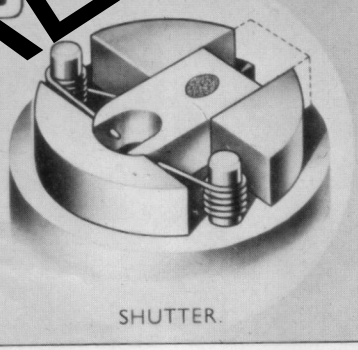


CENTRIFUGAL SAFETY CATCH.

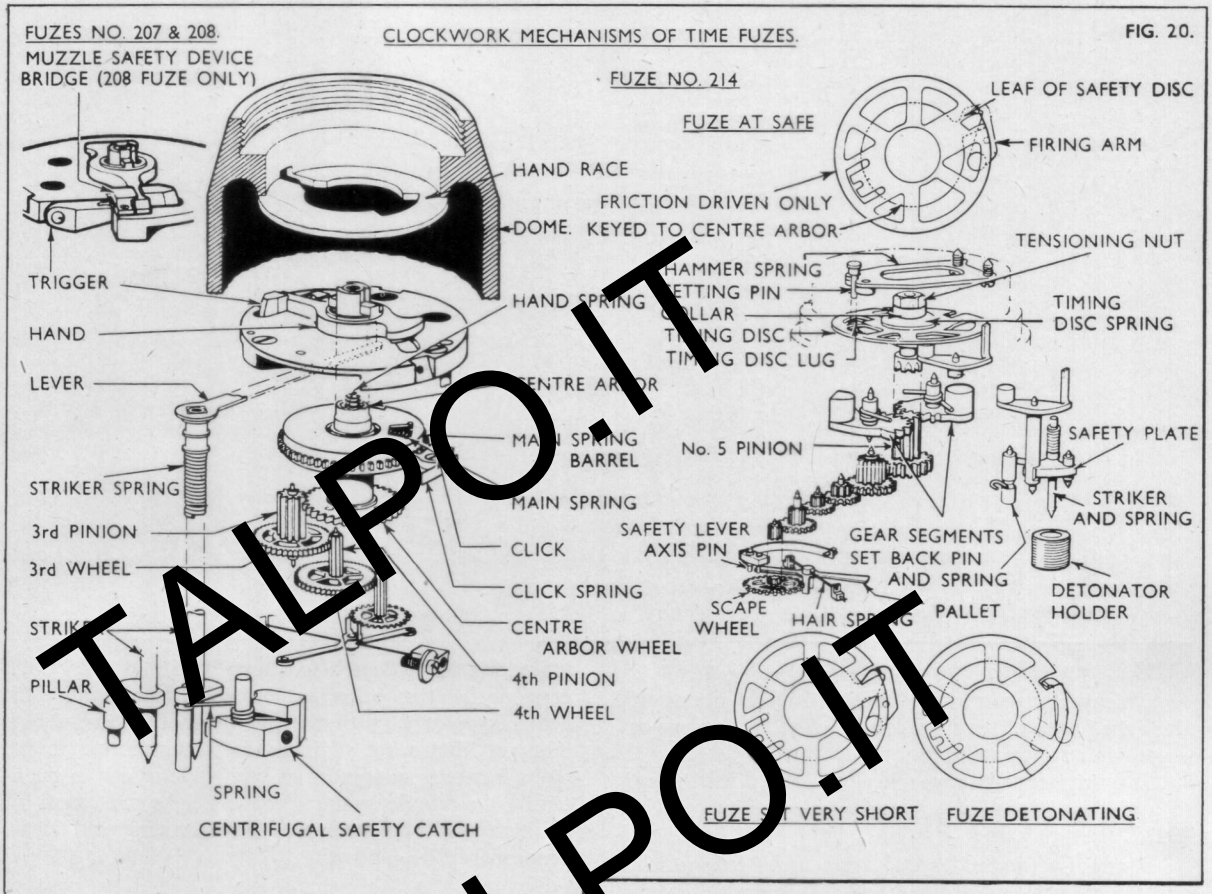


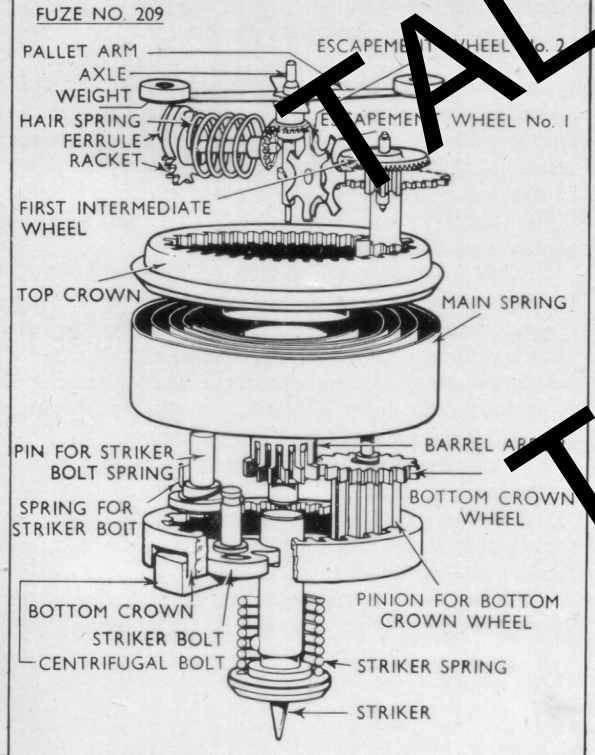
CENTRIFUGAL SAFETY CATCH.





SHUTTER.





5.22333 Centrifugal

With the Junghans clock, a pair of toothed quadrants or gear segments with integral weights near one end of the teeth, are mounted eccentrically on either side of and in mesh with a central pinion. The gear segments are assembled with the weighted ends towards the centre of the fuze. A small coiled spring is also mounted on each arbor of the gear segments to assist in starting the clock.

On rotation of the shell the weights are forced outwards by centrifugal force, and resisted by the springs, rotate the gear segments and thus the central pinion.

5.2234 Gear Train

A sequence of gear wheels to give the required step up ratio from the drive to the escapement forms the gear train.

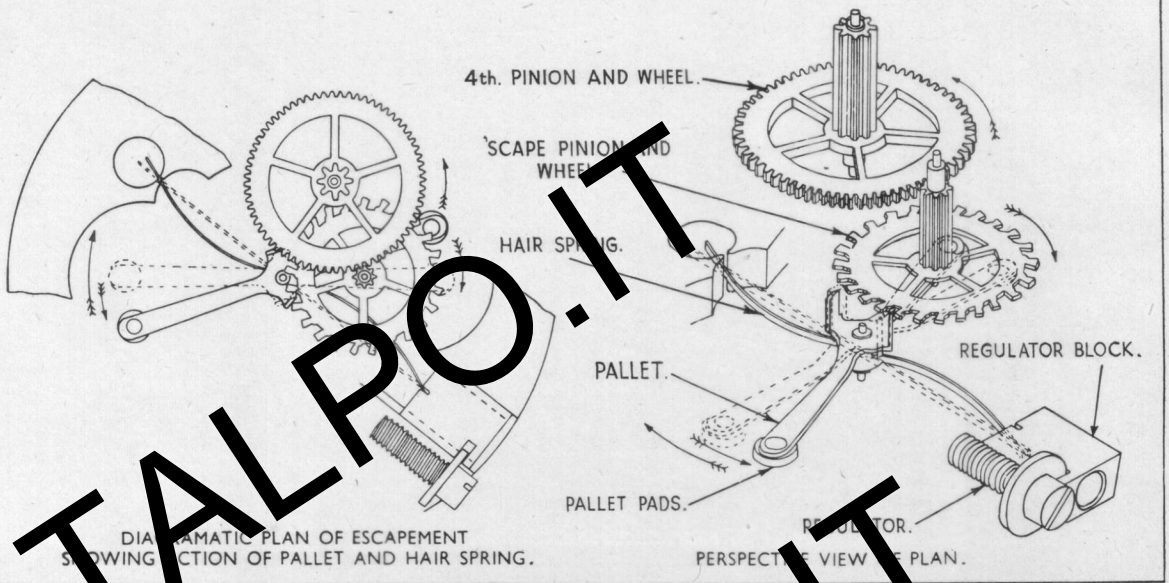
The larger wheels are termed gear wheels (or just wheels) and the smaller ones pinions.

Pairs of wheels and pinions are generally mounted together on the same arbor.

The ends of the arbor, usually reduced in diameter and coned, are termed pivots. Holes drilled in the plates form bearings for these pivots.

As with the plates, the wheels and pinions are identified either by being numbered or named according to their function.

TIME FUZE MECHANISM. FIG. 21.



5.2235 Escapement

This is the controlling mechanism by means of which the power of the drive is allowed to drip away—or escape—in a steady stream.

It comprises the escape wheel, pallet and hairspring.

5.22351 Escape Wheel

A wheel with specially shaped teeth for engagement with the pallet pads (*see below*) and the last wheel in the gear train.

5.22352 Pallet or Balance Arm

This consists of a straight steel bar with widened or weighted ends, termed the "Pallet Arm", at the centre of which and at an angle to it, are two short arms with the ends turned up or down. These short arms are termed "Pallet Pads" (or sometimes just "pallets") and engage the teeth of the 'scape wheel one at a time.

The pallet is mounted on a Pallet Arbor.

The pallet performs the same function as the balance wheel of a watch.

5.22353 Hairspring

A thin spring, either held loosely between two fixed supports or coiled with one end only fixed. The centre of a straight spring or the free end of a coiled spring is connected to the pallet arbor.

5.22354 Action

Vibration of the hairspring and pallet disengages one of the pads from the 'scape wheel. In doing so, the pad receives an impulse or kick from the escape tooth as it jumps forward before being momentarily locked by the entry of the other pallet pad into an adjacent tooth. This action is repeated by the disengagement of the second pad. The resulting series of impulses is transmitted to the pallet arm and results in an oscillation which is maintained at a rate determined by the weight and length (or moment) of the balance arm and the bending or torsional properties of the hairspring.

5.2236 Timing

As with an ordinary clock, the fuze mechanism must be regulated for correct time keeping. This is affected by adjustment of the hairspring and is generally done before the mechanism is assembled into the fuze and before the fuze is "filled", *i.e.*, before the explosive elements are assembled. Unlike an ordinary clock, however, the speed of running is affected by the rotation of the projectile. This "spin effect" is determined for each type of mechanism and is allowed for when regulating.

With the clock correctly adjusted, the time taken for the fuze to function from the instant of firing the gun depends upon the arrangements made for starting the clock and for regulating the firing mechanism at the end of the time set. In general terms, the time of running is set by the positioning of a "*plate*". This plate incorporates a "*slot*" into which an "*arm*" is designed to slip at the end of the time as set. Either the plate is rotated by the clock against a fixed arm, or *vice versa*.

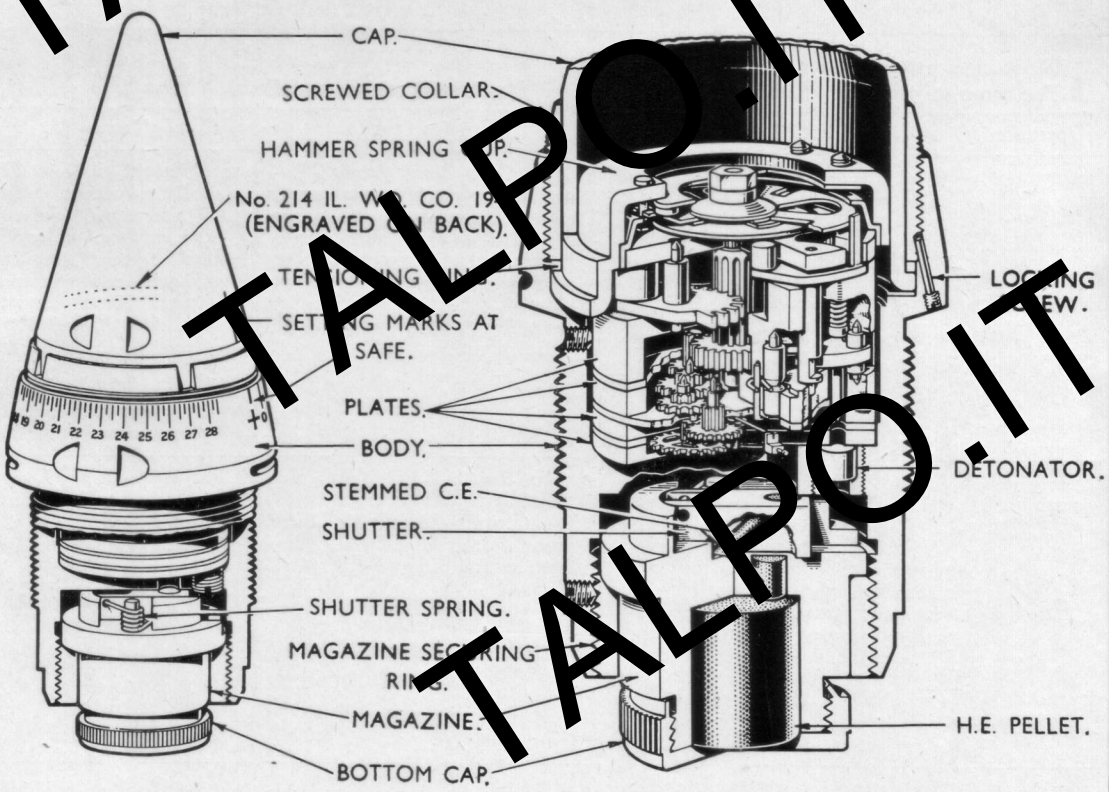
This rotation is started by the firing of the gun and the slipping of the arm into the slot actuates the firing mechanism.

