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ARMAMENTS DESIGN DEPARTMENT

Technical Report No. 2/46 Part N.

GERMAN AMMUNITION - A SURVEY OF WARTIME DEVELOPMENT

GRENADES

Armaments Design Department,
Ministry of Supply,
Fort Halstead, Kent.
November, 1946.

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for C.E.A.D.

Abstract

This report includes critical and detailed descriptions of a large number of German grenades. All types of grenade are dealt with, and the report is illustrated by many drawings.

35-1-13

A.D.TECHNICAL REPORT NO. 2/46

GERMAN AMMUNITION: A SURVEY OF WARTIME DEVELOPMENT

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39	" (Dr.R.Beeching)
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41	" (S.A.F.R.)
42	" (D.1, Col.Lambert)
43	" (D.2, Col.Speechly)
44-46	" (D.2, Ammunition Section)
47	" D.5.
48	" D.6.
49	" D.9.
50-75	" T.1 Registry

FOREWORD BY COLONEL G.K.SPEECHLY

In September 1945 it became clear that the quantity of technical information and material which had already arrived in this country from Germany was very large and was increasing in bulk at such a rate that it might be difficult to assimilate before a great deal of the subject-matter became stale. Moreover, where further investigation or corroboration was required, it might be unobtainable because of the dispersal of the British and German technicians concerned.

It was also clear that, to make full use of the material, the available technical information would have to be extracted, classified, and sifted, by personnel who were experienced in the actual practice of the type of work being considered.

For these reasons, in spite of the fact that there was a lot more detail to come and many loose ends, it was decided in the Ammunition Group of the Armaments Design Department to form a team of Design Officers and Draughtsmen to exploit what had been found out about German Gun Ammunition, Projectiles, Grenades and Mines essentially from the point of view of the way they were designed and developed. Rockets and Fuzes are not included.

P.T.O.

The team, working under my direction, consisted of:-

W.J.Ashby
S.C.Huggins
R.W.Martyn, M.Eng., Major, R.E.
E.R.S.Pearce
G.S.Sanders, B.Sc.(Eng), A.C.G.I., A.M.I.Mech.E.
R.W.Strutt
J.U.Woolcock

R.G.Holton, A.M.I.Mech.E., and W.D.Morton, B.A., also contributed.

The work of this team is recorded in the 16 separate parts of this report, under the following headings:-

Part	A	High Explosive Shell	S.C.Huggins
"	B	High Velocity, Fin Stabilised and Rocket Assisted Projectiles	G.S.Sanders
"	C	Armour Piercing Projectiles	G.S.Sanders
"	D	Driving Bands	G.S.Sanders
"	E	Cartridge Cases	R.W.Strutt and E.R.S.Pearce
"	F	B.L. and Q.F.Cartridges	R.W.Strutt
"	G	Primers	E.R.S.Pearce
"	H	Tracers	E.R.S.Pearce
"	J	Anti-Aircraft and Aircraft Cannon Ammunition	J.U.Woolcock
"	K	Recoilless Gun and Special Aircraft Gun Ammunition	R.W.Strutt and J.U.Woolcock
"	L	Methods of improving the ballistic performance of guns by control of burning of the propelling charge	R.W.Strutt
"	M	Mortar Bombs	E.R.S.Pearce
"	N	Grenades	W.J.Ashby
"	P	Anti-Personnel Mines and Igniters	R.W.Martyn
"	Q	Anti-Tank Mines, Igniters and Anti-Lifting Devices	R.W.Martyn
"	R	Demolition Stores and Accessories	R.W.Martyn

As the members of the team could not be spared from their normal duties for an indefinite period, it was decided that the work should be completed by 1st February, 1946. For this reason any details which may come to light after this date will not have been dealt with. If anything of major importance comes to light, addenda will be circulated.

The team have examined a vast quantity of material, both in German and in translations, and have interrogated many German technicians and some members of the team have visited Germany. They have made analyses of technical detail, sketches and graphs, and Mr.Woolcock has also made formal translations of German technical documents.

The monographs which comprise the several parts of the report are not intended to treat the subjects exhaustively. They give a broad general outline of the facts as they have been ascertained, with illustrations, and provide a sifted bibliography for any who wish to follow the matter in greater detail. It is hoped that they will be of some interest to others besides the draughtsmen and designers for whom they were primarily prepared.

Our thanks are due to the personnel of the C.I.O.S. and B.I.O.S. organisations, the Halstead Exploitation Centre, the Naval Intelligence Authorities, M.I.(10) War Office, the U.S.Naval Attache and many others who gave us information and facilities which greatly assisted us in our task.

Fort Halstead,
Nr.Sevenoaks, Kent.
1st February, 1946.

GERMAN AMMUNITION : A SURVEY OF WARTIME DEVELOPMENT

PART N. GRENADES

Contents

In this report, grenades are classified according to their means of projection. For convenience, the types of grenade described in Parts 1 - 5 are presented in the following order:-

High Explosive
Anti Tank
Smoke
Pyrotechnic
Miscellaneous

Part 6, dealing with the Panzerfaust type of weapon which had a predominantly anti-tank role, is developed in historical sequence.

PART 1 - SUMMARY

(1) General

In the early part of the War, design development was organised to meet tactical requirements, but from 1944 onwards these became subordinate to supply and transport problems. In general, there seemed to be a lack of central direction of grenade design and little liaison between designers. This, together with the supply problem, probably accounts for the very large numbers of stores which have been produced, few of which can be classified as standard field equipments.

A single problem was frequently given to different firms for solution, and this led to considerable variation in similar types of stores.

A remarkable feature was the short time interval between the stating of a requirement and the issue of the store to field formations. Alterations to the design were not, however, uncommon after trials had been carried out in battle.

(2) Anti-Personnel Grenades

(a) Hand Grenades

Lethality

Most grenades had thin bodies and their effect depended on blast. As the need for increased lethality became obvious, fragmentation sleeves, both plain and segmented, were introduced. These were alleged to give a radius of lethality of 100 metres, but the German criterion of lethality is not known. There has been little evidence of over-fragmentation.

Materials

According to availability and the manufacturer, the following materials have been used for explosive containers :-

Mild Steel
Tinned Plate
Plastic Materials
Light Alloys
Nipolit.

Initiation

The general form of initiation was by means of a pull friction igniter and a detonator for the main filling. Later, pellets were introduced, as supply difficulties enforced the dilution of the usual TNT filling.

(b) Rifle Grenades

Method of projection

A rifled cup discharger was preferred. The grenades were pre-rifled, and in flight were spin stabilised. Great difficulty was experienced in obtaining stability at high angles of projection.

Materials

Again according to availability, plastics, steel and light alloys were used. Local shortages of materials led to the improvised use of wood and sometimes concrete.

Development

Design action was directed to improving lethality and performance. German rifle grenades ranged further than the British, but they carried a smaller "pay load".

Great attention was paid to cartridge design to increase the effective range of rifle and pistol grenades. Many accidents were caused by troops using non-interchangeable stores. In connection with this, the following translation from a German instruction to users is worth noting:-

(1) Each type of rifle grenade is to be propelled only by the appropriate blank cartridge. Other types of bulletted blank will not be used, as this may lead to premature on discharge. (Rifle Grenades are packed singly

in cartons, and the appropriate blank cartridge is attached by a paper strip).

(2) Rifle grenades arm on discharge. It is therefore forbidden to touch or lift a blind as this may cause detonation.

(3) Rifle grenades can therefore only be considered safe to handle if they are still in their original cartons, and even then they should be treated with the respect due to all unfamiliar ammunition.

Design action was initiated to evolve a centrally channelled grenade (for a 5 cm. discharger cup) in order to eliminate the need of special cartridges. A standard 7.92 mm. round was to pass through a diaphragm of self-sealing rubber stretched across the base of the tail unit. The diaphragm was secured to the body by a pin catch which disengaged under air pressure after leaving the discharger, so that the diaphragm was discarded. The grenade was to be side fuzed.

Work on rocket-assisted rifle grenades had been started, but only rough sketches were found for one design, that was for a projectile 147 cm. long and of 7 kgm. weight.

(3) Anti-Tank Grenades

(a) Hand Grenades

Experiments were carried out with the object of producing a shaped charge stick grenade. The conclusion reached was that 300 gm. of RDX/TNT, with a 1 mm. steel cone of 60 degrees angle and 80 mm. stand-off, would give the required penetration of 100 mm. A great deal of work was done to defeat the possible use, by us, of a magnetic grenade. A paste, Zimmerit, (Chemische Werke Zimmer A.G. Berlin) for application to tank armour was issued. It had the composition :-

Polyvinyl	25 per cent
Wood fibre	10 per cent
Barium Sulphate	40 per cent
Zinc Sulphide	10 per cent
Ochre	15 per cent

Some work was done on magnetic grenades.

(b) Projected Grenades

Rifle Grenades

Rotated grenades with shaped charges were produced which ranged further than the British fin stabilized type, but with lower target performance. These grenades were superseded by the recoilless types.

Recoilless (Panzerfaust) Types

This was a series of unrotated, hollow charge projectiles. Development was directed to increasing the strength of the launcher tube so that it would be useable for several firings.

On earlier models a zinc cone was tried, but this gave poor performance especially against skirting plates. The final design to appear in battle was alloyed to have a 220 mm. penetration at normal incidence.

For use at high angles in the anti-personnel role, a fragmentation ring was envisaged.

(4) Smoke Grenades

Hand Grenades

Development was directed towards producing a larger, denser and more persistent smoke cloud. The requirement for satisfactory performance at low temperature and low relative humidity led to the use of titanium chloride, containing 25 per cent silicon tetrachloride with a 27 per cent calcium chloride solution. White phosphorus was not used in any German smoke store as it was considered too dangerous to handle during manufacture.

Glass containers were often used for smoke grenades.

(5) Miscellaneous

Among the large numbers of special grenades produced for use with Signal Pistols were :-

Small anti-personnel H.E. grenades.
Smoke grenades
Illuminating grenades (including one type which was used in an attempt to dazzle night fighters)
Propaganda grenades
Signal grenades (with a potassium nitrate base)

The illuminating and signal grenades were generally of lower candle power than the British. Some difficulty was experienced in producing efficient colouring matter.

Captured H.E. grenades were generally only used locally for booby traps.

(6) Explosive Fillings

Summary

German grenade filling technique was based on the "melt pouring" process, although pre-pressed charges were extensively used. Stemming was considered unsafe.

Safety precautions were of very low standard judged by British practice.

Supply difficulties enforced the use of non-explosive diluents with T.N.T. In 1944, common salt up to 60 per cent and "scheidl-mehl" stone powder were used as diluents. Owing to shortages, a great deal of breaking-down and recovery of T.N.T. from unwanted stores was undertaken.

Montain wax was adopted as a stabilising agent with explosives of low F. of I.

Types of H.E. used in grenades

The general range used showed nothing unusual, except for the introduction of Nipolit.

Melt loading was almost exclusively employed for small stores. Filling with pre-pressed biscuits was the alternative.

T.N.T. mixture with ammunition nitrate and sometimes aluminium powder, RDX/TNT, and PETN/wax fillings were commonly used. Supply difficulties led to research for and introduction of suitable diluents and substitutes for T.N.T. These included :-

Methylamine nitrate - mixed with sodium nitrate
Trinitrodichlorobenzol
Dinitrobenzol - substitute for T.N.T. in amatols
Hexal - 75 per cent hexogen, 25 per cent aluminium
DINA
Ethylene diamine dinitrate
Dinitronapthalene
Dinitrophenylamine
Hexanitrodiphenylamine

Towards the latter end of the war, up to 60 per cent common salt was frequently used, especially in alumined explosives.

Filling Factory technique

Pre-formed charges, pressed hydraulically, were often fitted into grenades. Such fillings proved loose and were not always satisfactory.

With smaller stores, cavities were often drilled into the solidified H.E.fillings.

A typical Filling Factory had the following shops under one roof:- empty casing store; pre-heating room (for shells), melt-mixing room, pouring room, cooling tunnels, drilling bays and finishing room.

Small stirrers were often inserted in pouring buckets to agitate the melt while it cooled to the lowest practicable temperature for pouring.

Composition of German gaines

Four types of gaine were used in German grenades :-

Gaine	A	B	C(Large)	C (Small)
Initiator	60/40 lead azide/lead styphnate 0.45 gm.	70/30 lead azide/lead styphnate 0.32 gm.	lead azide/lead styphnate 0.41 gm.	lead azide/lead styphnate 0.3 gm.
Detonating Composition	Cyclonite 0.45 gm.	Cyclonite 0.45 gm.	PETN 0.35 gm.	PETN 0.6 gm.
Magazine Filling	Cyclonite 92/WMX 8 37.5 gm.	Lower:- cyclonite 92/WMX 8 30.0 gm. Upper:- cyclonite 92/WMX 8 21.0 gm.	PETN/Wax 33.8 gm.	PETN/Wax 16.8 gm.

Pellets, where used, were of PETN/Wax and were of a small size compared with British pellets.

Detonator

The standard detonator used in all German explosive grenades was the No.8 Sprengkapsel, which, in performance, was very similar to the British No.8 detonator.

PART 2 - HAND GRENADES

(1) Summary

H.E. Grenades

Two main types of H.E. hand grenade, the egg and the stick, were produced in large numbers. Several different marks and modifications of each exist. As originally designed their main effect depended on blast, but fragmentation sleeves were issued later.

Anti-Tank Grenades

Based on the hollow charge principle, anti-tank grenades were designed either for throwing against or placing on a tank. Attachment to the target was achieved by use of magnets or by an adhesive composition.

Smoke Grenades

The smoke composition used was of either the HCE or titanium tetrachloride type.

Igniters

For initiation, the Germans relied almost entirely on friction igniters. Although modifications were made the basic design remained unchanged. A table of types of igniter, showing the stores in which they were used and their salient features, is given below:-

"Brennzunder" Friction Igniter	Delay	Store in which used	Remarks
BZ 24	4½ sec.	H.E.Stick Grenade 24	Friction composition in lead capsule. Actuated by wire loop.
B239 (modified)	4½ sec.	H.E.Stick Grenade 24	Aluminium capsule.
B239 for egg-grenade		Egg grenade 39 Strike grenade 42 Smoke grenade 41	Pale blue knob Friction.
BZ40 for egg-grenade		Egg grenade 39	Spring-loaded striker and cap. Royal blue knob.
NBZ 38		Smoke stick grenade	Friction
NBZ 39		Smoke stick grenade	Friction
Safety fuze igniter Zdsachn Anz 29		Smoke grenades	Friction
Zdsachn Anz 39			Grey knob Friction. L.H.thread.

(2) Stielhandgranate 43. (Stick grenade, H.E., 43 - early model).

Dimensions	Total weight 1 lb. 6 oz. Filling 7 oz. T.N.T.
General	The H.E. head, painted field grey, was permanently fixed to a solid wooden handle. The igniter screwed into the top of the H.E. head which could be fitted with the smooth or segmented fragmentation sleeve.
Initiation	B.Z. 39 for egg-grenade, or B.Z.40 with a No.8 detonator.

(3) Stielhandgranate 24. (Stick grenade, H.E.24).

Dimensions	Overall length	1 ft. 2 in.
	Length of head	4 $\frac{1}{8}$ in.
	Dia. of head	2 $\frac{3}{4}$ in.
	Length of handle	10 in.
	Weight	1 lb. 2 oz.
	Weight of filling	6 oz.
	Effective range:	
	of fragmentation	10-15 yards
	of blast	6-7 yards
	Throwing range	about 30 yards.

General — This offensive grenade, similar to the St.H.24 of World War I, consisted of a cylindrical body of thin gauge steel, containing a bursting charge. It was fitted with a wooden handle which contained a friction type igniter, operated by a pull cord. A smooth or segmented fragmentation sleeve could be fitted.

Mechanical features — The bursting charge of loose T.N.T. was enclosed in a waxed-paper container, and was filled into a steel cylinder. A steel adapter, internally threaded, fitted over the cylinder to receive a hollow, breech handle, which housed the igniter assembly. The holder was threaded internally to receive the brass bush on the igniter. This assembly was retained by steel and millboard washers, and was attached to a spring by a rivet which was carried under the cap.

Initiation — Initiation was by a friction igniter, Brennzunder 24 (B.Z.24) and a No.8 detonator. The detonator was a push fit in the igniter assembly.

Packing — The head, handle and igniter assembly were separately packed.

Advantages — The only advantage this grenade had over similar British types was its slightly greater throwing range.

Use — The grenade was used mainly for training in the later stages of the War.

(4) Stielhandgranate 39 (Stick grenade, H.E. 39).

Dimensions	Overall length	1 ft. 4 in.
	Weight	1 lb. 6 oz.
	Weight of filling	7 oz.
	Effective range of burst	16 yards
	Throwing range	about 25 yards.

General — This grenade was very similar to the St.Hdgr.24. The main differences between the '24' and '39' stick grenades were:-

(i) The head of the 39 type was of 2 mm.(0.08) steel.

(ii) The igniter cord was attached directly to the cap and not to a ring as in the 24 type.

(5) Stielhandgranate 43 (Stick grenade, H.E.43 - late model).

Dimensions	Total weight	1 lb. 6 oz.
	Filling	7 oz. T.N.T.

General — The H.E. head, painted yellow and field grey, was screwed on to a solid wooden handle. The igniter screwed into the top of the H.E. head. The grenade could be fitted with a smooth or segmented fragmentation sleeve.

Initiation — The initiation system consisted of an igniter, BZ. fur Eihdgr 39 or BZ.40, and a No.8 detonator

(6) Handgranate 43 (Grenade H.E.43).

Dimensions	Filling	7 oz., T.N.T.

General — The grenade consists simply of the H.E. head of the stick grenade fitted with a smooth or segmented type 43 (later model) fragmentation sleeve.

Initiation — Eihdgr 39 and detonator No.8.

(7) Stielhandgranate-Nipolit (stick grenade-Nipolit)

Dimensions	Weight	19 oz.

General — This grenade, composed entirely of high explosive, was of the "offensive" type and presumably was introduced as a result of the shortage of metal and T.N.T.

Design features — The cylindrical head of nipolit had a nipolit handle driven into it. The base of this handle was of increased diameter, and was drilled to take the detonating composition and an egg-type igniter (with delay) fitted with a hexagonal nut. The igniter was anchored in the nipolit by means of a threaded steel collar with a flange, which was held in place by means of a nipolit washer, forced in after insertion of the retaining collar.

Manufacture — Fabrication of the grenade was simple, and assembly quick. Machining operations were greatly reduced in number by the use of Nipolit. The only filling operations were concerned with the detonating and delay compositions.

(8) Behelfs Stielhandgranate Beton-I. (Stick grenade, concrete, I)

Dimensions	Overall length	14 in.
	Length of concrete head	4 in.
	Diameter of concrete head	2 $\frac{3}{4}$ in.
	Thickness of concrete casing	$\frac{1}{2}$ in.
	Total weight	1 lb. 4 oz. to 1 lb. 11 oz.
	Filling	Stnd. 100 gm. charge T.N.T. (3$\frac{1}{2}$ oz.).

General — This grenade appeared in North Africa, and was probably of local manufacture only.

Design features — The grenade consisted of a rough wooden handle, to the end of which was secured, by two strands of thick wire, a 100 gm. charge, which was surrounded by a coarse concrete casing, about $\frac{1}{2}$ in. thick. The charge, a normal "barrel" demolition one, was threaded, and the normal stick grenade friction igniter was used. The handle was grooved to take the extension cord, and had a small cut-out portion in the base to take the pull-ring.

Initiation — Igniter B.Z. 4.5 SEK and a No.8 detonator.

(9) Behelfs Handgranate-Holz. (Stick grenade - wood)

The empty assembly of this "offensive" type grenade was made entirely of wood.

Dimensions	Total weight	13 oz. approx.
	Overall length	15 in.
	Length of head	5$\frac{1}{2}$ in.
	Diameter of head	2$\frac{1}{2}$ in.
	Weight of explosive	50 gm.

Design features — A cylindrical turned wood head was threaded internally for a short distance to receive a wood handle. The head was bored out to a depth of nearly 5 inches and contained half a "barrel charge" (i.e. half a 100 gm. standard demolition charge), and the remaining space was taken up by a rough wooden peg. The handle was bored throughout its length and was closed at the end by a plain metal cap.

Initiation — The igniter system consisted of a safety fuze igniter and a detonator assembly containing a 45 mm. length of safety fuze to give a delay of 4$\frac{1}{2}$ seconds. The assembly was known as the "Sprengkapselzünder 28". An extension cord passed through the length of the handle to a pull-off knob under the metal cap.

Filling — 50 gm. (1$\frac{3}{4}$ oz.), T.N.T.

(10) Geballte Ladungen (Bundle charges)

These charges consisted of six stick grenade heads, without detonators, firmly bound round a central grenade which acted as a primer. They were used by assault engineer troops in attacking fortifications, obstacles and A.F.Vs. The maximum distance to which a charge could be thrown was stated to be 12 metres (approx. 40 ft.). As a protection against the ingress of moisture, it was recommended that the detonator sockets in the grenade heads be covered over. The effect of the charge was due, presumably, to blast, as there was very little metal in the assembly. The method of use against tanks is obscure, but they would seem to be of more use against the tracks and bogies than against the crew. There was mention in German instructions that an impact fuze was used to ensure detonation in actual contact with a tank. No details of the fuze are, however, available.

(11) "Shaving Stick" grenade (I & II)

Dimensions	Overall length (I)	3 ⅝ in.
	Overall length (II)	4 in.
	Max. diameter	2 in.
	Igniter	BZE (blue cap)
	Delay	4 ½ in.
General	The body of this type of grenade consisted of a thin, yellow painted aluminium cylinder, with the standard egg igniter screwed into the top.	
	By substituting the B.Z. fur Eihdgr for a D.Z.35 Pressure igniter, the assembly could be used as a booby trap.	

(12) Eihandgranate 39 (Egg grenade, H.E.39)

Dimensions	Total weight	8 oz. (Amatol filled)
		or 10 oz. (TNT filled).
	Filling	Amatol or T.N.T.
		4 oz. Amatol
		or 6 oz. T.N.T.
General	The egg-shaped metal body was painted field grey, and an igniter screwed in at one end. The grenade could be fitted with a special fragmentation jacket.	
Initiation	The ignition system was Igniter BZ. für Eihdgr. 39 and detonator No.8.	

(13) Eihandgranate 39 Ub (Egg grenade, 39, practice).

Dimensions	Overall length	3 in.
	Maximum diameter	2 in.
	Weight	12 oz.
	Igniter	B.Z. fur Eihdgr.
	Delay	4½ sec.
	Colour	Body - black
		Igniter - blue cap.
General	The grenade was identical with the H.E. version, except that it was filled with a "spotting" charge. The standard igniter was used.	

(14) <u>Kleine Eihandgranate-Nipolit</u> (Small egg grenade - Nipolit)

Dimensions	Weight of Nipolit body	250 gm.

General — The igniter and anchor were very similar to those used with the Nipolit stick grenade. No hexagonal nut was fitted, but there was incorporated a "butterfly" type nut, the ends of which were turned down over the grenade body. The central body of the main grenade body was made of Nipolit.

(15) <u>Gross Eihandgranate-Nipolit</u> (Large egg grenade-Nipolit)

Dimensions	Weight of Nipolit	500 gm.

General — Essentially the same as the small Nipolit egg-grenade, this version was of larger diameter. The grenade incorporated a greater amount of Nipolit and of PETN/Wax than the smaller type.

(16) <u>Splittermantel</u> (Fragmentation jacket)

Dimensions	Thickness of metal jacket	3/32 in.

