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TEXT BOOK

OF

AMMUNITION

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1945

5-8

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The War Office,
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PREFATORY NOTE

The information contained in this pamphlet is accurate and covers development up to July, 1944.

1. Cover, page 2.

PREFATORY NOTE. *Add* at end of paragraph :—

Details of development, etc., up to 31st December, 1946, are given in Addendum No. 1 (1947) notified in A.C.I. **667** of 1947.

CONTENTS

GRENADES

CHAPTER I

DESIGN

1. Definition

Grenades are small bombs suitable for throwing by hand or for firing from a rifle or from a projector. They may contain high explosives for anti-personnel or anti-tank use, or for demolition purposes; smoke-producing materials for screening purposes; signal or illuminating compositions; incendiary compositions; or chemicals.

2. Means of projection

The earliest grenades were designed to be thrown by hand, and this is still the main means of projection, the grenades being spherical, egg-shaped, or cylindrical, and some fitted with wooden throwing handles in an attempt to obtain a greater throwing range. With the latter, ribbons were sometimes attached to the handle to enable the grenade to fly nose first and thus make it possible to use a percussion nose fuze.

The limited range obtainable by throwing, however, led to the introduction of new weapons or modifications to existing types and these may be classified as shown below.

(*a*) *Special projectors*, such as the Japanese 50-mm. grenade thrower, the Northover Projector, and the last war German "Granatenwerfer". The Japanese weapon is a small mortar with which range alterations are obtained by varying the chamber capacity. The Northover Projector is a simple, smooth bore barrel mounted on a tripod and fires grenades No. 36M, No. 68 and No. 76 by means of a gunpowder charge. The German weapon was really a small spigot mortar.

(*b*) *Rodded grenades.*—With this type the grenade had a long steel rod screwed into its base, the rod being a sliding fit in the bore of the rifle. The range could be varied in some cases by varying the length of rod inserted into the barrel.

The disadvantages of this system were very serious, for, in addition to the potential damage due to recoil effects which is always attendant on the firing of comparatively heavy grenades from a rifle, the action of the steel rod on the bore rapidly rendered the weapon unfit for its normal role. The grenades were also awkward to carry and tended to be rather inaccurate. Rodded grenades are now obsolete.

(*c*) *Smooth bore discharger cup.*—This method makes use of a small cup attached to the rifle and overcomes part of the disadvantage of the rodded grenade. In this method the range can be varied by altering the elevation of the rifle, or by the use of gas ports which allow a greater or less portion of the propellant gases to escape. The use of gas ports may lead to inaccuracy by occasional projection of unburned propellant through the ports.

(*d*) *Rifled discharger cup.*—In this system the discharger cup is rifled and the grenade has a pre-engraved driving band. On loading, the rifling of grenade and discharger are matched and the grenade twisted down into position. This method will give greater accuracy, a somewhat longer range and allows the use of a nose or base percussion fuze as required, but it has several drawbacks. The grenade must be limited in size to prevent the rifle twisting out of the firer's grip, or the weapon must be specially supported to overcome this effect. Further, the cup and its attachment to the rifle must be made strong enough to overcome this twisting effect, and the necessity of aligning the rifling of grenade and cup, then twisting the grenade into position, must entail a decrease in the rate of fire. This method is used by the Germans.

(*e*) *Spigot attachment.*—A very simple method of projection is to use a spigot tube attached to the forward end of the rifle. The grenade has a hollow tail tube closed at the end attached to the grenade body, and this fits over the projecting spigot. The tail tube becomes the " barrel " of the system. A low trajectory is used and range is varied by alteration of elevation. The spigot discharger has a number of advantages, the chief of which will be discussed later. It is a very handy device being merely a steel tube, 0·8 inches in diameter and 7 inches long, and much lighter than the discharger cup.

(*f*) Many types of spring gun and catapult have also been devised for projecting grenades.

It must be emphasized that the firing of grenades from rifles is at best an unsatisfactory operation, unless the weight of the grenade is greatly reduced; and it is capable of causing considerable damage to the rifle. This is one of the reasons for the introduction of the light 2-inch mortar, which was designed to make the use of a rifle discharger a matter of emergency only. In certain types of fighting, however, such as jungle warfare, the rifle dischargers may prove superior to the light mortar in general handiness.

The cartridges used for grenade projection are, in the British service, of the unbulleted type with a suitable rapid burning propellant (*see* Pamphlet No. 5). Various foreign powers use cartridges with a hollow wooden bullet, and in the last war the French and Germans used rifle grenades with a channel through the centre, which allowed the passage of the bullet of the ordinary ball round used for projection. This bullet, in passing through the hole in the grenade, set off a delay system which subsequently initiated the explosive filling.

3. Design

A consideration of the factors affecting the design of grenades shows that some of them are inter-related in such a way that the best results can only be obtained by compromise. For instance, it is an advantage to have as big a charge of explosive or other filling as possible, but increase in this direction generally means an increase in the overall weight of the grenade, which will reduce the range and with the H.E. grenade, may bring the thrower within the danger zone of the bursting grenade. If the grenade is to be fired from a rifle there are also weight limitations imposed by the strength of the rifle barrel or stock.

While it is generally desirable that the range of a grenade, whether thrown or fired, should be the maximum obtainable with a reasonable degree of accuracy, the attainment of this ideal will involve a reduction in the weight of the grenade. When thrown by hand, the corresponding reduction in size of the danger zone, owing to the reduced content, while it would render the grenade less effective, might at the same time be an advantage in adding to the safety of the thrower; further, a larger number of grenades could be carried without increasing the load, a desirable feature from the point of view of transport. When projected from a rifle or other weapon, however, the safety of the user is to a great extent assured by the added range, and the loss in effectiveness at the target end becomes of greater importance. A lighter grenade will probably also be affected by the wind to a greater extent with a consequent loss of accuracy.

The solution, from the point of view of these contradictory requirements of range, weight, and danger zone, would appear to be the adoption of different grenades for throwing and for firing. This policy has been followed by certain foreign Powers, notably the French, who had three distinct types; an "offensive" grenade, depending mainly on blast effect, with a small danger zone, and suitable for use by troops in the open; a "defensive" grenade, giving good fragmentation with a relatively large danger zone, and suitable for use only by troops fighting from behind cover; and a rifle grenade. This method of

dealing with the problem has undoubted advantages, but the use of a single type of grenade for all purposes is better from considerations of manufacture and supply.

Even in the days when the grenade was almost invariably filled with high explosive and used as an anti-personnel weapon only, the question of design was a most intricate one. The features that are most desirable to incorporate were often contradictory, and further complications were introduced by the frequently incompatible requirements of the designer who had to study, among other things, the mechanical build-up and ease of manufacture of the grenade, and the user, who wanted a weapon that was absolutely fool-proof and of the greatest efficiency. Nowadays, when the grenade has been adopted for a much wider range of uses—including the attack of armoured fighting vehicles, the production of smoke screens, etc.—it is still more difficult to lay down any hard and fast principles of design, and it is in general necessary to consider each type of grenade individually, bearing in mind the use to which it will be put and the method of projection that will be employed.

There are, however, certain considerations that are generally applicable to all types, and even if, owing to some specific demand peculiar to a particular type of grenade, these requirements cannot always be fully satisfied, they will always have an important bearing on the design of any grenade.

(*a*) *Weight.*—Since the chief methods of projection of grenades at present are by throwing or by firing from an attachment to a rifle, the weight of any type of grenade is limited by the strength of the thrower or the risk of damage to the rifle. A maximum weight of about 1½ lb. is probably desirable, but this is exceeded in some instances.

(*b*) *Reliability.*—Certainty in action is more difficult to obtain with grenades than with most other forms of ammunition, owing largely to the difficulty experienced, particularly with the high explosive hand grenades, of water-proofing the interior of ammunition stores which have to be easily opened by the unit for the insertion of detonators. If blinds do occur, it is important that the blind grenades should be reasonably safe to handle.

The possibility of prematures at any stage, whether during storage or transport, or in actual use, should be eliminated.

(*c*) *Locking devices.*—Safety caps, retaining pins, protective lids, and similar devices should be of such a nature and size that they can be easily removed and, if necessary, replaced by a man wearing gloves and without the use of tools.

(*d*) *Manufacture.*—Ease and cheapness of manufacture are desirable requirements. The big expansion in the demand for this type of weapon in time of war means that production may have to be carried out by unskilled labour in factories originally designed for other purposes. This requirement has a bearing on (*b*) above, since it involves a simplicity in design which may militate against absolute reliability.

(*e*) *Inspection.*—The grenades must be easy to inspect.

(*f*) *Packages.*—They must be packed in suitable man loads and stand any form of transport and storage to which they may be subjected in the field, even if the detonators are carried in the same package as the grenades.

Grenades filled with high explosives are in general more dangerous to the user than are other types, and the requirements set out in the following paragraphs relate particularly, although not entirely, to this type of grenade.

The danger zone should be such that the average man can throw the grenade far enough to keep himself outside that zone. With the rifle grenade this requirement is of smaller importance.

The grenade should be designed so that it will not explode if it is accidentally dropped by the user after the removal of the safety device. This implies an arming mechanism of a type which acts as an additional safety device until

the grenade has travelled far enough for the user to be outside the danger area of the bursting grenade. With rifle grenades, the force of setback might be employed to arm a fuze, or the flash from the propellant or the passage of a bullet through a channel in the grenade might be used to ignite a train of explosives incorporating a delay.

The use of safety fuze which is ignited at the instant the grenades leaves the hand—as in No. 36M grenade—is clearly not in accordance with this condition, but the simplicity of this method of initiation has advantages in manufacture and assembly which might be held to outweigh, in this instance, the disadvantage of a slightly increased risk to the user.

This type of grenade, employing a length of safety fuze with a specified delay, has several further disadvantages in use. In the first place it is not safe if dropped by the user after the safety device has been removed. It is not possible for the user to make any alteration in the length of the safety fuze, and hence in the time of delay of the grenade. It is important that the delay should not be too long, or the enemy will either be able to take cover after the grenade has been thrown, or may even be able to pick up the grenade and throw it back. The delay should therefore be no longer than the maximum time that an average thrower can keep the grenade in the air, and this has been found to be not more than four seconds. If, however, the same grenade is to be used for firing from a rifle, then a delay of four seconds is inadequate, and may result in the grenade exploding in mid-air. For this purpose a delay of at least seven seconds is desirable. If the one grenade is to be used for both purposes it is not possible to compromise, and the longer delay must be adopted, but this obviously detracts from the efficiency of the grenade for hand use. It has therefore been found desirable to produce grenades of this type suitable for use either by hand or with a rifle, but not both.

A further consideration is that safety fuze cannot absolutely be depended upon to give reliable results, particularly if bent at a sharp angle, and blinds, hangfires, or prematures may accordingly be expected when safety fuze is used. In spite of the simplicity of this type of initiation, therefore, there is a considerable weight of opinion in favour of some kind of percussion fuze.

The design of a percussion fuze for grenades, however, also presents some problems. Unless the grenade has a device such as a tail or cloth ribbons to keep it "nose on" to the target, it will not be possible to use a percussion nose fuze, and a fuze of the "Allways" type will be necessary. Such a fuze must, for reasons of safety to the user, incorporate a device that will not allow the fuze to be fully armed until it has travelled some distance from the thrower's hand or from the discharger cup or projector. Such a fuze has been in the service for many years and its latest modification, fuze No. 247, is used with several types of grenade. It has not, however, proved as reliable in action as the safety fuze type and for some purposes a striker mechanism employing a spring-actuated striker on a cap and safety fuze is still preferable.

Regarding the question of fragmentation, an important factor would seem to be the nature of the terrain and the normal conditions in which the grenade is likely to be used. For street fighting and for the attack of trenches, a grenade which breaks up into small fragments moving with a high velocity may be used with good effect and with comparative safety to the user; but in open country this type of grenade introduces a considerable element of risk to the thrower, and a grenade with a more limited danger zone may answer the purpose better. Such a type of grenade would have to depend less on the violent projection of metal fragments and more on blast effect.

Smoke grenades must be effectively sealed since if white phosphorus is used, leakages will be dangerous, and, if H.C.E. compositions are used, ingress of moisture produces a danger of spontaneous inflammation of the composition.

Chemical grenades must also be free from leakage and it is desirable that they do not arm as early as the other types.

4. Types of grenade

For the purposes of this book, grenades are classified according to their use as follows:

(*a*) Anti-personnel H.E. grenades.
(*b*) Anti-tank grenades.
(*c*) Smoke grenades.
(*d*) Signal and illuminating grenades.
(*e*) Training grenades.

These types are discussed individually in the succeeding chapters.

CHAPTER II

ANTI-PERSONNEL H.E. GRENADES

5. Introduction

Anti-personnel effect can be achieved with H.E. grenades in two ways—by fragments or by blast.

The fragmentation type has a relatively thick metal casing which will scatter a large number of lethal fragments over a considerable area. With this type, therefore, it is necessary for the thrower either to be well out of range of these fragments or to be behind solid cover. The No. 36M grenade is of this type.