The sequence of this action and the operation of the safety and other devices is shown in the following table:

Instant	Operation	Detail
Before firing . . .	Setting	The time of running is set on the fuze by rotating the dome or cap to position an internal circular "plate" relative to the centre arbor
Firing of gun . . .	Locking of fuze setting	Set-back or centrifugal action fixes the "plate" in the position set
	Unlocking of clock	Set-back or centrifugal action
Shell travelling up bore of gun	Clock jambed	Friction on pivots and bearings due to set-back probably prevents clock starting
Shell leaves muzzle of gun	Shutter armed	Detonator and magazine connected
	Striker armed	Centrifugal device withdrawn from striker
	Clock freed	Set-back ceases and the escapement starts. Centre arbor rotates either the "plate" against the "arm" or *vice versa*
Shell still near muzzle of gun	Muzzle Safety	The "arm" prevented from slipping into the "slot" when the plate position corresponds to zero setting by a muzzle safety device
Expiration of time as determined by setting	Striker released to fire the detonator	The "arm" slips into the "slot" in the "plate" to trigger the striker

FUZE No. 214.

FIG. 22



5.2237 Detailed Nomenclature and Functioning

The "plate", "slot" and "arm" referred to in the previous paragraph take various forms with different clocks. The nomenclature and functioning of these key components in the three typical mechanisms is shown in the following table:

Mechanism	Thiel	Junghans	Tavaro
Fuze	206, 207, 208, 211	214	209
"Plate" .	*Hand Race*. A race-way formed as an integral part of the dome	*Timing Disc*. Frictionally held to *Centre Arbor*. Above this and screwed to the dome is a *Hammer Spring* and *Setting Pin*, the latter engaging an upturned lug on the disc	*Bottom Crown*. Geared to *Centre Arbor* and to moving *Cap*
"Slot" . .	Silhouette of hand cut in flat surface of hand race	Small curved slot cut in from the periphery of timing disc	Bevelled slot cut in rim of bottom crown
"Arm" .	*Hand*. Slotted to the centre arbor and kept bearing on the under surface of the hand race by the hand spring	Finger of *Firing Arm Lever*. Kept bearing on the periphery of the timing disc by centrifugal force acting on a weight on the other end of the lever	"Follower" toe of *Striker Bolt*. Kept bearing on the inside of the rim of the bottom crown by the striker bolt spring
Bore Safety Device	*Fuze Safety Ledge*. Covers the hand at short settings to prevent entering slot	*Safety Disc*. Secured to the centre arbor with a projecting leaf to mask the slot at short settings	*Centrifugal Bolt*. Has a raised and bevelled step which occupies slot in bottom crown at short settings and prevents entry of toe of striker bolt

5.2238 Detailed Sequence of Action

The complete sequence of action of the three typical fuze mechanisms is as follows:

Operation	Thiel Clock	Junghans Clock	Tavaro Clock
Setting . .	Hand race of dome rotated against friction between dome and body as maintained by pressure of sleeve on tensioning ring. Hand held by lug of trigger	Setting Pin on dome rotates Timing Disc on centre arbor against friction between disc and arbor and between dome and body as maintained by pressure of sleeve on tensioning ring. Centre arbor held by locking of pallet arm by safety lever and timing disc held by setting pin	Cap rotated against friction on securing washer between fixed cap and top of clock frame and between top of cylinder and clock frame. Rotation of cap winds up mainspring and turns bottom crown. After crown has turned through about $1\frac{1}{4}$ secs. of setting, the bevelled edges of centrifugal bolt and slot force the centrifugal bolt through the slot to lie on the outside of the bottom crown
Locking of Setting	*Fuzes* 206 *and* 207. Splined *Locking Ring* inside the dome sets back to shear the wire rivets in the side and be impaled on *Locking Pins* in the body to lock the dome and thus the hand race *Fuzes* 208 *and* 211. *A Locking Weight* inside the dome and above the hand race sets back to shear the *Shear Wires* and drive *Locking Pins* into recesses in the body and thus lock the dome to the body	*No* positive locking device. Reliance is placed on friction between timing disc and centre arbor after freeing of timing from setting pin	*Centrifugal Locking Levers* engaged *Toothed Ring* inside fixed cap to lock the moving cap and thus the bottom crown
Unlocking the clock	The *Trigger* sets back and releases the hand. Trigger kept back by *Trigger Locking Bolt*	The timing disc is released from setting pin by the hammer setting back and flattening the upturned lug of the timing disc. The timing disc is now free to rotate with the centre arbor	No positive unlocking action at this stage

Operation	Thiel Clock	Junghans Clock	Tavaro Clock
Opening of Shutter	Shutter swings open by centrifugal force and thus connects detonator and magazine. (Similar action also occurs with the gaine shutter used with Fuzes 206 and 207)	Shutter swings open by centrifugal force and thus connects detonator and magazine	The leaves of the shutter open by centrifugal force to open the passage between striker and detonator. Should the striker be prematurely released, the striker will lock the shutter leaves permanently in the closed position
Arming of Striker	*Centrifugal Safety Catch* swings out to withdraw toe of catch from cam of striker	*Set Back Pin* drops back and no longer prevents rotation of firing arm	
Freeing of Clock	Escapement started by vibration of shell and the centre arbor rotates the hand	The *Safety Lever* moves clear of the end of the pallet arm and in doing so distorts the hairspring and gives a flick to the pallet arm to start the escapement. The centre arbor turns the timing disc	The *Stop Levers* fly outwards and release the pallet arm and thus allow the centre arbor to rotate the bottom crown back towards the zero position
Muzzle Safety	Hand prevented from rising by the *Muzzle Safety Bridge*. (Fuzes 208 and 211 only at settings below 0.5 (0.72 secs.)	Arm of firing lever prevented from entering slot of timing disc by projecting leaf of safety disc at settings below 1.32 (1.67 secs.)	"Follower" toe of striker bolt prevented from entering slot in bottom crown by step of centrifugal bolt occupying slot at settings below 1.25 (1.25 secs.)
Running of clock in flight	After rotating clear of the muzzle safety bridge the hand bears on the under surface of the hand race	Finger of firing arm bears on the periphery of the timing disc as it rotates	"Follower" toe of striker bolt bears on inner surface of bottom crown as it turns. Centrifugal bolt kept clear of the slot by centrifugal force
Release of striker	Hand spring forces hand up through slot of hand race to release the lever and allow the striker spring to rotate the striker cam off the pillar and force the striker down on to the detonator	Centrifugal force makes the fingers of the firing arm lever slip into slot of timing disc to rotate the firing arm lever and allow the striker safety plate to swing clear of the striker. The spring can then drive the striker down on to the detonator	Striker bolt spring makes the "follower" toe of the striker bolt slip into slot in bottom crown to withdraw the other toe from slot in striker to allow striker to be driven down on to the detonator.

5.23 Proximity or Variable Time (V.T.) Fuzes

5.231 General

Proximity or "Variable Time" fuzes are operated by the reflection of wireless waves from the target. These waves are transmitted from the fuze and the reflected waves from the target interfere with the direct waves to give a beat which is utilized to trigger the firing mechanism of the fuze.

The distance from a standard size and nature of target at which these fuzes will operate is predetermined. The size and nature of the actual target being engaged affect its powers of reflection and impose small variations on this predetermined distance.

Safety devices are included as for other types of fuzes. These may be either electrical or mechanical.

A self-destruction device is included in fuzes for use in the A.A. role to prevent functioning of the fuze on nearing the ground should it not have been operated by the target.

5.232 Elements

The V.T. fuze is essentially a self-contained battery wireless transmitter and receiver with built-in aerial. It consists of an oscillator, amplifier and firing circuit and is used with a gaine or auxiliary detonator.

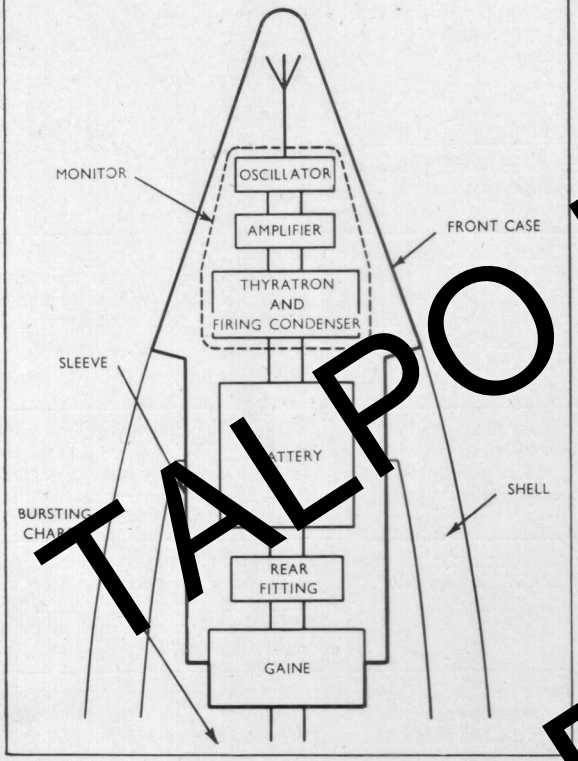
5.2321 Aerial

This consists of either a plated steel cup embedded in the plastic nose of the fuze or a half loop of wire fixed over a former in the nose. The two types of fuzes are referred to as "Capped" and "Capless" respectively.

5.2322 Battery

This is a reserve type of primary battery with the electrolyte contained in a glass ampoule which is broken by set-back on firing the gun. It gives high tension supply for the plates and low tension for heating the filaments of the valves and negative bias for the grid of the thyratron in the firing circuit.

BLOCK DIAGRAM OF V.T. FUZE. FIG. 23



5.2323 Oscillator

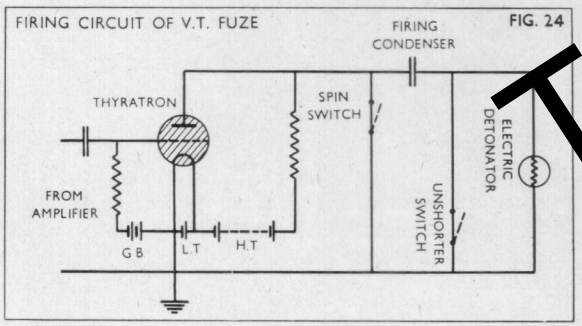
This is a combined transmitter and detector which sends out waves of radio frequency and receives them again after reflection from the target. The interaction of the two waves produces *Beat Impulses* of audio frequency.

5.2324 Amplifier

This amplifies the signals from the oscillator and passes them on to the firing circuit. Pentode valves are employed for A.A. fuzes to give high sensitivity. For fuzes for use in the ground role, triodes are used.

5.2325 Firing Circuit

FIRING CIRCUIT OF V.T. FUZE FIG. 24



This consists of a grid condenser, thyratron or gas filled triode valve, firing condenser and electric detonator, together with a spin switch and unshorter switch.

The grid of the thyratron is negatively biased and receives the amplified signals from the amplifier. The plate or output circuit is completed through the firing condenser in series with the detonator. The unshorter switch shunts the detonator and the spin switch shunts the whole of the output.

The grid and firing condensers are charged by the battery through resistances. When a strong enough signal is received on the grid, the bias is destroyed and the thyratron triggered, allowing plate current to flow and the firing condenser to discharge through the detonator and thus initiate the magazine.

5.23251 Unshorter Switch

This consists of a metal cup, the top of which is fitted with a central insulated contact stud. The bottom of the cup is made porous. The cup is contained in a steel shell, the bottom of which forms a sump beneath the cup.

The cup is filled with mercury and the switch is mounted radially with the contact stud towards the centre of the fuze.

Before firing, the mercury keeps the switch closed and thus shorts the detonator. A few seconds after firing, centrifugal action forces the mercury into the sump to open or unshort the circuit and thus give Delayed Arming.

5.2325[illegible] Spin Switch

This consists of a metal reed contact operated by centrifugal force. The contact opens soon after firing and with A.A. fuzes it is also designed to close again when the spin has decreased in flight to a predetermined extent. Before firing, therefore, the switch provides safety in handling by discharging the firing condenser to earth should the battery be accidently activated.

In flight, if the thyratron is not operated by a target signal, the eventual closing of the switch again will give self-destruction by discharging the firing condenser, this time through the detonator, thus initiating it.

5.2326 Gaine and Auxiliary Detonator

This consists of a shutter assembly over a C.E. magazine. Two shutters are mounted one above the other, one displacing a disruptive detonator and the other [illegible] filled channel from the axis of the fuze.

5.233 Safety Devices

5.2331 Before Firing

The battery is not activated until the gun fires.

The spin switch is closed and shorts the firing condenser.

The unshorter switch shorts the electric detonator.

The shutter prevents a flash from the electric detonator from initiating the magazine.

5.2332 After Firing

The unshorter switch provides delayed arming and muzzle safety.