General — Metal fragmentation jackets, produced for filling to the standard H.E. egg grenade 39, were made in two identical halves. Two ears were welded to each half of the jacket for quick assembly to the grenade, an operation which took about a quarter turn.

Jackets were serrated to a total of 96 fragments, each approximately $\frac{1}{2}$ in. x $\frac{3}{8}$ in., under ideal conditions.

(17) <u>Booby traps and adaptations</u>

While the subject of Booby Traps is fully dealt with in another pamphlet, mention can well be made here of a few mechanisms improvised from grenades.

The standard H.E. egg grenade 39, fitted with the standard BZE igniter, cap coloured blue, and therefore of entirely conventional appearance, was often used as a booby trap. The igniter functioned instantaneously by reason of the fact that the small steel tube, containing the delay, was unscrewed from the main body of the igniter. This operation could be done easily with two pairs of pliers. The flash from the match composition initiated the detonator immediately the friction wire of the igniter was pulled.

Cases also occurred where the standard egg grenade was fitted with a ball cap coloured red. This igniter gave a delay of 1 second.

Use was made also of the British No.69 (Bakelite) grenade, as a booby trap by removing the creep spring from the No.247 fuze.

In the North African campaign, captured British No.75 grenades were used as mines, by tying 3 together on a board, drilling the centre one and inserting a "press-type" detonator. The assembly was designated "Engl. Tellermine, H.G. 75, Mk.I".

(18) Methods of carrying grenades

Stick grenades were originally constructed with carrying hooks on the side of the head, so that they could easily be carried on the belt, a practice which was discontinued after 1933.

During the war, grenades, detonators and igniters were packed in metal ammunition cases, each usually holding about 15 sets. On the march or in action they were carried either in these boxes, or in sandbags. The individual issue, usually 2 per man, were placed, head uppermost, either in the belt or the jack boots.

Troops on patrol were equipped with a special grenade carrying jacket, presumably similar to our "jungle jackets" used in the Far East campaign. Made of a heavy, dark cloth, it fitted over the tunic, rather like a sleeveless pullover. In it were 10 pockets, 5 in front, 5 behind, in which hand grenades could be placed, head downwards. These were all accessible to the wearer, and it was said that an even distribution of weight was obtained.

(19) Magnetic anti-tank grenade

Dimensions	Total weight	7 lb.11 oz.
	Filling	3 lb. 5 oz.,RDX/TNT 50/50 of density 1.67
	Exploder	PETN/Wax, 90/10, of density 1.58
	Penetration	110 mm.IT 80 homo plate or 20 in.concrete .

(There was a series of this type of grenade of weights 2,3,5,8 and 10 kgm.)

Design Details — Designed on the hollow charge principle, the cavity liner of the grenade was a 60 degree cone, made from 17 mm. mild steel plate.

Three permanent horse-shoe magnets of an Alnico type alloy (VDH.546) provided the means of adhesion to a target. They were bolted to the underside of a plastic base-plate. The magnet assemblies were bolted between the pole pieces by brass bolts which were partly recessed into grooves in the magnets. The pole pieces of the magnets were cold shaped from dead mild steel bar of section 3 3 cm. x 2 cm. The acting surfaces were ground, probably after assembly to the base plates.

Initiation — BZ.24 with No.8 detonator.

(20) Panzer Hand Mine.(Hollow charge, anti-tank, sticky grenade)

Weights		Grammes	Pounds
	H.E.container and exploder housing	77	0.17
	Igniter adaptor	37	0.08
	Charge liner	66	0.15
	Cover and handle	19	0.04
	Sticky pad holder and pad	18	0.04
	Adapting ring	10	0.02
	Transit plug	5	0.01
		232	0.51

General — The grenade was painted olive green to the rear of cannelure on the cylindrical portion (supporting cone), and white forward of it. Stencilled on the H.E.container was "Fif 42", and on the transit plug "42 fif SD".

Design Details — The H.E.container was cold drawn from low carbon mild steel strip, approximately 0.5 mm. thick; the V.D.H. varied from 193 to 127. A cannelure formed in the cylindrical wall, 15 mm. from the forward end, acted as a seating for the cone.

The exploder housing was cold pressed from dead mild steel strip, approximately 1.5 mm. thick; V.D.H. figure 202. It was crimped into the rear of the container and screw threaded externally for attachment of the igniter adapter.

The igniter adapter was cold drawn from mild steel strip 1.5 mm. thick; V.D.H. value varied from 209 -133. It was screw threaded at the rear end to accommodate the igniter.

The charge liner was cold drawn from dead mild steel strip, 1.5 mm. thick; V.D.H. fig.193 to 143. The exterior surface of the liner was machined and the wall thickness decreased regularly from 1.5 mm. at the mouth (or base) to approximately 0.5 mm. at the apex. The included angle was 32 degrees. 8 equally spread holes, 1.5 mm. dia., were drilled through the flange.

The sticky pad holder was a cold pressing from dead mild strip, 0.25 mm. thick; V.D.H.varied from 165 to 117.

The adapting ring was cold pressed from dead mild steel strip, 0.25 mm. thick; the V.D.H. varied from 159 to 113. The sticky pad holder was fastened to its forward flange by a crimped over collar made from dead mild steel strip, and this made a push fit into the forward cylindrical end of the H.E. container, where it held the charge liner in position on its cannelure seating. The H.E. container was indented into the ring in 6 places to secure it in position.

The lid, carrying a handle, was pressed from low carbon mild steel strip, 0.25 mm. thick, and its V.D.H. figure varied from 162 to 117. It was made a push fit over the sticky pad holder.

(21) Buchsenhandgranate M.42 (n),I.

Dimensions

Overall length (incl cap)	5.93 in.
Body length	4.17 in.
Body dia.	2.32 in.
Neck length	1.18 in.
Neck dia.	0.55 in.
Weight (as packed)	18.35 oz.
Filling	6 oz., Block T.N.T.

General — The grenade had a grey finish, with a bright yellow band 10 mm. wide round top of body.

Stencilling :- BHD GR M42 (n)
R 7 42
Vor Gebrauch
Sprengkapsel Nr. 8
Einsetzen

The store was packed 15 to a wooden box, with detonators No.8 and 15 pull igniters BZ24.

Design Features — The body of this grenade, of Norwegian origin, consisted of a light metal canister, closed at both ends. The upper closing disc carried a central tube leading to the bottom of the body. This tube, threaded internally for a short distance at about 2/3 of its length from the top, acted as the detonator and igniter holder. A short tubular metal neck surrounded the top of the tube, the neck being closed in transit by a push-on metal cap. The grenade was packed with a loop of string, ending in a wooden button, lying loosely in the internal tube. Inside the body was a loose coil ($5\frac{1}{4}$ turns) of 4 mm. dia. lead alloy rod, deeply notched at every 10 mm. on the outside of the turn, to give approximately 88 fragments.

Arming — To arm, the pull-off cap and button with strings were removed and a No.8 detonator inserted into the tube, mouth end uppermost. An igniter, BZ.24 was looped to the end of the string and screwed into the tube, and the push-on cap replaced if the grenade was not required for immediate use. Before throwing the wood button was sharply pulled.

(22) Disc grenade

Dimensions — Diameter 3-5/16 in.
Thickness 17/32 in.

General — The grenade was made from a Nipolit disc drilled to receive an igniter and detonator.

Initiation — B.Z.E. 39 (Blue knob)
No.8 detonator.

(23) "Nipolit" cylinder hand grenade with fragmentation sleeve.

Dimensions — Total weight 15 oz. $10\frac{1}{2}$ dr.

(24) Panzerwurfmine 1(L)(Hollow charge, anti-tank grenade)

Dimensions — Total weight 3 lb.
Filling $18\frac{1}{2}$ oz., cast RDX/TNT
Exploder $2\frac{3}{4}$ oz. PETN/Wax (6 pellets)
Penetration 88 mm. at normal.

General — The grenade had a yellow painted, pear-shaped body with stencilling "PWM 1(L)"

Design Details — The grenade had a hollow handle which contained six PETN/Wax pellets. On the handle were four fabric fins attached to sprung metal ribs which were retained by a metal cap. The grenade armed on throwing when the sprung ribs were released from the cap.

Initiation. — "All-ways" impact fuze.

(25) Panzerhandmine S.S.(Hollow charge, sticky grenade).

Dimensions	Total weight 14¾ oz. Filling 7¼ oz., cast RDX/TNT,50/50. Exploder Prossed PETN/Wax 90/10 pellet. Penetration 125 mm. IT80 homo.plate.
General	The grenade was cone shaped and painted field grey. The adhesive base was protected in transit by a tinned plate cover, and the fuze hole at the apex of the cone by a black plastic transit plug.
Design Details	The hollow charge cavity was in the form of a truncated cone, which had an internal angle of 32 degrees. The liner tapered from 3 mm. at the mouth to 1 mm. at the apex. The mouth of the grenade was closed by a thin steel cap to which was rivetted a felt pad impregnated with an adhesive. This adhesive consisted essentially of a mineral oil/polyisobutylene composition. Accidental adhesion was prevented by a thin steel pull-off lid.
Initiation	Egg-grenade friction igniter (4½ sec.delay)or impact fuze.

(26) Panzerhandmine S.S. (Hollow charge, sticky grenade-hand thrown)

General	This grenade was similar to the "hand-placed" grenade, but had an alternative "impact fuze" so that the grenade could be thrown. A linen streamer armed the fuze and kept the grenade pointed in the correct direction.

(27) Nebelhandgranate 39-1940 type (Stick, smoke grenade).

Dimensions	Total weight about 1 lb. 10 oz.(average) Type of filling HCE/AL, 80/20. Weight of filling 11 oz.
General	The head, which was painted field grey, had a white interrupted band and white stencilling. The head screwed on to a hollow wooden handle which contained a friction igniter. This was protected by a closing cap.
Initiation	The grenade was fitted with ignition tube N.4, igniter BZ.38, or igniter BZ.39.

(28) Nebelhandgranate 39-1941 type (Stick, smoke grenade)

Dimensions	Total weight about 1 lb.10 oz. (average) Filling 15¾ oz. HCE/ZN 47/53.
General	The head, painted field grey, had a white interrupted band. "39" was stencilled in white on the head which screwed on to a hollow wooden handle containing the igniter.
Initiation	The grenade was fitted with ignition tube N.4, igniter BZ.38, or BZ.39.

(29) Nebelhandgranate 39-1942 type. (Stick, smoke grenade)

Dimensions	Total weight about 1 lb. 10 oz. (average) Filling 15 ¾ oz. HCE/ZN. 57/43.
General	The head, painted field grey, had a white interrupted band and white stencilling "39 B". It screwed on to a hollow wooden handle which contained the igniter.
Initiation	The grenade was fitted with ignition tube N4, and igniter BZ.38 or BZ.39.

(30) Nebelhandgranate 42 (Egg grenade, smoke)

Dimensions	Total weight 9¾ oz. Weight of filling 6 to 6½ oz. HCE/ZN. Length 5 ¼ in. approx. Max. Diameter 2 in. approx.
General	The grenade had a metal body, was egg-shaped and painted field grey, with white stencilling 'Nb.Eihgr 42'. There were three holes in the hollow top for smoke emission. A pull igniter, Zdschn Anz 29 or 39, screwed into the top of the grenade.

(31) Blendkörper 1 H and 2 H (Glass smoke grenade)

Dimensions of Blendkörper 1 H	Total weight 10½ to 13 oz. Type of filling Titanium and Silicon tetrachloride 77/23. Weight of filling 9 to 10½ oz. Overall length 5½ to 6½ in. Diameter 2½ in.
Dimensions of Blendkorper 2 H	Total weight 17 oz. Type of filling Titanium and Silicon tetrachloride 77/23, and central tube containing Calcium chloride. Weight of filling 9 ½ oz. with 1⅛ oz. calcium chloride
General	Both grenades were designed for attacking A.F.Vs and pillboxes, and relied for their effect on the penetration of apertures by the smoke-producing liquid. The 2 H was a development for use at low temperature and low relative humidity.
Design Details	The grenade consisted of a moulded glass pear-shaped bulb, and was about 2 in. in dia. (maximum) and 4 in. in height to the neck where it flared out to form a collar, approximately 1 in. high by 1½ in. dia. The neck had 3 corrugations which served to secure a sealing ring. The bulb weighed 150-160 gm. (about 5 oz.) when empty, and had a capacity of about 170 cc. (10 cu.in.).

Design details (cont.) An internal flange at the base of the neck, together with a white plastic washer, provided a seating for a test-tube shaped central tube, also of moulded glass. The grenade was sealed with a sulphur and cement plug. Molten sulphur was poured in to cover the top of the inner tube. The main portion of neck was then filled with a "plaster of paris" cement and finally covered with a layer of sulphur.

The bulb was filled with 250-270 gm.(9 oz.) of a mixture of titanium tetrachloride (72-77 per cent) and silicon tetrachloride (28-30 per cent), whilst the central tube contained 36-40 gm, (about 1½oz.) of a 27 per cent aqueous solution of calcium chloride.

The 2 H model produced a larger and denser cloud than the 1 H, but of very short persistence.

In conditions of low relative humidity, performance of 1 H was likely to be poor.

The central tube of calcium chloride was probably incorporated to improve performance by providing the water required for reaction, particularly in conditions of low relative humidity. Likewise the silicon tetrachloride was added to the titanium tetrachloride to depress its freezing point. This conclusion was borne out by a statement on the label that 2 H did not freeze, and was useable at temperatures down to - 40 degrees C.

(32) Nebelhandgranate 41 (Smoke grenade)

Dimensions
Total weight 1 lb. 5½ oz.
Type of filling 1940: HCL/AL, 80/20 11 oz.
1941: HCL/ZN, 47/52 15¾ oz.
1942: HCL/ZN, 57/43 15¾ oz.

Description This grenade was the head portion of the Smoke, Stick Grenade 39, removed from the stick and fitted with a plastic adapter to take the BZ für Lihdgr 39 igniter or Zdschr mit 29 or 39. The grenade was fitted with the usual ignition tube No.4.

(33) Brandwurffgranate (Incendiary grenade-bursting)

Dimensions
Weight of Nipolit body 1[illegible] gm.
Weight of Thermit C. 2[illegible] gm.
Overall length 4.5 in.
Diameter (largest) 2.6 in.

General This grenade appeared to be the only incendiary hand grenade in use by the G.A.F.

Design features The external body was fabricated from Nipolit in two parts. Other items were conventional in design.

The manufacture of this grenade involved very little complicated tooling. The body could be moulded, pressed or machined, depending upon the Nipolit used; the central tube and spacers were plain cardboard sleeves; the incendiary pellets could be pressed and the steel anchor and igniter were standard items.

Initiation — On pulling the "egg-type"friction igniter, (which had no delay), flash from the composition ignited the quickmatch, which in turn ignited the incendiary pellets. When sufficient heat was generated, the thermite ignited. It is not known whether the Nipolit body contributed to the fire or whether it burnt to detonation when burning pellets would be scattered.

(34) Lachrymatory grenade

Dimensions	Overall length	5 in.
	Max. diameter	1½ in.
	Filling	C.A.P.

General Description — Below the lid of the sheet aluminium case was a cylindrical holder, retained in position by four indentations in the case to correspond with four indentations in the holder. This holder had a screwed projection to take a friction igniter with its 4 in. length of string and wire loop. A dished aluminium piece below the holder contained a small compressed charge of black powder. On the upper side of this charge was a thin disc of white powder. The main filling consisted of ten cylindrical pellets of a yellow compound, and one pellet of a white substance wrapped in cellophane. The charge was held between two dished pieces. On ignition, the grenade generated a lachrymatory vapour which escaped through holes in the holder. The lid was secured to the container by a blue coloured piece of adhesive tape.

PART 3. RIFLE GRENADES

(1) Summary

General

Very few examples of fin stabilised rifle grenades fired from spigots were seen: most were designed for firing from rifled cup dischargers.

Stability

Grenades fired from the cup dischargers were in all cases spin stabilised, and the driving bands, for which plastics were widely used, were pre-engraved.

H.E. grenades

Although many modifications existed, the H.E. rifle grenades were of the same basic design. The maximum range achieved was 500 yards, but the explosive filling was only slightly more than 1 oz. Some designs catered for alternative hand or rifle use.

Anti-tank grenades

All anti-tank grenades of this class were based on hollow charge design. It was thought that at low rates of spin the performance would not be unduly degraded.

Cartridges

A large number of cartridges were produced with the object of increasing range. Most grenades had a cartridge designed particularly for that grenade and for none other, a policy which led to many accidents.

(2) Schiessbechur fur F.G.42. (Discharger cup for Parachutist's automatic rifle).

The 30 mm. (1.18 in.) rifled grenade discharger was an attachment for the improved pattern of Parachutist's automatic rifle.

The discharger made use of the same rifled barrel as the standard discharger for the rifle, but unlike the latter which clamped on the rifle, it had an adaptor which was threaded internally at the rear with the same square section thread as the compensator of the F.G.42 rifle.

To fix the discharger to the F.G.42, the compensator at the muzzle of the rifle was unscrewed and replaced by the discharger.

No special sights were discovered, and no reference to the grenade discharger appeared in the Official Handbook for the weapon.

(3) Propelling cartridges for German grenades

The following types of propelling cartridge were used during the War:-

(a) For the propaganda grenade (G.Kart fur G Propgr.), crimped mouth, red cap annulus.

(b) For the H.E. grenade (G.Kart fur G. Sprgr), crimped mouth; early pattern; yellow cap annulus.

(c) For the H.E. grenade (G.Kart fur G.Sprgr), long neck closed by a plug held in by coning the mouth; replaced (b) above, yellow cap annulus.

(d) For the H.E. grenade (Treibpatr. fur G.Sprgr), closed with a blue wooden bolt, being introduced as stocks of (c) were used; blue wooden bullet.

(e) For the H.E. grenade (long range), closed with a yellow wooden bullet, to boost the grenade range (from 250 to 500 yd. approx.), yellow wooden bullet.

(f) For the small A.P. grenade (G.Kart fur G.Pzgr), crimped mouth; black cap annulus.

(g) For the large A.P. grenade (G. Treibpatr. fur. gr. G. Pzgr), closed with a black wooden bullet.

(h) For the small A.P. grenade (SS.46), crimped mouth; plain brass cap.

(i) For the large A.P. grenade (AA.61), long neck closed by a plug held in by coning the mouth; plain zinc cap.

(j) For the anti-tank rifle grenade (Treibpatrone 318), mouth closed with plain wooden bullet; plain wooden bullet.

(4) Gewehr Sprenggranate 30 (Cup discharger)
(3 cm. H.E. rifle grenade, type 1 of 6 types)

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN/Wax
	Range	275 yd.
	Propelling cartridge	1 gm. cartridge closed by coning the mouth on a small waxed pellet.
General	The body was painted yellow, with a black nose, and had a brown plastic pre-rifled base. The grenade could also be used in the hand role.	
Initiation	The grenade was fitted with Impact Fuze AZ 5071 or "All-ways" AZ 5097, and incorporated a mechanism for self-destruction after 11 sec.	
	For hand throwing, the perforated base was unscrewed and the pull friction igniter used.	

(5) 3 cm. H.E. rifle grenade, type 2.

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN/Wax
	Range	275 yd.
	Cartridge	1 gm. cartridge closed by coning the mouth on a small waxed pellet.
General	The body was painted yellow, with a black nose, and it had a brown plastic pre-rifled base. Designed for low angle fire, no self-destroying mechanism was included.	
Initiation	The unperforated base held an AZ.5071 impace fuze; this could be unscrewed when using the grenade for hand throwing with the 4½ sec. delay pull friction igniter.	

(6) 3 cm. H.E. rifle grenade, type 3.

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN/Wax
	Range	275 yd.
	Cartridge	1 gm. cartridge closed by coning the mouth on a small waxed pellet.
General	The body was painted yellow, the nose black, and the brown plastic base was pre-rifled.	
	Used as a rifle grenade only for low angle fire, this grenade had a fixed, non-perforated base.	

(7) 3 cm. H.E. rifle grenade, type 4.

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN.
	Range	275 yd., with a 1 gm. cartridge closed by coning the mouth on a small waxed pellet.
	OR	500 yards, with a 1.5 gm. cartridge with a short yellow bullet.
General	The grenade, which had a yellow body, black nose and brown plastic pre-rifled base, was stencilled "Weitschuss". It was fired only at low angles and contained no self-destroying mechanism. For hand throwing, the unperforated base was unscrewed to expose the friction igniter.	
Initiation	The grenade was fuzed AZ.5071.	

(8) 3 cm. H.E. rifle grenade, type 5.

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN.
	Range	275 yards, with a 1 gm. cartridge closed by coning the mouth on a small waxed pellet.
	OR	500 yards, with a 1.5 gm. cartridge with a short yellow bullet.
General	Fuze. AZ.5071. AZ 5097 on later modifications (The grenade was used with a rifle for low angle fire only)	
Initiation	The grenade was fuzed AZ.5071 or AZ.5097.	

(9) 3 cm. H.E. rifle grenade, type 6.

Dimensions	Total weight	9 oz.
	Filling	1 oz. PETN.
	Range	275 yards, with a 1 gm. cartridge closed by coning the mouth on a small waxed pellet.
	OR	500 yards, with a 1.5 gm. cartridge with a short yellow bullet.

General — The grenade could be used for high or low angle fire, since the "all-ways" fuze AZ.5097 was incorporated in the design.

Design Detail — The steel of the body, which was of VDH 130, had the composition:-

C	Mn	Si	S	P
0.17	0.43	0.07	0.027	0.071

A macro-etch of an axial section indicated that the cavity was probably formed by hot piercing.

(10) Sprenggranate 3 cm. Ub. (3 cm. practice rifle grenade).

The practice grenade was designed for hand or rifle use, and was fired at high or low angles. The base plug was removable.

The granade was fitted with a live igniter and delay train, and a "spotting" charge may have been incorporated.

The body was of blued steel, the rifled base-plug of brown plastic and the plug, representing cap and fuze, was of black plastic.

(11) Gross Gewehr Panzergranate. (Large, hollow charge anti-tank grenade for 3 cm. rifled discharger cup).

Dimensions	Total weight	13¾ oz.
	Filling	4½ oz. TNT with PETN/Wax exploder.
	Range	110 yards.
	Penetration	90 mm. IT80 plate at normal.

General — This grenade, of the follow charge type, consisted of a steel head containing fuze and gaine. The propelling cartridge contained a wooden bullet.

Design Details

(a) Grenade Head - The body, which was of pressed steel, contained a steel cone around which the H.E., which appeared to be T.N.T., was cast. The cone was positioned by a cannelure on the grenade body. A steel disc with a small central hole rested on the cone, and above the latter was a steel cap over which the grenade body was spun.

Below the T.N.T. was an exploder pellet of PETN/Wax.

(b) Grenade Stem - Two varieties of stem were seen, one entirely of light alloy, the other of plastic with a steel shank by which it was screwed on to the head of the grenade. In the latter, the plastic base was secured to the shank by extruding

the plastic into eight holes round the circumference of the shank. At the base of the stem was a rifled band which corresponded with the rifling in the discharger cup.

The stem was divided into two compartments by a perforated septum, the lower containing the fuze, the upper the gaine. In the septum was a small flash pellet, held in place by a perforated screw plug.

The gaine consisted of a light alloy case into which was inserted a light alloy "top hat" containing the igniferous detonator, the space between being filled with what appeared to be PETN wax. The gaine was closed by a tissue paper disc and light alloy washer over which the case was spun.

The gaine was surrounded by a cardboard tube, and at either end were two cardboard washers.