The blast type of grenade, called by the French and Americans the " offensive " grenade, depends for most of its effect on the blast from the detonation. For this reason, the thrower is usually quite safe at a short distance from the burst and need not be behind cover. Such a grenade has a casing of light metal, the fragments of which are too small to have any lethal effect beyond the immediate vicinity of the burst, or of bakelite, rolled paper, or fabric, which normally give no lethal fragments. While it is true that this type of grenade kills in general only within a very short distance of the burst, it must be remembered that most of the grenades of this type contain one or two heavy metal components, which may prove lethal over a considerable distance.

The No. 69 is a grenade of this type and is described below.

6. Grenade No. 36M, Mark I (*Fig.* 1)

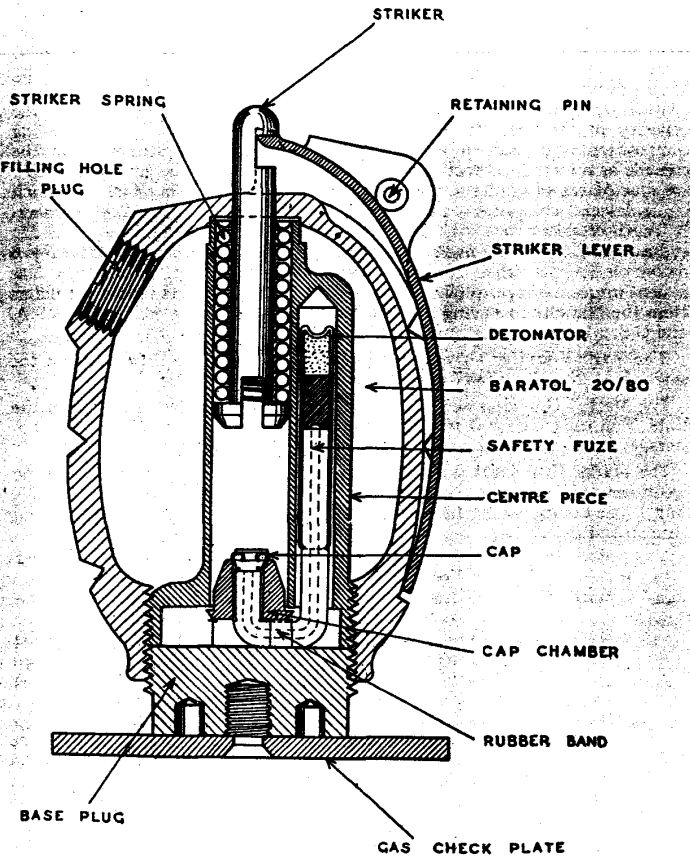
The body is oval in shape and made of cast iron, the wall being segmented in an attempt to control fragmentation. A screwed plug hole is formed in the side for filling the high explosive. There is a large-diameter hole in the base of the grenade body and a small hole diametrically opposite. The large hole is screw-threaded to take the centre-piece which accommodates the striker assembly and the igniter set. The centre-piece (which may be made of aluminium, steel or tinned brass, or may be a zinc alloy casting) screws into the base of the grenade, and its upper end fits into a recess against a lead washer at the top of the grenade. There are two sleeves in the centre-piece, the central one for the striker assembly, and the offset one of smaller diameter for the detonator of the igniter set.

The base plug screws into the same hole as the centre-piece, and can be removed for the insertion of the igniter set. When this grenade is used for firing from a rifle or projector, the base plug has a gas-check plate made of steel screwed on to it. This plate is a sliding fit in the discharger cup or the projector.

The steel striker has a flanged head with two nipples positioned to strike the rim-fire cartridge of the igniter set correctly. It is also slotted vertically

FIG. I.

GRENADE, NO. 36 M.



to allow the gases from the burning safety fuze to escape beyond the flange and so remove excessive pressure, which would alter the rate of burning of the safety fuze. The stem of the striker is surrounded by a spring which rests on the flange at the striker head, and which is under compression, pressing the striker downwards. The other end of the striker stem is slotted on one side, and while the spring is compressed this part of the striker projects from the top of the grenade. The end of the striker lever fits into the slot and prevents the striker from being forced down on to the rim-fire cap. The striker lever is made of rust-proofed steel. It has two trunnions projecting from it, which pivot on a fulcrum formed on the grenade body. It is curved to allow it to fit closely to the grenade body, and is retained in position by a retaining pin (commonly referred to as the safety pin), passing over it and through two holes in the fulcrum bracket.

As there are three holes through the body wall, it is difficult to ensure complete watertightness under normal conditions of storage in the field. It is therefore necessary to use a non-hygroscopic filling, and moreover, a filling which, even if it does get wet, will not attack the metals with which it is in contact. Baratol satisfies these conditions, and it is stemmed in to the capacity of the grenade, no fixed weight being specified. Waterproofing composition is pressed in around the striker where it protrudes from the grenade as a further protection against moisture entering the grenade. There are four Marks of igniter set in use with this grenade. The Mark II, which is obsolescent, comprises a rim-fire cartridge, seated in a zinc alloy chamber. A length of safety fuze with a burning time of about seven seconds, has one end attached to the rim-fire cartridge, and the other end crimped into a No. 6 detonator (copper-cased) containing fulminate composition. The safety fuze is bent into a U-shape to fit the centre-piece. The Mark III igniter set differs from the Mark II in having an aluminium-cased detonator containing A.S.A. and C.E. It also has a seven-seconds delay.

The Mark V igniter set uses the same detonator as the Mark III, but the safety fuze, No. 17, burns for four seconds only.

The Mark VII igniter set burns for four seconds also, but differs from the Mark V in using safety fuze No. 20 to overcome bituminous exudation in hot storage, a defect liable to occur with the Mark V.

The Marks II and III igniter sets are used for grenades which are to be fired from a rifle or projector, while the Mark V igniter set is for hand grenades only. The distinguishing features of the various Marks of igniter sets may be summarized as follows :—

Mark II ..	Yellow safety fuze ; copper detonator with the closed end convex.
Mark III ..	Yellow safety fuze ; aluminium detonator with the closed end concave.
Mark V ..	White safety fuze ; aluminium detonator with the closed end concave ; rubber band one-eighth of an inch wide around the safety fuze at the bend ; in later issues, a paper band has been used instead.
Mark VII ..	External appearance and identification as for Mark V. Originally known as the Mark VI, but the nomenclature was changed as a Mark VI already exists to an Indian design.

Weight of filled grenade—approx. 1 lb. 11¼ oz.

Action.—To prepare the grenade for use, the base plug is unscrewed and the igniter set inserted. The base plug is then replaced and screwed fully home. Before throwing, the retaining pin is withdrawn, the striker lever being held down by the hand holding the grenade. On throwing, the lever is released

and pivots on the fulcrum, being thrown clear and allowing the striker spring to force the striker down smartly on to the rim-fire cap. The firing of the cap ignites the safety fuze, which burns for the specified time before firing the detonator, which in turn detonates the baratol filling. When fired from a discharger cup or from a projector, the lever rests against the side of the cup or the bore of the projector until the grenade is clear of the weapon.

In addition to the possibility of a blind or premature with this grenade due to the use of safety fuze, certain other defects in the design or assembly may give rise to trouble.

(*a*) The offset position of the detonator, with the considerable air gap on one side of it formed by the striker sleeve of the centre-piece, may cause inferior detonation on that side and consequently uneven fragmentation.

(*b*) Where too much waterproofing composition has been used at the place where the striker enters the grenade body, this composition may work down on to the striker spring and cause its action to be sluggish. In severe cases this may weaken the striker blow to such an extent that it will not fire the rim-fire cartridge.

(*c*) Distortion of the lead washer in the recess that contains the head of the centre-piece may prevent the striker from moving down.

(*d*) After inserting the igniter set, if the base plug is not properly screwed home, the blow from the descending striker may knock the base plug and the igniter out of the grenade. The detonator will then function away from the grenade, with danger to the thrower, and the grenade itself will be blind.

(*e*) If the grenade falls on very hard ground such as rock or metalled roads, the body, being made of cast iron, may break open. If so, the igniter set may be thrown clear of the grenade, thus giving a blind.

(*f*) Pinholes in the cast centre-piece between the detonator sleeve and the striker sleeve have been found to be a very unlikely cause of prematures. Trials have been carried out with the partition between the two sleeves entirely removed, and the grenades so treated all functioned correctly.

Marking.—The grenade is varnished to prevent rusting. It has a filling ring of red crosses around the upper part of the body, and a green band round the middle.

Packing.—Old stocks of this grenade were packed in boxes stencilled " HAND OR RIFLE ". The present practice is for grenades to be packed either as HAND grenades or as RIFLE grenades.

Hand grenades are packed 12 in Box G.36, with 12 igniter sets Mark V or VII and one base plug key. The box is stencilled on each side with " 12 GRENADES HAND No. 36M MK: I ", the Lot number of the filled grenades, and filling details of the detonators. On each end of the box is stencilled " No. 36M HAND " and 20/80, three red crosses being superimposed on the fraction. On the lid " 4 SECS " is stencilled in two-inch lettering. The igniters are packed with the grenades in a circular tape-banded tin, in which they are supported by a wooden packing piece. Owing to the difficulty of obtaining properly seasoned wood for these packing pieces, some trouble has been caused by the effects of damp on the igniter sets. In some instances the caps have been found to be corroded, and this is a reasonably certain source of blind grenades. In other instances the moisture has caused exudation of part of the bituminous layer of the safety fuze, but trials appear to show that this has no effect on the functioning of the igniter set. In order to remove this source of trouble, igniter sets may in future be packed in grease-proof paper, ready bent to the correct shape for insertion into the grenade, or in tinned plate boxes with two perforated diaphragms replacing the wood block. The label on the tin is red, and gives detail of the Lot number, filler and date of filling.

Package dimensions .. .. .. 22 in. × 6¼ in. × 6½ in.
Filled weight .. .. 28 lb.

Rifle grenades are packed 12 in Box G. 36, together with :

12 igniter sets, Mark II or Mark III.
12 gas-check plates.
14 ballistite cartridges (either ·303 in. or ·30 in.).
1 base plug key.

The box is marked in a similar manner to the box containing hand grenades, with the substitution of the word RIFLE for the word HAND in the relevant places. On the lid is stencilled " 7 SECS ". If ·30-inch cartridges are packed with the grenades, the box has a red band painted round it, and " WITH ·30 CARTS " stencilled on the side. The Marks II and III igniter sets are packed in a similar way to the Mark V, but the label on the tin is yellow. The ballistite cartridges are in a rectangular tin with a label giving details of the contents. In the case of the ·30-inch cartridges, this label has a red band across it.

A new type of all-purpose key has been designed for this grenade and is suitably shaped to remove or replace the base plug, to recock the striker, and for use as a gauge to ensure that the detonator chamber is clear before inserting the detonator.

Package dimensions .. .. .. 22 in. × 6¼ in. × 6½ in
Filled weight .. .. 29 lb.

7. Fuze No. 247, Marks I and II (*Fig.* 2)

This fuze is used in grenades No. 69, No. 73, No. 77, No. 79, and No. 82. It is of the " Allways " type, *i.e.*, it functions on impact irrespective of how the grenade strikes, and is very similar to the fuze used in the old No. 54 grenade.

The body, safety cap and closing cup are of bakelite and the complete assembly screws into a recess in the top of the grenade, being held there by suitable cement.

The safety cap, milled on the outside, screws on to the top of the body in such a way that only about one-eighth turn is required to remove it. Because of the ease with which this cap can unscrew, it is always secured against accidental removal by a strip of adhesive tape attached to the body of the grenade and to the outside of the safety cap. The fuze body is screw-threaded internally to take the closing cup, the inner surface of which is concave to receive the large lead/antimony ball. Below the ball is the steel needle, its head also concave and having a hole in its stem through which passes the safety bolt. The needle has a double point since there is a danger that a plain-pointed needle would simply push the composition out of the base of the percussion cap instead of initiating it, the cap having a hole in its base closed only by a thin brass disc. Attached to the needle is a light creep spring, the other end of which rests on an internal shoulder of the cap pellet. This creep spring keeps needle and cap pellet apart in flight, the latter being in no way fixed in the body. The cap pellet carries the percussion cap containing 1·2 gr. D.C.A., which is secured by burring a thin lip of metal over its edge. Around the body is wound a length of tape having at its outer end a lead weight and at its inner end the safety bolt, which passes through the holes in the mechanism holder and the needle. This safety bolt holds the needle off the percussion cap

The letters " A " and " Z " are used after the mark to indicate the material used for the cap pellet as :

Mark IA—Brass cap pellet.
Mark IZ—Zinc alloy cap pellet.

The Mark II fuze is designed to give more certain functioning on impact by the use of a heavier cap pellet and a more powerful igniferous detonator.

The differences between Marks I and II are that the Mark II has:

(*a*) the cap pellet of lead/antimony alloy,
(*b*) a single point striker,
(*c*) a 1·7 gr. igniferous detonator.