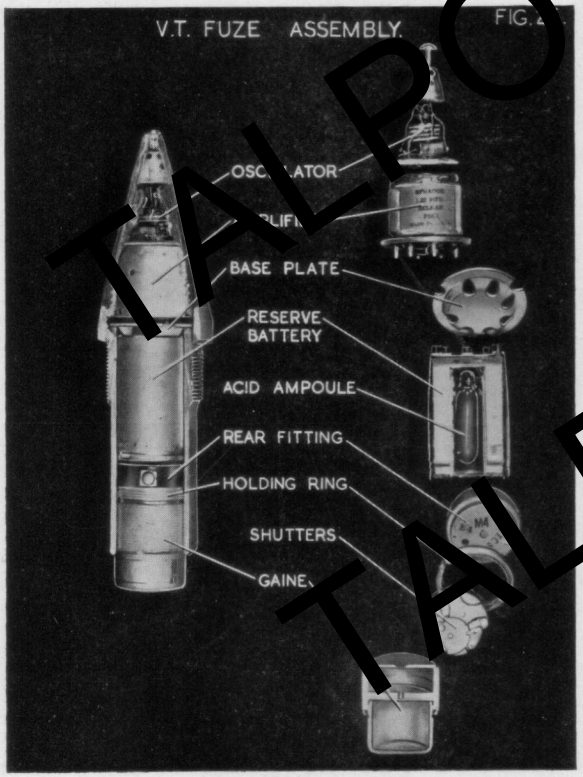
The battery is not fully activated until about half a second after firing.

5.2333 In Flight

The spin switch gives self-destruction should the fuze not be operated by the target.

5.2334 Disposal of Blinds

The active life of the battery is no more than about two minutes.



5.234 Assembly

Sub-assemblies of the components consist of the monitor or bundle, reserve battery, rear fitting and gaine.

The monitor comprises the oscillator, amplifier and firing circuit except for the spin switch, unshorter switch and electric detonator embodied in the rear fitting. The gaine contains the shutter and magazine assembly.

The fuze body or container consists of a plastic front case moulded on to a metal base ring or threaded insert into which a sleeve or can is secured from underneath.

The base ring is threaded externally for screwing into the fuze hole of the shell and has two parallel slots for engagement by the key for inserting and removing the fuze.

The cylindrical steel sleeve is of smaller diameter to enter the fuze hole of the shell. It is screw-threaded externally at the top to enter the base ring. The interior has a left-hand thread to take a holding ring to support the battery and rear fitting and also to take the top of the gaine.

The front case contains the aerial and monitor and the sleeve houses the battery and rear fitting with the gaine screwed into the base.

Some types of fuze have a heavy coating of wax on the outside which should *not* be removed.

5.23 Characteristics

Fuzes are generally designed within fairly narrow limits according to their particular role, and are often specific to particular guns.

Fuzes for use in the A.A. role have an arming time of about 1½ seconds and the spin switch gives self-destruction. The time to self-destruction is predetermined and limits the minimum Q.E. below which the fuze should not be used when firing over friendly territory. These fuzes function within sixty feet of an aircraft target.

Fuzes for use in the ground role are less sensitive, have an arming time of over five seconds and the spin switch does not give self-destruction. These fuzes function at about fifty-five feet over dry land when fired in the lower register and at about ten feet in the upper register.

5.236 Service Fuzes

Fuzes now in the service were all made in the United States and the only British A.A. gun for which they are approved is the 3.7-inch Marks 1 to 3.

5.2361 Nomenclature

All fuzes carry the U.S. Navy designation of Mark 45.

In the development stage, each type of fuze was given a "T" number. This is followed by an "E" number to designate the model. A final letter may also be used to indicate a minor modification. This is the system used to describe these fuzes in the British service. An example of a complete nomenclature is:

T.149 E.1A

An alternative nomenclature has been adopted by the U.S. Army now that the fuze is standardized. In this case, each type is given an "M" number followed by an "A" number to indicate the model. An oblique stroke, followed by a number may also be used to denote a minor modification.

e.g. T.149 E.1A becomes M.95 A.1/1

The three types of fuze approved for use with the 3.7-inch Marks 1 to 3 guns are described below.

5.2362 T.97 (M.98)

This fuze is for use in the ground role only. It can be distinguished from the A.A. fuzes by having a truncated nose.

5.2363 T.98 (M.94)

This is the standard A.A. fuze with a contour modelled on that of the British No. 208 mechanical time fuze.

It has a mean time to self-destruction of about thirty seconds and a minimum safe Q.E. of thirty degrees.

5.2364 T.149 (M.95)

This varies from the T.98 fuze only in that the mean time to self-destruction is about ten seconds and the minimum safe Q.E. is reduced to fifteen degrees.

5.24 Percussion Fuzes

5.241 General

Percussion fuzes are of various types according to the speed of action required. Generally speaking, the Direct Action fuze has the fastest action, followed closely by the Graze fuze and finally by the Delay Action Graze fuze.

The essential elements of percussion fuzes are the firing mechanisms accompanied by the holding and safety devices. These have already been described in detail in para. 5.1.

A self-destruction device is necessary for shell fitted with percussion fuzes when used in the A.A. role to prevent functioning of the fuze on impact with the ground should the target be missed. Such a device may be embodied in the fuze as a time element or be entirely separate as with a shell igniter (para 5.42).

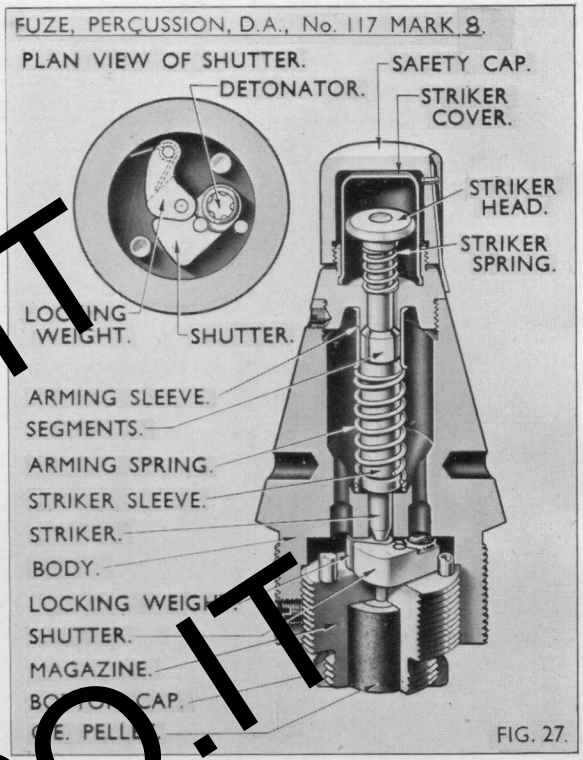


FIG. 27.

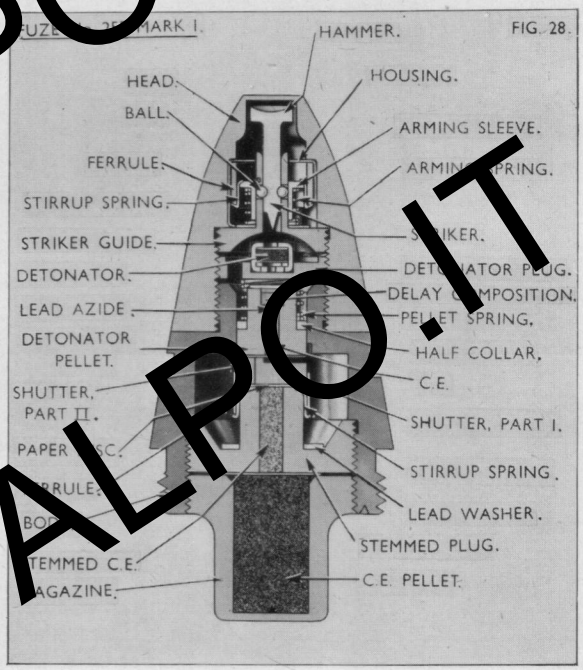


FIG. 28.

5.242 Direct Action (D.A.) Fuzes

These fuzes depend for their action on the driving of a striker on to a detonator by direct action on impact with the target.

be moved by a crane or derrick, as in loading and unloading ships, they should *not* be placed in nets or slung by the handles. The correct procedure is to use ammunition trays or scale-boards, on which they can be carefully stacked and secured.

Should packages be badly damaged, they and their contents should be set aside for technical examination; a procedure which must also be adopted if the package is dropped, whether any damage is apparent or not.

V.T. fuzes and auxiliary detonators are invariably bulk packed and should not be removed from their respective package until just before fuzing the shell prior to firing. Similarly, V.T. fuzes and auxiliary detonators will be removed from shell and replaced by plugs before transporting and storing. The auxiliary detonators will be removed from the fuzes and replaced by the special left-handed plugs and both fuzes and auxiliary detonators then replaced in their particular packages.

9.222 Protection

9.2221 General

Packages should be kept dry, not exposed to direct sunlight and protected from extremes and particularly large and rapid changes of temperature.

9.2222 Damp

The handling or movement of packages in wet weather should be avoided whenever possible. When this must be done, every precaution should be taken to avoid rain, snow, etc., reaching the packages.

The erection of a tarpaulin or corrugated iron screen over the vehicle or stack and the careful covering and uncovering of the vehicle or stack as the loading or unloading proceeds, will usually afford sufficient protection.

Covered vehicles should be used whenever possible.

Packages suspected of containing water should be opened, the contents and packages cleaned and dried and the whole repacked.

Wet primers are a fruitful source of misfires or hangfires.

9.2223 Sun

Any kind of protective covering that may be available should be used to protect the packages against sunlight in transport and in the dump.

9.2224 Temperature Variations

As extreme temperatures may affect the efficiency of the ammunition, though not its safety, every possible effort should be made to obtain uniform temperature by night and day. Such conditions are only possible in the field by the use of underground or semi-underground storage. The advantages of below ground storage are so many that the co-operation of the R.E. should be sought where necessary.

9.223 Stacking

9.2231 Packages

Packages should be stacked on some form of support which keeps them at least three inches clear of the ground, one end of every package being exposed to the air.

Both wood and steel packages can be stacked to a height of 11 feet, although a stack of five or six feet high is the best limit to work to in the field. With small dumps, a height of two or three feet may be found sufficient.

When above ground, storage has to be adopted, the ammunition stacks should be covered with tarpaulins, corrugated iron sheets or any other form of improvised cover which may be obtainable. The cover should be about 12 inches above the top of the stack to provide adequate ventilation. If the ventilation is inadequate, sweating may result. Additional ventilation may be provided during the day by raising the cover at the shady end of the stack.

If only a limited quantity of portable covers such as tarpaulins are available, the *protection of ammunition must have prior claim.* Tarpaulins should be protected from damage by the sharp corners of packages.

9.2232 Loose Shell

9.22321 General

Shell piled loose with grummets should usually be placed on the base on wood dunnage. If piled or stacked horizontally, the lower tier should rest on suitable supports clear of the ground. The pile may be four feet high.

Alternate layers of shell should be placed head to base, special care being taken to avoid damage to driving bands.

Shell may be placed alongside cartridges or the two may be kept separate, the latter probably being the better arrangement.

Some form of covering should be arranged if possible in order to prevent rusting and to give protection against the sun.

9.22322 Plugged Shell

Weather has very little effect on plugged shell and they may need very little attention as long as they are well painted or free from rust.

9.22323 Fuzed Shell

As the fuze may be rendered unserviceable by dampness, direct sunlight or extremes of temperature, fuzed shell require more careful treatment and should be well protected. Oily rags must not be used on fuzed shell as the oil may creep into the fuze and render the explosive unserviceable.

9.3 PREPARATION

9.31 General

A certain amount of ammunition will have to be got ready at each gun for instant use. The quantity prepared

should be kept as low as possible consistent with operational requirements because exposed rounds are much more liable to deterioration than those in packages.

The preparation of ready-use ammunition calls for great care to ensure that it is really ready for use and that all components are in a completely serviceable condition.

The following procedure should be adhered to as closely as possible:

Select only sound, clean and dry packages, and if possible, *all from the same batch*.

Open the packages methodically and carefully, taking care not to damage the contents.

If the ready-use ammunition is to be stored in racks, recesses, etc., out of the packages, the latter should be reassembled when empty, placed under cover, and sufficient retained for use should a change in position be ordered.

The ready-use ammunition should, as far as possible, be replaced in its original package if not fired. If not all have been expended, the packages should be returned to R.A.O.C., together with all unused components.

Individual components should be examined and prepared as follows:

9.32 Primer

The primer should not project beyond the surface of the case. If it does, it should be screwed home with the primer key, but if this is not possible, the primer should be removed, another inserted and screwed home correctly, luting being applied to make a watertight joint. Only "Luting, thick, Mk. 4" will be used.

The primer should always be screwed in tightly, but while it must not project beyond the surface of the case, it may lie slightly below the surface to the extent of 0.015-inch, *i.e.*, about the thickness of the finger nail, and still be accepted as fully serviceable.

The cap of the primer must be clean and free from grit.

9.321 "Q" Primers (except for 40 m/m. ammunition)

Not more than the threads of the primer should be filled with luting, any excess being wiped off *before* inserting into the case. After insertion, also, any excess should be removed.

9.322 "A" Primers and all primers for 40 m/m. ammunition

Luting should be applied liberally in order to give a cushioning effect, especially with power ramming, any excess of luting being wiped off the surface *after* insertion.

9.33 Cartridge Case

9.331 General

The case should be dry, clean, free from rust marks, cracks, dents or fluting.