Fuze

A star shaped retaining spring with four prongs fitted over a projection on the top of the striker body, and was held in place by a burring of the projection over a washer on top of the spring. The four prongs of the spring were bent downwards into grooves in the striker body. Round the striker body was an arming collar which had two grooves cut on the inside. An arming spring was compressed between a lip on the arming collar and a second collar at the bottom of the striker body. Around the inside of the arming collar and resting on the striker body was a steel tape which acted as an additional safety device, and prevented any possibility of the fuze being accidentally armed when screwing on the base plug.

The fuze was positioned by a stem on the base plug fitting into a recess in the rear of the striker body.

Action of Fuze

On firing, the shock of discharge caused the arming sleeve to set back against its spring. The four prongs of the retaining spring were therefore forced out of the lower groove in the arming sleeve and engaged in the upper groove, retaining the arming sleeve in its lowest position. This allowed the steel tape to unwind and the striker was then free to move forward on impact.

The grenade appeared to be quite safe in transit, as a trial showed that a blow of 16 in.lb. was required to arm the fuze.

Penetration

A trial with this grenade showed that it would penetrate at least 50 mm. of "homo" hard armour at 30 degrees. With some grenades, a tapered steel plug was found protruding from a hole in the armour plate.

(12) Small, hollow charge anti-tank grenade for 3 cm. rifled discharger cup.

Dimensions	Total weight	9 oz.
	Filling	1¾ oz., T.N.T. with PETN/wax exploder.
	Range	110 yards
	Penetration	40 mm. at 30 degrees.
	Prop. cartridge	crimped mouth cartridge.
General	This grenade was constructed in two parts, the head and the stem; the latter was of similar construction to that of the Gross Gewehr Panzergranate. Only light alloy stems have been found so far.	
	The head screwed on to the stem with a fine right-hand thread.	

Design Detail

(a) Construction of Head - The head seemed to be made of a seamless steel tube, with one of smaller diameter inserted in the rear end for the screw thread.

The cone was of steel and the inside had marks indicating that it had been made by pressing, although the exterior showed machining marks. The apex was open.

Three small holes were drilled in the flange, probably for air escapes during filling with T.N.T. The ballistic cap was pressed from steel. This cap and the cone were secured by a rolled cannelure in the body and turnover of the fore end.

The thickness of the wall of the cone diminished towards the apex. The interior angle was about 19.5 degrees.

The exploder, apparently of pink PETN wax, fitted into a cavity in the main filling of T.N.T. No traces of any material were found between the exploder and the T.N.T.

There was a small cavity in the surface of the penthrite wax and a thick paper disc between the filling and the gaine.

The T.N.T. was well consolidated and difficult to remove.

(b) Construction of Stem - The stem was machined from light alloy or alumimium and was very similar to that of the larger grenade. It screwed over the male thread in the head.

The flash pellet, detonator, gaine and fuze seemed identical with those in the larger grenade.

The fuze cavity varied in the size of bore. There were also small variations about the needle hole.

The rifling grooves were milled from a band left proud near the rear end of the stem, the remainder of which did not bear machine marks.

The base plug had a right-hand thread.

The Fuze

This seemed to be identical with that used with the larger grenade.

The Propelling Cartridge

The 7.92 mm. cartridge with a copper coated steel case was loaded with 13.3 grains of ungraphited N.C.

Penetration

Several rounds were tested:-

Range: 50 yards. Elevation: 4 degrees
Angle: plate tilted back at 30 degrees to normal.
Perforations about ½ in. by 3/8 in., were obtained on a 38.5 mm. I.T. 70 plate. A thicker plate was not available.
Some rounds left a "slug" of steel in the hole.
Small pits were made on a mild steel plate one foot behind the armour plate.
The grenades were stable in flight, and, after sighting, there was no difficulty in hitting the target.

(13) Gewehr Panzergranate 46 mm. (46 mm., hollow charge rifle grenade).

Dimensions		
	Total weight	15 oz.
	Weight of filling	5 oz., cast RDX/TNT
	Length	7½ in.
	Max.dia.	1.7/8 in.
	Penetration	90 mm. of I.T. 80 plate
	Prop.cartridge	Crimped mouth cartridge.

Description

The rust-proofed metal head, 46 mm. dia., had a black distance cap and rust-proofed metal tail unit with a pre-rifled band.

Design Detail

The main components were body, hollow-charge liner, impact cap, tail tube, cast filling of cyclonite/TNT (50/50), gaine and fuze. With the exception of the igniferous cap and gaine, all metal components were of steel.

The body was cylindrical at the top and conical at the bottom, and ended in a short cylindrical neck which fitted into the tail tube. Its wall thickness was 0.035 inches. The lower part of the conical portion was reinforced by an internal sleeve. A deep cannelure, approximately ¾ inch from the top of the body, formed a seating for the flange of the hollow charge liner.

The liner consisted of a coned sleeve, 2.1 inches in length, with a flange which turned into a cylinder for approx. ¼ inch from its mouth. The cone opened at an inclused angle of 36 degrees, and its wall thickness tapered from 0.037 inches at the mouth to 0.22 inches at the other end. The flange was pierced by six equidistant holes.

The impact cap seated on the rim of the liner and was secured by lightly turning in the mount of the body.

The tail tube was cylindrical, approximately 3 inches in length, and had a wall thickness of approximately 0.048 inches. Externally at the rear end it was provided with eight lands, each approximately 1.2 inches in length. The tube was secured to the neck of the body under a wide cannelure, and prevented from rotating by eight spot welds spaced around the cannelure. The rear end of the tube was threaded internally and closed by the fuze housing.

The bursting charge in the grenade body and tail tube consisted of a cast filling of Cyclonite/TNT (50/50), weighing 4 oz. 13½ dr. A cavity formed in the base accommodated

the small gaine (Kl.Zdlg.34 Np).

An inverted thin steel cup with central flash hole was inserted between the gaine and fuze, as a push fit in the tail tube, so that the flat bottom bore firmly against the top of the gaine and the surrounding H.E. filling. The cup was retained by the bottom cone of the fuze assembly.

Gaine, Kl Zdlg. 34 Np.

The gaine was contained in an inverted aluminium cup, with a flash hole covered by a piece of gauze in its base. The main filling, of PETN/Wax (87/13), weighed approximately 3.7 dr., and the initiator fillings of lead azide and lead styphnate (70/30), and PETN. weighed 6.48 grains and 5.09 grains respectively.

Fuze

The fuze was of the "all-ways" type and was held in compression between the apices of two cones forming a holder. It weighed 1 oz. 1 dr.

The holder consisted of two steel cones, the lower of which was threaded externally for insertion in the tail of the grenade, and internally to receive the mouth of the other cone. The apex of the upper cone was provided with a flash hole.

The fuze consisted of an inertia pellet, needle, arming collar, cap holder, creep spring and an igniferous cap. All components except the cap were of steel.

The inertia pellet was cylindrical and formed with a solid base shaped to fit in the apex of the lower cone. Externally, on one side, there was a key-way to engage a key on the arming collar, and a recess forming a notch to engage a flat spring on the arming collar when the fuze was armed. The recessed pellet was formed with a central spigot, in the base which was bored to receive the striker and provide a guide for the creep sprin . The rim of the pellet had a projecting stop, and adjacent to it, a slot which gave a clearance for the stop pin on the cap holder, when this had been turned to the armed position, to avoid the pin impeding the forward movement of the inertia pellet on impact.

The arming collar was a sliding fit over the inertia pellet, and was prevented from turning by an internal key which engaged the key-way in the inertia pellet. The top of the collar was slotted to engage the stop pin which protruded from the side of the cap holder. A flat spring cut in the side of the collar bore against and projected beyond the top of the inertia pellet to hold the collar in the safe position.

The cap holder was cylindrical with a radiussed head. It was bored centrally in three diameters to form two chambers connected by a needle guide. The small chamber in the head housed the cap whilst the large chamber in the base accommodated one end of the creep spring and the top of the spigot. The stop pin projected from the side and was the main safety arrangement. On assembly, it rested on the rim of the inertia pellet, thereby preventing relative movement of pellet and cap holder.

The spiral creep spring was held in compression between the inertia pellet and the cap holder. One end was turned inwards and secured in a radial slot at the bottom of the recess in the inertia pellet whilst the other was turned up and secured in a boring in the cap holder. During assembly the spring was tightened by two turns of the cap holder in a clockwise direction, and held in this position by the stop pin engaging the slot in the rim of the arming collar. The creep spring was compressed and the assembly was secured firmly when the fuze cones were tightened.

The igniferous cap consisted of a cup-shaped brass shell with a perforated base closed on the inside by a tinfoil disc, and one grain of cap composition. The mouth of the cup was closed by a disc of tinfoil. None of the components was varnished.

The composition, as fojnd by analysis, consisted of Mercury fulminate 10.2 per cent, Potassium chlorate 60.3 per cent, Antimony sulphide 29.5 per cent.

The cap was inserted in the holder base first.

Action of Fuze

On acceleration, the arming collar set back and was held to the rear by its spring which engaged in the notch on the inertia pellet, thereby freeing the stop pin. This allowed the cap holder to be rotated anti-clockwise under the action of the creep spring. This rotational movement was limited by the projecting stop on the inertia pellet which placed the stop pin in line with the slot adjacent to it.

Creep action was prevented by the creep spring.

On impact or graze, the inertia pellet compressed the creep spring and carried the needle on to the cap. Sideways action of the cap holder carried the cap on to the needle. The flash from the cap detonated the gaine in the grenade.

Perforation of Armour

At short range, the grenade perforated 70 mm. of IT.80 homogeneous plate in direct normal attack. At longer ranges the thickness of plate perforated increased towards a limit of 90 mm. (deduced from static trial). A skirting plate of ¼ inch mild steel, 11 inches in front of the armour, completely defeated the grenade.

(14) S.S. Gewehr Panzergranate 61 (61 mm., hollow charge, anti-tank rifle grenade).

Dimensions	Total weight	1 lb. 4 oz.
	Filling	3½ oz., Cast RDX/TNT
	Range	220 yards.
	Prop. cartridge	Cartridge mouth coned on to a small waxed pellet.

General

The grenade was similar in design to the 46 mm. hollow charge rifle grenade, but had a larger body, hollow charge liner and impact cap, and had a greater weight of explosive filling. It was fired from the 3 cm. rifled discharger cup which could be fitted to the 7.92 mm. Mauser rifle.

Design details

The grenade differed from the 46 mm. type mainly in the following particulars. The grenade weighed approximately 1 lb. 4 oz. and had an overall length of approximately 9.45 inches. The maximum diameter of the body was 2.42 inches.

The hollow charge liner opened at an included angle of 32 degrees, and was provided with a flange in which were eight equidistant holes. The metal tapered in thickness from 0.057 inches at the mouth to 0.020 inches at its other end.

The impact cap seated on the flange and not on the rim of the liner.

The bursting charge consisted of a cast filling of cyclonite/TNT (50/50) and weighed 8½ oz.

The tail tube and fuze assembly was similar to that of the 46 mm. grenade.

Gaine

The gaine was similar in dimensions to that of the 46 mm. grenade, but the body was made of steel and the filling was retained by a washer of tufnol type material instead of aluminium.

The main filling of PETN/Wax (90/10) weighed approximately 3.6 dr., and the initiator fillings of lead azide and lead styphnate (75/25) and PETN. weighed 4.72 grains and 6.56 grains respectively.

Perforation of Armour

At short range, the grenade perforated 100 mm. of homogeneous plate IT.80 in direct normal attack, increasing to approximately 125 mm. at longer ranges (as deduced from static trials).

(15) Gewehr Blendgranate 42 - Gw. .B.Gr.42 (Smoke, bursting grenade, 42).

Dimensions	Total weight	1 lb. 1 oz.
	Filling	100 cc. Titanium Tetrachloride and burster.
	Range	110 - 165 yd.
	Propelling cartridge	Short yellow wooden bullet.

General

The grenade was fired from the 3 cm. rifled discharger cup, using a 1.5 gm. propelling cartridge, and was used for blinding purposes in attack against A.F.Vs.

The grenade was of dark green colour, and on the head was stencilled 'B' in white. The collar was stencilled 'G.Gr.42' in white.

Design Details

The grenade consisted of a body with a filling of smoke composition, skirt, stem, rifled base cap, self-destroying delay arrangement, central tube containing an opening charge, fuze mechanism and a detonator which formed part of the self-destroying arrangement. The body, skirt and stem were made of thin sheet metal and were welded together.

(a) Body (Fore) - The cylindrical body was formed with an ogival head, from metal 0.025 inches thick. The base was slightly reduced in diameter and fitted into the forward end of the skirt. The joint was cannelured and spot welded at six points under the cannelure. Spaced equidistant around the inside of the body were three baffles, consisting of shaped strips of sheet metal, flanged along one edge. Each flange was spot welded to the body at three points, and the baffle projected towards the centre to

support the central tube. The rear end of each baffle extended into the stem.

(b) Filling - The grenade filling, contained in the body and stem, consisted of approximately 5¾ oz. of Titanium tetrachloride. It was a clear yellow liquid and fumed strongly when exposed to air. The grenade was filled to within approximately 12 cc. of its total capacity.

(c) Body (Hind) - The fluted skirt of the grenade increased slightly in diameter towards the base where it was strengthened by folding in the edge.

The tubular stem was approximately 29.8 mm. (1.18 in.) in external diameter. The forward end was flanged and the rim of the flange was turned over and reinforced by a channeled steel ring, "U" shape in section. The flange and ring were inserted in the base of the body and secured by welding their rims together. The rear end of the stem was reduced in diameter in two steps; both steps were threaded externally, the larger for the attachment of the base cap and the smaller to receive a hexagonal locking nut which secured the central tube.

The steel base cap was threaded internally at the mouth and was formed with eight external lands. The base of the cap was pressed in to form a hollow spigot, the top of which was recessed to leave a thin diaphragm separating the spigot cavity and the recess which protruded into the cavity. The cavity was extended to the rear by a short tube, flanged at one end and turned in at the other. This flange was welded to the base of the cap. A thin washer of laminated cardboard, approximately 1.36 inches in diameter, was fitted over this tube. It was held firmly between the flange of the tube and a thin sleeve which fitted over the tube and was spot welded to it.

The recess in the top of the spigot contained 0.68 grains of flashing composition, coloured blue, which was pressed into a small cup, closed by a transparent paper disc. The cup was retained by a steel washer secured by turning the rim of the recess over.

(d) Tracer - The cavity in the base of the cap and in the tube extension contained a tracer type delay composition. It consisted of approximately 15.4 grains of a grey coloured composition pressed in one increment, followed by a heavily consolidated reddish brown composition, weighing approximately 54.0 grains, pressed in by a drift having a large flat ended spigot. The compositions were retained by three washers of thick paper under a steel washer and a thin steel disc. The disc was secured by turning in the rim of the tube extension.

(e) Fuze Housing - The central steel tube housed a tubular cardboard distance piece, gaine, fuze and a detonator assembly forming part of the self-destroying arrangement, in a bakelite holder.

The cardboard distance piece was 2.78 inches long and 0.492 inches and 0.23 inches in external and internal diameter respectively. It was accommodated at the upper end of the tube, and below it was fitted a gaine which functioned as an opening charge.

The gaine, approximately 0.85 inches in length and 0.5 inches in diameter, consisted of an aluminium cylinder, closed at one end, and containing a main filling and a detonator assembly. The main filling of PETN/Wax weighed 46.3 grains. The detonator assembly comprised a flanged cylindrical container having in its base 1.03 grains of PETN. composition and above it a composition of lead azide/lead styphnate/calcuim silicide, weighing 2.41 grains. The container was closed by an inverted flanged cup, and was housed in a cavity in the open end of the main filling. The gaine was closed by turning in the mouth over a cardboard washer. It was assembled in the central tube next to the cardboard distance piece with the open end facing the fuze assembly.

The tube itself was approximately 6.3 inches long, 0.55 inches in external diameter and 0.2 inches in thickness. The upper end was closed by inserting an inverted steel cup which was secured by welding. The lower end was provided with a narrow flange, in front of which was fitted a lead washer. The tube passed through the base of the stem and was secured at its lower end by screwing a hexagonal nut down on to the flange of the stem, thereby compressing the lead washer. This arrangement effectively sealed the joint against the escape of the smoke filling. The upper half of the tube was supported by the baffle plates.

Fuze

The fuze assembly consisted mainly of the body fitted with an igniferous cap, a striker, arming sleeve, expanding tape spring, hexagonal wire spring and an arming sleeve spring. All metal components were of steel.

The cylindrical body was approximately 1.7 inches long and 0.5 inches in diameter, and was enclosed near the top by a thick diaphragm with an internal projection. The body was recessed centrally to receive the percussion cap and the diaphragm bored and shaped to form a striker guide. The bottom was closed by turning the rim over the striker mechanism retaining washer which had a square of thin paper varnished to its underside.

The percussion cap consisted of a steel cup, with a perforated base, filled with 5 grains of a yellow-green cap composition. The composition was directly exposed to the striker needle through the perforation in the base of the cup. The mouth of the cup was covered by a paper disc which was secured around the edge by varnish. The cup itself was retained by turning the top of the fuze body over a steel washer, which had a paper washer on its underside.

The striker was tubular, approximately 1.19 inches long and 0.27 inches in diameter. The forward end was closed and formed with an integral needle. Four longitudinal flash channels were bored equidistant around the base of the needle. Externally, near the forward end, the striker body was grooved circumferentially to accommodate a steel hexagonal spring ring, and the base was reduced in diameter to fit into a washer which was secured by burring the rim of the base under the washer. The striker was centred in the fuze by the arming sleeve, and longitudinal movement was prevented by the expanding tape spring.

The arming sleeve was slightly shorter than the striker and was made in two diameters. The smaller diameter was a sliding fit around the top of the striker. In the unarmed position it was retained beyond the top of the striker by a helical spring and accommodated the expanding tape spring which

prevented the striker moving forward. The sleeve also held the hexagonal spring in the circumferential groove in the striker. The larger diameter of the arming sleeve was a sliding fit in the fuze body, and surrounded the upper half of the main spring.

The arming sleeve spring was held in slight compression between the internal shoulder on the sleeve and the washer at the base of the striker.

The detonator assembly, comprising a detonator in a short tubular bakelite holder and forming part of the self-destroying arrangement, was approximately 0.56 inches in length. It was set between the base of the fuze and a rubber washer in front of the base cap spigot. The detonator consisted of a flanged cylindrical container, having in the base PETN. weighing 0.85 grains, and above it a composition of lead azide/lead styphnate/calcium silicide, weighing 2.52 grains. The container was closed by an inverted flanged cup. The detonator was secured in the holder by its flange, which was held between the end of the holder and a bakelite washer varnished to it.

Action of Fuze

(a) Self-destroying arrangement - On firing, the flash from the cartridge pierced the thin steel closing disc in the base cap and ignited the delay and tracer composition. After a short delay, and if the fuze had not already functioned, heat generated caused the composition in the recess at the top of the spigot to fire the lower detonator. The flash from this passed through the striker to the cap in the fuze body. The flash from this cap initiated the detonator in the gaine, which, in turn burst the grenade.

(b) Fuze - On acceleration, the arming sleeve set back to compress its spring. Rebound was prevented by the arms of the hexagonal wire spring which it released. The coiled tape spring was then free to expand so that on graze or impact the striker, arming sleeve and its spring moved forward as one unit, through the expanded tape spring, carrying the needle on to the igniferous cup at the top of the fuze body. The flash from the cap initiated the detonator in the gaine, which burst the grenade.

(16) Panzer Gewehrgranate, P.40 (Hollow charge, anti-tank grenade. Spigot discharger. G3.P.40).

Dimensions	Total weight	1 lb. 2 oz.
	Range	300 yards
	Prop. cartridge	Long plain wooden bullet.
General	The grenade had a bulb-shaped head with a slightly convex top. The tail unit was hollow, had 6 fins, and carried in transit the propelling cartridge. A removable black rubber plug closed the tail. A small alloy detonator holder was fitted into the rear of the H.E. head by unscrewing the tail. The grenade was painted dark green.	

(17) Gewehr propagandagranate (propaganda rifle grenade)

Dimensions	Total weight	8 oz.
	Filling	Ejection charge and 2 oz. of propaganda leaflets.
	Range	500 yards (air ejection after 2 sec.)
	Recognition notes	Black body, black cap and a light alloy pre-rifled base.
General	40 of these grenades, which were discharged from the 3 cm. cup, were packed with 41 cartridges and a supply of propaganda leaflets in one box.	

Design Detail

The body consisted of a cylindrical steel tube closed by a loose fitting ballistic cap. Propanda leaflets were enclosed in two semi-cylindrical steel covers within the main body which rested on a cup-shaped platform. The pre-rifled base contained the ejecting charge and delay train.

On discharge, flash from the propelling cartridge ignited the ejection charge. This charge ejected the platform (which protected leaflets from flash), leaflet covers, leaflets and ballistic cap during flight.

(18) Gewehr Fallschirmleucht Panate (White illuminating star on parachute).

Dimensions	Total weight	10 oz.
	Filling	Parachute star and two ejection charges
	Range	Illuminates target up to 700 yd.
	Prop. cartridge	Short yellow wooden bullet
General	This grenade, fired from the 3 cm. discharger cup, was intended to provide illumination for night attack, particularly against armour, at ranges up to 650 metres (710 yd.), and was, according to German instructions, to be used only where illumination by the signal pistol grenade "Fallschirm Leuchtpatrone 41" was inadequate. The body was varnished brown and had a white nose cap and a brown plastic pre-rifled base. The name was stencilled on the body in white.	
Result of trial	When tested, the flare burned with a pale yellow flame for 35 sec. at about 30,000 c.p. The delay to ejection of parachute was 6½ sec. followed by a further delay of 2 sec. before ignition of the star.	

PART 4. SIGNAL PISTOL GRENADES

(1) Summary

General - The standard smooth bore Walther 27 mm. signal pistol, for which over 40 different types of signal cartridge were designed, was adapted to fire H.E., anti-tank, signal, smoke and illuminating grenades.

Propulsion - The propellant was usually an integral part of the grenade, although in some designs the cartridge case obturated in the pistol.

Stabilisation - Both fin and spin stabilised grenades were fired from the pistol which could be fitted with a smooth or rifled liner.

(2) Improvised signal pistol

A captured German document, dated March 1944, indicated that signal pistols were in short supply and details were given of an improvised mechanism which could be made by Unit Artificers.

The apparatus was made from the handle of a standard stick hand grenade fitted with a short barrel and firing mechanism, which consisted of a long striker bolt formed with a firing pin at one end and a knob or ring at the other. The striker bolt carried a striker spring between the flange and the closing cap of the handle. The barrel consisted of a short tube which was attached to the end of the handle normally carrying the H.E. head, and it was hinged to facilitate loading.

To fire, the striker bolt was pulled to the rear to compress the spring and then released. Slight differences in design were encountered.

(3) 2.6 cm. Sprenggranatpatrone L.P. mit Zeitzünder (26 mm., time fuzed, H.E., signal pistol cartridge grenade).

Dimensions	Total weight	11 oz.
	Overall length	7 in.
	Filling	2 oz. RDX/TNT 54/46
	Range	4 yd.
	Propellant	4 discs (0.32 in. dia. 0.014 in. thick) weighing 0.46 gm. and of composition -
		Nitrocellulose 90 per cent
		Diphimylamine 8.5 " "
		Volatile matter 1.5 " "

General

The grenade consisted of an H.E. projectile in the form of a cylinder with a round nose (similar to a test tube), approx. 1.0 inch in dia., and 5.0 inches long (identified by letter 'a' in sketch) secured in a steel, lacquered, cartridge case ('b') of the signal cartridge type. Fired from the standard signal pistol (Leuchtpistole), the range was only about 12 feet. The projectile burst after a delay of 1 second and had to be fired from A.F.Vs or similar cover. It was intended for use in close combat. The yellow painted projectile carried the following stencilling in black letters:- "2.6 cm. Sprenggranatpatrone L.P. mit Zeitzünder".