Action.—The safety cap is removed and the grenade thrown. In flight the tape unwinds due to the lead weight, and the safety bolt is pulled free. This action leaves the needle and cap pellet separated only by the creep spring. If the grenade strikes fuze first, the cap pellet moves forward due to its inertia bringing the percussion cap into contact with the needle; landing base first, the inertia of the ball forces the needle down on to the cap; if the grenade lands on its side, the ball forces its way out of the concave surfaces of the needle head and closing cup and pushes the needle on to the cap. On impact at any other angle, the combined movement of ball and cap pellet will function the fuze.

The flash produced by the percussion cap initiates the detonator or priming composition contained in the body of the grenade.

From the action of the fuze it will be seen that the length of the tape governs the length of time required to arm it, and if a shorter arming range is required, it can be obtained by shortening the tape. This has been done with the grenade No. 82.

A further modification has been introduced when the fuze is used in grenade No. 79. To augment the flash from the percussion cap a strand of quick-match has been inserted in the flash hole of the fuze below the cap.

Marking.—The top of the safety cap and down the sides to the milling are painted to distinguish the various types as shown below:

Fuze	Cap Filled	Colour	Use
Normal	D.C.A. ..	Black (unpainted)	Grenades Nos. 69, 73, 77 & 79
Special (4¼-in. tape)	D.C.A. ..	Red	Grenade No. 82
Special	"B" Mixture	Green	Was used with early No. 79 grenades
Drill	Unfilled ..	White	For drill grenades

As a result of the introduction of the Mark II fuze, the number and mark of fuze will now be embossed on top of the safety cap.

8. Grenade, Hand, No. 69, Mark I (*Fig.* 2)

The body of this grenade is made of moulded plastic in two parts, the parts being screwed and cemented together before filling. In the upper part of the body is a screw-threaded recess to take the fuze; in the lower part there are screw-threaded holes for the filling plug and for the base plug. A detonator channel consisting of a tube of bakelized paper connects the hole in the fuze recess with the base plug hole. The H.E. filling may be picric acid, amatol 80/20, or baratol 20/80, about 3¼ oz. These fillings are inserted through the filling hole in the dry powdered form.

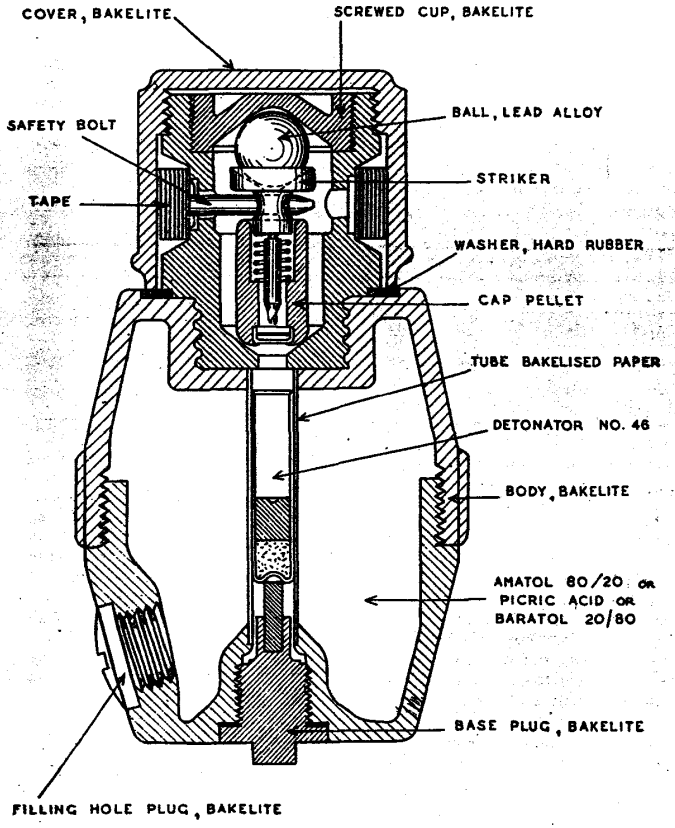
The base plug has a short rubber plug at its inner end, to help to support the detonator in position, and to obviate the possibility of the detonator being nipped by the bakelite plug.

The No. 247 fuze and the filling plug are screwed into the body over a hard-rubber washer, and cemented at the filling factory to prevent their removal. The base plug also has a rubber washer, but is not cemented in place as it has to be removed by the user of the grenade to permit insertion of the detonator.

The detonator used is the No. 46, containing A.S.A. and C.E. A strip of adhesive tape secures the safety cap of the fuze to the body of the grenade, during storage and transport. Weight of filled grenade—13 oz. 6 dr. approx.

FIG. 2

GRENADE , HAND , NO. 69 , MARK I.



Action.—The base plug is removed and the detonator is inserted with its open end towards the fuze. The base plug is then replaced and screwed home. Before throwing, the safety cap of the fuze is removed. The grenade is thrown and on impact the fuze functions as described in para. 7. The flash from the cap passes down the paper tube and fires the detonator, which in turn detonates the H.E. filling of the grenade.

Since the greater part of this grenade is made of plastic material, the effect produced is almost entirely confined to blast, although the metal ball and cap pellet may be thrown to some distance with considerable violence. The blast effect is very localized, and for this reason this grenade is useful for open warfare where the user may not be able to throw from behind cover.

This grenade has been found to function successfully except when it falls on long grass or under similar conditions where the fall is cushioned to some extent. A heavier grenade, *e.g.*, with a cast iron body, is not subject to this defect, but if such a body were used, the risk to the thrower would be enhanced.

The performance in this respect will be improved by the use of the No. 247 Mark II fuze. Some difficulty has also been experienced in inserting the detonator. This may be due to the central bakelized paper tube not being manufactured to specification so that the inner surface of the tube tends to de-laminate, and a film of very thin untreated paper loosely attached to the inner wall of the tube is dislodged by the intrusion of the detonator, thereby preventing the detonator from being pushed far enough in. The tube has in some instances been found to be distorted by faulty filling methods.

Packing.—These grenades are packed 34 in Box B.167 in nine paper tubes with a millboard disc between each two grenades and closed by wood plugs. Eight of the paper tubes contain four grenades in each, but the ninth tube holds only two grenades, the other half of the tube containing two wooden cylinders with tinned plate lids, each holding 17 detonators in drilled recesses. This particular tube is stencilled " DETONATORS " in two places diametrically opposite, and is placed in the middle of the top layer of tubes.

Dimensions of box	21¾ in. × 9½ in. × 9½ in.
Filled weight	46 lb.

9. Grenade, Hand, No. 82, Mark I (*Fig.* 3)

This grenade is designed for rapid arming by the use of a shortened tape on the fuze No. 247. It was formerly known as the Gammon Bomb.

The body is a stockinette bag, the top of which is clamped between the tinplate fuze housing and the steel cup by rivets. An aluminium primer tube is secured to a tinplate securing cap which screws on to the underside of the fuze housing. The bag is gathered at its base by an elastic band to assist in holding the charge of P.E. when this is inserted.

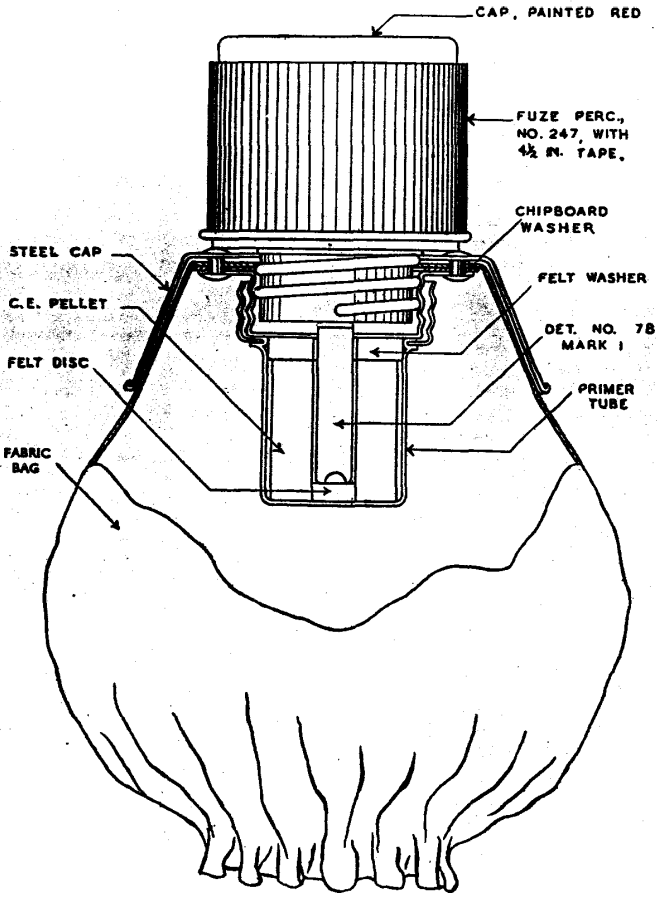
The grenade is fuzed with fuze No. 247, wound with a 4½-inch tape in place of the usual 12 inches, and the top of the safety cap is painted red, to indicate this fact. The primer tube carries a perforated C.E. pellet under a felt washer and there is a small felt disc at the base of the hole to protect the detonator when this is inserted in preparing the grenade for use. The detonator is the No. 78 Mark I, a short No. 27 type.

Action.—The grenade is prepared by inserting the detonator in the primer tube, open end towards the fuze, then screwing the primer tube on to the fuze housing. P.E. is then packed into the bag and the safety cap removed. On throwing, the action is the same as for the No. 69 grenade (*see* paras. 7 and 8).

Marking.—The steel cup is painted buff and the top of the safety cap, red. The number of the grenade and its mark, empty details and fuzed lot number are stencilled on the steel cup.

FIG. 3.

GRENADE, HAND, Nº 82, MARK 1



Packing.—The following components are packed in a steel box G.70 fitted with packing shields :—

40 empty grenade bodies, fuzed, in four tins.
40 filled primer tubes in four tins.
40 detonators, No. 78, Mk. I, in four tins.
Dimensions of box .. .. .. 19·15 in. × 8·34 in. × 7·85 in.
Weight filled .. .. .. 32 lb.

The P.E. is packed separately.

CHAPTER III

ANTI-TANK GRENADES

10. Grenades for anti-tank use may be designed for the purpose of penetrating the armour and thereby incapacitating the crew or putting the engines out of action ; or for breaking the tracks, thus immobilizing the tank ; or for setting the tank on fire, and possibly at the same time, by producing a dense smoke, temporarily unsighting the driver. Each of the various types of anti-tank grenade in use in the British Service covers one or more of these requirements.

Since these grenades are either thrown or projected with a low velocity, the ordinary principles of armour-piercing as applied to gun ammunition will not hold good, and penetration performance will depend on the effects of blast as produced by a quantity of high explosive detonating in direct contact with the armour or with the track, or on the application of the hollow charge principle.

The five different types of anti-tank grenade in use at present are all designed on very different lines, and illustrate forcibly the difficulty of making any but the broadest generalizations concerning the design of ammunition for anti-tank purposes.

11. Grenade, Rifle, No. 68, Anti-tank, Marks IV and V (*Fig.* 4)

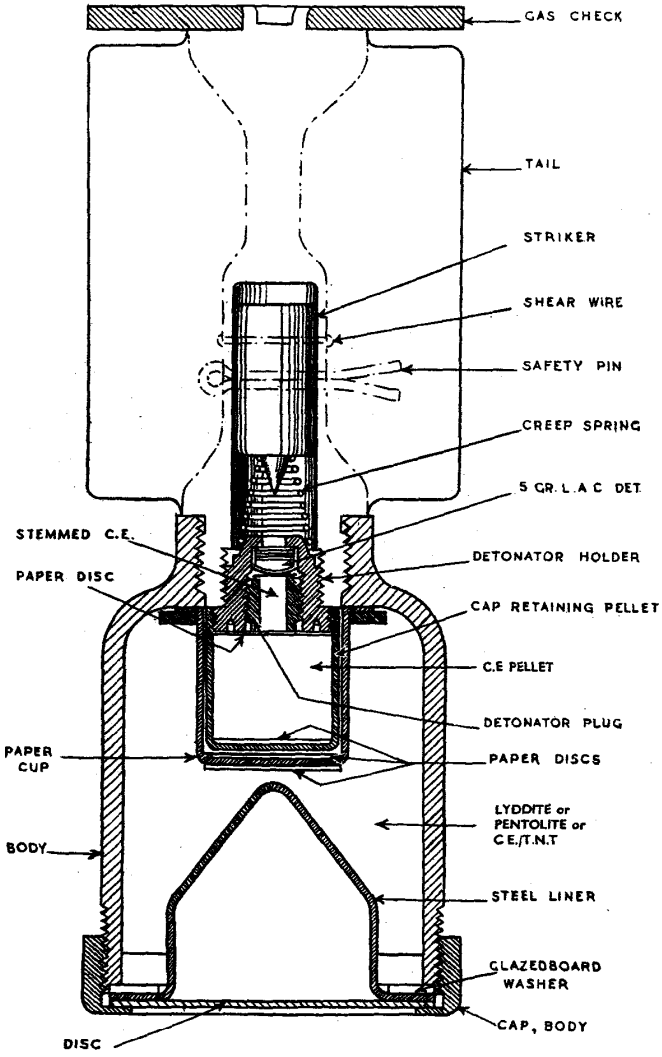
The grenade body is made of steel or die-cast Mazak, in the shape of a bell with cylindrical walls. The open end is threaded externally to accommodate the body cap, which secures in position the thin metal disc—made of brass, tinned plate, or steel—and the steel cup liner which fits into the cavity in the high-explosive filling. The hole at the other end of the body is threaded internally to take the tail. The tail is made from a Mazak die-casting. It has four straight vanes, and at the end that screws into the grenade body it is centrally recessed to accommodate the striker mechanism and screw-threaded internally for the detonator holder. The striker is made either of rust-proofed steel in one piece, or of a steel needle secured into a Mazak striker body. There are two holes bored through the striker body corresponding with holes bored through the central portion of the tail, through one of them passes the safety pin, and through the other the copper shearing wire. The detonator holder carries a 5-grain A.Z. detonator at the end nearer the striker and the magazine for the C.E. pellet at the end which fits into the grenade body. There is a creep spring between the striker needle and the detonator. The gascheck may be of steel, secured to the tail by passing a bezel at the rear end of the tail through the hole in the gascheck and then pressing the bezel over the edge of the hole all round in Mark V, or the gascheck may be of Mazak cast integrally with the rest of the tail unit—Mark IV. The filling is about 5½ oz. lyddite, pentolite or a mixture of C.E. and T.N.T., the two latter having a T.N.T. topping. The channel in the detonator plug between the detonator and the C.E. pellet is filled with stemmed C.E.