9.3311 Cracks and Fluting

Straight cracks not exceeding $\frac{1}{4}$ inch in length at the mouth of the case can be ignored, but cracks or fluting elsewhere render the case unserviceable and the cartridge should be returned to R.A.O.C., marking the package "Cracked cartridge case".

9.3312 Dents

Slightly dented cases may be accepted if they gauge in the gun. (*See below.*)

9.3313 Rust

Rust marks from steel packages, if slight, can usually be removed by a *lightly* oiled rag, care being taken to keep the oil from reaching the primer or propellant and to wipe over the case with a dry rag afterwards.

Badly rusted cases should not be used but should be cleaned as far as possible, repacked, and if practicable returned to R.A.O.C.

9.3314 Gauging

Cartridges, both fixed and separate loading, but except those for the 3.7-inch Mk.6 gun, may be chamber gauged in the gun and should go fully home. The breech mechanism should not be closed, however, unless the striker has first been removed.

Any cartridge which fails to gauge in the gun should be tried in other guns.

Cartridges should be loaded by hand when gauging and all power ramming gear should *not* be used.

Frequent gauging should be avoided as it tends to weaken the cartridge case/projectile joint.

Any cartridge failing to gauge should be repacked and returned to R.A.O.C. and the package suitably marked.

9.332 Fixed Ammunition

There should be no movement between the case and the projectile. Slight looseness is not harmful, provided that the cartridge will gauge in the gun, but very loose cases should be replaced in their packages and segregated pending their return to R.A.O.C.

9.333 Separate Loading Ammunition

The closing lid should be examined to see that it is sound, serviceable and in the proper position. Only cartridges with serviceable lids should be held for ready-

9.34 Projectiles

These should be dry, clean, well painted, free from rust and have undamaged driving bands.

Rust can be removed by using a fine grade of emery cloth or a scratch card.

Unpainted surfaces of 6-pr. projectiles and upwards may be coated with warm "boiled linseed oil, lead free", using a brush, and allowed to dry. One coat is sufficient and should be applied to the unpainted parts only, otherwise the projectile may become "high to Gauge".

Projectiles smaller than 6-pr. should have the bare places coated with "lead free mineral jelly" and *not* linseed oil.

Capped projectiles should have the caps firmly attached and not deformed.

9.35 Fuzes

9.351 General

Projectiles designed for base fuzes are issued complete with fuze.

Shell for nose fuzes may be issued fitted with either a plug or fuze. It is most important that the fuze should be screwed fully home into the shell and secured by the fixing screw.

If a washer is fitted beneath the fuze it must be properly centred as any protrusion will seriously affect the ballistics.

V.T. fuzes are invariably issued separately and the bases of the fuzes plugged. The plug is removed and the gaine or auxiliary detonator inserted immediately prior to fuzing the shell.

9.352 Suitability of Fuze

The suitability of a fuze for any particular shell is governed by the extent of the fuze intrusion into the shell cavity as well as by the explodering system essential to particular fuze/shell combination. These details are shown in the Method of Filling (M. of F.) drawings of the projectile. Appendix H gives particulars of service methods of filling, and Fig. 33 shows typical explodering systems for Time and D.A. fuzes.

Provided that the use of these fuzes is approved for any particular gun, the following assemblies of fuzes and other components, as stated, are interchangeable:

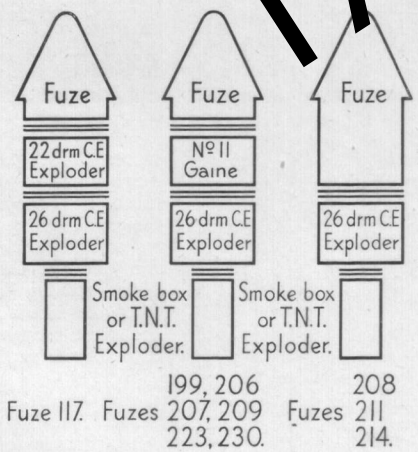
Assembly			Guns for which fuze is approved	
Fuze		Component	Calibre	Mark
No.	Mark			
117	10–15*	22 drm. C.E. Exploder*	5·25-in.	1 & 2
			3·7-in.	1 to 3
199	All	No. 11 Gaine	3·7-in.	1 to 3
207	All	No. 11 Gaine	3·7-in.	1 to 3
208	1 to 4	None	5·25-in.	1 & 2
			3·7-in.	1, 2, 3 & 6†
208	5 & 6	None	3·7-in.	6
214	1	None	3·7-in.	1 to 3
223	All	No. 11 Gaine	3·7-in.	1 to 3
251	All	None	40 m/m.	All
255	All	None	40 m/m.	All

*Mk. 14 must NOT be used with REDUCED charge.

†Fuzes of R.O.F.(B) manufacture only for Mk. 6 gun.

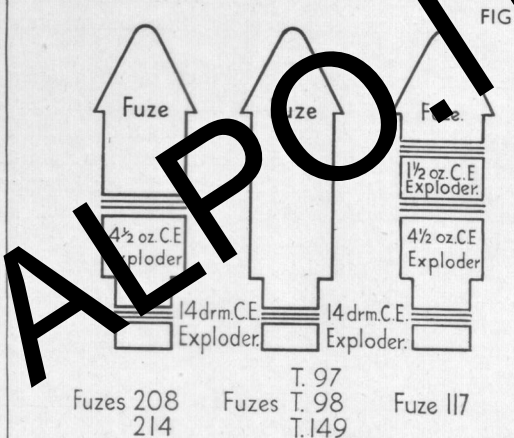
The greater intrusion of V.T. fuzes, with their accompanying auxiliary detonators necessitates special methods of filling. The following diagram shows typical explodering for V.T., Time and Percussion fuzes:

FIG. 33



TYPICAL EXPLODER SYSTEMS FOR D.A & TIME FUZES.
(M. of F. 8029, 12056 & 14261.)

FIG. [illegible]



TYPICAL EXPLODER SYSTEMS FOR V.T., TIME AND D.A. FUZES.
(M. of F. 18831 and D2(L) 555/GT/230.)

With these methods of filling, assemblies are interchangeable as follows:

Assembly			Guns for which fuze is approved	
Fuze		Component	Calibre	Mark
No.	Mark			
208	1 to 3	4½ oz. C.E. Exploder *	3·7-in.	1 to 3
T.97	All	None	3·7-in.	1 to 3
T.98	All	None	3·7-in.	1 to 3
T.149	All	None	3·7-in.	1 to 3
117	10 to 15	4½ oz. C.E. Exploder,* plus C.E. Pellet	3·7-in.	1 to

*For Practice Projectiles, dummy exploders consisting of wooden blocks with a central flash hole or felt washers are used. C.E. exploders must *NOT* be used.

9.353 Fuzing and Re-Fuzing

9.3531 General

The operation of fuzing or re-fuzing projectiles requires careful supervision and should be undertaken under conditions approaching as closely as possible to "field laboratory conditions" as defined by Regulations for the Army Ordnance Services, Part 6, Supply of Ammunition in the Field, paras. 120 to 139 inclusive. In particular, the operation will be carried out under cover, and no fires, naked lights, lighters, matches or smoking materials will be allowed in the vicinity.

The atmospheric conditions of the hut or tent in which the operations of opening up and closing the shell are carried out must be quite dry to prevent moisture entering the shell when opened up.

All components must be perfectly dry before insertion, and only one shell at a time must be worked upon during breaking down and assembly. All operations must be carried out "under precautions".

In all shell operations, cleanliness and careful handling are most important and it is essential that no dirt, dust, grit or extraneous matter be allowed to enter the shell, or come in contact with any components. Before the removal of any components, therefore the exterior of the shell must be thoroughly cleaned and the components stored in perfectly clean packages until required again.

If the round is complete, it is essential that the projectile is firmly held and the cartridge case well supported lest the projectile be loosened in the case.

Cartridge clips should always be put on to protect the primers.

To sum up, therefore, although re-fuzing is normally a laboratory job, if the three basic principles of

DRYNESS
CLEANLINESS
CARE

are observed, it can be carried out by battery personnel in a satisfactory manner.

9.3532 Tools Required

The correct implements should invariably be used in order to minimize damage to ammunition and danger to personnel. The following tools should be available:

Tool	Use
Clip, Cartridge	Protection of primers of Q.F. ammunition.
Fuze Key No. 119	Inserting and Removing Nos. 199 and 207 fuzes.
Fuze Key No. 121	Inserting and Removing No. 117 fuze.
Fuze Key No. 175	Inserting and Removing Nos. 208, 214, T.97, T.98 and T.149 fuzes.
Fuze Key No. 222	Inserting and Removing Plugs. Removing plug from base of Nos. T.97, T.98 and T.149 fuzes.
Fuze Key No. 223	Inserting and Removing Fuze No. 208 made after 1945.
Gaine Key No. 69	Removing No. 11 Gaine.
Hook, extracting exploders Mk. 2	Extracting Exploders.
Improvised Scraper or length of wire of *non-ferrous* material	Clearing shell cavity.
Wrench, Rock "U", 3-in. Mk. 1	Holding shell when inserting or removing fuzes.
3/16-in. Drill with adjustable collar	Drilling seating for point of fixing screw into fuze threads.

9.3533 Stores Required

The following stores should also be available:

Item	Vocab. Section	Remarks
Cement R.D. No. 1 or 1A, lead free	U	To cover recess of screw fixing fuze after insertion of screw.
Composition R.D. 1154	U	To fill interstices between time rings of combination time fuzes and between the screwed collar, dome and body of mechanical time fuze.
Disc, Tracing Cloth, 1·78-in. diam.	12	Each exploder (including the bottom exploder or smoke box, according to design) should be covered by two of these discs, shiny sides together. The discs act as bearings when the fuze is screwed home and prevent movement of the exploder.
Luting, thin, Mk. 5, lead free	U	To coat threads of fuze before insertion and to coat threads of fixing screw before insertion.
Naphtha	U	For dissolving R.D. cement when removing set screw fixing fuze.

CARTRIDGES

40 M.M. GUN

(Where more than one item is shown below. these are alternatives)

Charge	Mark	Brass Case Mark	Primer No.	Propellant M. of F. Des. No. CIA/A. 347 with Foil			Projectile		Fuze No.	Tracer
				Nature and Size	Weight oz.		Filled Mark	Method of Filling Design No.		
				H.E. Shell						
F	44T	1* 2 3 4	12	NH 023 NH 025	10	14	5T 7T	DD/L/11606 DD/L/13674	255	No. 11
F	45T	1* 2 3 4	12	NH 023 NH 025	10	9½	5T 7T	DD/L/14279	255	No. 14
F	46T	1 1* 2	18	NH 023 NH 025	10	14	2T 4T 6T	DD/L/11606 DD/L/13674 DD/L/19675	255	No. 11
F	47T	1 1* 2	18	NH 023 NH 025	10	14	5T 7T	DD/L/11606 DD/L/13674	255	No. 14
F	48T	1 1* 2	18	NH 023 NH 025	10	9½	5T 7T	DD/L/14279	255	No. 11
F	53	3 4	12	NH 023 NH 025	9	4	4	DD/L/19674	255	No. 14
				Practice Projectile						
F	3T	1 1* 2	18	WT 120–040 WMT 124–040	9	0	2T	DD/L/12409	251	No. 12
F	4T	1* 2 3 4	12	WT 120–040 WMT 124–040	9	0	2T	DD/L/12409	251	No. 12
F	5T	1 1* 2	18	WT 120–040 WMT 124–040	9	0	3T	DD/L/13568	251	No. 11
F	6T	1* 2 3 4	12	WT 120–040 WMT 124–040	9	0	3T	DD/L/13568	251	No. 11
F	7T	1 1* 2	18	WT 120–040 WMT 120–040	9	0	6	DD/L/14479	251	No. 11
F	8T	1* 2 3 4	12	WT 120–040 WMT 124–040	9	0	6	DD/L/14479	251	No. 11
F	9T	1 1* 2	18	FNH/P 022	11	12	6	DD/L/14479	251	No. 11

CARTRIDGES

40 M.M. GUN

(Where more than one item is shown below, these are alternatives)

Charge	Mark	Brass Case Mark	Primer No.	Propellant M. of F. Des. No. CIA/A. 347 with Foil			Projectile		Fuze No.	Tracer
				Nature and Size	Weight oz.	dr.	Filled Mark	Method of Filling Design No.		
Practice Projectile										
F	10T	1* 2 3 4	12	FNH/P 022	11	12		DD/L/14479	251	No. 11
F	15T	1* 2 3 4	12	FNH/P 022	11	7	9T	DD/L/17062	251	No. 14
F	17	1* 2 4	12	NH 025	10	14	6	DD/L/14479	255	No. 11
F	18	1 2 3 4		NH 025	10	14	6	DD/L/14479	251	No. 11
S.A.P. Shot										
F	1	1 1* 2	18	WT 144–048 WMT 148-048	10	4	1	No filling		
F	2T	1* 2 3 4	12	WT 144–048 WMT 148–048	10	12	1	No filling		
F	3T	1 1*	18	WMT 211–100	11	4	3	DD/L/13074 DD/L/161478		Cavity
		2					4	DD/L/14187 DD/L/16147A D2/L/1450/GF/121		
F	4T	1* 2	12	WMT 211–100	11	4	3	DD/L/13074 DD/L/16147B		Cavity
		3 4					4	DD/L/14187 DD/L/16147A D2/L/1450/GF/121		
S.A.P. Shot										
F	1T	1 1* 2	18	WMT 211–100	11	4	2T 4T	DD/L/13074 DD/L/14187 DD/L/16147 D2/L/1450/GF/121		Cavity
F	2T	1* 2 3 4	12	WMT 211–100	11	4	2T 4T	DD/L/13074 DD/L/14187 DD/L/16147 D2/L/1450/GF/121		Cavity