Identification at night was made possible by the fact that the rim of the cartridge case was serrated halfway round the circumference.

Design details

(a) Assembly - The projectile (a), filled cast RDX/TNT (j), contained a standard No.8 aluminium detonator (k), and had a base plug (m), which housed a mechanical pull igniter comprising a striker (d), spring (t), igniter body (e) and igniter pull ring (p). This was similar to the grenade igniter, "Brennzunder mit Schlagbolzen". A 1 second delay element was incorporated. The ring of this igniter was connected to a steel plate (i) at the base of the cartridge case (b) by a coiled spring (q) so that as the projectile left the cartridge case, the tension on this spring actuated the pull igniter.

The cartridge case contained a standard (German) percussion cap (h) and the propellant in the form of 4 discs (r) held just above the percussion cap in the steel plate. The propellant was only sufficient to project the grenade 12 feet.

The projectile was secured in the case by a cannelure, and a guide pin (f) secured in the steel plate of the case passed through the coiled spring into a hole in the rear face of the projectile base plug (m).

(b) Projectile - The projectile body consisted of a steel tube, of uniform wall thickness and had a closed hemispherical nose. A steel base plug (m) was inserted flush with the bottom of the projectile body and was secured by a deep cannelure, which also served to secure the projectile in the case. The base plug carried the igniter assembly, and had 4 drilled 'blind' holes, two on each face (diametrically opposite). The two in the rear face permitted an alternative assembly of the guide pin secured in the case. The purpose of the two holes in the forward face was not clear, but might be to facilitate assembly, or the sample examined might have been a prototype.

The projectile contained a cast filling of RDX/TNT with a central cavity to accommodate the detonator. The top of the filling was covered by a cardboard washer (t).

(c) Igniter assembly - The igniter, of die-cast alloy, was of similar construction to the standard mechanical grenade igniter, except that the delay fitment gave a 1 second delay instead of the 4½ seconds of the standard type. A German No.8 detonator, with aluminium body (k), was held on the igniter stem (delay fitment) (l), and fitted inside the cavity in the projectile filling. The igniter screwed into the base plug (m). The end of the igniter assembly nearest the percussion cap was coated with a sealing composition to prevent any penetration of the propellant gases.

The static load required to operate the igniter was 4 lb.

(d) Cartridge case - The cartridge case (b) consisted of a steel tube with a base attached by means of a rolled edge, which was serrated half-way round its circumference for means of identification. The bottom of the cartridge case was a steel plate (i) held in position by a cannelure. This plate was drilled centrally to accommodate the percussion cap (h) and the propellant charge (r), the latter being in the form of four discs, retained under a millboard disc (g) 3.5 mm. thick, which in turn was held against the end of the standard copper percussion cap (h). Two holes were drilled through the steel plate. A coiled spring (q) connected to the igniter pull ring (p) was anchored by a peg (s) in one hole, and through the other a guide pin (f) was inserted and secured by burring. This guide pin passed through the coiled spring and fitted into a hole in the rear face of the base plug (m).

(4) Nurfgranate 326 L.P. (New model)

Dimension		
	Weight of grenade	4½ oz.
	Muzzle velocity (from short barrelled pistol)	200 ft./sec.
	Gas pressure	2¼ tons/sq.in.
	Wall thickness	0.08 in.
	Radius of burst	30 yards.

General

This nose-fuzed, fin-stabilised grenade was designed for firing from either the short or long barrelled signal pistol.

Range and Accuracy

Fired from the short barrelled pistol, the range was stated to be nearly 300 metres (330 yd.). Fired from the long barrelled pistol, the range was stated to be nearly 500 metres (550 yd.). Using the short barrelled pistol fitted with a butt, folding sights and forehand grip, the Germans claimed to be able to put 9 out of 10 shots on an upright target 80 cm. (2½ ft.) square, at a range of 100 metres (110 yd.). A similar claim was also made for hits on an upright target 80 cm. (2½ ft.) square, at a range of 100 metres (110 yd.), using the long barrelled pistol. A similar claim was also made for hits on the figure of a man, standing 200 metres (220 yd.) away, with the long barrelled pistol.

(5) Nurfkorper 361 L.P. (Smooth bore signal pistol - H.E. grenade 361 L.P., early model).

Dimension		
	Total weight	Approx. 15 oz.
	Filling	6¼ oz., T.N.T.
	Range	75 - 100 yd.
	Length of grenade	6 in.

General

A standard H.E. egg grenade (39 type), with detonator, was screwed on to a plastic projector stem, which had a short cartridge at the base.

Initiation

The 4½ sec. delay igniter was initiated on firing by means of an igniferous cap.

Use

A reinforcing tube was supplied where this grenade was used. This "Laufverstarker" consisted of a hollow brass tube which was inserted into the barrel of the broken pistol from the breech end.

After withdrawing the safety pin, the Nurfkorper 361 L.P. was inserted into the barrel from the muzzle. The pistol was cocked and fired.

(6) Wurfkörper 361 L.P. (smooth bore - H.E. grenade 361 L.P. latest model).

Dimensions	Total weight	15 oz.
	Filling	6¼ oz. TNT.
	Range	75 - 100 yd.

General

In this design, the egg grenade head was screwed on to an adapted wooden stem.

Note: A novel adaption of the standard egg grenade on a projector stem consisted of an illuminating head with the delay reduced from 4½ to 1 sec. The grenade was designed to be fired from a signal pistol by the tail gunner of a night bomber, if pursued by a fighter, to blind, momentarily, the attacker.

(7) Panzerwurfkorper 42 L P. (Smooth bore)

Dimensions	Total weight	1 lb. 5 oz.
	Filling	6½ oz. Cast TNT.
	Range	Best at 50 yards.

General

The pear shaped head carried a tail unit having a pre-rifled band, which was attached by a shear wire to the projector stem. The grenade was fired from the signal pistol fitted with a 23 mm. rifled liner, special sights and an attached butt. The propellant tube remained in the pistol after firing. A penetration of 80 mm. at normal was claimed. Fitted with a graze fuze and armed by set-back, the maximum range of the missile was stated to be 82 yards.

(8) Signal, Smoke grenade

Dimensions	Weight of complete round	4½ oz.
	Weight of propellant	11.6 grains
	" " grenade	1411 grains 3¼ oz.
	" " smoke composition	555 grains

Analysis of the smoke composition was :-

Dye	37 per cent
Sodium chlorate	25 "
Carbohydrate (Pentose)	38 "

General

The complete round, for use with the 27 mm. rifled Walther pistol, consisted of a pre-rifled light alloy grenade in a light alloy cartridge case. The grenade emitted a puff of reddish-brown smoke, approximately 1.8 seconds after firing.

Design details

The grenade consisted of a light alloy case, pre-rifled for most of its length to correspond with the pistol rifling and contained a signal composition. Two increments of red composition were pressed into the nose and on this rested a light alloy tube containing eight further increments, heavily consolidated. A hole through the composition in the tube contained three strands of

quickmatch. The base plug was either of light alloy or plastic, and screwed into the body on a left-hand thread. A central hole (threaded right-handed) took a delay pellet, and eight other holes were bored through the plug for smoke emission. The delay pellet was a brass tube containing delay composition. This tube was threaded internally, presumably to hold the delay composition more firmly.

PART 5. BATTLE PISTOL GRENADES

(1) Summary

General

Designed for short range work, the Battle Pistol was an adaptation of the Signal Pistol designed for firing a wide range of cartridges. While some of these were of the H.E. type, the majority were of the target - indicating type.

As an added complication, liners, smooth or rifled, could be fitted for firing special projectiles.

(2) Kampfpistol

Dimensions	Weight of pistol	5½ lb.
	Overall length (unfolded)	23 in.
	Overall length (folded)	12 in.
	Calibre without liner	27 mm.
	Calibre with liner	23 mm.

(a) The Kampfpistol

The battle pistol was the original signal pistol modified by boring out and rifling the barrel. A small circular bubble sight was attached to the left side of the pistol.

Four types of ammunition designed for this weapon were identified :-

H.E.	Sprengpatrone für Kampfpistol
Smoke	Nebalpatrone für Kampfpistol
Indicator	Deutpatrone für Kampfpistol
Signal illuminating star on parachute	Fallschirm Leuchtpatrone für Kampfpistol

The ammunition for the unrifled pistol could however still be fired, though bulged cartridge cases, and in the case of the grenade 326 L.P., a slight loss of range would probably result.

(b) The new Kampfpistol

In this weapon the basic signal pistol was not modified by rifling as in the Kampfpistol, but a loose steel liner was fitted. This liner was rifled and formed with a base to prevent the firing of any normal breech loaded ammunition. A removable sight was fixed on the barrel, and a folding butt provided. All parts could easily be assembled using a screw driver. By removal of the liner, any type of ammunition suitable for the original signal pistol could be fired. It should be noted, however, that the H.E. grenade 361 L.P. could not be fired from the rifled liner but required fitment of the smooth bore liner. Furthermore, NONE of the ammunition designed for the original Kampfpistol could be fired with or without the liner.

(3) Wurkfkorper 361 (H.E. grenade 361 K.P.)

Dimensions	Filling	T.N.T.
	Range	The pistol was sighted up to 110 yards.

General — The standard H.E. egg grenade, type 39 with a No.8 detonator, was screwed on a thin plastic projector stem fitted with a safety pin. This grenade was fired from the battle pistol with a smooth bore liner. With a suitable stem the grenade could also be fired from a rifled bore.

(4) Sprengpatrone fur Kampfpistole (Rifled H.E. cartridge - early model)

Dimensions	Total weight	5 oz.
	Filling	330 grains PETN/Wax.
	Range	The pistol was sighted to 100 yards.

General — The round consisted of a pre-rifled projectile, with a nose fuze armed by set-back and spin, in an aluminium cartridge case. This early model had a large magnesium and brown painted fuze. The batch number was stencilled on the base in red.

The fuze of a later model was pointed with a red plastic tip, and had a yellow band painted round the base. "Sprgr. Patt. K.P" was stencilled on the base of the round.

(5) Nebelpatrone fur Kampfpistole (Rifled Smoke cartridge - early model).

Dimensions	Total weight	5½ oz.
	Filling	Smoke composition
	Range	The pistol was sighted to 110 yards.

General — The round consisted of an aluminium, pre-rifled projectile in an aluminium cartridge case. In this model, the fuze was large (brown painted) and similar to that used in the early H.E. round, but had a gunpowder charge in place of the gaine. "Nebel Z" was stencilled on the base. The fuze was armed by set-back and spin.
A later model had a rounded nose integral with the projectile.

(6) Nebeleihandgranate 42/11 (Smooth bore, Smoke grenade).

Dimensions	Total weight	Approx. 15 oz.
	Range	76 - 100 yards.

General — The assembly consisted of a standard smoke egg grenade, 42 type with an N.4 igniter, screwed on to a projector stem. It was used in a pistol with a rifled liner, special sights and with the folding butt attached.

(7) Deutpatrone fur Kampfpistole (Rifled. Target-indicating cartridge.)

Total weight 5½ oz., coloured smoke composition.

General — The round comprised an aluminium, pre-rifled projectile in an aluminium cartridge case. The nose was rounded like the later model of the smoke cartridge.

The nose was plain in some cases, in others it was painted blue. "Nebel Z" was stencilled on the base. Ignition was from delay pellet to quickmatch.

(8) Fallschirm-Signalpatrone Grün Für Kampfpistole

Dimensions	Total weight	4 oz.
	Filling	Star, parachute, ejection and ignition charges.
	Range	The pistol was sighted to 110 yards.

General — The aluminium, pre-rifled projectile had a green plastic nose cap. The cartridge case was also of light alloy.

"F Sig.Z" was stencilled on the base.

(9) Fallschirm-Leuchpatrone für Kampfpistole (Illuminating star on parachute).

Dimensions	Total weight	4 oz.
	Filling	Star, parachute, ignition charge and ejection charge.
	Range	The pistol was sighted to 110 yards.

General — The aluminium, pre-rifled projectile, fired from an aluminium cartridge case, had a black plastic nose-cap. "F" Leucht Z" was stencilled on the base.

The propellant flash ignited a delay pellet which led to the star ejection charge.

(10) Nachrichpatrone für Kampfpistole (Rifled. Message cartridge)

Dimensions	Total weight	4¾ oz.
	Filling	Message form, pencil and small amount of orange smoke composition.
	Range	The pistol was sighted up to 110 yards.

General — The alumium, pre-rifled projectile with a long black plastic nose contained a message form and pencil. The cartridge case was of light alloy. "Nachr.Z" was stencilled on the base.

PART 6. RECOILLESS PROJECTILES

(1) Summary

This section includes a short historical survey of the development of recoilless projectiles of the Panzerfaust type, details of the individual ammunition, and finally, a summary of interviews with Dr. Langweiler who was concerned with the development of these stores. The latter includes notes on proof trials and the general lines of research in this field.

(2) Historical Survey

The appearance of Russian T34 tanks in large numbers on the Eastern Front proved the inadequacy of anti-tank weapons available to the individual Infantryman, and Dr. Langweiler, of H.S.A.S.G. (Hugo Schneider Aktien Gessellschaft) Leipzig, was charged with the development of a suitable weapon in the summer of 1942.

(i) Faustpatrone

The answer to the requirement was the recoilless Faustpatrone, and the first projectile was fired from a tube 14 in. long. The complete weapon weighed approximately 5 lb. There were no sights and the weapon was fired by holding the tube in one hand with arm extended sideways.

The subsequent provision of sights necessitated firing the weapon from the shoulder, and so the launcher tube was lengthened to protect the user from flash.

A new design with improved ballistics and penetration performance was called the Panzerfaust (klein) 30 m, a weapon which, after satisfactory comparative trials with a captured American bazooka, went into mass production in October 1943.

(ii) Panzerfaust 30 m. or Faustpatrone 2.

Further development was directed to increasing the penetration, with an increase of propellant to maintain muzzle velocity. Both this and the Panzerfaust (klein) were demonstrated to the Heereswaffenamt at Kummersdorf in March 1943, and in July of that year, 3,000 of each type were ordered for Troop Trials on the Eastern Front. Results were good, and in October 1943, mass production was ordered at the rate of 100,000 Panzerfaust (klein) 30 m. and 200,000 Panzerfaust 30 m. per month. This target was not achieved until April 1944.

(iii) Panzerfaust 60 m.

Penetration performance of the Panzerfaust 30 m. was accepted as adequate, and further development concentrated on increasing the range. This was achieved with the Panzerfaust 60 m. which was completed during the early months of 1944. Production was gradually switched over from Panzerfaust (klein) 30 m. to Panzerfaust 60 m. during the summer of 1944.

(iv) Panzerfaust 100 m.

Greater range was still demanded and led to the development of the Panzerfaust 100 m, completed in September 1944, and put into production in November of the same year. An interesting aspect of this weapon was the use of two propellant components, separated by an air gap, to obtain staggered ignition and thus a flatter pressure-time curve.

(v) Panzerfaust 150 m.

The Panzerfaust 150 m was designed by January 1945. Production began in February, and continued until April when 100,000 weapons had been manufactured - mainly by R. Tümbler of Dübeln, Saxony. Few, if any of these weapons reached the troops. The main characteristics of this weapon were:-

(a) A redesigned bomb (occasioned by the shortage of explosive in Germany), in which the combination of a hemispherical cone, control of the detonation wave by compressed paper embedded in the H.E., and a long pointed nose for greater stand-off, was claimed to equal the penetration performance of previous bombs, with the use of only half the weight of H.E.

(b) A larger propellant charge, in two components, to give the bomb an M.V. of 82 metres per second and so increase the range.

(c) A fragmentation sleeve which could be fitted on the bomb by the user for anti-personnel effect.

The shortage of projector tubes became serious at this time and the Panzerfaust 150 m was being redesigned so that the user could rapidly reload and fire 10 bombs from the same tube. To do this, the propellant charge was attached to, and in prolongation of, the bomb tail shaft; and the trigger mechanism on the tube contained a strip of ignition caps. Development was expected to be completed by May 1945, and production was to begin immediately.

(vi) Panzerfaust 250 m.

The Panzerfaust 250 m. was scheduled to replace all other types by August 1945. The mechanical construction had been decided, but experiments with the propulsion system were still being undertaken when the war ended. The salient features were:-

(a) Increased range. The bomb was of similar design to the Panzerfaust 150 m but with a longer tail shaft (for longer shot travel in the bore). The propellant charge, in two components, was greater and the rear end of the projector tube was choked and finished with a venturi. The M.V. was to be 120 to 150 metres per second.

(b) Reloading and electrical firing. The propellant charge was fitted on, and in prolongation of, the bomb tail shaft. Ignition was by means of an electric fuze. A pistol grip on the projector tube contained a trigger-operated impulse magneto, similar to that of the anti-tank rocket launcher. A positive lead connected the magneto to a simple female socket at the front of the

projector tube. The bomb possessed a corresponding male plug, connected to the fuze in the propellant by a wire running through the tail shaft. The circuit was completed by earth return.

The long tail shaft, required for increased M.V., and the tactical limit to the overall length of the projector tube left little space for the propellant system. As it was found impossible to stagger the ignition of the two components of propellant by the air gap system hitherto used, each component was separately ignited by an electric fuze, the necessary time interval being obtained by incorporating an induction coil in the circuit. A steel disc, 1 mm. thick and with a small central perforation, was placed behind the front component to prevent flash leaping the restricted gap and prematurely igniting the rear component of propellant.

(3) Panzerfaust 30 (Klein)

Dimensions	Length of launching tube	31¾ in.
	Outside dia. of launching tube	1.39 in.
	Length of projectile	14¼ in.
	Max. diameter of projectile	3.95 in.
	Muzzle velocity	98 ft./sec.
	Penetration	140 mm. at 30 degrees to normal.
General	The bomb was propelled by a gunpowder charge.	

(4) Panzerfaust 30

Dimensions	Length of launcher tube	31.5 in.
	Outside diameter of launcher tube	1.9 in.
	Thickness of metal of tube	0.09 in.
	Length of projectile	19.5 in.
	Max. diameter of projectile	5.9 in.
	Muzzle velocity	98 ft./sec.
	Penetration	200 mm. at 30 degrees to normal.
General	Mass production started in October 1943. The bomb was propelled by a gunpowder charge.	

(5) Panzerfaust 60

Dimensions	Weight of complete store	8 lb. 2 oz.
	Weight of propellant	¾ oz.
	Weight of H.E. filling	3½ lb., RDX/TNT 54/46
	Muzzle Velocity	148 ft./sec.
General	Although generally similar to the Panzerfaust 30, several improvements were incorporated in this design.	
	A more rigid sight with a large luminous patch and with range apertures at 30, 60 and 80 metres, was provided. A small projection on the rim of the bomb served as foresight.	

Design Details

Projector - Consequent upon an increase in the propellant charge, the projector tube was of thicker metal (0.12 in.).

Firing Mechanism - The redesign of the firing mechanism gave a straight flash channel from the cap to the propellant charge. The cap was similar to that used in mortar bomb cartridges, and was of sufficient power to penetrate the card sleeve enclosing the propellant. The earlier disadvantages of a paper window in this sleeve were thus overcome.

Projectile - The stem of the head and the socket on the tail were plain, and attachment was by means of a stud on the head engaging in a spring clip in the tail.

The new fuze had a stronger spring for greater safety in transit, a striker body of a zinc base die-casting, and a more sensitive cap.

(6) Sprengfaust

This high explosive bomb, fired from a projector tube, was an adaptation of the recoilless Panzerfaust.

In April 1944, the German Army stated a requirement for a fragmentation bomb based on their experience of the Panzerfausts. In June 1944, at Doberitz, the Sprengfaust was produced. It consisted of a bomb specially developed for fragmentation, without any hollow charge effect but fired from the projector tube of a Panzerfaust 60. On impact with the ground, a small charge exploded which threw the bomb into the air to a height of 3 to 4 metres, where it exploded.

After trials at Kumnersdorf on 1st March, 1945, the Army rejected this model on the grounds that it meant the carriage of another type of ammunition. Instead of this projectile, a fragmentation sleeve was demanded which could be easily fitted to the normal hollow charge bomb as occasion demanded.

(7) Panzerfaust 100

Development History - A notable difference between this and the Panzerfaust 60 was the propellant charge. This, necessarily larger than in the "60", was divided into two increments separated by an air gap. By this means a greater muzzle velocity (62 metres per second) was obtained without increasing the maximum gas pressure in the projector tube.

Dimensions	Length of projectile	19.25 in.
	Max. diameter	5.95 in.
	Muzzle velocity	200 ft./sec.

General - Essentially the same as Panzerfaust 60 this new design gave a higher muzzle velocity. The aperture sight was calibrated at 50, 100 and 150 metres. Production was started in November 1944.

Design Details

The high muzzle velocity was achieved by using a larger amount of propellant which was divided into two increments separated by an air gap. By this means the pressure was kept

down sufficiently to allow the use of the original Panzerfaust 60 launcher tube with this more powerful projectile.

The fins of the bomb tail were reduced in size and tapered from the front to the rear.

(8) Panzerfaust 150

Dimensions	Length of projectile	21.85 in.
	Muzzle velocity	270 ft./sec.
	Penetration	200 mm. at 30 degrees to normal (Alleged to defeat a skirting plate).
	Filling	2 lb., RDX/TNT 50/50

General

Although lighter and of smaller diameter than the Panzerfausts 60 and 100, this later development, which was in production but not in action at the end of the war, embodied several important modifications as well as maintaining the penetration performance of earlier models.

A projector tube was provided which could be reloaded in action, and a fragmentation sleeve could be fitted to the bomb as required.

Design Details

Projectile - The projectile head contained a parabolic steel liner with mouth diameter 98 mm. and varying in thickness from 2 mm. at the base to 1.7 mm. at the top. A circular wad of paper was incorporated in the H.E. charge just forward of the point of initiation in order to increase the performance. It was claimed that this system caused collapse of the cone from the sides and gave better focussing. Since a parabolic liner was used, the stand-off had to be greater than with the 60 degrees cone, and this was provided by a corrugated cone made from 1/32 in. sheet steel. The blank was serrated so that, on forming up, the apex could be turned over to give a radius. The joint in the cone was a spot welded lap seam.

The percussion base fuze was to have been modified to incorporate an igniter time element operated by the propellant gases.

Launcher tube - Originally the same as that for the Panzerfaust 100, the launcher tube was to have been modified to allow reloading in action. A strip to carry five ignition caps was to be fitted to the tube so that, after firing, a new cap could be placed in position by pushing the strip along with the thumb.

In this case the cartridge was to be integral with the bomb.

Propulsion system - The propelling charge, fitting inside the tube, was in two increments. Each increment, of 90 to 100 grammes of powder, was contained in a chamber at the two ends of the cardboard cylinder, leaving an air gap at the centre. The propellant was sealed from the air gap by means of a thin paper diaphragm. On firing, the flash from the cap penetrated the cardboard cylinder and ignited the propellant in the front

chamber. Flash from this increment passed across the air gap and ignited the propellant in the rear chamber. Thus by staggering ignition, the peak pressure of the propellant gas was maintained within reasonable limits even with a large quantity of propellant.