Weight of filled grenade—1 lb. 15½ oz.

Action.—The safety pin, the cord of which carries a tinned plate tablet bearing the words, "TO BE WITHDRAWN FROM GRENADE BEFORE

FIG. 4.

GRENADE, RIFLE, NO. 68 A.T. MARKS IV & V.



FIRING ", is first removed. The shear wire is *not* removed. The grenade is then loaded with the gascheck towards the propellant cartridge. On firing, the set-back of the striker shears the copper shear-wire, and thus frees the striker, which is held off the detonator, in flight, by the creep spring. On impact, the inertia of the striker carries it forward, overcoming the creep spring, and causing the needle to penetrate the detonator. The firing of the detonator initiates a detonation which passes by way of the stemmed C.E. and the C.E. pellet into the main filling. The hollow charge design of the high-explosive filling forms a high-velocity jet which penetrates the target.

There have been five different Marks of this grenade, all of which are now obsolescent. A brief description of these earlier marks is given below.

Mark I.—This grenade has small vanes on the body in addition to the vanes on the tail. The gascheck is fixed to the tail unit by a bakelite screw in the earlier grenades and a brass screw in those of later manufacture. The bakelite screw was designed to fracture when the grenade was fired, so enabling the gascheck to drop off at the beginning of flight, and thereby causing the grenade to offer less resistance to the air. It was found, however, that in practice the disadvantages of such a device out-weighed the advantages. These screws were very easily broken in storage and transport; and of those that survived to be loaded into the discharger cup, some failed to break when the grenade was fired, thus defeating the object for which they were introduced, while some of those which did break caused small pieces of bakelite to fall into the discharger cup or down the barrel of the rifle, so that the rifle had to be up-ended to remove the debris before re-loading. To overcome this trouble, the bakelite screw was replaced by a brass screw which was intended merely to hold the gascheck on to the tail, and not to fracture on firing. It was also found that the presence of the gascheck made no appreciable difference to the flight of the grenade. The filling of this grenade is RDX/BWX 91/9 or P.E. The detonator holder and container for the C.E. pellet are combined in one unit and the cap which holds the C.E. pellet in the magazine is of bakelite. The cavity in the high-explosive filling is hemispherical with a cylindrical extension and the cup liner is of brass.

Mark II.—There are no small vanes on the body of this grenade, the tail vanes being lengthened to increase the vane area. The gascheck is secured to the tail either by means of a brass screw, or by using the pressed bezel method described previously. The filling is the same as for the Mark I.

Mark III.—This grenade has a filling of either lyddite or C.E./T.N.T. 30/70. The shape of the cavity in the hollow charge is cylindro-conoidal and, although the high explosive used is less violent, this shape is found to give a performance equal to that of the earlier Marks. The magazine is similar to that in the Marks IV and V. The detonator is held in place by spinning the edge of the detonator holder on to it. The gascheck may be of steel, secured by the pressed-down bezel of the tail unit; or of Mazak, cast integrally with the tail unit.

Some doubt existed whether the spun-in detonator in the Mark III was firmly secured, and a new type of detonator holder with a detonator plug screwing up against the detonator was introduced. This necessitated an alteration in the Mark and at the same time it was decided to differentiate between the two current methods of securing the gascheck. The Mark IV therefore has the new detonator holder, with the zinc alloy integral gascheck; while the Mark V has the new detonator holder with the steel gascheck.

To overcome the possibility of prematures with the Mark III type of detonator holder, Mark III grenades have been modified by replacing the old detonator holder by the new Mark IV type. Grenades so modified have the letter " R " stencilled after the last figure of the lot number and the Mark is altered to IV. This marking also appears on the packages.

All marks are now obsolescent.

Marking.—The grenade is painted buff with a red filling ring round the body below the body cap and is stencilled with lot number, filler's initials and date of filling.

The various fillings are shown as follows :

RDX/BWX 91/9	Green ring with " RDX/BWX 91/9 " stencilled on it in black
P.E.	Green ring with " P.E." stencilled in black
C.E./T.N.T. 30/70	Green ring with " CE/TNT 30/70 " stencilled in black
Pentolite ..	Broad green ring with narrow black ring superimposed on it
Lyddite ..	" LYD " stencilled in black

Packing.—Seventeen grenades are packed in a steel box, P.59, each in a rolled paper cylinder, together with 20 rifle grenade cartridges in a sealed tin box.

Dimensions of box	19½ in. × 8½ in. × 8 in.
Weight filled	49½ lb.

12. Grenade, Hand, No. 73, Anti-tank, Mark I

This grenade is intended for use against A.F.Vs. though it is more usefully employed for demolition work. It consists of a cylindrical tinplate container, about 9½ inches long by 3½ inches diameter. It has a tin lid which screws on to the container, interrupted threads being used to allow the removal of the lid to be done rapidly. In the middle of the lid is a recess, roll-threaded with coarse threads to take Fuze No. 247 (*see* para. 7). The fuze is cemented into position and issued with the grenade. On the under side of the lid, screwed on to the fuze housing, is the detonator tube. This has a hollow stem designed to accommodate the demolition type detonator which is used to initiate the H.E. filling of the grenade. The detonator used is a No. 8 commercial detonator. The No. 6 commercial detonator which was first specified is now used for practice only, and the detonator tube has been adapted to take the No. 8. The H.E. content of the grenade is approximately 3½ lb. of polar ammon gelatine dynamite (P.A.G.D.) wrapped in two layers of manila or kraft paper. When the lid is screwed on to the grenade the tube of the detonator container fits into a cavity formed in the top of the H.E. filling. There is a thin grey-board disc inside the container beneath the paper-wrapper filling. At the top of the filling is a felt disc intended to absorb any possible exudation from the high explosive used.

The lid is temporarily secured to the body when issued, by means of a strip of adhesive tape, which also helps to seal the joint against the ingress of moisture.

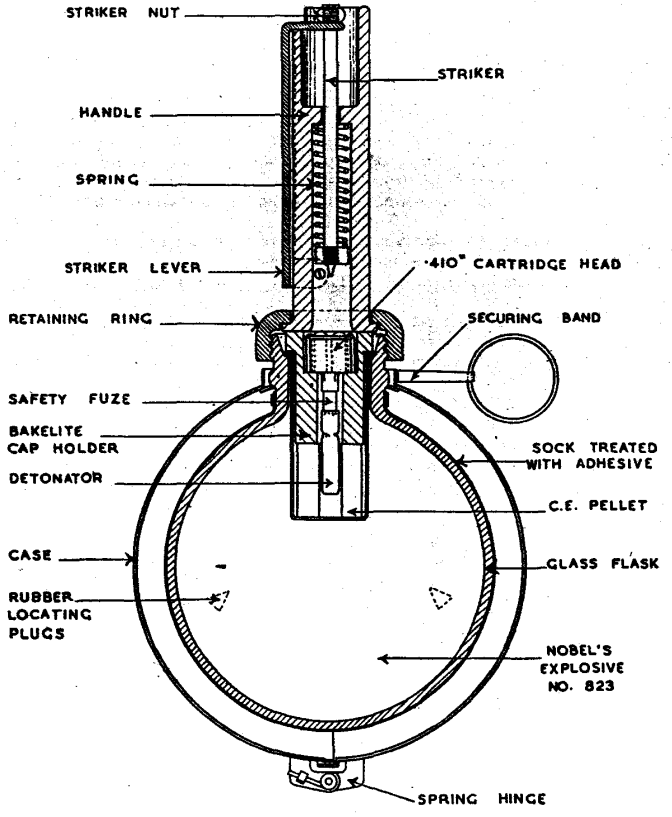
This grenade was declared obsolete in October, 1941, but re-instated as obsolescent in March, 1943.

Action.—Before use, the lid of the grenade is taken off (after removing the adhesive tape). The detonator tube is unscrewed from the underside of the lid and the detonator inserted closed end first. The detonator tube is then replaced on the lid and the lid is screwed back on the grenade. The absence of the adhesive tape is now an indication that the detonator is in place. Some of the earlier issues of this grenade had badly-fitting lids, and it was sometimes necessary, on replacing the lid, to use the adhesive tape as a packing in the screw threads to ensure that the lid did not fall off on throwing the grenade. This fault was remedied in later issues.

Marking.—The body and lid of the grenade are painted buff with a red filling ring round the upper part of the body. The filled lot number, filler's initials, and date of filling are stencilled on the body and the type of filling is indicated by the letters " P.A.G.D." or " N.G." stencilled in black. The number and mark of the grenade are also shown.

FIG. 5.

GRENADE, HAND, Nº 74, A.T. MARK I



Packing.—Ten grenades are packed in a steel box, B.166, together with a cylinder containing 10 detonators.

Dimensions of box	19·7 in. × 9 in. × 13·2 in.
Filled weight	62 lb. approx.

13. Grenade, Hand, No. 74, Anti-tank, Mark I (*Fig.* 5)

This grenade was originally known as the grenade S.T. and may be referred to as the "sticky bomb". It is a H.E. hand grenade with a time delay designed to be thrown at or placed on an A.F.V. and to stick there until it detonates.

The body consists of a spherical glass flask, enclosed in a sock of woollen material which has been treated with a viscous adhesive, and having a short neck, which is screw-threaded externally. Fitting inside the neck and projecting some way into the body is a thin aluminium cup which holds the detonator assembly when this is inserted. In transport and storage the mouth of the flask is closed by a plug, either a flat wooden disc held in place by a screwed moulded plastic ring, or a hollow moulded plastic plug shaped to fit the interior of the aluminium cup and secured by a cork or cork substitute disc and a flat-topped screw cap which is protected from accidental removal by a strip of adhesive tape.

The filling is about 1¼ lb. of Nobel's Explosive No. 823 which is a nitroglycerine explosive of a consistency similar to that of vaseline, with a life of two years in temperate climates and one year in hot.

To protect the glass flask till the grenade is ready for use, it is enclosed in a metal casing which consists of two hemispheres held together at the base by a spring hinge. This casing springs apart when the metal tape around its neck is removed. A number of small rubber studs project from the inside of the casing to ensure that the adhesive does not prevent the casing opening. For protection in transport the joint in the casing is covered by a strip of adhesive tape, in the earlier models. This tape must be removed before the grenade can be used.

The handle, of moulded plastic, is carried separately from the body in storage. The striker is carried in the handle and has a striker spring acting between a perforated diaphragm at the top of the handle and the flange of the striker head. A "Mills" type striker lever fits under a nut at the top of the striker and lies against the side of the throwing handle, being held in position by a safety pin which also blocks any downward movement of the striker. The safety pin carries a label with the legend, "Danger. Do not remove this pin until the grenade is to be thrown." The handle is attached to the glass flask when preparing for use by a moulded plastic screwed ring.

The detonator assembly, also packed separately, consists of a 0·410-inch cartridge head fitted on to a brass sleeve which is crimped on to a length of white safety fuze. The other end of the safety fuze is crimped into an A.S.A./C.E. detonator. This assembly is housed in a bakelite holder and the projecting part of the detonator fits into a perforated C.E. pellet. The C.E. pellet and holder are secured together by a length of adhesive tape. Two rubber bands are placed round the bakelite holder to centre the detonator assembly. Should these be wrongly placed or not spaced properly, a blind may result due to incorrect positioning of the cap. A delay of 5 seconds is obtained with this assembly.