CARTRIDGES

40 M.M. GUN

(Where more than one item is shown below, these are alternatives)

Charge	Mark	Brass Case Mark	Primer No.	Propellant M. of F. Des. No. CIA/A 347 with Foil			Type	Projectile		Plug	Tracer
				Nature and size	Weight oz.	Weight dr.		Filled Mark	Method of Filling Design No.		
					Practice						
F	1T	1 1* 2	18	WT 120–040 WMT 124–040	9	0	Practice Projectile	4T	DD/L/14107	Rep. Fuze 251	No. 11 No. 12
F	2T	1 1* 2	18	FNH 025	10	14	Practice Projectile	4T	DD/L/14107	Rep. Fuze 251	No. 11 No. 12
F	3T	1 1* 2	18	FNH/P 022	11	12	Practice Projectile	4T	DD/L/14107	Rep Fuze 251	No. 11 No. 12
F	4T	1* 2 3 4	12	WT 120–040 WMT 124–040	9	0	Practice Projectile	4T	DD/L/14107	Rep. Fuze 251	No. 11 No. 12
F	5T	1* 2 3 4	12	NH 025	10	14	Practice Projectile	4T	DD/L/14107	Rep. Fuze 251	No. 11 No. 12
F	6T	1* 2 3 4	12	FNH/P 022	11	12	Practice Projectile	4T	DD/L/14107	Rep. Fuze 251	No. 11 No. 12
F	7T	1 1* 2	18	WMT 211–100	11	2	Practice Shot	6T	DD/L/14218 DD/L/16197 D2/L/1450/GF/121		Cavity
F	8T	1* 2 3 4	12	WMT 211–100	11	2	Practice Shot	6T	DD/L/14218 DD/L/16197 D2/L/1450/GF/121		Cavity

Appendix F

PRIMER AND IGNITER DETAILS

Primer													Gun and Propellant Charge			
			Obturation				Filling									
							Magazine	Cap and/or Bridge Plug Recess								
Number	Mark	Type	Ball	Cone Plug	Cap Holder	Bridge Plug	G.12 Powder	A. Compo	Q.F. Compo	Gun-cotton Dust			5·25-in. Mk. 2	3·7-in. Mk. 6	3·7-in. Mks. 1-3	40 m/m.
							gr	gr	gr	gr						
9	1†	P	*				437½		1·2						R	
	2†	P		*			437½		1·2						R	
	3	P		*			437½		1·2					F†	R	
	3/1	P					437½		1·2					F	R	
	4	P		*			437½		1·2					F	R	
11	1	P	*				164		1·2						FR	
	2†	P		*			164		1·2						FR	
	3	P		*			164		1·2						FR	
12	3	P		*			64	0·8								F
17	1	E				*	415			3·0			FR			
	2	E				*	415			3·0			FR			
18	1†	P			*		54	0·27								F
	2	P			*		54	0·27								F

NOTES: No. 12 Primer fits Mks. 1*, 2, 3 and 4, 40 m/m. cases
No. 18 Primer fits Mk. 1 cap or Mks. 1* and 2 with Adapter
P (Percussion), E (Electric), F (Full Charge), R (Reduced Charge)

Igniter				
Number	Filling G.12 oz.	Propellant	Charge	Gun
37	1·0	NH 050	Full	3·7-in. Mks. 1–3
39	2·0	N/S 164–048	Full	3·7-in. Mks. 1–3
61	8·5	N/P/S 263–066	Full	5·25-in. Mk. 2
74	1·0	N 045	Reduced	3·7-in. Mks. 1–3
89	1·0	NH 050	Full	3·7-in. Mks. 1–3

NOTES: † Coloured cent
1 dram (dr) = 27·34 grains (gr)
1 gramme (grm) = 15·34 grains (gr)

Appendix G

EMPTY COMPONENTS

Cartridge Cases

Gun		Mark of Case	Primer Gauge (ins.)	Remarks
Calibre	Mk.			
5·25-in.	2	2	1·2	Orthodox brass case. Takes Mk. 2 Whitemetal lid which is secured by turning over four tangs at mouth of case
		2*	1·2	Above converted by forming cannelure below lid
		3	1·2	As for Mk. 2*, but of new manufacture
		3/1	1·2	Similar to Mk. 3 but mouth not tanged. Modified cannelure forms seating for Mk. 3 Plastic lid which is secured by coning the mouth of the case over the rim of the lid
3·7-in.	6	1	1·2	Orthodox brass case
3·7-in.	1–3	1	1·2	Orthodox brass case
40 m/m	All	1	1·08	Orthodox brass case. Takes No. 18 Primer only
		1*	1·08	Mk. 1 case converted by enlarging primer hole to take on Adapter for No. 12 Primer. Takes either No. 18 Primer or Adapter with No. 12 Primer
		2	1·08	As for Mk. 1* but of new manufacture
		3	0·63	Canadian manufacture. Similar to Mk. 1 but primer hole takes No. 12 Primer direct, without an adapter
		4	0·63	British manufacture. Similar to Mk. 3

Projectiles

Gun		Type	Mk.	Design No.	Remarks
Calibre	Mk.				
5·25-in.	2	H.E. Shell	3	DD/L/13[illegible]	8 c.r.h. 2-in. fuze hole gauge single driving band to design No. DD/L/7025/3. Interior lip below fuze hole threads as seating for No. 11 Gaine
			3/1	D2/L/3065/GE/380	Similar to Mk. 3, except for straight through fuze hole to take V.T. fuzes, smaller base plate and closer tolerances to give more concentric fuze hole
		Practice Projectile	4	D2/L/3311/GE/447	Similar to Mk. 3/1 H.E. shell, but without base plate
3·7-in.	6	H.E. Shell	4	DD/L/16262	8 c.r.h. 2-in. fuze hole gauge. Driving bands to design DD/L/15882/1 comprising two narrow forward bands and one wide rear band with three flanges, the front flange being very high
			4/1	D2/L/3064/GE/694	Similar to Mk. 4, except for straight through fuze hole to take V.T. fuzes; smaller base-plate and closer tolerances to give more concentric fuze hole
		Practice Projectile	2	D2/L/3310/GE/[illegible]5	Similar to Mk. 4/1 H.E. shell, but without base plate
3·7-in.	1–3	H.E. Shell	1	DD/L/7212A	8 c.r.h. 2-in. fuze hole gauge. Single driving band to design No. DD/L/T 6278A/1. Interior lip below fuze hole threads as seating for No. 11 Gaine
			1****	DD/L/18653	Similar to Mk. 1, but interior lip turned down sufficiently to permit entry of V.T. fuzes

Gun		Type	Mk.	Design No.	Remarks
Calibre	Mk.				
		H.E. Shell	5	D2/L/999/GE/230	Similar to Mk. 1****, but with straight through fuze hole and alternative smaller base plate
			5/1	D2/L/3585/GE/230	Similar to Mk. 5, but with small base plate; two driving band ribs instead of three and closer tolerances to give more concentric fuze hole
		Practice Projectile	1	D2/L/3309/GE/7	Similar to Mk. 5/1 H.E. Shell, but without base plate
		S.A.P. Shot	1T	DD/L/123	Steel. 1–4 c.r.h. Base recessed for tracer cavity and steel closing disc
			1	DD/L/14105	Similar to Mk. 1T, except that base not prepared for steel closing disc
			2T	DD/L/14105	Similar to Mk. 2T, except for slightly larger diameter tracer hole
			2T	DD/L/11434A	Steel. 1·4 c.r.h. Base recessed for tracer hole and steel closing disc
			3T	DD/L/13999	As for Mk. 2T, but not prepared for steel closing disc
			5T	DD/L/13999	Similar to Mk. 3T, except for slightly larger diameter tracer hole
		A.P.C.B.C. Shot	1	D2/L/1604/GE/446	Steel body, penetrative and ballistic caps. Base recessed with four tracer holes
		Practice Shot	1T	DD/L/14767	Cast iron. Similar to S.A.P. Shot Mk. 1T
			2T	DD/L/14953	Steel. Similar to Mk. 1T
			3T	DD/L/14767	Similar to Mk. 1T, except for slightly larger diam. tracer hole
			4T	DD/L/14953	Similar to Mk. 2T, except for slightly larger diam. tracer hole
40 m/m.	All	H.E. Shell	2T	DD/L/10495	1·2-in. fuze hole gauge. Copper driving band to design No. DD/L/9051/1. Internal tracer socket in base
			4T	DD/L/10495	Similar to Mk. 2T, except for driving band of gilding metal and modified tracer hole
			5T	I.G.4530	Canadian. Similar to Mk. 4T, except that indenting cannelure is close to driving band
			6T	I.G.4531	Canadian. Similar to Mk. 4T, except for modified tracer hole and copper driving band
			7T	CIA(A)2284	U.S. Naval shell modified to take British fuze and tracer. Gilding metal driving band
		S.A.P. Shot	1	DD/L/11025	Steel. Truncated nose and recessed base
			2T	DD/L/11025B	Similar to Mk. 1, except for tracer hole in base being modified to take steel closing disc
			3T	DD/L/13112	Similar to Mk. 1, but with pointed nose and modified tracer hole
			4T	DD/L/14106	Similar to Mk. 3T, but tracer hole not prepared for steel closing disc

Gun		Type	Mk.	Design No.	Remarks
Calibre	Mk.				
		A.P. Shot	2T	DD/L/13672	Steel. Pointed nose. Base recessed for tracer and steel closing disc
			4T	DD/L/14101	Similar to Mk. 2T, but tracer hole not prepared for steel closing disc
			6T	I.G.4057	Canadian. Similar to Mk. 2T, except for shorter tracer hole
		A.P.C. Shot	7T	D2/L/1435/GE/247	Steel body with penetrative cap
		Practice Shot	4T	I.C.4095	Canadian. Steel. Similar to A.P. Shot Mk. 6T
			2T	DD/L/15819	Cast Iron. Similar to A.P. Shot Mk. 4T
		Proof Shot	4	DD/L/9776A	Flathead. Representing H.E. Mk. 4T
				DD/L/16117	Representing A.P.
			13	DD/L/20035	Representing H.E. Cylindrical Base
		Break-up Proof Shot	3	DD/L/11012	Solid cast iron. Representing H.E. Mk. 2T. Pointed
			7	DD/L/11012	Hollow cast iron. Representing H.E. Mk. 4T with T. & I. No. 11
			8	DD/L/11917	Similar to above
			9	DD/L/20503	Similar to above. Representing H.E. Mk. 4T with T. and I. No. 14
			10	D2/L/29[illegible]/GE/684	Bakelite
		Paper Shot	[illegible]	DD/L/[illegible]96[illegible]	Rolled paper cylinder with ramming stop near [illegible] end. Filled steel shot
		Shell, Proof of Fuzes	1	DD/L/19968/1	Similar to Proj. Practice, using "Standard" Shell

DUE TO THE NEED TO RETAIN
UNIFORM PAGE SIZING
PAGES NUMBER 73 TO 76
HAVE BEEN PLACED AT THE END
OF THIS PDF DOCUMENT.

APPENDIX I

SUMMARY OF FUZES, TRACERS AND IGNITERS

FUZE		GUN				FUZE DETAILS													
							Percussion		Time							V.T.	Magazine		
							D.A.		Mechanical										
Number	Mark	5·25-in. Mk. 2	3·7-in. Mk. 6	3·7-in. Mks. 1–3	40 m/m.	Intrusion with C & A washer (ins)	Instantaneous	Delay	Combination	Thiel	Junghaus	Tavaro	Fuze Graduations Min.	Fuze Graduations Max.	Time of Functioning (secs.) Min.	Time of Functioning (secs.) Max.	Time self-destruction (secs.)	C.E.	Powder
117	10–15	*		*			*											*	
199	All			*	*					*			0	30	0	25			*
206	All	*								*			0	21½	0	43			*
207	All	*		*						*			0	30	0	43			*
208	1,3	*		*						*			¾	29½	¾	43		*	
	5, 6		*							*			¾	28½	¾	43		*	
209	All											*	0	40	1¼	40			*
211	All	*								*			0	21½	¾	43		*	
213	A						*			*			0		0	80		*	
214											*		0	2	1⅜	43		*	
223	A			*			*		*				0	30	0	25			*
230	Al	*					*											*	
230P	All	*																*	
251	All				*		*											*	
255	All				*			*										*	
255A	All				*		*											*	
T.97	All			*														*	
T.98	All			*														*	
T.149	All			*													30	*	
																	10		

TRACER and/or IGNITER		Gun		Colour of Tracer	Time of Burning (secs.)	
Type	No. of F.	3·7-in. Mks. 1–3	40 m/m.		Min.	Max.
T. and I. No. 11 . .			*	Red		7
T. and I. No. 12 . .			*	Red		8
T. and I. No. 14 . .			*	Red	12	16
Integral	DD/L/13074	*	*	White	5	7
Integral	DD/L/14187	*	*	White	5	7
Integral	DD/L/14218	*	*	White	5	7
Integral	DD/L/16147	*		Red	5	7
Integral	DD/L/16341	*		Red	5	7
Integral	DD/L/17228	*		White	5	7
Integral	D2/L/1450/GF/121	*		Red	5	7
Integral	D2/L/1451/GF/122	*		Red	5	7
Integral	D2/L/1452/GF/218	*		Red	5	7
Integral	I.G. 4045		*	Red	5	7
Integral	I.G. 4046		*	Red	5	7