Loading - The cardboard cylinder containing the propellant was fixed to the end of the bomb's tail. In transit, a waxed cardboard cylinder with a closed end fitted on the propellant tube and extended forward over the tail shaft covering three quarters of the spring steel tail fins. Immediately prior to loading the bomb into the projector tube, this sleeve was removed. A small ring, covering the forward quarter of the fins to prevent them from unwrapping, was pushed forward along the tail shaft by the front rim of the projector tube when the bomb was loaded.

Fuze - The final fuze was to have been a modified version of the Faustpatrone Zünder 8002, (originally designed for the Panzerfaust 60). The modification consisted of the inclusion of a combustible time pellet which was ignited on discharge to give self-destruction after 3 seconds. This was fitted immediately behind the fuze in the base of which a hole had been bored. A further hole was drilled in the striker assembly so that the flame from the time element could pass right through into the fuze detonator. This time element functioned only if the projectile did not strike a target before its time of burning had elapsed, since it did not interfere with the percussion mechanism of the main fuze.

The delay composition, consisting of 50 per cent Barium Nitrate, 25 per cent Aluminium powder and 25 per cent Magnesium powder, eventually fired an igniferous detonator at the end of the delay element.

The time element was introduced to eliminate the danger of blinds from bombs falling on a soft surface, and to give an air-burst against infantry.

It was also suggested that the weapon could usefully be fired against low flying aircraft. Its effect would depend on blast, fragmentation and the jet effect. This last effect was valued very highly by Dr. Langweiler.

(9) Panzerfaust 250

General

Although development was not complete at the end of the war, the main features of the Panzerfaust 250 had been settled. The salient features were:-

(a) increased muzzle velocity: 300 - 400 ft./sec.
(b) a reloadable tube
(c) an electric firing mechanism.

Design Details

Increased muzzle velocity - The bomb, essentially the same as the Panzerfaust 150, was fitted with a longer tail shaft to give a longer shot travel. The projector tube was of similar proportions to the Panzerfaust 150, but the rear end was choked and finished with a venturi.

The weight of propellant, which was in two increments, and was fixed in prolongation of the tail shaft, was increased, and this, together with the venturi, increased the muzzle velocity to 120-150 metres per second.

Firing mechanism - An electric firing mechanism was incorporated. The projector tube was fitted with a pistol grip containing a magneto operated by a trigger, the system used on the Panzerchreck. The positive lead from the magneto led forward to a single socket plug at the front of the projector tube. The male plug for this socket was mounted at the front of the bomb tail shaft, and a lead continued through the tail shaft to the electric primer in the propellant charge. The circuit was completed by earth return.

Ignition of propellant - The long tail shaft, required for the increased shot travel, and the short length of projector tube, demanded for ease of handling, left a very limited space for the propellant, and it was found impossible to use the air gap system to stagger the ignition of the two increments. This, therefore, made it necessary to ignite each increment separately by means of an electric primer. The necessary time interval was obtained by incorporating an induction coil in the circuit. A disc of steel, 1 mm. thick and with a small central perforation, was positioned behind the front increment to prevent the flash leaping across the reduced air gap and prematurely igniting the rear increment. On firing, this disc was distorted and was ejected from the rear of the tube by the propellant gases.

Experiments in connection with the time interval, and with the prevention of flash ignition of the rear increment, were still in hand at the end of hostilities.

Summarised information relating to the Panzerfausts is given in the table on Page 48.

(10) Faustpatrone Zünder

There were four models of the fuze developed for the Panzerfaust, the principle of functioning being the same in each case.

The following is a brief description of each and their fundamental differences:-

(a) F.P.Z.8001 - This model was designed for firing in the Panzerfaust 30 (Klein) and the Panzerfaust 30 m. The detonator employed was not very sensitive and blinds often occurred when the projectile struck soft earth.

(b) F.P.Z.8002 - This was the first type of fuze for the Panzerfaust made by the firm of Brune at Neheim, and was designed for use in the model 60 m. A stronger arming spring, fitted to cope with the increased shock of discharge, had the advantage of rendering the fuze safer to handle. The very much more sensitive detonator introduced completely eliminated blinds on soft earth. Very few fuzes were produced to this interim design.

(c) F.P.Z.8003 - Containing an entirely new striker assembly this fuze was easier to produce and eliminated a defect in functioning of the coiled spring.

All models of the Panzerfaust could use the F.P.Z.8003, with the exceptions of the Panzerfaust 30 and 30(Klein), in which

DETAILS OF PANZERFAUSTS

Model	M.V. Metres/sec.	M.V. ft./sec.	Total weight (complete) lb.	wt. of bomb lb.	dia. of bomb mm.	Length of bomb ins.	Shape of liner	Liner Material	wt. of Filling lb.	Length of projector ins.	dia. of projector ins.	wt. of projector lb.	wt. of propellant	Fuze	Penetration of Armour at 30° to normal	Sighted up to:-	Development date
Prototype			5½							14						No sights	Mid-summer 1942
30m (Kl)	30	98	7⅜	3½	100	14¼	Cone	Zinc	1½	31¾	1⅜	3⅞	53½GRM (1 oz. 14 dr)	F.P.Z 8001	140	30 m. (33 yd.)	December 1942
30m	30	98	11½	6¾	150	19¼	Cone	Steel	3½	31½	1⅞	4⅞	95 GRM (3 oz. 5½ dr)	"	200	30 m. (33 yd.)	Jan.-Feb. 1943
60m	45	148	15	6¾	150	19¼	Cone	Steel	3½	32⅜	2	8⅛	134GRM (4 oz. 12 dr)	F.P.Z 8003	200	80 m (87 yd.)	April 1944
100m	62	203	15	6¾	150	19¼	Cone	Steel	3½	31½	2	9	190GRM (2x95)	"	200	150 m (164 yd.)	September 1944
150m	82	269	14¾	5¾	105	21¾	Parabolic	Steel	2	31½	2	9	"	"	200	200 m (219 yd.)	January 1945
250m	120-150	394-492	13¾	6	105		"	Steel	2	35	2	7¾	"	" (UMG)	200	"	August 1945

All Figs. approximate

the arming springs were too strong.

(d) F.P.Z.8003 (modified) - No details of this fuze are available. It was to be designed for the Panzerfaust 150 and 250.

Fuzes marked "Wa" and "Wc" were not safe to fire unless tested by shaking in a direction along their longitudinal axes, and then dropping on to the ground from a height of about 20 inches.

These tests were ordered as a result of faulty assemblies, from H.A.S.A.G. of Meuselevitz, and Tummler of Dobeln, getting into service. The chief fault was the omission of the coiled leaf spring, which left only the arming spring to prevent the striker hitting the detonator in the event of any sudden shock.

At a later date, the top closing disc of the fuze was provided with a small inspection hole, so that the presence or absence of the coiled leaf spring could be ascertained at final inspection of the assembled fuze.

Proof of fuzes

Fuzes were normally manufactured in lots of 1500. Out of each lot, 20 were taken, inserted in dummy heads and fired against armour plate. All twenty had to fire or a fresh sample of twenty was taken and the firing repeated. Any failures in this further sample condemned the whole lot.

(11) Summary of Interviews with Dr. Langweiler

Lines of German Research and Development

(a) Spaced armour

The Germans claimed that the following spaced targets could be defeated by the later models of Panzerfaust:-

50 mm. armour - 18 inches air space - 100 mm. armour.
20 mm. armour - 36 inches air space - 100 mm. armour.

Dr. Langweiler was unable to comment on damage likely to be done behind a target, but stated that from experiments it was found that blast pressures behind a spaced target were considerably less than behind a single plate.

During development trials, measurements were made of the rise of pressure behind targets, and some effort was made to assess the incendiary effect by means of oil-soaked rags. Thin steel "witness" plates to indicate and measure the residual power of the jets were not used.

Trials were conducted with the very little Allied hollow charge ammunition captured. High speed photographs of the projectile in flight were taken, and careful measurements made of the recoil force on the projector. The American "Bazooka" was estimated to be able to perforate 90 mm. and the British P.I.A.T. 120 mm. armour at 30 degrees to normal. From British trials, the following results were obtained in comparing the German Panzerfaust 30 mm. and the British P.I.A.T.

Weapon	Int.dia.of mouth of bomb case.	Penetration of armour at normal	Corresponding factor in Milnes' formulae
Panzer-faust 30M	140 mm.	200 mm.	1.43
P.I.A.T.	82.5 mm.	115 mm.	1.40

It was apparent that:-

(i) The greater penetration of the Panzerfaust 30M was due to its larger diameter.

(ii) The Panzerfaust 30M was sometimes able to defeat skirting plates.

The German view of our weapons was that penetration was not sufficient for the weight involved, and that a weapon designed for use by one man should be recoilless.

The Germans, in keeping with British research, carried out firing trials against many substances, e.g. sand, wood, gravel and glass, to determine whether any of these could be used as a protection against hollow charge attack. Success was not obtained, since the first round always removed so much material that a large area was laid open to attack by subsequent shots. It was considered that the best defence was by means of spaced armour, using as large a space as possible.

(b) Flame effect

The Germans also appeared to attach importance to the flame effect behind the target, more so in fact than the remaining power of the jet itself. Enhancing this flame effect would most likely be the best method of increasing the efficiency of hollow charges. By incorporating up to 30 per cent of powdered aluminium in the H.E. charge, the flame effect would be very greatly increased, without reducing the penetrative performance. Only the great shortage of aluminium in Germany prevented its use in the Panzerfausts. Some German designers thought that with this filling it would be worth using a cone of small angle, say 30 degrees or less, which would give a deeper penetration into armour, but produce a hole of considerably smaller diameter than that given by a hemisphere or a cone of larger apex angle. Dr. Langweiler, when questioned about this, admitted that the Germans had experienced great difficulty in manufacturing small angled conical liners sufficiently accurately. Squareness of liner face, alignment along the longitudinal axis, and alignment with the bursting charge, body and nose cap are of primary importance.

After noting the high temperature of the shaped charge jet, an attempt was made to secure sufficient ionization of gases to achieve atomic disintegration, but German research was unsuccessful in this direction.

(c) Liners

Many different materials were tried for liners, including steel, zinc, aluminium glass (tried in January 1944) etc.

For the early Panzerfaust, the 30M (Klein), a zinc liner was used. The zinc volatized and a very hot, burning jet of metal

followed through. As the armour thickness increased, further development was undertaken and steel was employed as the liner material to give better penetration performance. Supply problems stopped further research and development on aluminium. A little success was achieved with glass liners, but experiments were discontinued owing to transportation difficulties.

Dr. Langweiler said that he considered the ideal liner to be of Tungsten Carbide, claiming that it would give 20 per cent better penetration than the next most effective material, i.e. steel. Liners of this material were very expensive to produce and the material itself was too valuable to use and was difficult to handle in large scale production.

Proof of Panzerfausts (Projectile and Projector)

The launcher tubes, each of which was tested, were arranged in batteries of 20. A steel block or dummy head was inserted in one end of each tube and a proof charge, fired by an electric puffer or detonator, in the other. After firing, each tube was inspected. This method was superseded by a hydraulic pressure test, similar to that carried out on the combustion chamber of the Panzerschreck.

In the first stages of the war, when normal mild steel tubes were used, very little trouble was experienced, but as the war developed, the quality of the steel deteriorated, and, according to Dr. Langweiler, in certain lots 10 per cent rejects were common.

One firm, Kronprinz A.G. für Metallindustrie, were of the opinion that bursts were not due to the tubes being faulty, but that the pressure generated, 350 kgm/sq.cm., was too high for the tubes, an opinion that Dr. Langweiler favoured. They also stated that they had not evolved any satisfactory method of testing other than firing and taking the actual pressure in each tube. Dr. Langweiler did say that he had received instructions from Hitler that no special materials, alloy steels, etc., or any materials whatever in short supply were to be used.

Proof of the complete weapon was carried out by sub-calibre firing.

Out of a lot of 1500, four boxes were selected. These boxes each contained four Panzerfausts, and with the exception of 5 which were fired against a proof target, all were checked for correct dimensions. The proof target consisted of 3 medium quality armour plates, 50 mm. thick, set parallel to each other, with a 20 mm. gap between each, and this assembly was set at 30 degrees to normal to simulate attack against a 200 mm. plate at normal. Dr. Langweiler stated that the gap between each plate had, during some proof firings and experiments, been increased to 30 mm. and even 50 mm. There are reports of three 55 mm. plates being used with 2½ inch air gaps.

Of this 1 per cent taken for proof, 1 failure was allowed for the sample of 5 rounds, but even so, this failure was not to show appreciable diffusion of the jet. If production was found to be satisfactory, the number taken for proof was gradually reduced. Firing was normally carried out at the Proving Ground of Schleiben near Hertsburg.

PART 7. MISCELLANEOUS GRENADES

(1) Rocket Assisted Grenades

Prototypes, the general shapes of which are shown in the sketches, were made up to three designs. With the first type, which was an anti-tank hollow charge grenade with a pre-rifled shank, the range obtained was about 560 yd. The weight of the grenade (4 lb. at target) was however very great for shoulder firing, the spin imparted was insufficient for stability and accuracy was very poor.

A second type, rather dangerous to the user, was entirely rocket propelled. The rocket charge was ignited by flash from a small blank cartridge.

The third design was potentially better. The base and rifled shank were made of wood, and the hollow charge cavity was filled with rocket propellant. The H.E. charge was detonated on impact by an electric nose fuze which was armed by a small propeller. Three sizes of grenade were tried, of 80, 88 and 100 mm. diameter, and each was to range about 100 yd. The cavity of the largest type was to carry two rocket charges. Gases from the first charge escaped through inclined venturis to give rotation, the second charge then took over to boost the thrust.

(2) Pressluft Granate (Compressed air grenade).

The use of this grenade was disclaimed by the Germans, but other reports state that grenades of this design were used on the Russian front at the Battle of Kiev.

(3) Centrally - channelled grenade

Dimensions

Discharger cup	Overall length	14.60 in.
	Max. internal length of cup	10.86 in.
	Diameter	1.97 in.
	Thickness of cup wall	0.08 in.
	Weight of cup	6.06 lb.
Projectile	Overall length	5.04 in.
	Diameter of central channel	0.35 in.
	Max. diameter of body	1.93 in.
	Max. diameter of tail unit	1.94 in.

General — This grenade was designed for use with a 5 cm. discharger cup, and was to eliminate the need for special cartridges.

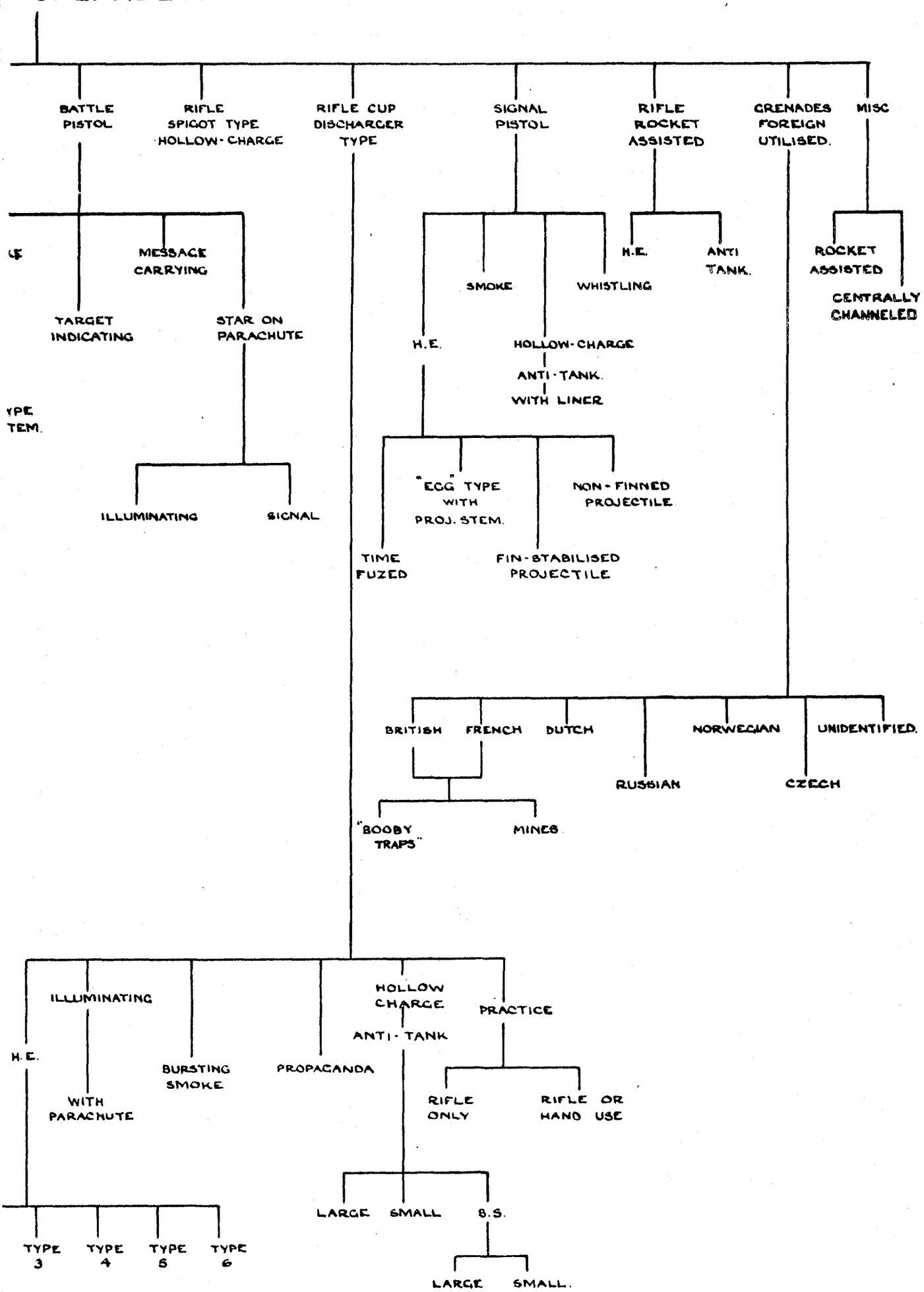
Design details

The grenade had a central channel to allow the passage of a bullet from a standard 7.92 mm. round, and to provide sealing after the round had passed. A diaphragm of self-sealing rubber was stretched across the base of the tail unit and secured to the body by a pin catch. This catch disengaged under air pressure when the grenade left the discharger so that the diaphragm was discarded.

In trials, a range of 380 yards was obtained. It was intended that the grenade should be side fuzed.

FIG. 1.

FICATION OF GRENADES.



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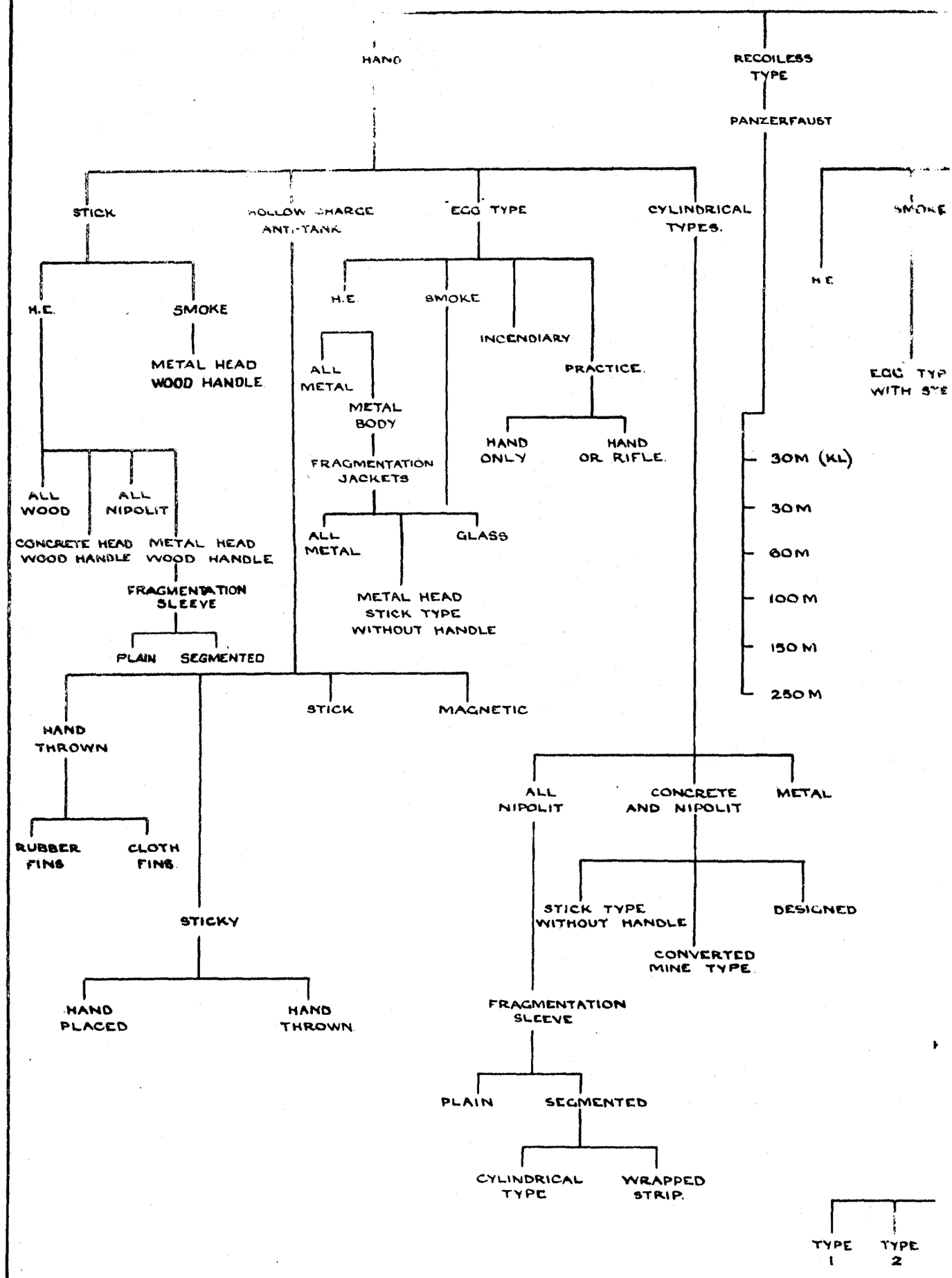
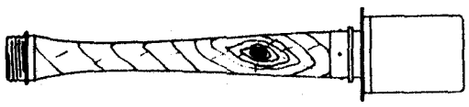
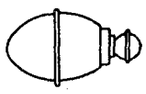
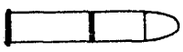




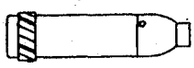
Grenade, Stick, Hand, H.E., 24.



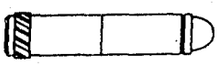
Grenade, Egg, H.E.



Grenade, H.E., 27 m/m.

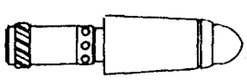


Grenade, Rifle, H.E., 30 m/m., Type I.



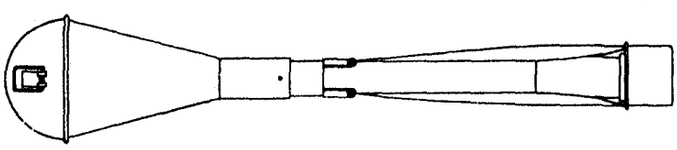
Grenade, Rifle, A.Tk., 30 m/m.

Grenade, H.E., 27 m/m., Battle-pistol.



Grenade, Rifle, A.Tk., 30 m/m., Large.