This grenade has proved rather too fragile for Service conditions, since breakages occur in transport, and leakages have been rather frequent because insufficient air space is allowed for expansion of the viscous explosive in warm conditions and there is no positive sealing of the filling. A weak point in the detonator assembly is the necessity for correct positioning of the rubber bands. Prematures have been caused by the striker nut working loose, thus releasing

the striker, which, on the safety pin being withdrawn, can then drive down on to the cap without the thrower being aware of the fact. This difficulty has been overcome.

Weight of grenade, 2¼ lb.

Action.—The plug is removed from the mouth of the grenade, the detonator assembly inserted, care being taken that the rubber bands are correctly positioned on the bakelite holder, and also that the cap does not project above the rim of the holder. In the latter event there is a danger of the rim of the cap forming a gas seal which will not allow the gases from the burning safety fuze to escape and premature detonation will occur. The handle is screwed in position and the casing removed by pulling off the metal tape securing it. Immediately before throwing, the safety pin is withdrawn and the grenade thrown or placed on the target with sufficient force to break the glass flask. The hand must be removed from the handle quickly as otherwise the action of the striker may be too sluggish to fire the cap. After a delay of 5 seconds the detonator will initiate the C.E. pellet which sets off the main filling. From trials it is considered that over 1 inch of armour plate is required to give protection against this grenade.

Marking.—The outer casing is painted buff with a red filling ring on the upper part just below the neck. The following stencilling is in black:

74 A.T. I .. .. Grenade number, type, and mark
823 .. .. Explosive filling

followed by the filler's initials and date of filling.

Packing.—Five grenades are packed in a steel case, each flask being held in a claw-type spring fitting closed with a spring ring. Five handles wrapped in corrugated paper are also packed in this case. Five detonator assemblies are carried in a cardboard tube attached to the lid of the case by spring clips.

Dimensions of case .. .. .. 18 in. × 11 in. × 6 in.
Weight filled .. .. 22 lb.

Three of these cases are packed in a wooden crate of the following dimensions:

21½ in. × 20½ in. × 13½ in.
Filled weight .. 84 lb.

14. Grenade, Hand, No. 74, Anti-tank, Mark II (*Fig.* 6)

This grenade is used for the same purposes as the Mark I above, but is a much more satisfactory design.

The body is a bakelite moulding in two parts with a short neck which is screw-threaded internally, and has two holes diametrically opposite to take two projections in the metal casing, so positioning it. The woollen cover, treated with adhesive, is also used. The filling is about 1½ lb. of Nobel's Explosive No. 823, the small reduction in content being due to the provision of an adequate air space to allow for expansion of the filling. Resting on a flange inside the body is an aluminum primer tube, which is held in position by a rubber sealing ring and a bakelite sealing plug. A perforated C.E. pellet is carried at the base of the primer tube and is protected by a sponge rubber washer with a thin rubber grip washer above it. A thin cardboard cover, with becket, keeps dust out of the sealing plug.

The metal casing is similar to that used with the Mark I, except that the neck is closed by a spring clip and there is a metal loop on the spring hinge which can be used to carry the grenade on the webbing equipment.

The main differences between the handles for the Marks I and II are the sharp point of the striker to enable it to fire the detonator in the igniter assembly, and the fact that the handle screws direct into the top of the body, thus making a stronger union than was possible with the Mark I method. The possibility of prematures due to the striker nut unscrewing has been overcome by spinning

FIG. 6.

GRENADE, HAND, Nº 74, A.T. MARK II.

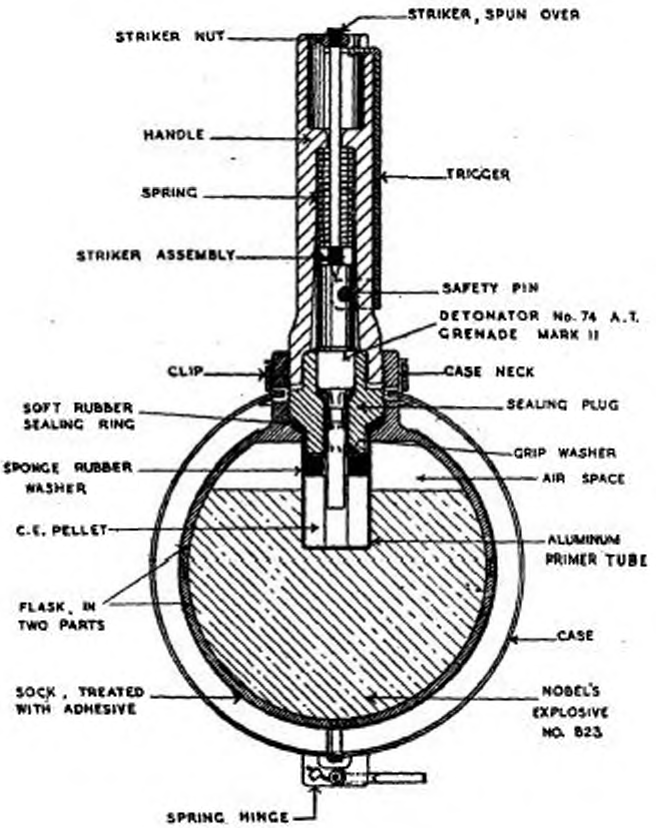
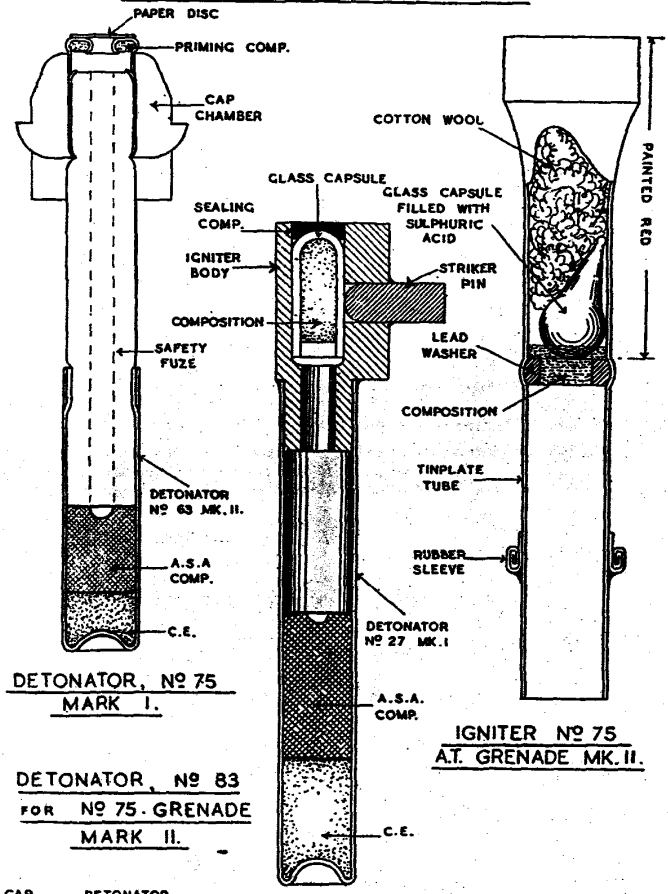


FIG. 7.

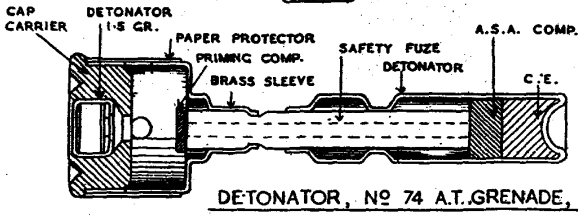
GRENADE IGNITER ASSEMBLIES



DETONATOR, Nº 75 MARK I.

DETONATOR, Nº 83 FOR Nº 75 GRENADE MARK II.

IGNITER Nº 75 A.T. GRENADE MK. II.



DETONATOR, Nº 74 A.T. GRENADE, MK. II.

over the end of the striker, while accidental removal of the trigger with the safety pin still in position is prevented by a projection between the arms of the fork at the top of the trigger.

The detonator assembly (*see* Fig. 7) has also been modified. A 1·5-gr. " B " mixture detonator is held in a metal cap carrier, which is secured to a brass sleeve wrapped with paper. This sleeve has four vent holes, the gases from the safety fuze escaping through them into the flutes in the sealing plug. The sleeve is crimped to a length of safety fuze with a plug of priming composition on top to help ignition. An A.S.A./C.E. detonator is crimped to the safety fuze, and the complete assembly gives a delay of about 5 seconds.

This detonator is being replaced by the Mark III as the 1·5-gr. " B " mixture detonator is too powerful, the flash from it tending to blow down the outside of the safety fuze and so ignite the A.S.A./C.E. detonator prematurely. The Mark III uses the cartridge head cap of the Mark I grenade.

Action.—The action of the Mark II is generally similar to the Mark I. The cardboard cover is removed and a detonator assembly pushed into the hole provided for it in the sealing plug, when it is prevented from dropping out by the thin rubber grip washer. The handle is screwed on and the casing removed. Thereafter the action is as for Mark I, but in this case there is no need for the sudden release of the handle which is necessary with the Mark I.

Marking.—The metal casing is painted buff with a red filling ring around the upper part and the number, type, and mark of grenade are stencilled in black. Also stencilled on the casing are the number of the filling—S23—the filler's initials and the date of filling.

Packing.—Four grenades are packed in individual shock-proof compartments in a steel case or wood box G.112. In the centre compartment are four handles, a holder containing the four detonator assemblies, and four clips with which the grenades can be attached to the webbing equipment.

Dimensions of case	13 in. × 13 in. × 7 in.
Weight filled	35 lb.

15. Grenade, Hand, No. 75, Anti-tank, Mark I (*Fig.* 8)

This is really an anti-tank mine filled with H.E. and is normally used as such, though it can also be thrown under the track of a tank. It is a remarkably simple design, easy to manufacture and very handy in use.

The body of the grenade is a 1-pint capacity flat tin with a short neck and screw cap at one end. The detonator holder is a tinplate sheet soldered to the body and folded to form two pockets, each of which will carry an igniter assembly. Both pockets are slotted on the side away from the body and the open ends are provided with metal tabs, which can be bent over to secure the igniter assemblies when they are inserted.

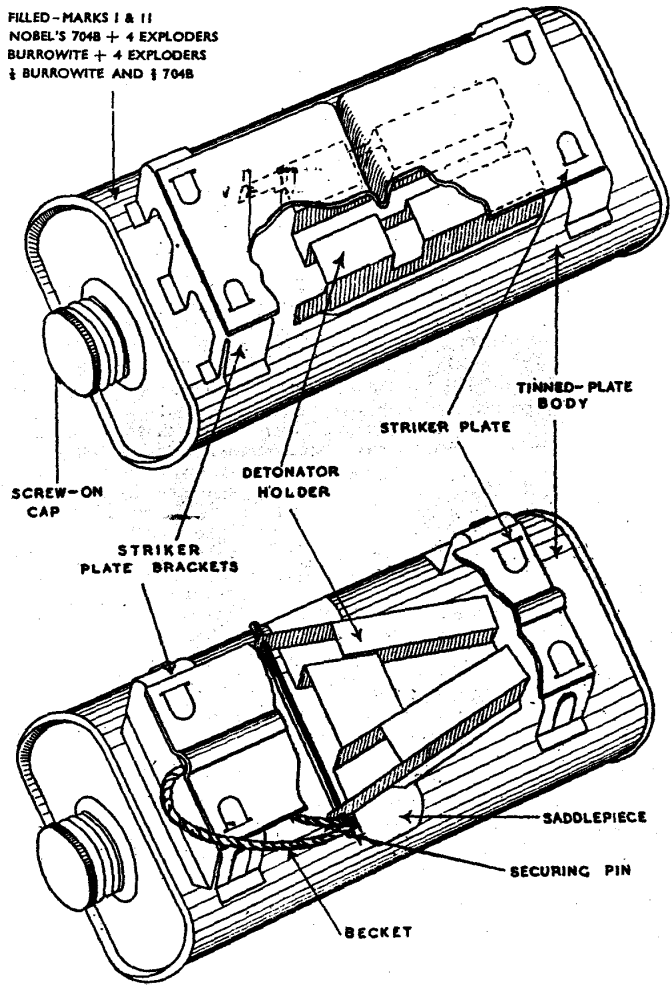
At either end of the same side of the body is a striker plate bracket, soldered in position, and designed to hold the striker plate by means of bend-over tabs. The striker plate is of steel with a transverse groove which forms a projection on the underside. This projection is the striker of the grenade and is positioned directly over the slots in the detonator holder.

The H.E. fillings are lightly stemmed in position in three or four increments and waterproofed by the insertion of a waxed felt washer below the screw cap, which is cemented in place. The original methods of filling were :

(*a*) Nobel's Explosive No. 704B.
(*b*) Nobel's Explosive No. 704B plus four exploders.
(*c*) Military Ammonal plus four exploders (when the grenade was known as the No. 75A).
(*d*) Burrowite plus four exploders.

FIG. 8.

GRENADE, HAND, No. 75, A.T. MARK I.



GRENADE, HAND, No. 75 A.T. MARK II.