Appendix J

AMMUNITION PACKAGES

Complete Packages

No.	Mk.	Contents	Outer Package			Inner Package			Remarks
			Type	No.	Mk.	Type	No.	Mk.	
5	1	1 rd. 3·7″ Mks. 1–3 Gun	Container	C.333	1				With positioning Ring
26	5	9 rds. 40-m.m. Gun, H.E., A.P. or Practice	Box	B.167A	1	Container	226	1	With fitments
26	11	21 No. 208 Fuzes	Box	B.167A	1	Cylinders	208F	2	Do.
26	12	9 Paper Shot 40 m.m.	Box	B.167A	1	Containers	271	1	Do.
26	13	9 40 m.m. Ctge. paper shot	Box	B.167A	1	Containers	272	1	Do.
26	14	17 No. 208 Fuzes	Box	B.167A	1	Cylinders	208F	2	Do.
36	1	1 rd. 3·7″ Mk. 6 Gun	Box	C.284	1				With lifting band and fitments
36A	1	1 rd. 3·7″ Mk. 6 Gun	Box	C.284	1/1				Do.
41		21 rds. 3·7″ Mks. 1–3 Gun	Box	C.235	2	Containers	23	1	

Details of Components

Type	No.	Shape	Material	Waterproof?	Contents
Container	6	Open-ended cylinder	Rolled paper	No	1 × 40 m/m. Gun Round
Do.	23	Do.	Do.	No	1 × 3·7-in. Mks. 1–3 Gun Round
Cylinder	199F	Closed cylinder	Tinplate	Yes	1 × Fuze No. 199 or 223
Do.	208F	Do.	Do.	Yes	1 × Fuze No. 208
Container	226	Cylinder with Metal end caps	Waterproof board	Yes	1 × 40 m/m. Gun Round
Do.	248	Do.	Do.	Yes	Do.
Cylinder	36	Cylinder with	Terne or Zinc	No	1 × 5·25-in. Mk. 2 Gun Cartridge
Box	B.167A	Rectangular	Steel	No	9 × 40 m/m. Gun Rounds in Container No. 226 OR 21 × Fuzes No. 208 in Cylinders No. 208F
Do.	C.213	Do.	Do.	No	2 × 3·7-in. Mks. 1–3 Gun Round
Do.	C.216	Do.	Do.	No	24 × 40 m/m. Gun Rounds in Chargers of 4
Do.	C.219	Do.	Do.	No	4 × 40 m/m. Gun Rounds in Containers No. 6
Cylinder	C.227	Cylinder with lid	Rolled paper with metal end pieces	No	1 × 5·25-in. Mk. 2 Gun Cartridge
Box	C.235	Rectangular	Steel	No	21 × 3.7-in. Mks. 1–3 Gun Rounds in Containers No. 23
Cylinder	C.268	Cylinder with double lid	Do.	Yes	1 × 3·7-in. Mks. 1–3 Gun Round in rolled paper liners
Hamper	C.280	Rectangular	Wicker with canvas cover	No	24 × 40 m/m. Gun Rounds in six chargers of four
Box	C.284	Do.	Wood	No	1 × 3·7-in. Mk. 6 Gun Round
Do.	C.297	Do.	Do.	No	24 × 40 m/m. Gun Rounds in Containers No. 6
Do.	C.300	Do.	Do.	No	2 × 3·7-in. Mks. 1–3 Gun Rounds
Cylinder	C.322	Cylinder	Steel	Yes	1 × 5·25-in. Mk. 2 Gun Cartridge
Container	C.333	Do.	Do.	Yes	1 × 3·7-in. Mks. 1–3 Gun Round
Cylinder	M.104	Do.	Do.	No	12 × Fuzes No. 199 or 223 in Cylinders No. 199F
Box	—	Rectangular	Do.	Yes	12 × T.98 or T.149 Fuzes in sealed metal cylinders and Key for inserting or removing fuze

Appendix K

WEIGHT AND STOWAGE DIMENSIONS

Cartridges

Gun		Projectile	Charge	Cartridge	
Calibre	Mark			Approx. Weight (lbs.)	Overall Length (ins.)
5·25-in.	2		Full	48	31·3
			Reduced	37	31·3
			Paper Shot	41	31·3
3·7-in.	6	H.E., fuzed	Full	$62\frac{3}{4}$	49·2
		H.E., plugged	Full	$60\frac{3}{4}$	46·2
3·7-in.	1–3	H.E. and Practice Projectile, fuzed	Full	$50\frac{1}{2}$	42·8
		Do.	Reduced	$45\frac{1}{4}$	42·8
		H.E. and Practice Projectile, plugged	Full	$48\frac{1}{2}$	39·0
		A.P. and S.A.P. Shot	Full	$50\frac{1}{2}$	36·4
		Practice Shot	Full	$50\frac{1}{2}$	37·0
		Do.	Reduced	$45\frac{1}{4}$	37·0
40 m/m.	All	H.E. and Practice Projectile, fuzed	Full	$4\frac{3}{4}$	17·6
		A.P., S.A.P. and Practice Shot	Full	$5\frac{1}{2}$	17·5

F. 117

FUZE, PERCUSSION, D.A., No. 117

Type	Direct Action					
Guns	Q.F. 3·7-in. Marks 1–3 Q.F. 5·25-in. Mark 2					
Fuze Mark	10	11	12	13	14	15
Charges for which the particular mark of fuze is approved	FR	FR	FR	FR	F only	FR
Projectile	H.E. Shell					
Fuze Key	Impulement Adjustment No. 121					

Description

Mark 8 (See Fig. 27). Not to be used with A.A. ammunition.

General

The fuze consists principally of a body, guide bush, striker assembly, striker cap, safety cap, detonator and shutter assembly and magazine with bottom cap.

The exterior of the body is cylindrical at the base and screw-threaded to enter the shell whilst the upper part is conical. The interior is formed into two compartments separated by a diaphragm.

The guide bush screws into the top of the body and supports the striker assembly consisting of the striker, striker spring, striker sleeve and segments, arming sleeve and arming spring. The head of the striker protrudes above the guide bush and is protected by the striker cover, while the point of the striker projects through a hole in the diaphragm. The safety cap fits over the striker cap and gives additional protection during handling and storing. It is removed before firing.

The detonator and shutter assembly is immediately under the diaphragm and consists of the shutter with detonator, locking weight and shutter spring. Under this is the magazine which screws into the bottom of the body. It contains C.E. and is closed by the bottom cap.

The shutter assembly prevents a prematurely-fired detonator from initiating the magazine and also, in conjunction with the striker assembly, prevents the detonator from being struck until the shell is clear of the muzzle.

Body

This is of brass and the lower portion is screw-threaded externally to the 2-inch fuze hole gauge. The upper conical portion has a flat top, a lateral threaded hole in the side for a set screw to secure the guide bush, and two key holes to take the No. 121 fuze key for inserting or removing the fuze. A lateral threaded hole in the lower threaded portion is for a set screw to secure the magazine.

The body is bored from both top and bottom to leave a diaphragm with a hole in the centre for the point of the striker. An annular recess at the top of this hole houses the lower end of the arming spring to prevent it being trapped under the flange of the striker spindle. Two other holes, diametrically opposite, act as vents to relieve pressure in the lower compartment should a detonator fire on the shock of discharge. One of these holes is immediately over the detonator when the shutter is in the closed or safe position.

The upper boring contains most of the striker assembly and is screw-threaded at the top to take the guide bush. The lower boring contains the shutter assembly and magazine and is screw-threaded at the bottom to take the magazine. Recesses in the under side of the diaphragm receive a hinge pin for the shutter and another for the locking weight in addition to one for a brass stop pin with fibre sleeve or a fibre stop pin. To prevent the magazine from fouling the shutter by being screwed too far in, two distance pieces are positioned in the shutter recess.

Guide Bush

The brass bush is formed with a coned flange in the middle to suit the contour of the body with the edge of the flange rounded. It is screw-threaded externally above the flange to take the safety cap and below the flange to enter the fuze body. It is secured by a set screw.

It is bored through the centre to form a guide for the striker. The upper end of the boring is enlarged to form a seating for the striker spring and cover, an annular recess at the bottom of the seating taking the turned out base of the cover. The lower end of the boring is formed with a countersunk edge to bear against the segments. A recess in the under-surface forms a seating for the arming sleeve.

Striker Assembly

The striker is assembled with its spring under compression between the striker head and the guide bush and with the point projecting through the central hole in the diaphragm of the body into a recess in the locking weight.

The striker sleeve and four segments are assembled around the striker spindle with the segments above the sleeve and between it and the countersunk portion of the guide bush. The segments are held in position by the arming sleeve which covers them, the arming sleeve being kept up in this position by the arming spring.

Set back of the arming sleeve on firing compresses the arming spring and frees the segments which then fall away or are displaced by centrifugal force. The striker spring is now able to carry the striker forward until the striker sleeve reaches the guide bush and the striker point is withdrawn from and thus frees the locking weight. In the fully armed position after leaving the muzzle, the detonator comes under the striker which is then kept off it by the striker spring assisted by creep forward. On

impact, the striker cover is crushed and the striker driven down on to the detonator.

Striker

The aluminium alloy striker has a separate mushroom shaped head secured by a split pin.

The striker spindle is circular in section, having a point at its lower end, above which is a flange to take the lower end of the striker sleeve. The upper end is reduced in diameter to fit the head and bored to take the split pin.

The striker head is bored centrally to fit the striker and radially for the split pin.

When assembled with the sleeve and segments, there is a small clearance between the bottom of the flange and the seating for the arming spring in the body diaphragm. This is to allow the striker to set back slightly on firing to relieve the pressure on the segments and allow them to fall away.

Striker Spring

This is a spiral of circular section steel wire and is assembled under initial compression between the striker head and the upper face of the guide bush. When the striker is released by the falling away of the segments, the spring carries the striker forward to withdraw the point from the recess in the locking weight.

Striker Sleeve

This cylindrical steel sleeve fits over the striker spindle, bearing against the upper face of the flange on the striker. The upper end is chamfered to bear against the lower countersunk edge of the segments.

Segments

The four brass segments together form a hollow cylinder around the striker spindle. The upper edges of the segments are chamfered while the lower edges are countersunk, viewing the segments as a cylinder. They are assembled between the guide bush and striker sleeve and keep the striker spring under compression until released by set back and centrifugal force, thus keeping the point of the striker in the recess in the locking weight.

Arming Sleeve

This is a hollow brass cylinder with the upper and lower edges turned over to form bearing surfaces for the arming spring and guide bush. The arming sleeve is assembled over the segments and above the arming spring which keeps it up in position until it is forced down by set back on firing.

Arming Spring

This is a spiral of circular section steel wire and is assembled over the striker sleeve between the arming sleeve and the bottom of the recess in the upper surface of the body diaphragm.

Set back of the arming sleeve on acceleration compresses the spring. After the segments have fallen away and acceleration has ceased at the muzzle, the spring reasserts itself and restores the sleeve to its original position.

Striker Cover

This brass dome-shaped cover fits over the striker head and is secured by the bottom ridged edge being crimped into an annular groove at the base of the upper recess of the guide bush.

The cover prevents air resistance during flight from reacting on the striker head to cause premature action of the striker.

The cover must not be removed when preparing the fuze for loading. The words "DO NOT REMOVE" are embossed on the top.

Safety Cap

This black-painted steel dome-shaped cap has a flat steel spring riveted into an oblique slot in the side. The free end of the spring engages on the milling on the guide bush and retains the cap in position. The cap has a milled ring around its circumference and is screw-threaded internally at the lower end for attachment to the guide bush.

The cap must be removed before firing, but NOT the striker cover underneath (*q.v.*). Up to the end of 1942, a warning label, L.1914, was attached to the safety cap and read as follows:

IMPORTANT
WHEN PREPARING THIS FUZE FOR FIRING
THE BLACK STEEL SAFETY CAP ONLY IS
TO BE UNSCREWED AND REMOVED

Detonator and Shutter Assembly

This consists of the shutter with detonator, locking weight and shutter spring. It is assembled under the body diaphragm and above the magazine.

Both the shutter and locking weight are designed to be rotated by centrifugal force about their hinge pins on the underside of the body diaphragm. The detonator is carried on one arm of the shutter and the striker recess is on the free end of the locking weight.

In the safe position the locking weight is under the striker and the detonator is displaced from both the striker and the channel to the magazine. The shutter is prevented from opening by a toe on the locking weight engaging a recess in the side of the shutter while the locking weight is kept in position both by the shutter spring and by the striker point engaging the top recess.

On release of the striker, the locking weight is freed and as soon as set back ceases on deceleration after leaving the muzzle, it swings out under centrifugal force. In doing so, its toe starts the shutter turning towards the armed position. It then continues to turn gently under centrifugal force until it comes up against the stop pin with the

detonator under the striker. The gentle rotation of the shutter is designed to avoid any shock to the detonator and the stop pin is of fibre or fibre covered for the same reason.

Shutter

The shutter which may be of brass or mazak with a brass inset, is bored through its centre for its hinge pin and has a recess in the top of one end for the detonator. The other end is enlarged to form a weight to operate under centrifugal force.