Grenade, Stick, Hand, Smoke (Early).



Panzerwurfmine I (L)

Grenade, Stick, Hand, Smoke, 39.

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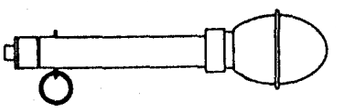
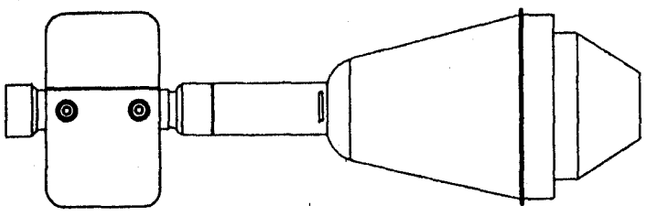
FIG. 2.

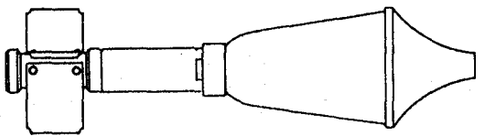


Grenade, H.E., 27m/m, Signal-pistol (Wurfkorper 361, LR)



Panzerfaust 30 M.

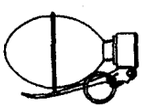
Grenade, H.E., 27m/m.



Panzerfaust 30 M (Small).

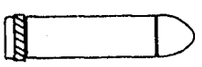
Grenade, Indicating, Battle-pistol.

Grenade, Illuminating Star on Parachute.

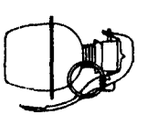


Grenade, Egg, French origin.

Grenade, Stick, H.E., Russian origin.

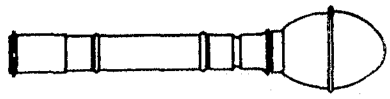


Grenade, Rifle, Propaganda.

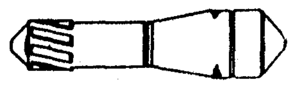


Grenade, H.E., French origin.

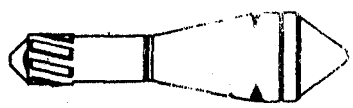
GRENADES.



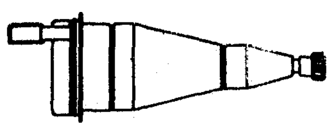
Grenade, Egg, H.E., on Projector stem.



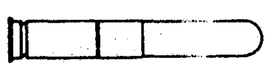
Grenade, Rifle, A.Tk., 46, s.s.



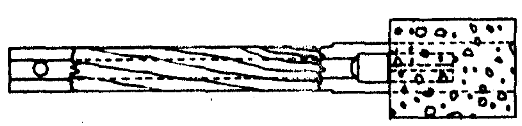
Grenade, Rifle, A.Tk., 61, S.S.



Grenade, H.C., Sticky, A.Tk., Hand-placed

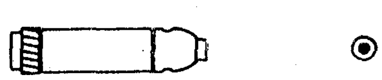


Grenade, H.E., 26 m/m., Pistol, Time-fuzed.



Grenade, Stick, Concrete, I.

Grenade, Pistol, Message-carrying.



Grenade, Rifle or Hand, H.E., 30 m/m.

Grenade, Rifle, Bursting-smoke, 42.

Grenade, Brown Smoke, Battle-pistol.

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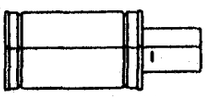
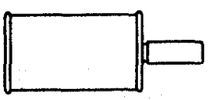
FIG. 3.

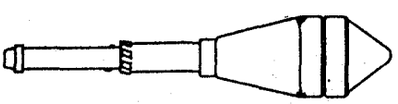
Grenade, H.E., 27m/m., Battle-pistol.



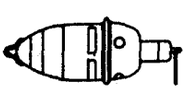
Grenade, Hand, H.E., M 42(n), Norwegian origin.



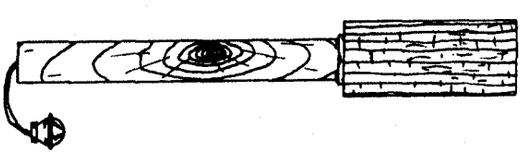
Grenade, Hand, H.E., M 42(n), Norwegian origin.



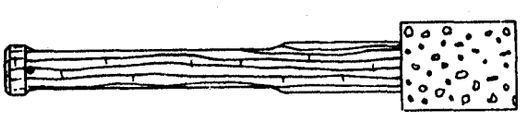
Grenade, A.Tk., 23m/m., Pistol (Panzerwür/korper 42 L.R).



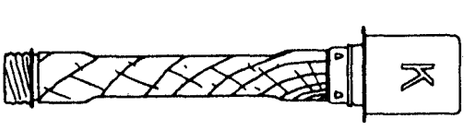
Grenade, Egg, Hand, Smoke, 42.



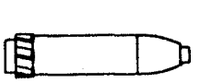
Grenade, Strick, Hand, All Wood.



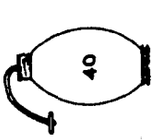
Grenade, Strick, Concrete, II.



Grenade, Hand, Strick, H.E., Cold-zones.



Grenade, Rifle or Hand, 30m/m., Practice.



Grenade, Hand, Egg, H.E., Dutch origin.

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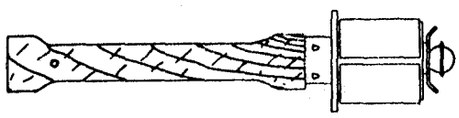
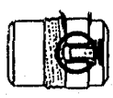
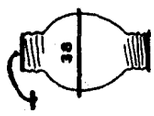
Grenade, Stick, Hand, H.E.



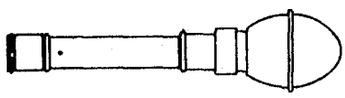
Grenade, Stick, Hand, H.E., with Frgmtn. sleeve.



Grenade, Hand, H.E., Czech. origin.



Grenade, Hand, H.E., Dutch origin.

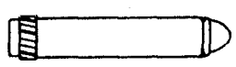


Grenade, Egg, H.E., on Plastic stem.

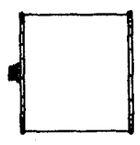
Grenade, White-smoke, 27 m/m., Battle-pistol

Grenade, Brown-smoke, 27 m/m., Battle-pistol.

Grenade, Indicating, Blue-smoke.



Grenade, Rifle, Illuminating, 30 m/m.



Grenade, Hand, H.E., Russian origin.

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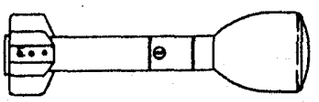
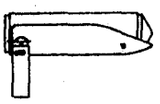
FIG. 4.



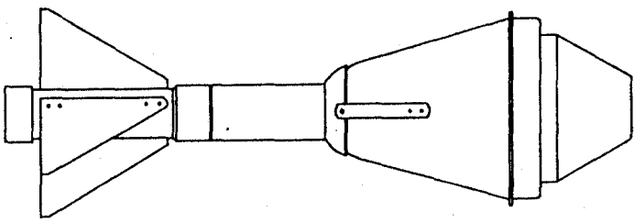
Grenade, Rifle, A.Tk., Spigot-discharger.



Grenade, Hand.

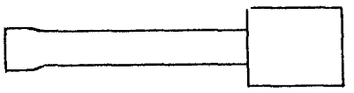
Grenade, Hand.

Grenade, Stick, Hand, H.E., 43.



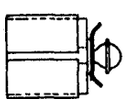
Panzerfaust 100 M.

Grenade, Green-flare with Parachute, 27mm., Pistol.

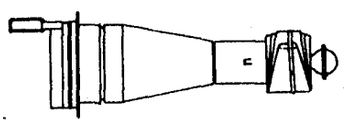


Grenade, Stick, Hand, All Nipolit.

Grenade, Hand; Cylindrical, All Nipolit (Solid).



Grenade, Hand, Cylindrical, All Nipolit (Plugged), with Frgmtn. sleeve.



Grenade, H.C., Sticky, A.Tk., Hand-thrown.

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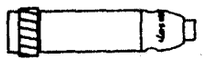
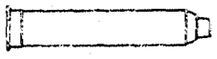
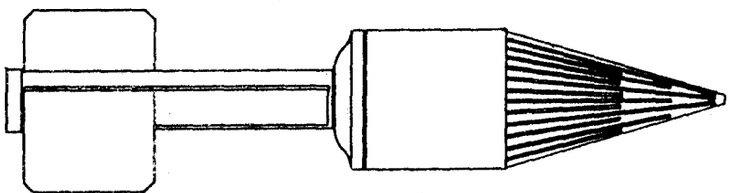


Grenade, Rifle, H.E., 30^{m}/$_{m}$, Type 5.

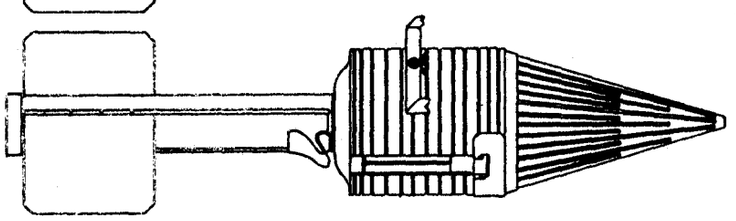


Grenade, H.E., 27^{m}/$_{m}$.

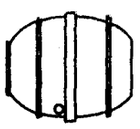
Projectile, Finned (for above grenade).



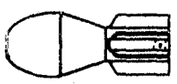
Panzerfaust 150 M.



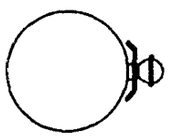
Panzerfaust 150 with Frgmtn. sk



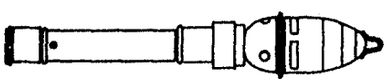
Grenade, Egg, Hand, Nipolit.



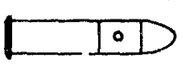
Grenade, H.E., with Central channel.



Grenade, Hand, Disc, Nipolit.



Grenade, Egg, Smoke, 42/II.



Grenade, Indicating, Red smoke (Alumn. rail, paper case).

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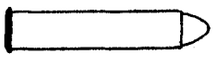
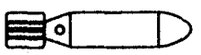
FIG. 5.

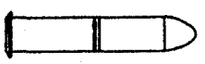
Projectile for above grenade.



Grenade, Indicating, Blue-smoke (Alumn. tail and case).



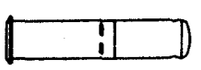
Projectile for above grenade.



Grenade, Indicating, Red-smoke (Plastic tail).

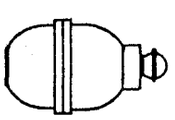
sleeve

Projectile for above grenade.

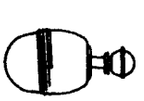


Grenade, Indicating, Blue-smoke (All steel).

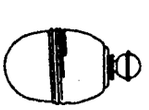
Projectile for above grenade.



Grenade, Incendiary, with Nipolit body.



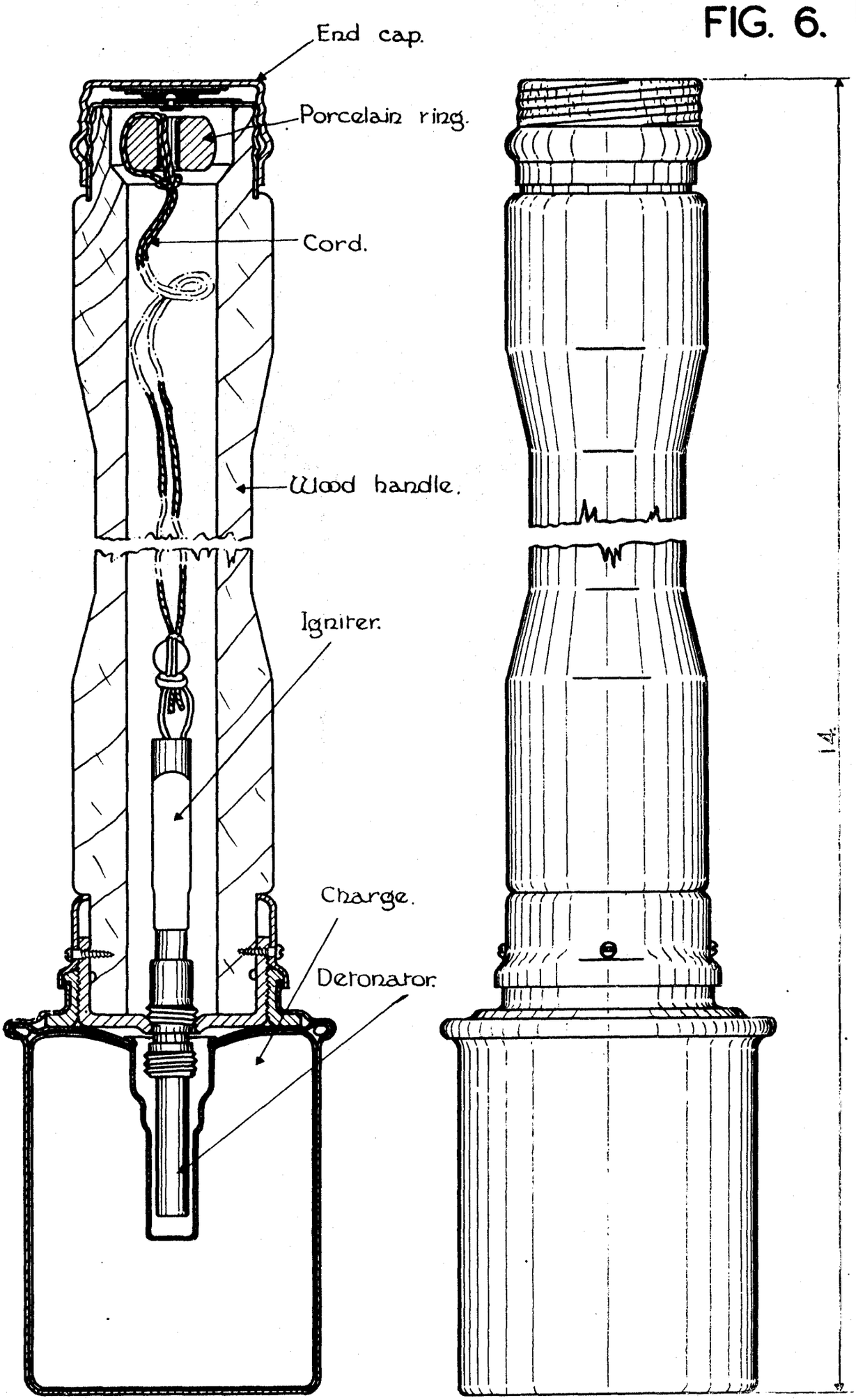
Grenade, Egg, Hand, H.E., Small (Screwed body).



Grenade, Egg, Hand, H.E., Large (Screwed body).

GRENADES.

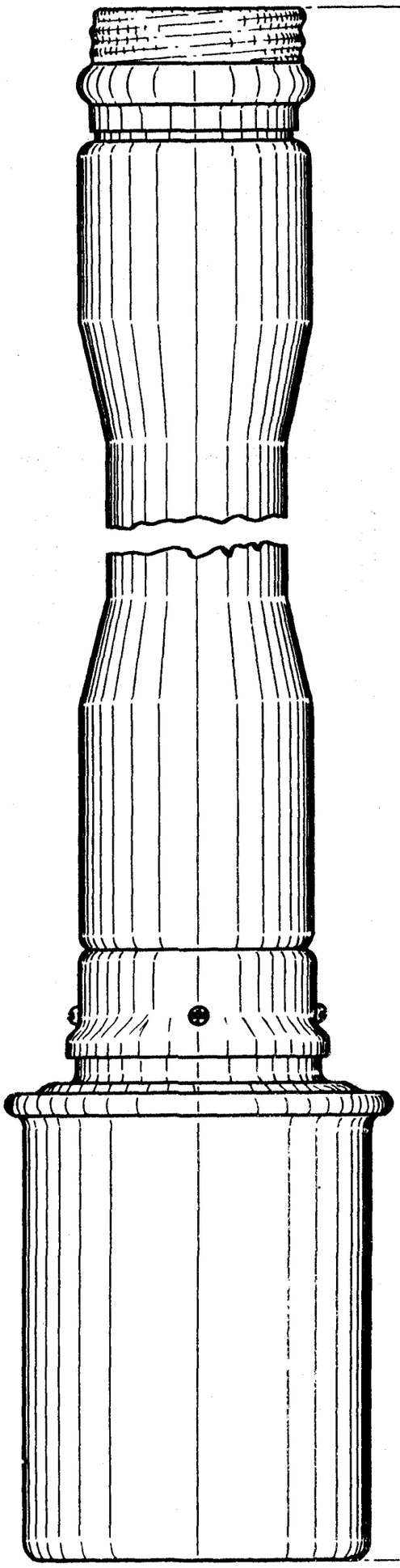
FIG. 6.



STICK, HAND GRENADE, H.E., 24.

A.D.D. 2/46 PTN.

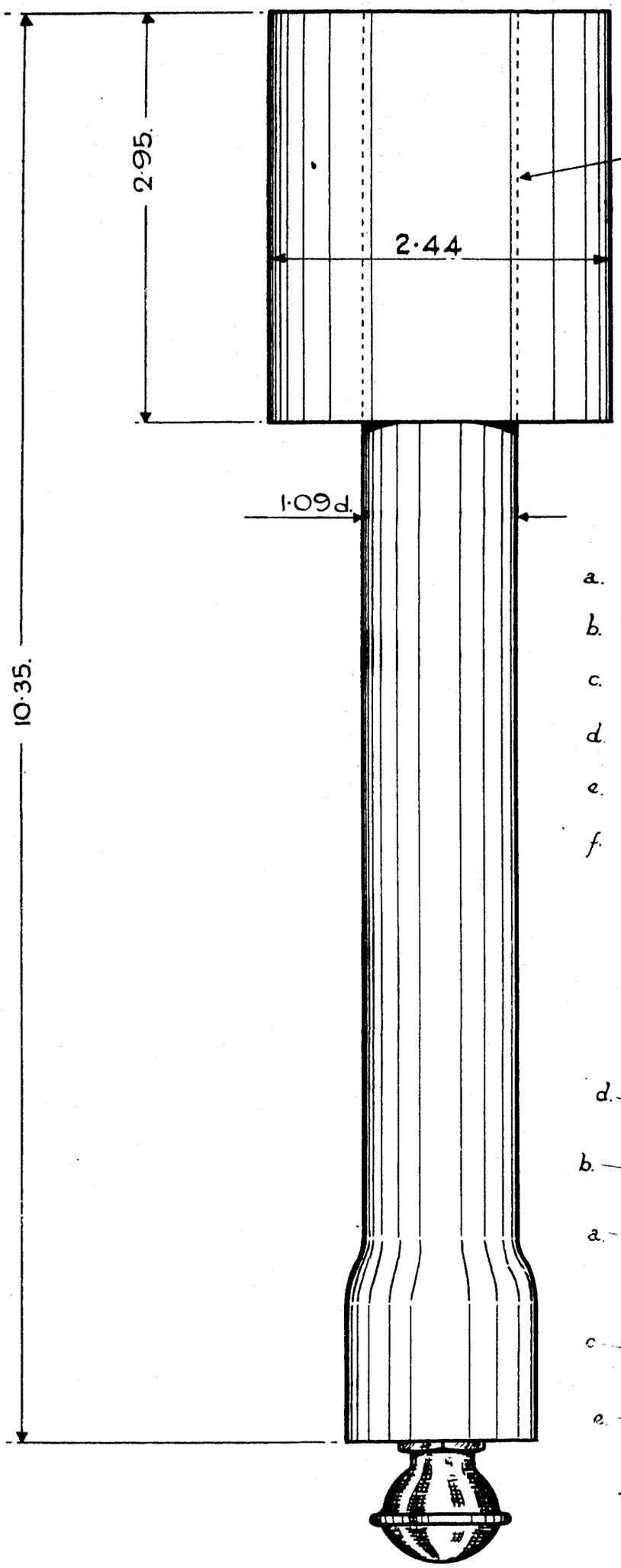
FIG. 7.



STICK, HAND GRENADE, H.E., 39.

A.D.D. 2/46 PT N.

FIG. 8.



LEGEND.

a. Delay tube.

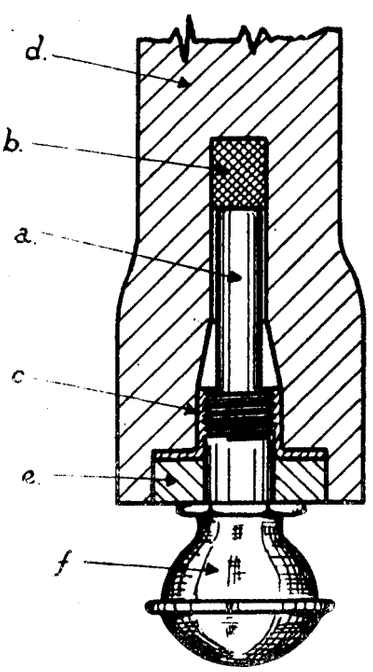
b. P.E.T.N./Wax.

c. Steel retaining collar.

d. Nipolit handle.

e. Washer.

f. Egg-grenade-type igniter.

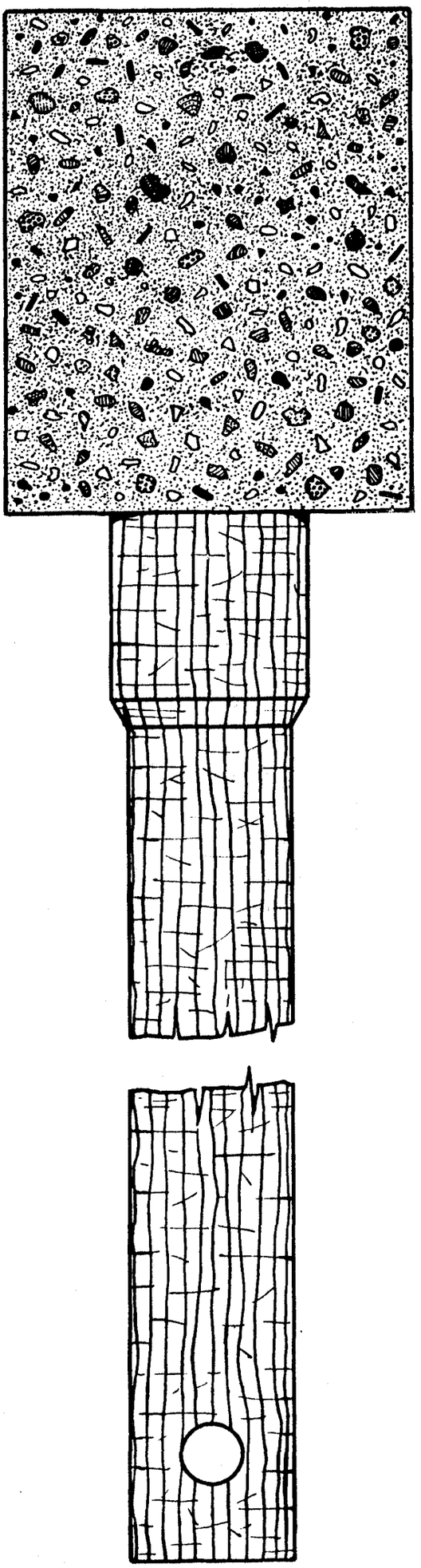


STICK, HAND GRENADE - NIPOLIT.

DIMENSIONS ARE IN INCHES.

A.D.D. 2/46 PT N.