The fillings now used are :

(*e*) Nobel's Explosive No. 704B plus four exploders.
(*f*) Burrowite plus four exploders.
(*g*) ⅛ Burrowite and ⅞ Nobel's Explosive No. 704B.

The exploders are cylindrical pellets, ¾ inch in diameter and 3 inches long, wrapped in waxed paper and lying transversely at the base of the body immediately under the detonators. Nobel's Victor Powder, Nobel's Explosive No. 673, and Polar Dynamite (25 per cent nitroglycerine) have been used, but only the latter is now approved for filling.

The igniter assembly consists of an igniter, No. 75 grenade, Mark II, a chemical igniter, and a No. 27 detonator, carried separately owing to the possibility of cracking of the glass bulbs in the igniter. The igniter Mark II (*see* Fig. 7) is a tinplate tube closed by flattening one end, and with a circumferential groove into which is pressed a lead washer. The hole in this washer is packed with an ignitory composition of potassium chlorate, sugar, and charcoal. Above the lead washer is a small glass bulb containing a mixture of sulphuric and nitric acids (93 per cent. of the former and 7 per cent. of the latter), the nitric acid serving to lower the freezing point and so ensuring better functioning at low temperatures. The bulb is protected by a cotton-wool packing. To provide an attachment for the detonator, a thin rubber tube is rolled on to the outside of the igniter. The flattened end of the igniter is painted red.

Weight of grenade—2¼ lb.

Action.—The igniter assembly is prepared by inserting the No. 27 detonator into the igniter and pushing it up until it touches the lead washer. The rubber tube is then rolled down to hold the detonator in position. An igniter assembly is inserted in each pocket of the detonator holder with the flattened end outwards and the metal tabs are bent over to secure them in position. The glass bulbs are then directly under the slots in the detonator holder and the striker. The grenade is then laid as an anti-tank mine or thrown in the path of a vehicle. In the latter event, the weight distribution and shape of the grenade ensures that, on reasonably flat ground, it will always come to rest on one of its flat sides. Pressure on the grenade crushes the striker plate down and the projecting striker breaks the acid bulb. Reaction ensues between the acid and the ignitory composition producing a flash to initiate the detonator, which then detonates the main filling.

One of these grenades, if fairly run over, will break the track of a German Pz. Kw. III or IV, but for the attack of the heavier types it is advisable to build up three or four grenades into a composite charge, and such a combination of four has broken the track of a Pz. Kw. VI.

This Mark I grenade is being superseded by the much more reliable and stronger Mark II. The main defects in the Mark I are:

(*h*) the comparatively weak striker plate assembly. When the grenade is thrown on rough, stony ground and falls striker plate first, the striker may be driven on to the igniter, causing detonation.
(*i*) The lack of support under the igniter. Pressure may distort the mine badly before the igniter acts, with consequent loss of power.
(*j*) The chemical igniter, though fairly efficient in action, is not a satisfactory method for Service conditions, due to the danger of the glass bulb cracking spontaneously. For early manufacture, however, it was well suited for rapid and easy production.

Marking.—The exterior of the grenade is painted buff with the number, type, and mark of grenade, stencilled or embossed on the side. When the exploders are Victor Powder and Explosive No. 673, a red filling ring is painted round the neck below the screw cap; with Polar Dynamite exploders a ring of red crosses replaces the red ring.

Details of filling are stencilled on the base of the grenade, though the lot number may appear on the side.

Nobel's Explosive No. 704B is shown by the stencilling "704B".

Burrowite is shown by the stencilling "BUR".

Military Ammonal is shown by the stencilling "A" on the side remote from the striker plate.

1/3 Burrowite and 2/3 No. 704B is shown by "1/3 BUR, 2/3 704B".

The presence of four exploders is shown by the stencilling " & 4 EXPRS".

When filled with Burrowite or Military ammonal, the cap is painted pink.

Packing.—Twelve grenades, 24 igniters, and 24 detonators are packed in a steel box, G.70. The detonators and igniters are packed in two separate containers marked "DETONATORS" and "IGNITERS" respectively, and are stowed at one end of the box behind a steel packing shield.

Dimensions of box	19½ in. × 8½ in. × 8 in.
Weight filled	40 lb.

16. Grenade, Hand, No. 75 Anti-Tank, Mark II (*Fig.* 8)

The main improvements in this grenade over the Mark I are the stronger design and a safer and more reliable method of initiation.

The body of the grenade is as for the Mark I. The detonator holder has two inclined pockets to give more reliable initiation by placing the detonators close enough together for the detonation of one to cause detonation of the other. Further the metal tabs at the open ends are pierced to take a soft wire pin, attached to the grenade by a cord, which holds the detonators in position.

The body, directly under the heads of the detonators, is strengthened by soldering on a saddle piece, the central bridge of which lies between the open ends of the detonator holder and prevents any sideways movement of the detonators.

The striker plate assembly has also been strengthened by using stronger brackets and having a striker plate with a longitudinal corrugation which projects away from the body of the grenade.

The H.E. fillings remain the same as for the Mark I.

The detonator No. 83, formerly known as the igniter special, No. 1 Mark I (*see* Fig. 7), used with this grenade is of the percussion type and overcomes the difficulty with the glass bulbs experienced in the Mark I. The body is of moulded plastic with two holes drilled in it; one to take a glass capsule containing an igniferous detonator composition, the other to take a steel striker pin sealed in position. Fitting over the projecting spigot of the body is a No. 27 detonator, cemented on.

The exploders are of Polar Dynamite (25 per cent. nitroglycerine), though Explosive No. 673 was approved at one time.

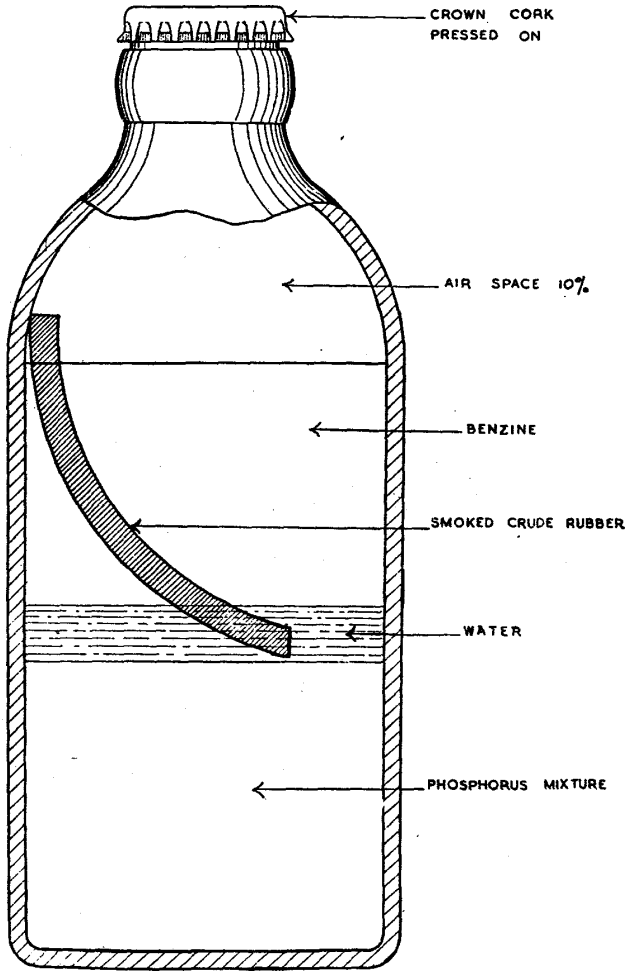
Action.—The detonators are placed in position, one in each pocket of the detonator holder, with the striker pin uppermost, and the securing wire is passed through the holes in the metal tabs. Pressure on the striker plate drives the striker pin down and grinds composition and broken glass together. The flash so produced initiates the detonator and hence the main filling.

A new feature incorporated in this mark are the tabs on either side of the striker plate brackets designed to take a length of signal cable or strong cord so that a number of grenades can be strung together to make laying of the grenades in a minefield a faster operation.

Marking.—The body is painted brown with two red crosses on the top, one either side of the screw cap. The filling details are shown in the same way as for the Mark I. The number, type, and mark of the grenade are embossed on the side.

FIG. 9.

GRENADE, HAND, OR PROJECTOR, Nº 76, S.I.P. MARK I.



17. Grenade, Hand or Projector, No. 76, S.I.P. Mark I (*Fig.* 9)

This grenade, formerly known as the A.W. Bomb or grenade S.I.P., is designed to be thrown or projected against A.F.Vs. with incendiary and smoke effect. It consists of a short necked, clear glass bottle of ½-pint capacity containing 128 c.cm. phosphorus mixture (75 per cent. phosphorus and 25 per cent. sulphide of phosphorus), 21 c.cm. water, 110 c.cm. benzine, and a stick of smoked crude rubber, 3¼ inches long and ¼ inch in diameter. A 10 per cent. free space is left above the filling for expansion. During storage the rubber gradually dissolves rendering the contents tacky and so assists their adhesion to the target. Grenades are sealed by a plain crown cork, early manufacture with red coloured corks and suitable for throwing by hand only, and later manufacture with green coloured corks showing the suitability of the grenades for firing from the Northover Projector.

Owing to the occurrence of prematures when the grenades were fired from the Northover, paper sleeves with a thick paper washer at the base were issued, but these are now obsolete. When the Northover is fired at depression the grenade is apt to slide forward in the barrel; this tendency was overcome by the use of cardboard washers fitting over the neck of the bottle.

Weight of grenade .. .. 19 oz.

Action.—The grenade must be thrown hard enough to break on impact, when the phosphorus mixture ignites in contact with the air, thus setting alight the benzine. It appears to be important that the grenade is not shaken before throwing, since agitation causes the formation of an emulsion in which droplets of phosphorus are protected from the air by a covering of water.

The burning phosphorus produces a dense cloud of smoke.

From the nature of this grenade it will be seen that care must be exercised in its use and storage, as there is a considerable fire risk.

Packing.—Twenty-four grenades are packed between wooden partitions in a wire-bound wooden box.

An enamelled plate is screwed to the inside of the lid giving full instructions for storage and fire precautions necessary.

Dimensions of box .. .. .. 21½ in. × 13¾ in. × 9¼ in.
Weight filled .. .. 53 lb.

CHAPTER IV

SMOKE GRENADES

18. Introduction

Smoke grenades are used either for local obscuration or for signalling.

For screening purposes, both the bursting type and the emission type are employed. The bursting grenades have a charge of white phosphorus or titanium tetrachloride, functioning being by a detonator which opens the casing and scatters the contents in contact with the atmosphere to produce the smoke cloud.

The emission type of grenade uses either a hexachlorethane or a carbon tetrachloride composition which, in burning, produces zinc chloride, and this reacts with the atmospheric moisture to produce a very dense smoke cloud. The composition is ignited by priming composition in the usual manner.

The emission type will produce a more prolonged screen, but it requires a short time to build up to full strength. The bursting type, on the other hand, gives immediate screening, though the smoke is not so lasting. An excellent all-round performance can thus be obtained by combining these two types into one composite or, as it is called, " duplex " grenade (the No. 81) which gives the immediate screening of the phosphorus and the prolonged effect of the emission type.

All the above smoke-producing agents, it will be observed, depend for their effect on atmospheric moisture and a certain amount of humidity is necessary for full efficiency.

These grenades do not require a very strong case, and tinned plate is normally used, but the necessity for a completely leak-proof container is most important, especially with white phosphorus fillings which inflame spontaneously in contact with air.

For certain signalling purposes, coloured smoke has been introduced and the coloured smoke grenade is intended to replace the No. 26 smoke generator. The grenade is of the emission type and the composition burns with enough heat to sublime a dyestuff which gives the required coloured smoke.

2. Page 29. Para. 18. *Add* at end :—

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Marking. In future the stencilling "PHOS" on grenades filled W.P. will be replaced by a half-inch white band round the body, one inch from the top, to facilitate detection of blinds.

This grenade has a percussion fuze and is of the bursting type, producing an immediate screen.

The cylindrical body is of tinned plate with a folded side seam and tinned plate top and bottom soldered to either end. The bottom is in the form of a truncated cone and is provided with a charging hole, sealed by a soldered charging hole plug. The top has a screw threaded recess formed in it; into the centre of which is soldered the detonator tube.

The fuze holder, with a milled skirt to provide a good grip, has a projection on the base to fit the threads of the top of the body and takes the fuze No. 247, which is cemented in position. Between fuze holder and top there is a waxed chipboard washer, and to secure the safety cap of the fuze, a strip of adhesive tape is used in the same manner as in the No. 69 grenade.

To prevent interference with the detonator, when this is in position, the No. 247 fuze must be of the type without a spigot projecting from the base.

The detonator used is the No. 63, Mark I, with an A.S.A./C.E. filling in an aluminium case, or Mark II with a fulminate filling and copper case, and it is packed separately from the grenade.

The filled weight of the grenade, with fuze, is 13¼ oz., containing 8 oz. white phosphorus.