A recess machined in the side forms a working surface for the toe of the locking weight which locks it at rest and starts it rotating to the armed position on leaving the muzzle.

The shutter is designed to open efficiently when the shell is spun between 1800 and 2200 revolutions a minute.

Detonator

This consists of a copper alloy shell containing two grains of detonating composition and three grains of lead azide, all retained by a brass disc and brass washer, secured by turning over five tabs on the shell. It is placed in its recess in the shutter, followed by a glazeboard washer and a brass washer, the whole being retained by spinning over the edge of the recess.

Locking Weight

This is an arc-shaped fitment of brass or mazak located above the magazine and below the body diaphragm. It is forked at one end to receive the shutter spring and bored vertically for the hinge pin. The other end is formed with a toe, which is machined to act as a working surface in the recess in the side of the shutter. The upper surface of the toe is recessed to take the point of the striker.

In the safe position the shutter spring keeps the toe engaging the recess in the side of the shutter and assists in preventing it opening. The striker point is also in the recess in the top of the locking weight and thus prevents the shutter opening whilst the fuze is at rest and until acceleration has ceased in the gun.

Shutter Spring

This is a spiral steel spring with two free ends. It is assembled on the hinge pin of the locking weight, one end bearing against the edge of the fuze body recess and the other engaging the forked end of the locking weight.

It keeps the toe of the locking weight engaged in the recess in the side of the shutter until overcome by centrifugal force, acting on both locking weight and shutter.

Magazine

This is of brass or mazak. The main upper portion is screw-threaded externally to suit the body whilst the bottom part is reduced in diameter for the bottom cap. It is secured in the body by a set screw at the side.

The magazine is bored from the base in two diameters, the larger bore containing a C.E. pellet which is assembled with the hard end nearest to the bottom cap, a paper disc being shellacked to the top surface. The smaller bore terminates in a diaphragm from 0·003 to 0·008 of an inch thick and is filled with stemmed C.E.

Bottom Cap

This may be of brass, aluminium alloy or steel and is screw-threaded internally to suit the magazine. It screws over the bottom of the magazine and retains the C.E. pellet. After filling the cap is crimped in two or more places to prevent it unscrewing.

Mark 15 (not illustrated)

This is similar to the Mark 8 except that:

The striker and striker head are of steel.

The striker cover is thicker and the striker head is of smaller diameter.

Mark 14 (not illustrated) **(NOT to be used with reduced charge)**

This is the same as the Mark 8 except for a thicker striker cover and smaller diameter striker head.

Mark 13 (not illustrated)

This differs from the Mark 8 in the following respects:

Thicker striker cover and smaller diameter striker head.

Steel striker, striker head, guide bush, magazine and body.

Mark 12 (not illustrated)

This differs from the Mark 8 in the following respects:

Thicker striker cover and smaller diameter striker head.

Steel striker and striker head.

Only one distance piece in the magazine recess.

Mark 11 (not illustrated)

This differs from the Mark 8 in the following respects:

Thicker striker cover and smaller diameter striker head.

Steel striker and striker head.

Only one distance piece in the magazine recess.

Shutter of brass only and of a slightly different design.

Mark 10 (not illustrated)

This differs from the Mark 8 in the following respects:

Thicker striker cover and smaller diameter striker head.

Steel striker and striker head.

Mark 4 (not illustrated) **(NOT to be used with A.A. ammunition)**

This is the same as the Mark 8 except that the striker, striker head, guide bush, magazine and body are of steel.

Mark 3A (not illustrated) **(NOT to be used with A.A. ammunition)**

This is the same as the Mark 8 except that the striker and striker head are made of steel.

Mark 3 (not illustrated) **(NOT to be used with A.A. ammunition)**

This differs from the Mark 8 in the following respects:

Striker and striker head of steel.

A single distance piece in the magazine recess.

Mark 2 (not illustrated) **(NOT to be used with A.A. ammunition)**

This differs from the Mark 8 in the following respects:

Steel striker and striker head.

Only one distance piece in the magazine recess.

Shutter of brass only and of a slightly different design.

Action

On Firing

The arming sleeve set back and compressing the arming spring, uncovering the segments. This movement, combined with a slight set-back of the striker, releases the segments which either fall clear or are displaced by centrifugal force.

On leaving the Bore

The striker spring reasserts itself and forces the striker and striker sleeve forward until the sleeve meets the guide bush and the striker point is withdrawn from the locking weight. This allows the locking weight to revolve by centrifugal force and in doing so its toe starts to turn the shutter into the armed position. The shutter continues to revolve gently by centrifugal force until it reaches the stop pin and the detonator comes under the striker.

The striker is now fully armed, the striker point being held clear of the detonator by the striker spring assisted by creep forward.

On Impact

The striker cover is forced on to the striker head and the striker forced down for its point to pierce the detonator. The resulting detonating wave passes through the magazine diaphragm to the C.E. in the magazine channel and magazine.

F. 208

FUZE, TIME, No. 208

Particulars

Type . . .	Mechanical, Thiel Movement						
Time of Running .	43 seconds maximum						
Fuze Mark . .	1	2	3	4	5	6	
Guns for which the particular mark of fuze is approved	3·7-in. Mks. 1 to 3 3·7-in. Mk. 6 (Fuzes made by R.O.F. (B) *only* 5·25-in. Mk. 2				3·7-in. Mk. 6		
Projectiles . .	H.E. shell and practice projectiles						
Fuze Keys — Inserting and Removing	Implements, Ammunition, Keys No. 223 and 175						
Fuze Keys — Setting .	Implements, Ammunition, Key No. 140						

Description

Mark 3 (see Fig. 19)

General

The fuze consists of a body containing a clockwork mechanism ("Clock") or movement with striker, detonator, shutter and magazine and covered by a dome and cap.

The exterior of the body is threaded at the bottom to screw into the nose of the shell, a copper and asbestos washer being put between fuze and shell to make a gas-tight joint.

The top of the body is enlarged and shaped to conform to the shell contour, this contour being maintained by the top part of the dome and the cap fixed on top of it.

The interior of the body is divided by a platform. The upper part contains the movement, a recess in the underside of the platform takes the detonator, and the bottom part contains the shutter and magazine.

The dome covers the top of the clock and can be rotated in the fuze body. The dome is retained by a screwed collar which bears down on to a spring tensioning ring over a flange at the foot of the dome. Adjustment of the screwed collar varies the stiffness or "tension" of the fuze.

Inside the dome at the top is a locking weight. Set-back of the weight on firing drives in locking pins to join the dome to the body and lock the dome as set. Beneath the locking weight is a platform or hand race, across which a shaped slot is cut. Rotation of the dome positions the slot and thereby sets the fuze.

The mechanism rotates a spring-loaded hand beneath the hand race.

The clock is driven by a mainspring and controlled by an escapement through a train of gear wheels.

The movement is started by the firing of the gun, the hand being released for rotation by the set-back of a trigger. A muzzle safety bridge prevents the hand from rising until 0·72 seconds after firing. Thereafter the hand bears on the under surface of the hand race until, at the end of the time as set, it has rotated until it is coincident with the slot in the hand race into which it rises.

The hand is mounted on a hollow hand centre, the rim of which engages a tip on the end of a lever fixed to the top of the striker. A cam on the striker rests on a pillar and the rising of the hand releases the lever which allows a striker spring to rotate the cam off the pillar and force the striker down on to the detonator and thus initiate the magazine. The striker is prevented from reaching the detonator before the shell leaves the muzzle by a centrifugal safety catch.

A shear wire between the body and dome prevents the dome being moved accidentally before loading; the tensioning ring prevents accidental movement of the dome during loading; the shutter stops a prematurely fired detonator from initiating the magazine; the trigger prevents the hand rotating until the gun is fired; the centrifugal safety catch stops the striker reaching the detonator before the shell reaches the muzzle and the muzzle safety bridge prevents the hand rising until the shell is well clear of the muzzle.

Body

This is of brass, the lower part being cylindrical and the upper part enlarged over a flange and coned at a radius of eight calibres when measured in conjunction with the shell for the 3·7-in. Mks. 1 to 3 guns.

The lower half of the bottom part is plain and the upper half is screw-threaded to the 2-in. fuze hole gauge. On the plain portion is a hole for a set-screw for fixing a magazine securing ring. In the threaded portion is a radial hole, closed by a plug, to give access to a regulator screw in the clock, and above this, three equidistant holes for screws to hold the movement to the body.

Under the flange is a small oblique hole for a grub screw to secure the screwed collar.

At the bottom of the upper coned part of the body is a small recess to take the head of the No. 223 fuze key and there are also two grooves diametrically opposite for the No. 175 fuze key. Either key can be used for inserting or removing the fuze. (The recess was introduced in 1945 and the grooves will be omitted in future manufacture.)

Two recesses near the bottom are to take the spring-loaded plungers of pawl type fuze keys (*e.g.* No. 140) for setting the fuze.

At the bottom is a radial hole for a shear wire, the inner end of the wire engaging a recess in the flange of the dome when the fuze is set to SAFE on assembly.

The top of the coned surface is graduated for nearly the whole circumference in quarter divisions from $\frac{3}{4}$ to $28\frac{1}{2}$, each whole division or "fuze length" being numbered from 1 to 28. A safety mark filled in with red paint and with the word SAFE engraved below, is on the ungraduated portion.

The interior of the upper part of the body forms a bearing for the dome and is screw-threaded to take the screwed collar to secure it.

The internal platform is formed by recessing from both top and bottom. The clock rests on top of the platform, being positioned from underneath by two dowel pins nearly diametrically opposite, and secured by three equidistant screws inserted from underneath.

Near the circumference of the platform is a hole for a detonator holder and underneath an eccentric counterbore for the flange of the holder with two screw holes for fixing it.

The bottom part of the body contains the magazine which is positioned by two dowel pins to the body platform. It is screw-threaded internally to take the magazine securing ring.

Movement

(see Fig. 20)

The clock is assembled as a complete unit and fixed to the top of the platform in the fuze body.

A detailed description is given under "Mechanism, Time, 45 seconds".

Dome

The aluminium alloy dome is cylindrical in shape with a flange at the base to take the tensioning ring. The top part is coned to conform to the fuze contour.

A small recess in the side of the flange registers with a radial hole in the fuze body when the fuze is set at SAFE. During assembly the shear wire is inserted to lock the dome at SAFE. It is sheared on setting the fuze. (This feature was not introduced until late 1942.)

The dome is assembled on a washer inserted on the bearing surface inside the enlarged upper portion of the fuze body. It is held in position by the screwed collar.

On the coned portion are two recesses for the spring-loaded plungers of pawl type fuze keys. A vertical indicating line is engraved for reading the fuze setting and the fuze number (208) and mark, manufacturer's initials and date of manufacture are stamped on the other side. At a slightly higher level and to one side is stamped the mechanism number.

The interior of the dome is recessed from both top and bottom to form a platform and hand race near the lower end. The lower and smaller recess covers the top of the clock and the upper recess houses the locking weight.

The lower surface of the platform forms a race-way for the hand of the clock and a diagonal slot shaped as a silhouette of the hand allows the hand to pass through at the end of the time as set. A small hole through the hand-race gives access to the trigger for arming it when testing.

Above the hand-race is the locking weight consisting of one large disc with three smaller ones fixed to it underneath by four screws. The large disc is fixed by three copper shearing pins to the wall of the dome. The small discs project partly beyond the edge of the large disc and the projecting portions are accommodated in slots cut in the inside wall of the dome. Vertical holes from each of these slots to the bottom of the dome take three locking pins. On firing, the shearing pins are sheared as the locking weight sets back on to the locking pins and drives them downwards. The pointed ends of the pins are thus wedged between the dome and recesses in the body, locking dome and body firmly together. This action prevents any alteration of fuze setting after firing.

The top of the dome is screw-threaded internally to take the cap and a small hole in the side takes a set-screw to secure it.

Screwed Collar

This cylindrical brass sleeve is threaded on the outside to engage the threads on the inside of the fuze body. The top is coned to conform to the fuze contour and four equidistant slots in the coned portion are for a tool used for assembly and for adjusting the collar.

The collar is assembled round the dome and screwed down on to corrugated steel spring wire tensioning ring above the flange at the base of the dome. Adjustment of the collar varies the pressure of the dome on the body. This pressure or "tension" is adjusted during assembly to resist a torque of about 225 inch-ounces which is sufficient to prevent movement of the dome during loading. After the tensioning has been done the screwed collar is fixed by a grub screw inserted from the under-side of the body flange.

Cap

This ballistic cap of aluminium alloy or plastic material is screwed into the upper end of the dome and secured by a set-screw. Two holes diametrically opposite are for an assembly tool. (They should *not* be used for inserting or removing the fuze.)

Detonator Holder

This cylindrical brass holder has an eccentric flange at the base for two fixing screws. Internally the top is recessed to take the detonator and below this is bored to form a small flash channel.

It is inserted in the platform from underneath with the detonator immediately beneath the striker.

Detonator

This consists of a copper shell containing three grains of lead azide topped with two grains of D.C. "A" mixture. The filling is covered and pressed in by a brass washer and disc and secured by turning over lugs on the top of the shell.

Magazine

This is of brass and is screw-threaded externally at the bottom to take a bottom cap. It is bored from the underside to form a chamber to take a C.E. pellet, the pellet being held in by the bottom cap over a cloth washer.

A collar is formed towards the top of the magazine, the under-surface of which forms a bearing for the magazine securing ring. The top forms a platform for the shutter assembly.