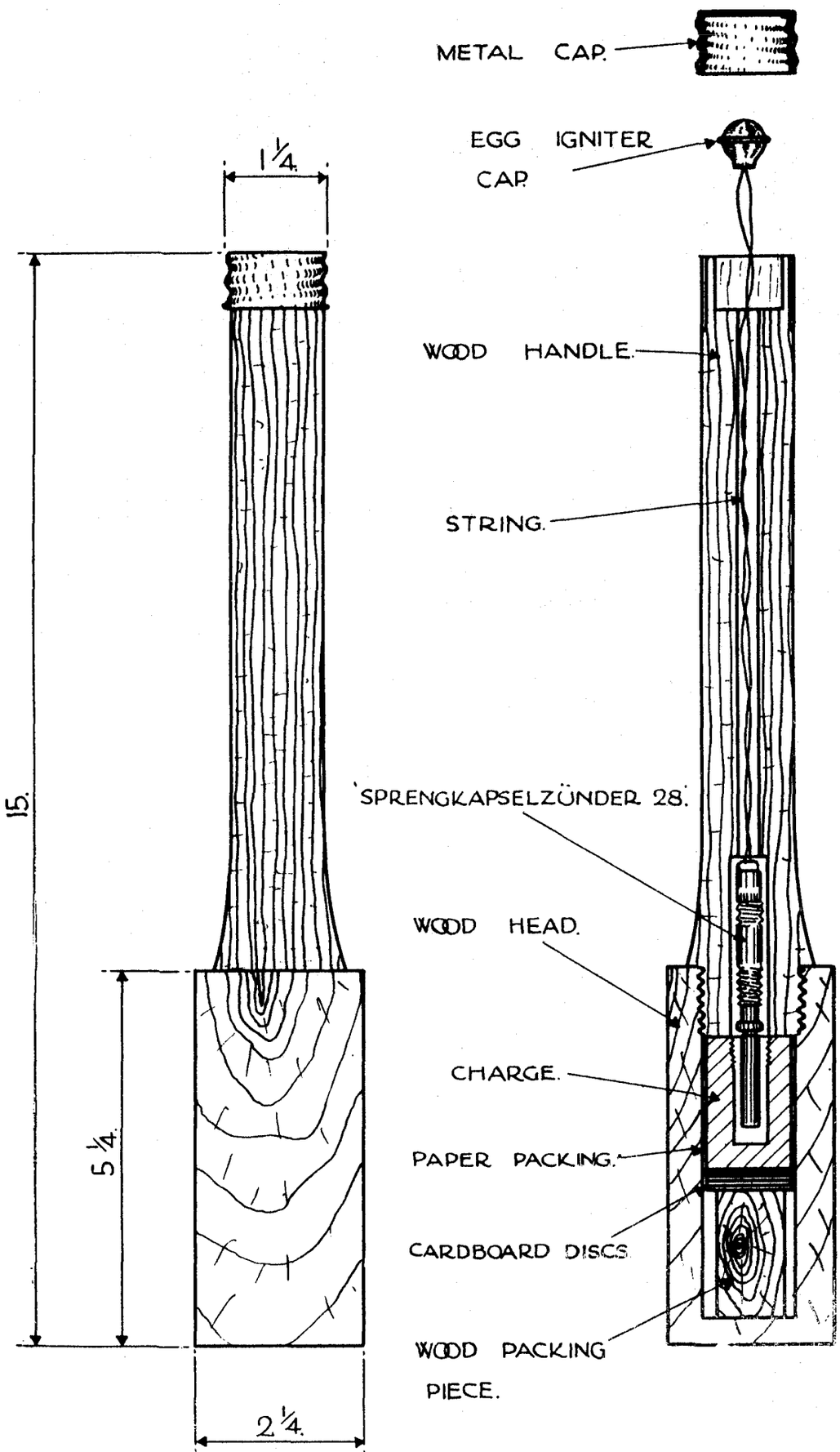
FIG. 9.



STICK, HAND GRENADE, CONCRETE, I.

A.D.D. 2/46 PT. N.

FIG. 10.

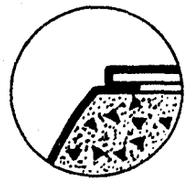


STICK, HAND GRENADE - WOOD.

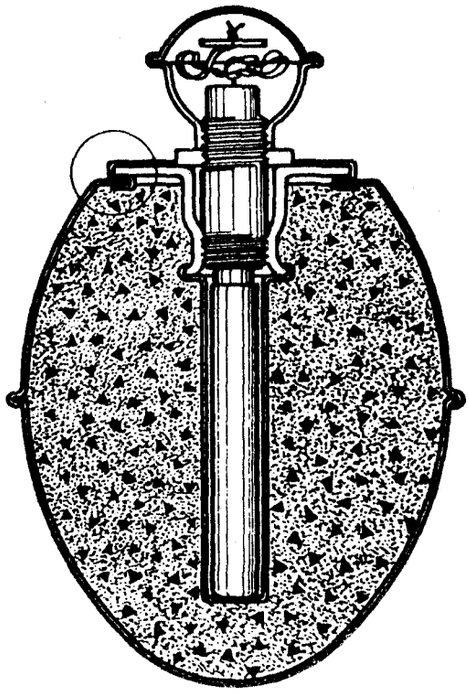
DIMENSIONS ARE IN INCHES.

A.D.D. 2/46 PTN.

FIG. 11.



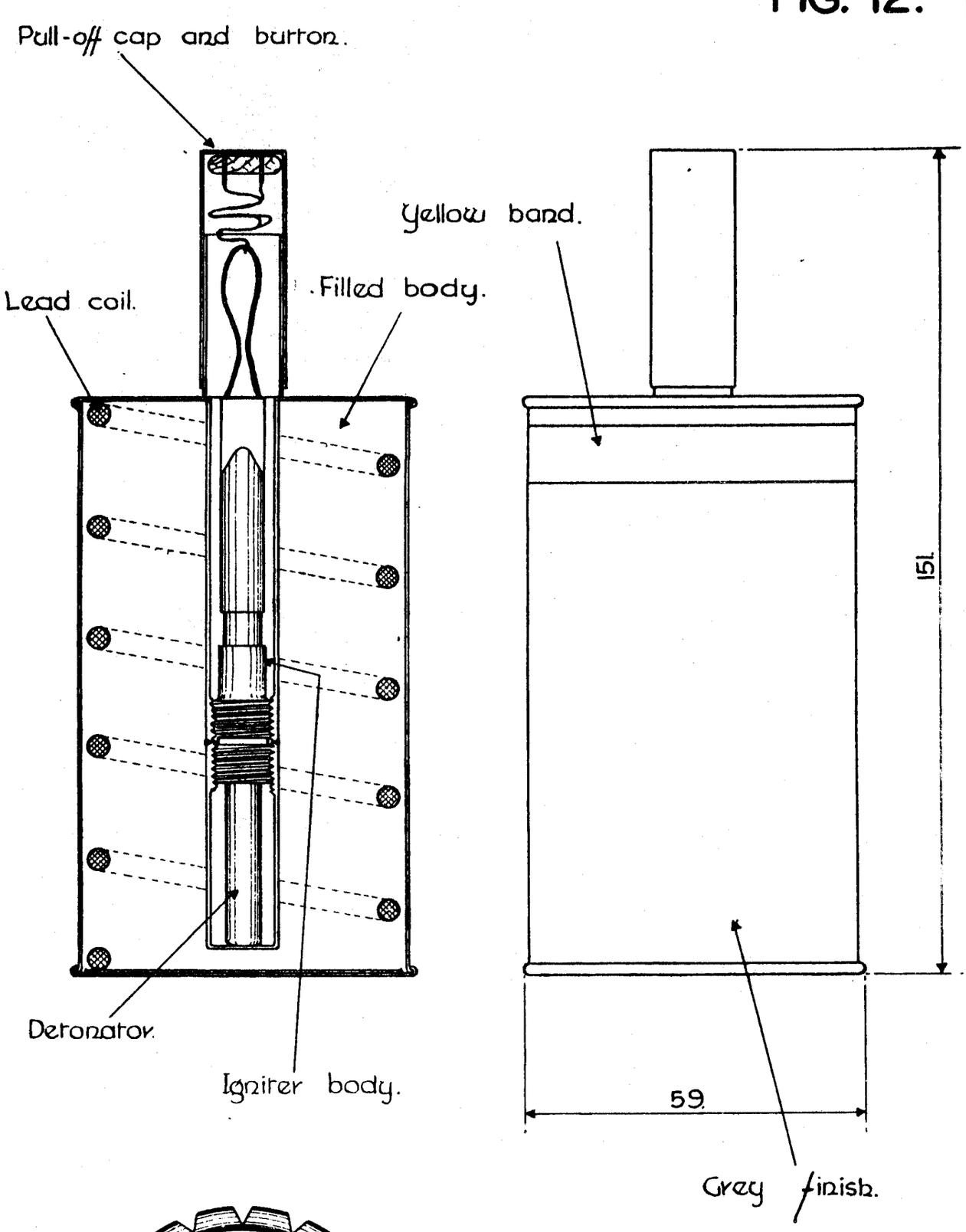
Alternative.

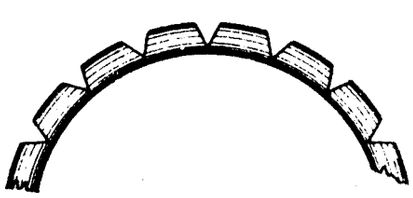


EGG, HAND GRENADE, H.E., 39.

W.O. 194/2 A.D.A.

FIG. 12.



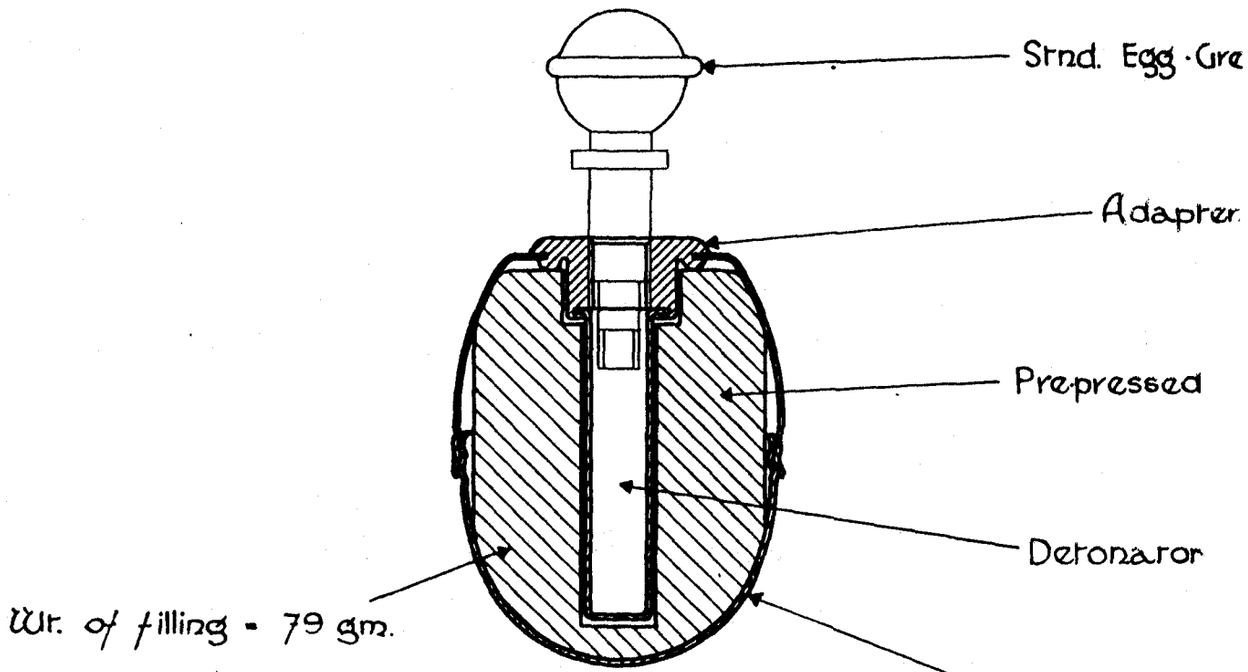


Section of lead coil showing notches.

HAND GRENADE, H.E., M 42 (n).

DIMENSIONS ARE IN MMS.

W.J.a.



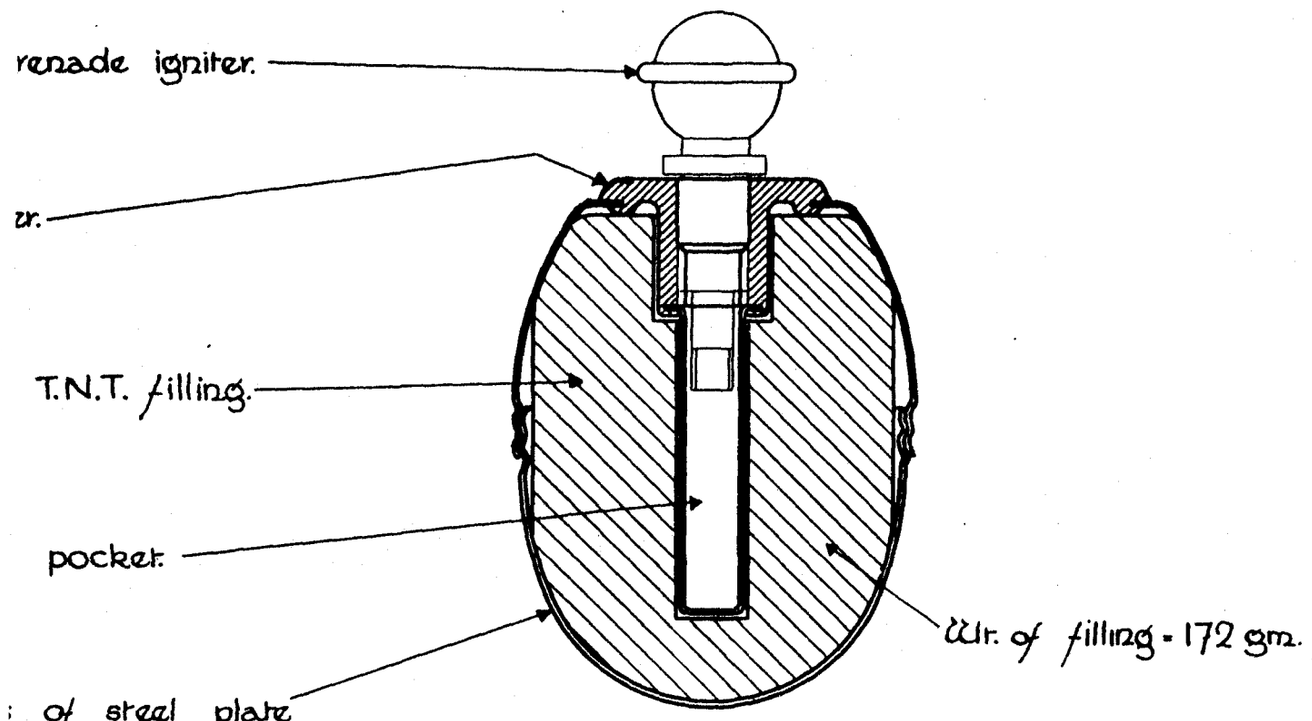
SMALL.

Total wt. - 139 gm

EGG, HAND GRENADE, H. E., M

A.D.D. 2/46 P.N.

FIG. 13.

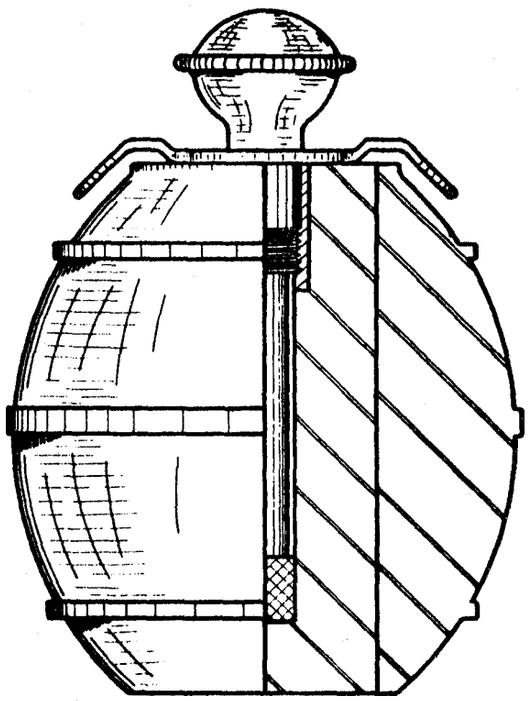


LARGE.

Total wt. - 274 gm.

WITH PRESSED CHARGE.

FIG. 14.

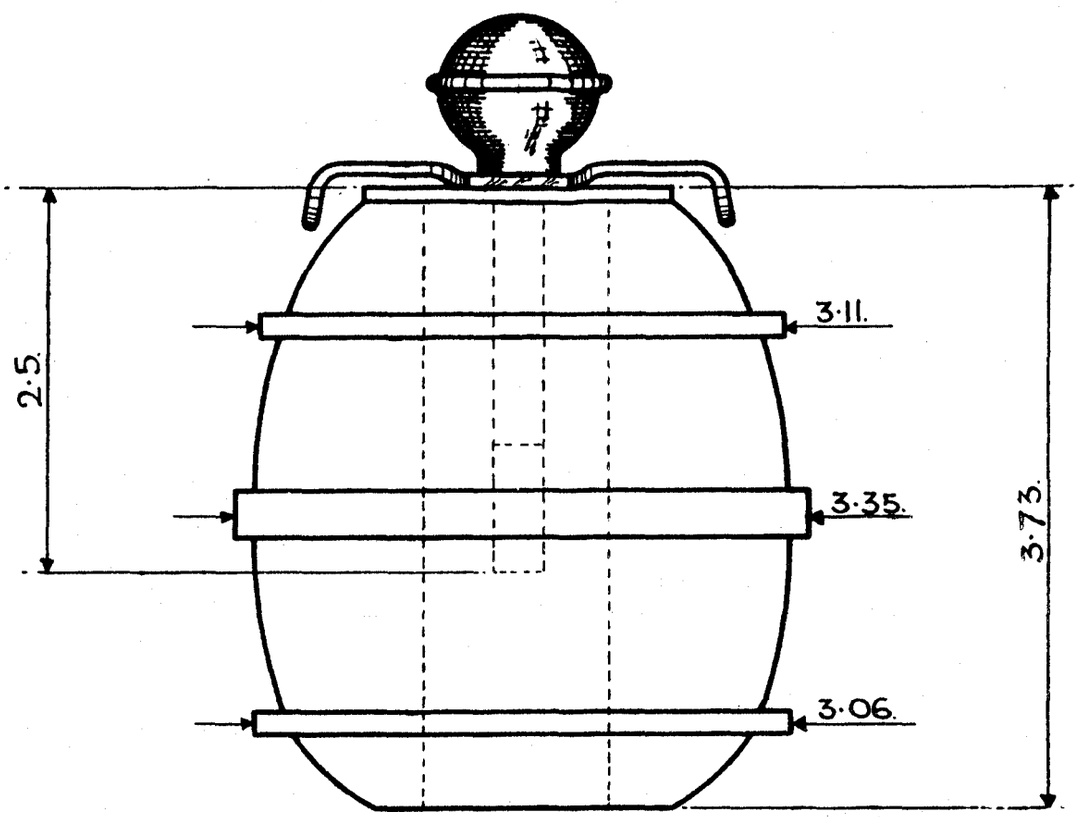


Scale - 1/1.

EGG, HAND GRENADE, SMALL - NIPOLIT.

A.D.D. 2/46 3rd N.

FIG. 15.



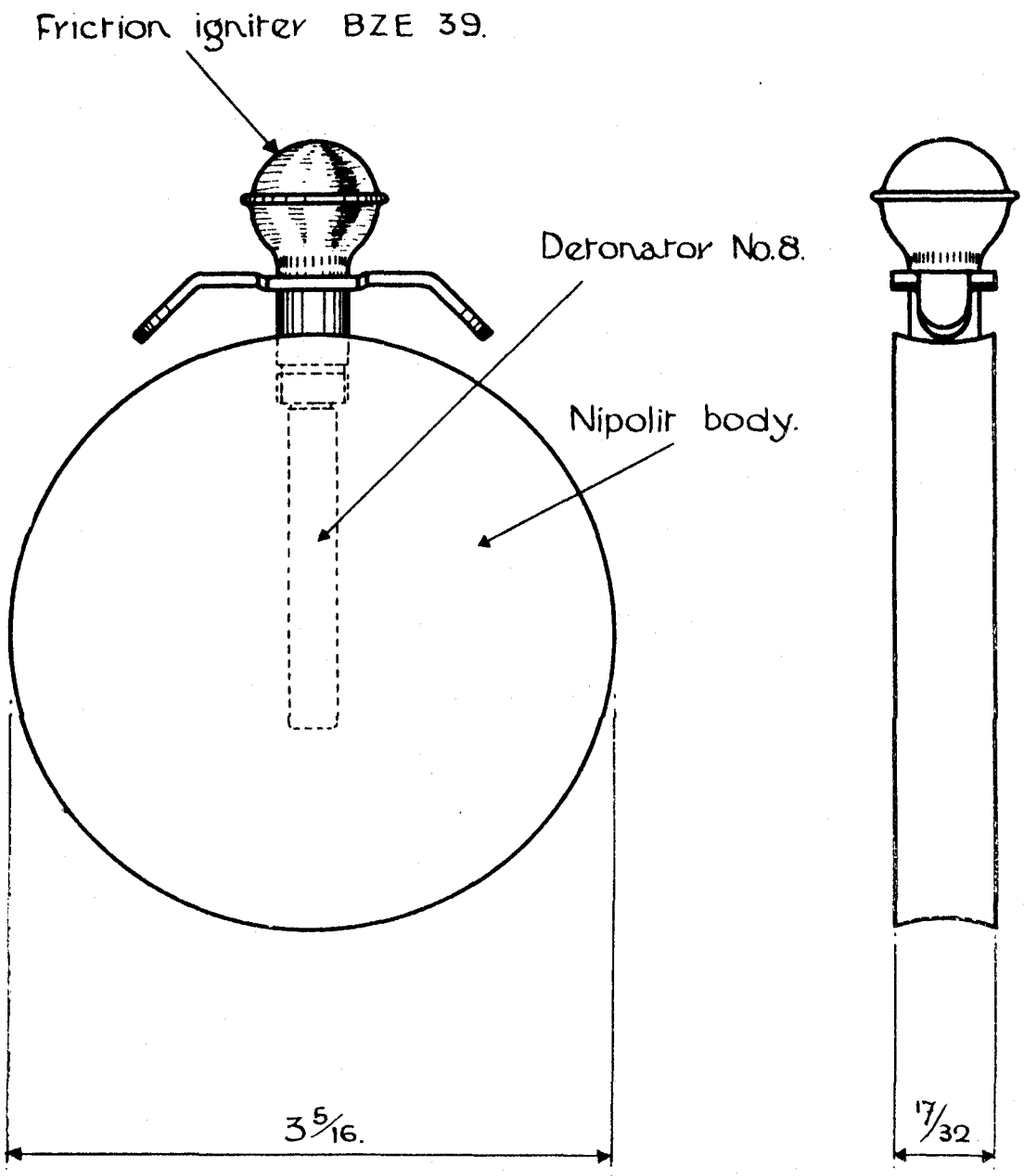
Not to scale.

EGG, HAND GRENADE, LARGE - NIPOLIT.

DIMENSIONS ARE IN INCHES.

A.D.D. 2/46 P.N.

FIG. 16.