Action.—The fuze holder is unscrewed from the top, the detonator inserted closed end first, and the fuze holder replaced. The subsequent action is as for the No. 69 grenade, except that the detonator bursts open the body and scatters the white phosphorus filling.

Marking.—The grenade is painted green with "PHOS" stencilled on it. Other stencilling shows the number and mark of grenade, filler's initials, date of filling and filled lot number.

Packing.—Originally as for grenade No. 69. Thirty-four grenades were packed in a steel box, B.167, in 9 cardboard containers, one of which carried two grenades and two cylinders, each containing 17 detonators, No. 63.

In the later and more widely used packing 34 grenades are carried in a steel box, B.166, 17 in each of two cardboard packing pieces. Each packing piece

FIG. 10.

GRENADE , HAND , Nº 77, W.P. MARK I

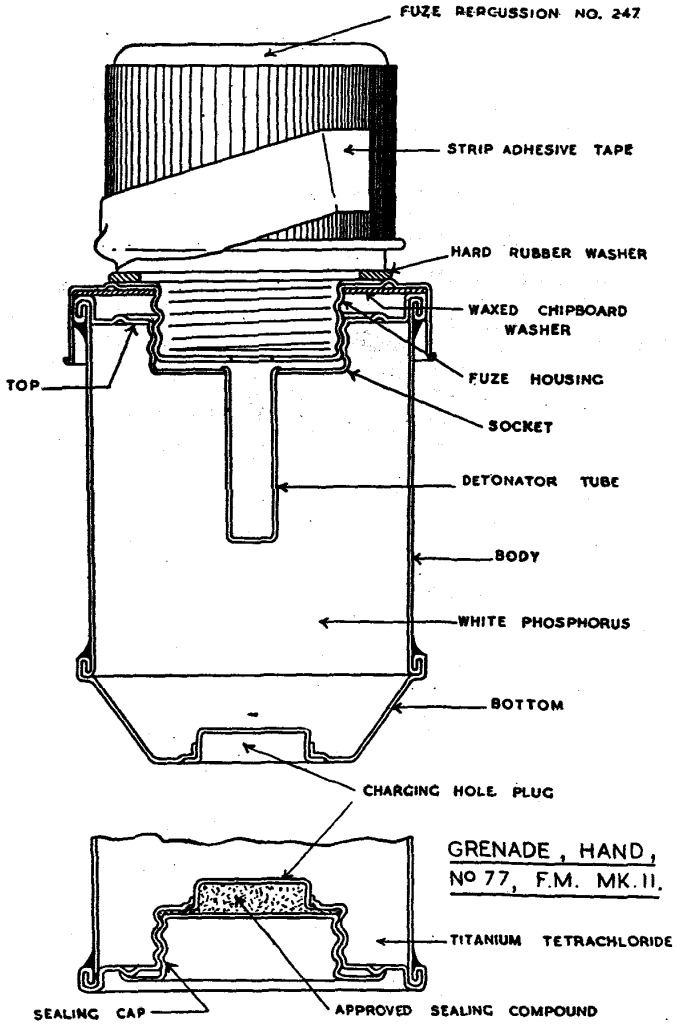
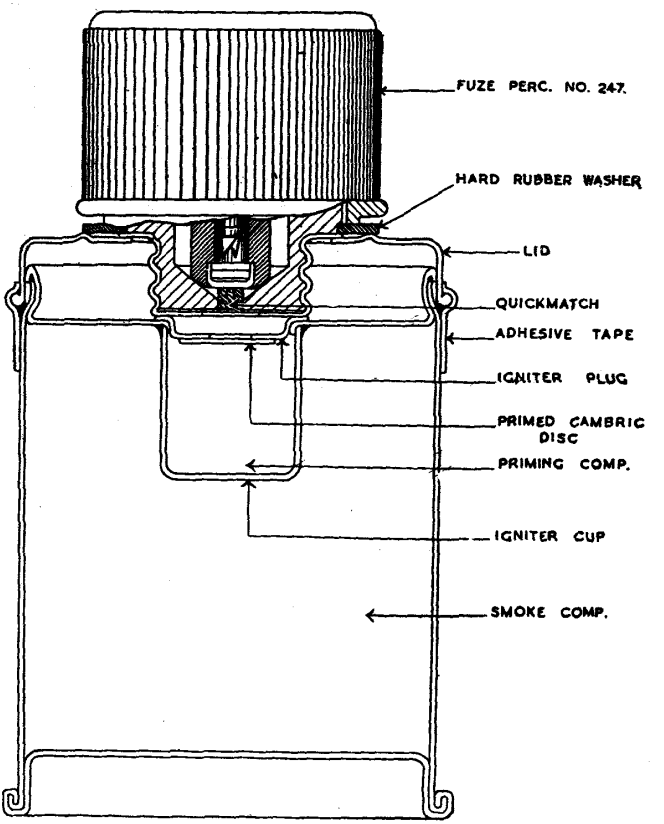


FIG. 11

GRENADE , HAND , Nº 79 , SMOKE MARK 1



has an extra hole, ringed with red paint, for a cylinder carrying 17 detonators No. 63.

Stowage dimensions	19·8 in. × 13·0 in. × 9·1 in.
Weight filled	41 lb. approx.

20. Grenade, Hand, No. 77, Smoke, F.M. Mark II (*Fig.* 10)

This grenade has the same action as the Mark I and differs only in the shape of the body, the method of sealing and the filling. It is used for training purposes only.

The body is completely cylindrical and the bottom is closed by a charging hole plug below which is a screwed sealing cup with scaling composition between the two.

The filling is titanium tetrachloride, F.M. being the code letters for this substance.

The detonator, fuze, and method of packing are as for the Mark I.

Marking.—The body is painted green with a red and white band around the middle, Stencilling gives the number and mark of the grenade, filler's initials, date of filling and filled lot number.

21. Grenade, Hand, No. 79, Smoke Mark I (*Fig.* 11)

This is a smoke emission grenade using the No. 247 fuze.

The body, of tinned plate, is cylindrical with bottom and top soldered in position. The top has a thin tinned plate igniter cup soldered to it and this is filled with priming composition, P.N.227, and closed by the igniter plug, to the base of which is stuck a disc of primed fabric.

The lid, provided with a screw-threaded housing for the No. 247 fuze, fits over the top of the body and is secured by tack soldering in four places, the joint being sealed by adhesive tape.

The No. 247, Mark I, fuze, when used in this grenade, has a 1-inch length of quick-match inserted in the hole in the base and held in place by a paper disc. This arrangement gives more certain ignition of the priming composition. The Mark II fuze does not require this quickmatch.

The fillings approved are:

P.N. 83(M)	14½ oz.
P.N. 398	1 lb. 3 oz.

The filled grenade, with fuze, weighs between 1 lb. 5½ oz. and 1 lb. 1 oz. depending on the filling used.

Action.—The safety cap is removed and the grenade thrown in the usual manner. On impact, the flash from the fuze ignites the priming composition and the fuze housing blows off due to melting of the solder securing it. In certain circumstances, the lid may be blown off. The smoke composition ignites and smoke is emitted from the hole in the top of the grenade. The time of emission is about 1½ minutes.

Marking.—The body is painted green and stencilled with the number and mark of grenade, filler's initials, lot number, date of filling, and the number of the composition used.

Packing.—Twenty-four grenades are packed in two tiers in a steel box, B.166, each tier having a special packing piece for 12 grenades.

Stowage dimensions	19·7 in. × 9·0 in. × 13·2 in.
Weight filled	88 lb. approx.

22. Striker Mechanisms Nos. 2 and 3 (*Figs.* 12 *and* 13)

These striker mechanisms, very similar to that used in American grenades, are used in certain smoke grenades. The No. 2 is for Grenade No. 80 and No. 3 for the Nos. 81 and 83 grenades.

FIG. 12.

GRENADE, HAND, Nº 80, W.P. MARK I.

WITH STRIKER MECHANISM Nº 2 MARK I.

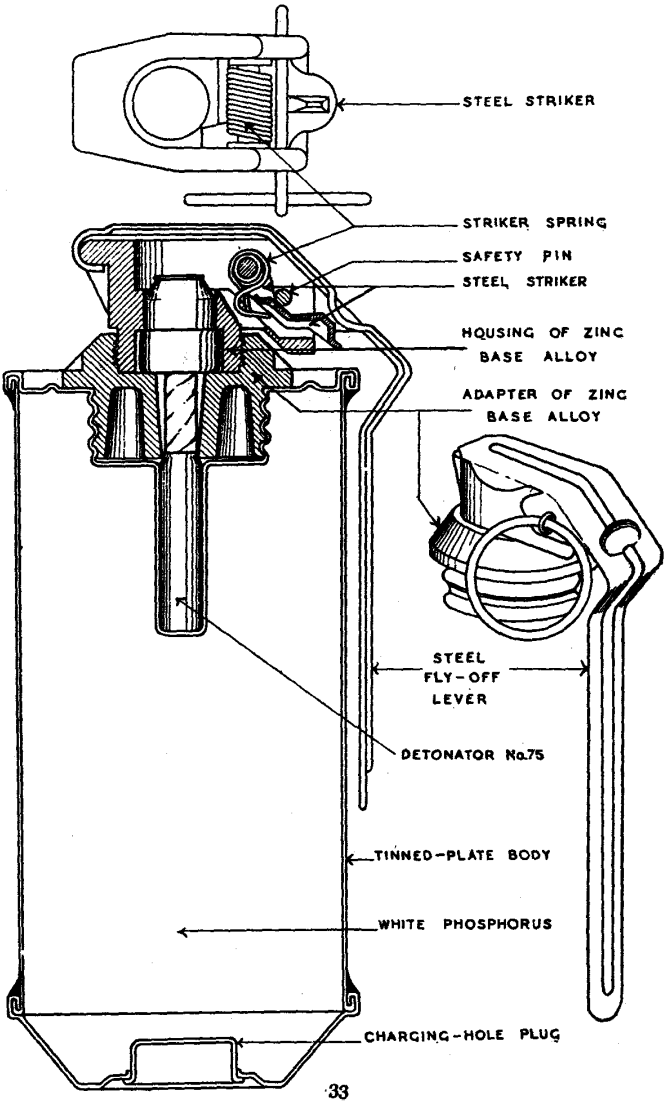
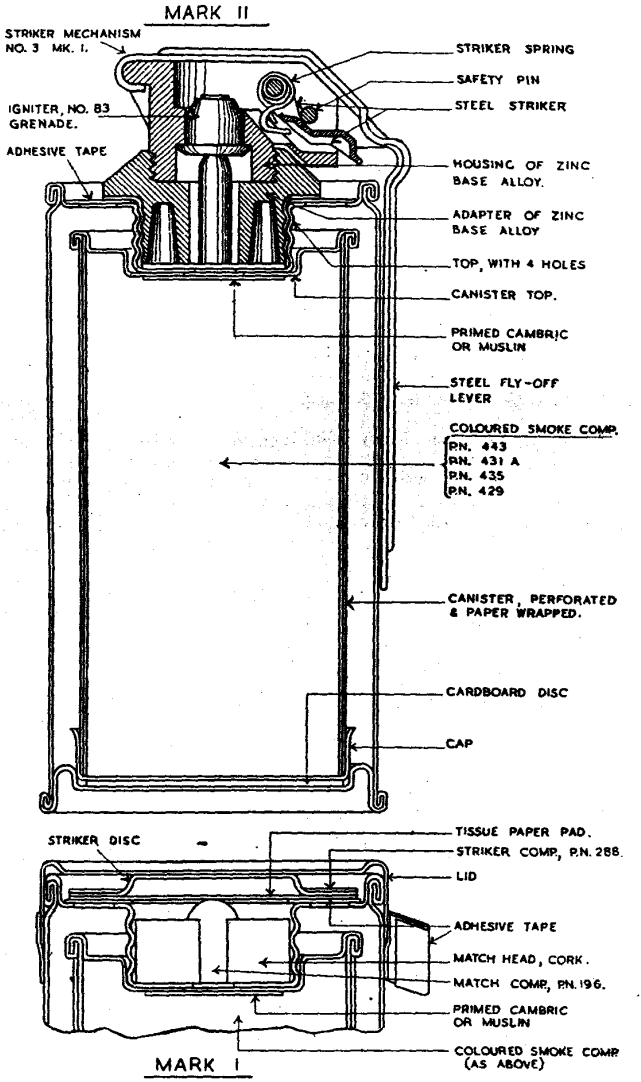


FIG. 13.

GRENADE, HAND, No. 83 SMOKE.



The adapter of zinc base alloy, is threaded externally to fit the grenade

3. Page 35. *Delete* from "the safety" in line 4 to "This latter" in line 5 and *substitute* :—

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the dimple in the fly-off lever, which in turn is held down by the safety pin (Figures 12 and 13 are incorrect in this respect). The fly-off lever

The mechanisms differ from each other only in the contour of the fly-off lever, the shape being adjusted to allow the lever to fit closely against the grenade body. They are distinguished by the No. 2 being zinc plated, while the No. 3 is rustproofed black.

The detonator used is carried between the housing and the adapter and projects below the latter into the body of the grenade.