A diagonal slot across the top accommodates the sliding shutter. Two dowel pins in recesses form pivots for the shutter springs and position the magazine to the fuze body platform.

A small channel, off centre, with a diaphragm left at the top, leads from the shutter slot to the chamber. It is filled with stemmed C.E.

The magazine is held in position by the magazine securing ring.

Bottom Cap

This may be of brass, aluminium alloy or steel, and is screw-threaded internally to suit the magazine. It screws over the bottom of the magazine and retains the C.E. pellet. After filling the magazine, the cap is crimped in two or more places to prevent unscrewing.

Shutter

The brass shutter slides in the shutter slot on the top of the magazine.

At one end is a diagonal channel filled with C.E. Small holes in the sides of a recess at the other end of the shutter take the ends of the two steel shutter springs which pivot on dowel pins and keep the shutter at the centre in the closed or safe position. In this position the diagonal channel is clear of both the detonator and magazine channels and the detonator is blocked by the solid part of the shutter.

When the shell is in flight and the spin of rotation of the shell exceeds 4,500 r.p.m., centrifugal force overcomes the springs and pulls the shutter outwards to the open or armed position. In this position the detonator, shutter channel and magazine channel are all in line.

Magazine Securing Ring

This is a brass collar screw-threaded on the outside to enter the fuze body from underneath. It surrounds the magazine and secures it by bearing on the under-surface of the collar formed on the upper part of the magazine. The ring is secured by a set-screw inserted from the side of the plain portion on the bottom of the fuze body. Four slots at the bottom are for an assembly tool.

Mark 1 (not illustrated)

This is similar to the Mark 3, except that the pivots of the third, fourth and 'scape wheels are of smaller diameter. The pinions are also smaller and the gear ratio consequently slightly different.

There is no hole in the fuze body to take No. 223 fuze key.

Marks 2 and 4

These marks were allotted for fuzes identical to the Marks 1 and 3 fuzes respectively, except that the body and certain other components were to have been made of steel instead of brass. They were never put into production.

Mark 5 (not illustrated)

The fuze body is identical with the Mark 3, the only difference being in the fitting of the No. 3 mechanism with Duralumin third, fourth and 'scape wheels instead of brass. This mechanism is specifically regulated to suit the ballistics of the 3·7-in. Mk. 6 gun.

Mark 6 (not illustrated)

The fuze body is identical with the Mark 3, the only difference being in the fitting of the No. 4 mechanism which has brass third, fourth and 'scape wheels as for the No. 2 mechanism in the Mark 3 fuze, but is fitted with a wider and stronger mainspring. The mechanism is specifically regulated for the ballistics of the 3·7-in. Mk. 6 gun.

Action

Before Firing

The setting of the fuze rotates the dome and thus positions the hand-race slot. In rotating the dome the shear wire is broken.

On Firing

The locking weight sets back, shearing the shearing pins and driving the locking pins downwards to lock the dome to the body and thus prevent any alteration of fuze setting.

The trigger sets back and frees the hand rotationally.

On leaving the Bore

The clock starts and the hand begins to rotate.

The centrifugal safety catch flies outwards to leave the striker supported only by its cam resting on the pillar.

The shutter slides outwards to bring the fire channel in line with both detonator and magazine channels.

When the shell is well clear of the muzzle, 0·72 seconds after firing, the hand clears the muzzle safety bridge and bears on the lower surface of the hand-race.

At the End of the Time as Set

The hand reaches the hand-race slot into which it rises. This releases the lever which allows the striker spring to force the cam off the pillar and the striker down on to the detonator. The resulting detonating wave passes through the C.E. in the shutter, the diaphragm above the magazine channel and the C.E. in the magazine channel and initiates the magazine and thus the main shell filling.

Safety Arrangements

Shear Wire

With the shear wire intact and in position as issued, accidental movement of the dome away from SAFE is

A small channel, off centre, with a diaphragm left at the top, leads from the shutter slot to the chamber. It is filled with stemmed C.E.

The magazine is held in position by a magazine securing ring.

Bottom Cap

This is of zinc alloy and is screw-threaded internally to suit the magazine threads. It screws over the bottom of the magazine and retains the C.E. pellet. After filling the magazine, the cap is crimped in two or more places to prevent it unscrewing.

Shutter

The brass shutter slides in the shutter slot on the top of the magazine. At one end is a diagonal channel filled with C.E. Small holes in the side of a recess at the other end of the shutter take the ends of the steel shutter springs which pivot on the magazine dowel pins and keep the shutter at the centre in the closed or safe position. In this position the diagonal channel is clear of both the detonator and magazine and the detonator is blocked by the solid part of the shutter.

When the shell is in flight and the speed of rotation exceeds 4,500 r.p.m., centrifugal force overcomes the springs and pulls the shutter outwards to the open or armed position. In this position the detonator, shutter channel and magazine channel are all in line.

Magazine Securing Ring

This is a zinc alloy collar screw-threaded on the outside to enter the fuze body from below. It surrounds the magazine and secures it by bearing on to the underside of the collar on the upper part of the magazine. The ring is secured by a set-screw inserted from the side of the plain portion on the bottom. The fuze in the set-screw may be omitted and the ring secured by staking through the set-screw hole. Four slots at the bottom are for an assembly tool.

Alternative Designs (Not allocated distinctive marks)

1. Dome Assembly

This consists of a dome and top cap. The dome covers the clock and has an internal platform to carry the hammer spring and setting pin.

Dome

This is an aluminium forging, is cylindrical in shape with a flange at the foot to take the tensioning ring. The top part is coned to conform to the shell contour, and is screw-threaded internally to take the top cap with a small hole in the side for a set-screw to secure it.

On the coned portion are two recesses for the spring-loaded plungers of pawl type fuze keys; a vertical indicating line is engraved on one side for reading the fuze setting and on the other side is stamped the fuze number (214), manufacturer's initials and date of manufacture.

The interior of the dome is bored from both top and bottom to leave a ring-shaped platform at the centre. The lower part covers the top of the clock and the platform has two screwed holes on one side for screws to fasten the hammer spring, and, diametrically opposite, a screwed hole for the setting pin.

The dome is assembled on a washer inserted in the bearing surface inside the enlarged upper portion of the fuze body. It is held in position by the screwed collar.

Top Cap

This is a hollow aluminium forging, the base of which is screw-threaded externally to enter the top of the dome to which it is secured by a set-screw. Two recesses at the base of the coned portion are for an assembly tool.

Hammer Spring

This is secured to the internal platform in the dome by two securing screws.

2. Dome Assembly

This is a single aluminium forging forming a combination dome and top cap and is similar to the assembled dome and top cap as described above.

3. Body

This differs from the body already described in that the internal platform is prepared to take an alternative design of detonator holder.

Near the circumference of the platform is a plain hole for the centre of the detonator holder with a small screwed hole on either side for the detonator holding screws, while the under-surface is recessed to take the flange of the holder.

Detonator Holder

This consists of a cylindrical brass holder with two opposite flanges at the base for the holding screws. Internally the top is recessed to take the detonator holder and below this is drilled to form a small fire channel.

It is inserted in the body platform from underneath.

Action (Mark 1)

Before Firing

The setting of the fuze rotates the dome and setting pin and thus positions the timing disc.

On Firing

The hammer's set-back and flatten the bent-up lug of the timing disc and thus free it.

The set-back pin drops down through its retaining spring and ceases to act as a stop to the pin protruding from the shaft of the firing arm and frees the firing arm.

On leaving the Bore

The safety lever of the escapement rotates centrifugally to release and help to start the escapement oscillating.

The centrifugal gear segments start to drive the clock to keep the escapement going and rotate the timing disc.

The shutter is pulled outwards to bring its fire channel in line with both detonator and magazine channels.

After 1·67 seconds the firing slot of the timing disc has rotated clear of the safety disc.

At the end of the Time as Set

The timing disc has rotated to bring the firing slot up to the finger of the firing arm. The finger slips into the slot and in doing so, rotates the firing arm and shaft. This releases the striker safety plate and allows the striker spring to drive the striker down on to the detonator. The resulting detonating wave passes through the C.E. in the shutter, the diaphragm above the magazine channel and the C.E. in the magazine channel and initiates the magazine and main shell fillings.

Safety Arrangements

Tensioning Ring

This prevents accidental movement of the dome during transport, handling and loading.

Centrifugal Drive

No energy is available for running the clock and rotating the timing disc until centrifugal force is created by rotation of the shell.

Set Back Pin

This stops the firing arm rotating before the gun is fired.

Shutter

This prevents a prematurely fired detonator from initiating the magazine and main shell filling. A detonator fired before the shell is loaded into the gun would result in a blind.

Striker Safety Plate

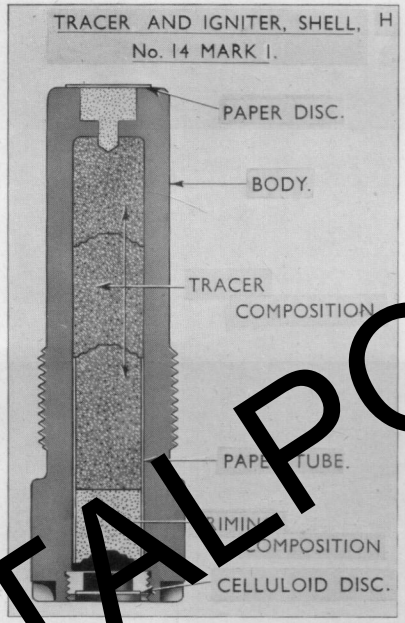
This stops the striker from reaching the detonator should the firing arm be rotated before the shell reaches the muzzle.

Safety Lever

This locks the escapement and prevents the clock starting until the shell is clear of the muzzle.

Safety Disc

This prevents the firing arm rotating until 1·67 seconds after firing by which time the shell is well clear of the muzzle. This device operates if the fuze is set too short.



Mk. 1 (illustrated)

This differs from the Mk. 2 in the shape of the smaller forward compartment and the closing of the tracer compartment by a celluloid disc and screwed ring. The filling is similar to the Mk. 2.

Action (All Mks.)

On firing, the propellant gases force in the closing cup and ignite the priming composition which in turn ignites the tracer composition. Should the shell not function by D.A. action, the tracer composition burns through to the gunpowder which ignites and explodes the shell filling.

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APPENDIX H—*contd.*

METHODS OF FILLING

(Where more than one item is shown below, these are alternatives)

Gun	Projectile: Filled Nature	Mk.	Empty Nature	Mk.	Method of Filling Design Number	Tracer and/or Igniter: Nature	Type	Igniter Pellet: Nature	Weight gr.	Main Filling: Nature	Weight * lb.	oz.	dr.	Depth of Nose Cavity (ins.)	Sur-round	Top-ping	Smoke Box or Pellet: Container	Nature	Weight oz.	dr.	Flash Pellet: Nature	Weight oz.	dr.	Exploders: Main (Bottom) Nature	Weight oz.	dr.	Supplementary (Top) Nature	Weight oz.	dr.	Gaine No.	Fuze No.	Plug Fuze Hole
40 m.m.	H.E.	2	H.E.	2	DD/L/19675	T. and I.	No. 11	G.20	55	RDX/TNT 60/40		2	6	1·7									C.E.		3					251	Mk. 7
		4		4						RDX/TNT/Al 91/9		2	6	1·7									T.N.T.		3					255	
	Practice Projectile	2T	H.E.	2 4	DD/L/12409	T. and I.	No. 12			S.R.274		1	4	1·7																251 255	Mk. 7
	Practice Projectile	3T	H.E.	2 4	DD/L/13568	T. and I.	No. 12			S.R.274		1	8	1·7																251 255	Mk. 7
	Practice Projectile	6	H.E.	2 4	DD/L/14479	T. and I.	No. 11			G.12 S.R.274																				251 255	Mk. 7
	Practice Projectile	9	H.E.	2 4	DD/L/17062	T. and I.	No. 14			G.12 S.R.274																				251 255	Mk. 7
	S.A.P. Shot	1	S.A.P. Shot	1	No filling																										
	S.A.P. Shot	2T	S.A.P. Shot	2T	DD/L/13074† DD/L/16147B†	Integral Tracer	Cavity																								
	S.A.P. Shot	3T	S.A.P. Shot	3T	DD/L/13074† DD/L/16147B†	Integral Tracer	Cavity																								
	S.A.P. Shot	4T	S.A.P. Shot	4T	DD/L/14187† DD/L/16147A† D2/L/1450/GF/121	Integral Tracer	Cavity																								
	A.P. Shot	2T	A.P. Shot	2T	DD/L/13074† DD/L/16147B†	Integral Tracer	Cavity																								
	A.P. Shot	4T	A.P. Shot	4T	DD/L/14187† DD/L/16147A† D2/L/1450/GF/121	Integral Tracer	Cavity																								
	A.P. Shot	6T	A.P. Shot	6T	I.G.4045 (Canada)	Integral Tracer	Cavity																								
	Practice Projectile (Rep.Shot)	4T	H.E.	2	DD/L/14107	T. and I.	No. 11 No. 12			H.E.S.																					Rep. FZ. 251
	Practice Shot	4T	Practice Shot	4T	I.G.4046 (Canada)	Integral Tracer	Cavity																								
	Practice Shot	6T	Practice Shot	6T	DD/L/14218† DD/L/16147A† D2/L/1450/GF/121	Integral Tracer	Cavity																								

* Design weight for filling, plus exploder † Obsolescent