In use, the safety pin is withdrawn, the hand holding the fly-off lever against the body of the grenade. On throwing, the striker, under the influence of the striker spring, throws the fly-off lever clear and swings over to strike the cap of the detonator.

23. Grenade, Hand, No. 80, Smoke W.P. Mark I (*Fig.* 12).

The body of this grenade is the same shape as the No. 77 Mark I, but is approximately 1½ inches longer.

The screw-threaded recess in the top takes the striker mechanism No. 2, and in the centre of this recess is soldered the detonator tube.

The detonator used is the No. 75, Mark II (*see* Fig. 7), very similar to the Mark V igniter for the No. 36M grenade, except that the safety fuze is straight. The cap holder carries a rim fire cap crimped on to the end of a length of safety fuze No. 17, the other end of which has crimped on a detonator No. 78. The Mark I detonator, now obsolescent, gives a less effective burst as it uses the No. 63 detonator on the end of the safety fuze, and this has a smaller filling than the No. 78. The Mark I is distinguished by having a ½-inch brown band on the white safety fuze, whereas the Mark II has the entire safety fuze coloured brown.

The filled grenade, containing approximately 13 oz. white phosphorus, weighs about 19½ oz.

Action.—The housing of the striker mechanism is unscrewed, the detonator [illegible] and the [illegible] replaced. The safety pin is withdrawn and

4. Page 35. Para. 23. Line 18. *After* " replaced" *insert* :—

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(Fig. 12 is incorrect in that the diameter of the central channel should be shown greater than the diameter of the detonator).

letters "PHOS".

Packing.—Twenty-four grenades with striker mechanisms, each in a paper container, and 24 detonators in a tin box are packed in a box P.59.

Stowage dimensions .. .. .. 19·15 in. × 8.35 in. × 7·85 in.
Weighs filled .. .. 43¾ lb. approx.

CHAPTER V

SIGNAL AND ILLUMINATING GRENADES

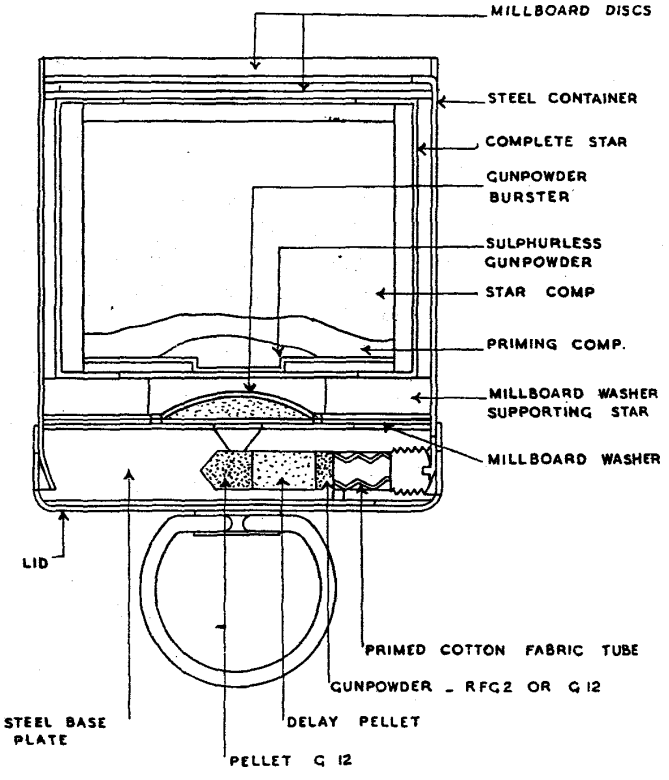
24. Grenade, Hand, No. 83, Smoke (*Fig.* 13)

This is a coloured smoke grenade used for signalling purposes, and e.g. to indicate positions of our own troops in daylight and is intended to replace the No. 26 smoke generator.

FIG. 14.

GRENADE, RIFLE, 2·5 INCH

No. 57, ILLUMINATING MARK 1



The normal-coloured smoke compositions are used, viz. a combustible (lactose or sucrose), an oxygen supplier (potassium chlorate) and a dyestuff, which may have to be a mixture of two dyes in order to obtain the desired colour. In action, the chlorate-lactose or chlorate-sucrose mixture burns at a temperature sufficient to sublime or volatilize the dye, the emission of which produces the desired coloured smoke cloud. Such compositions are easy to ignite, as is seen from the design of the grenade, and burn at relatively low temperatures; a necessity, since a high temperature would decompose the dye with loss of colour instead of merely subliming it. In addition, it is necessary that the coloured smoke is able to leave the burning surface quickly to prevent decomposition, and a certain amount of pressure must be built up in the container to allow of even burning of the composition.

The Mark I grenade will not be met in service, its design having been cancelled. It was intended to be introduced as a temporary measure on account of production difficulties, which have now been overcome. The main difference between the Mark I and the Mark II was in the method of ignition, the former having a match head igniter similar to that used with the No. 26 smoke generator, while the latter has the striker mechanism No. 3.

Mark II.—The body, of tinned ~~or terne~~ plate, is cylindrical with recessed top and bottom. The top has four smoke emission holes, each sealed with adhesive tape, and the roll-threaded recess carries the striker mechanism No. 3, the adapter of which is cemented in position. Cemented into the striker mechanism is the igniter, No. 83 grenade, which consists of a rimfire cap held in a cap holder and crimped on to a short length of fuze, instantaneous, Mark IV.

The bottom is recessed to provide a seating for the sheet steel canister. This canister, which carries the coloured smoke composition, is perforated by 0·15-inch diameter holes with centres 0·2 inch apart and the composition is held in place by a wrapping of paper. The base is covered by a sheet steel cap, a press fit only, and a firm fit of the canister in the body is obtained by the use of cardboard discs below the cap. The canister is recessed at the top to fit over the striker mechanism housing and ignition of the smoke composition is ensured by the use of a primed cambric or muslin disc shellacked to the underside of the top. The space between canister and body is empty.

Action.—The safety pin is withdrawn and the grenade thrown or placed in position. The striker mechanism functions as already described in para' 22, the rimfire cap ignites the fuze, instantaneous, which in turn ignites the primed fabric. The smoke composition then ignites and the resulting coloured smoke issues through the holes in the canister wall and in the top of the grenade body.

The details of fillings and grenade weight are given below:

Colour of Smoke	*Compositions Used*	*Weight of Composition*	*Weight of Grenade*
Red	PN 469*A*		
Yellow	PN 473*A*	Approx.	Approx.
Green	PN 468*A*	6 ounces	16 ounces
Blue	PN 471*A*		

Time of smoke emission—20 to 40 secs.

Marking.—The body of the grenade is painted green with stencilling in black to show grenade number, type, mark, filling details and composition number, and in white to show the colour of the smoke.

25. Introduction

A series of signal and illuminating rifle grenades, for use with the 2½-inch discharger cup and fired by means of the ·303-inch H. Mark Iz rifle grenade

cartridge, was introduced into the Service some years before the war, but these have since been replaced by the 2-inch mortar signal and illuminating bombs, and not many of this series should now be met.

The general construction of all members of this series is similar, individuals differing only in the type and number of stars ejected. It will suffice, therefore, to describe one only of these grenades and to summarize some particulars of the others.

26. Grenade, Rifle, 2·5-in. No. 57 Illuminating Mark I (*Fig.* 14).

The body of the grenade consists of a steel case closed at the base by a steel base plate and at the top by millboard discs. A steel lid, with ring for easy removal, fits over the base and protects the ignition arrangements.

The base plate has a radial hole drilled in it with a small hole at its outer end to allow of the flash from the cartridge, and a coned hole at its inner end connecting with the interior of the grenade. The radial hole, closed by a screwed plug, carries a tube of primed cotton cambric, a layer of gunpowder, a layer of delay composition, S.R. 250A, and finally more gunpowder to carry the flash through to the gunpowder burster of the grenade.

The star rests on a number of millboard washers which provide space for the burster, and consists of a cylindrical rocket paper case, with a wrapping of white paper, closed at the top by a millboard disc and by a millboard washer and muslin disc at the base. The filling is illuminating composition, S.R.577 ignited by a layer of priming composition, S.R. 252, and a layer of sulphurless gunpowder.

Action.—The lid is removed and the grenade inserted in the discharger cup base plate first. On firing, the grenade is projected into the air, and the propellant gases ignite the ignition system in the radial hole in the base plate, giving sufficient delay to allow the grenade to reach a height of about 250 feet before the gunpowder burster ignites. The burster blows the star case forward out of the body and at the same time ignites the star, which burns with a brilliant white light as it falls to earth.

27. Summary of Signal and Illuminating Grenades

The table below summarizes the particulars of grenades Nos. 57 to 62, which are all of the same general construction as that described above.

Number of Grenade	Type	Number of Stars	Time of Burning	Weight Filled	Overall Length
No. 57 ..	Illuminating ..	1	5½ sec. ..	1 lb. ½ oz	2⅝ in.
No. 58 ..	Illuminating w/parachute	1	28 sec. ..	1 lb. 7 oz.	5 in.
No. 59 ..	Day signal ..	12 Red or 12 Green or combination	7 sec. approx.	1½ lb. ..	3½ in.
No. 60 ..	Night signal ..	As for 59 ..	11½ sec. Red 8 sec. Green	1½ lb. ..	3½ in.
No. 61 ..	Day signal w/parachute	3 Red or 3 Green or combination	25 sec. Red 20 sec. Green	1 lb. 4½ oz.	5½ in.
No. 62 ..	Night signal w/parachute	As for No. 61 ..	12 sec. Red 19 sec. Green	1 lb. 4½ oz.	5½ in.

Markings.—All grenades are painted stone colour.

Illuminating grenades are marked with a red star in a white circle.

Day signals have coloured triangles; Night signals coloured discs.

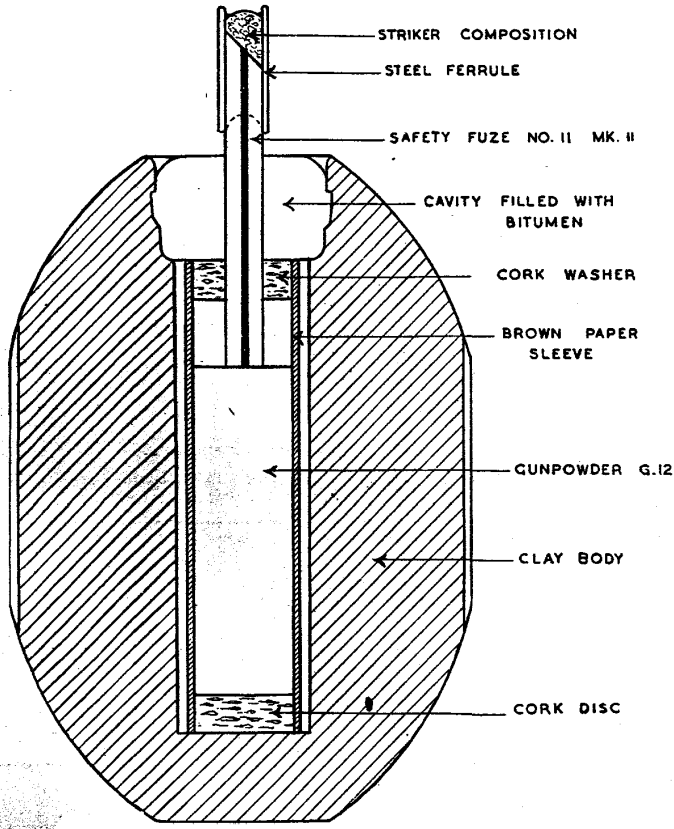
Nos. 59 and 60 have "M" stencilled on the coloured or parti-coloured triangle or disc.

Nos. 61 and 62 have three coloured triangles or discs to denote the colour of the stars.

FIG. 15.

GRENADE, HAND, CLAY, MARK I

WITH SAFETY FUZE.



CHAPTER VI

TRAINING GRENADES

28. Introduction

This chapter deals, very briefly, with grenades used for practice, drill and instructional purposes.

29. Grenade, Hand, Clay Mark I (*Fig.* 15)

This is a bursting type practice grenade with a thick-walled clay body grooved longitudinally.

The bursting charge is 177-gr. gunpowder contained in a rolled paper sleeve and is ignited by a length of safety fuze No. 11, sufficient to give a 5 seconds delay, and match composition.

Action.—The match composition is struck, and the grenade thrown. After a 5 second delay, the safety fuze ignites the burster which disrupts the clay body.

Marking—The body is painted white with a red filling ring near the top, and is stencilled "CLAY I", and with the manufacturer's initials and date of manufacture.

30. Drill grenades

These are for throwing practice or for firing at practice from a rifle and are similar to the actual service grenades except that they are weighted to correct weight with an inert filling. They are painted white.

31. Instructional grenades

These are for instruction in mechanism and are similar to drill grenades, but empty components are used and the grenades are unweighted. They are painted as for service grenades but without the red filling ring.

32. Practice grenades

Grenades of this nature will contain a small bursting charge designed to simulate the action of the service grenade. Marking will be decided when they are introduced into service.