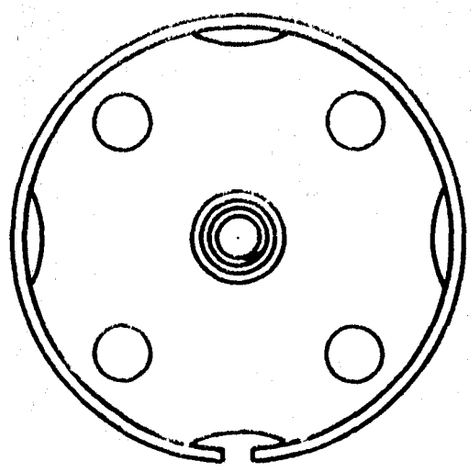


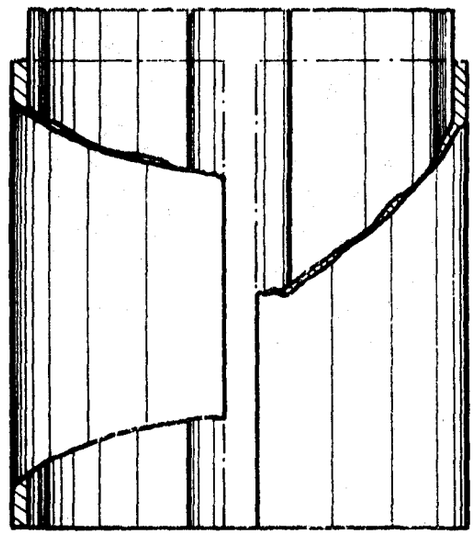
DISC, HAND GRENADE - NIPOLIT.

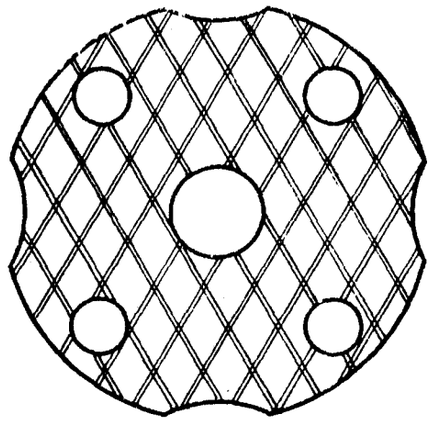
DIMENSIONS ARE IN INCHES.

A.C.D. 2/46 PT.N

FIG. 17.



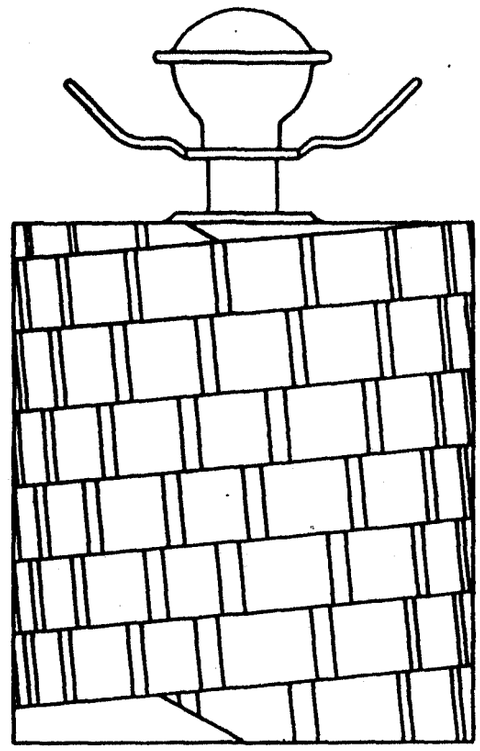


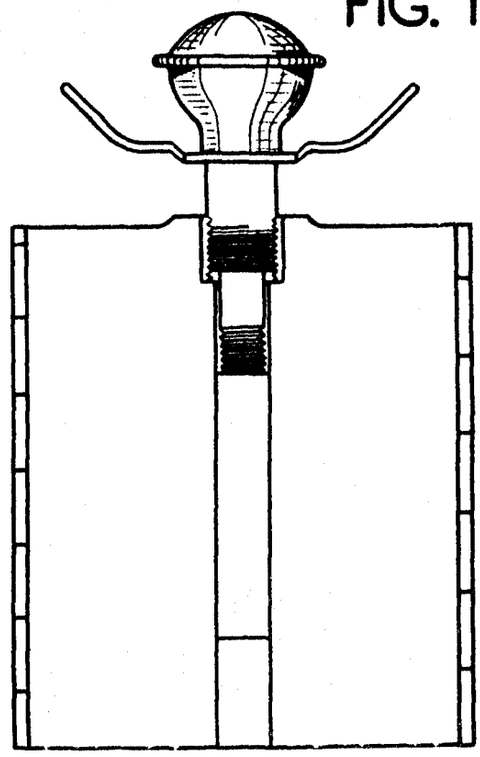


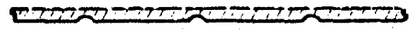
CYLINDRICAL, HAND GRENADE, NIPOLIT, WITH FRAGMENTATION SLEEVE.

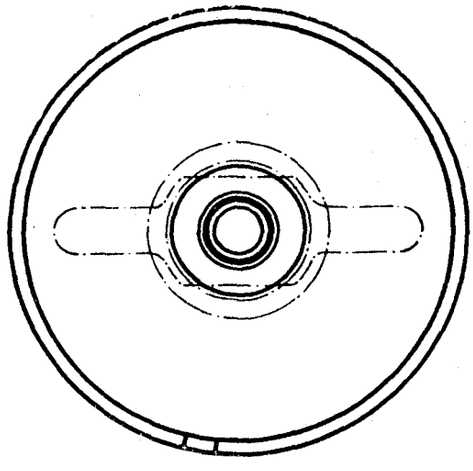
A.D.D. 2/46 PT.N.

FIG. 18.







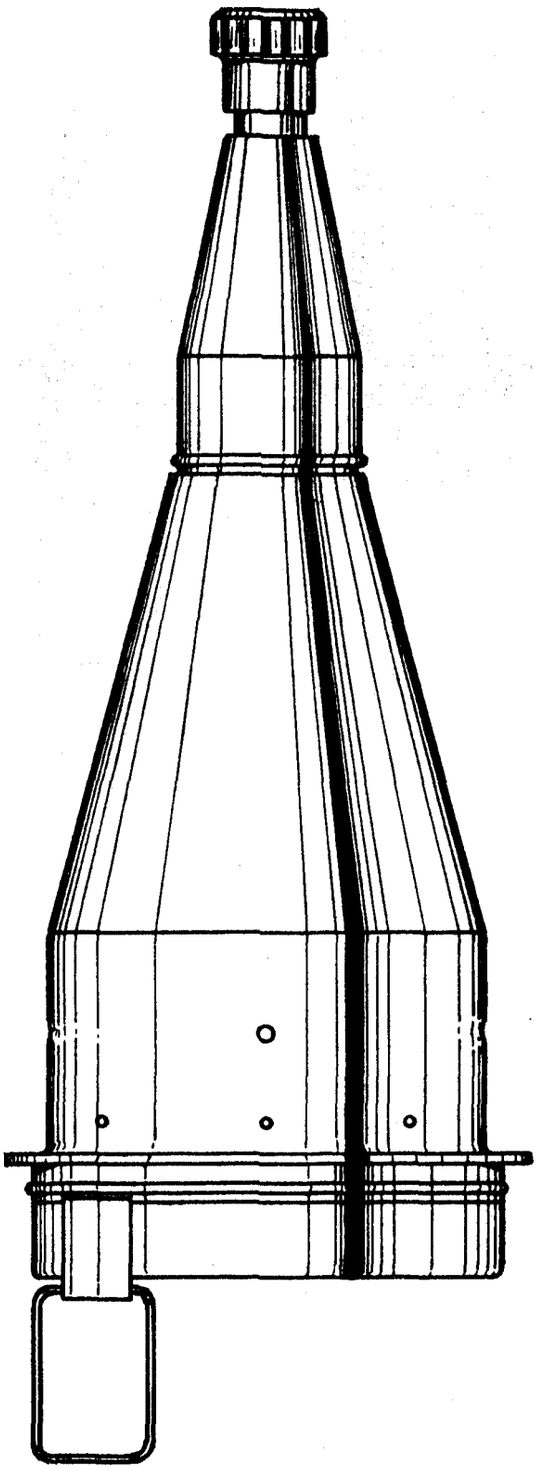


CYLINDRICAL, HAND GRENADE - NIPOLIT,
WITH WRAPPED FRAGMENTATION STRIP.

wjc

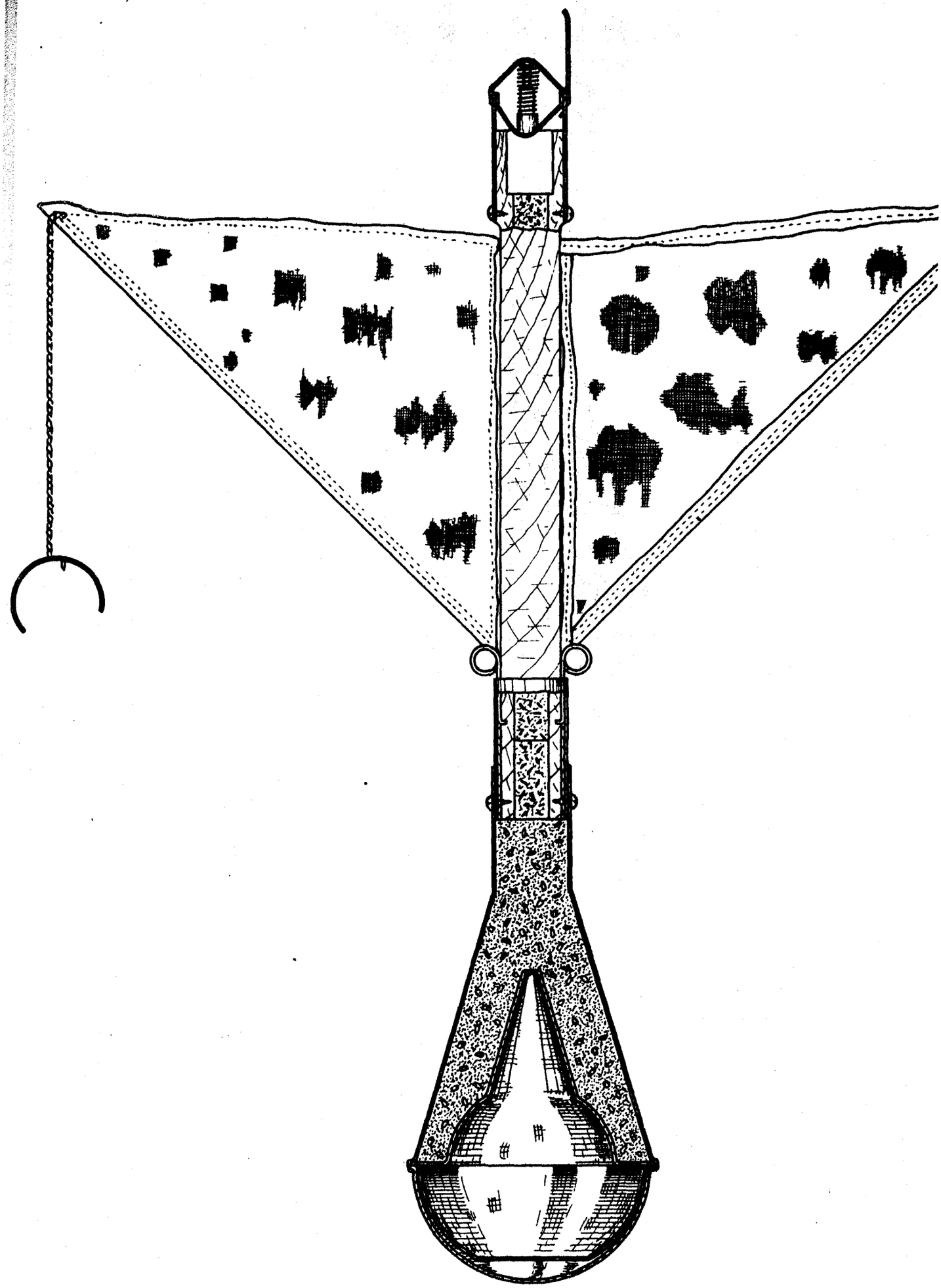
A.D.D. 2/46 PTN

FIG. 19.



ANTI-TANK, STICKY GRENADE-'PLACED.'

A.D.D. 2/46 PT N.

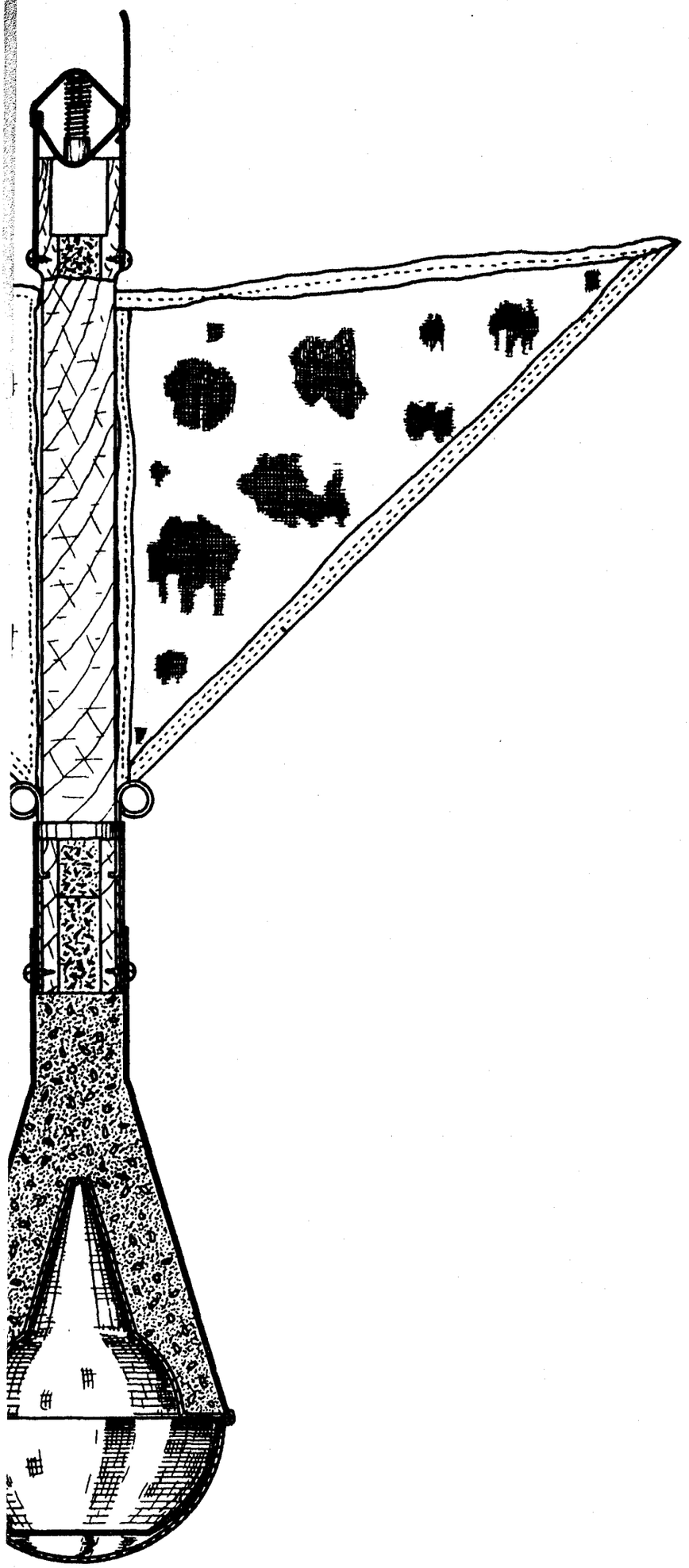


HOLLOW CHARGE, HAND GRENADE, ANTI

HOLLOW CHARGE, H

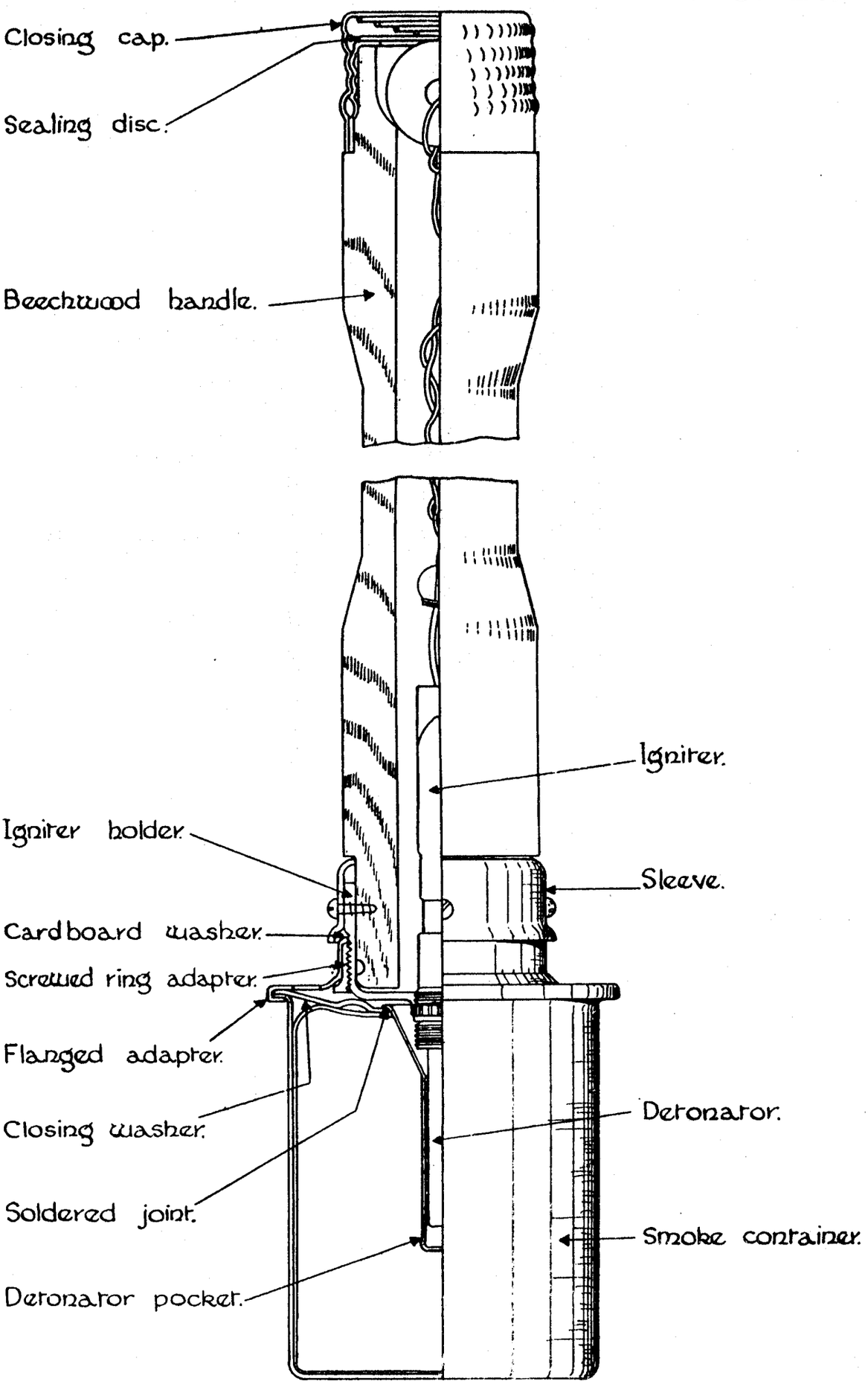
A.D. 2/46 PT. N.

FIG. 20.



HAND GRENADE, ANTI-TANK I (L).

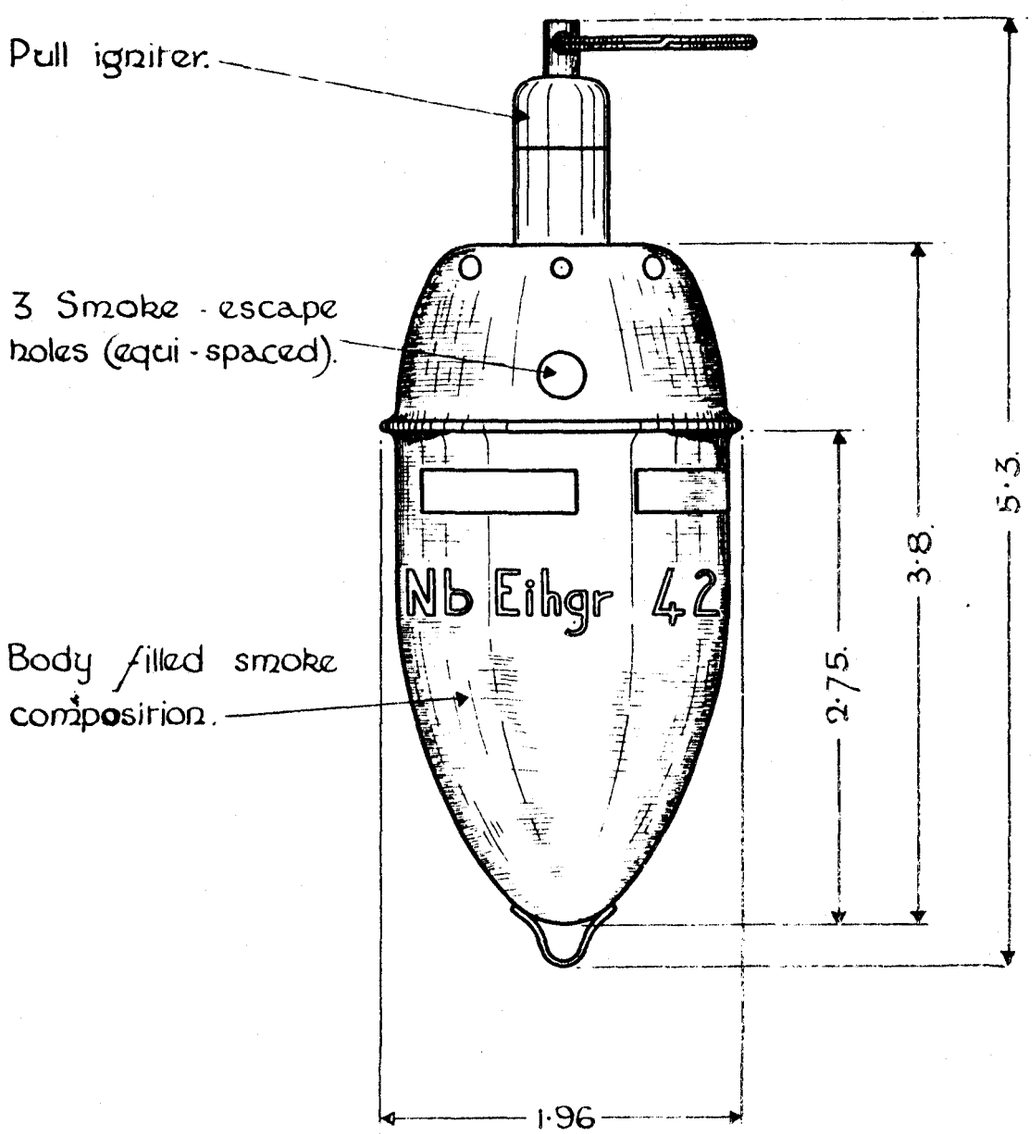
FIG. 21.



STICK, HAND GRENADE, SMOKE, 39.

A D D 2/46 PTN

FIG. 22.

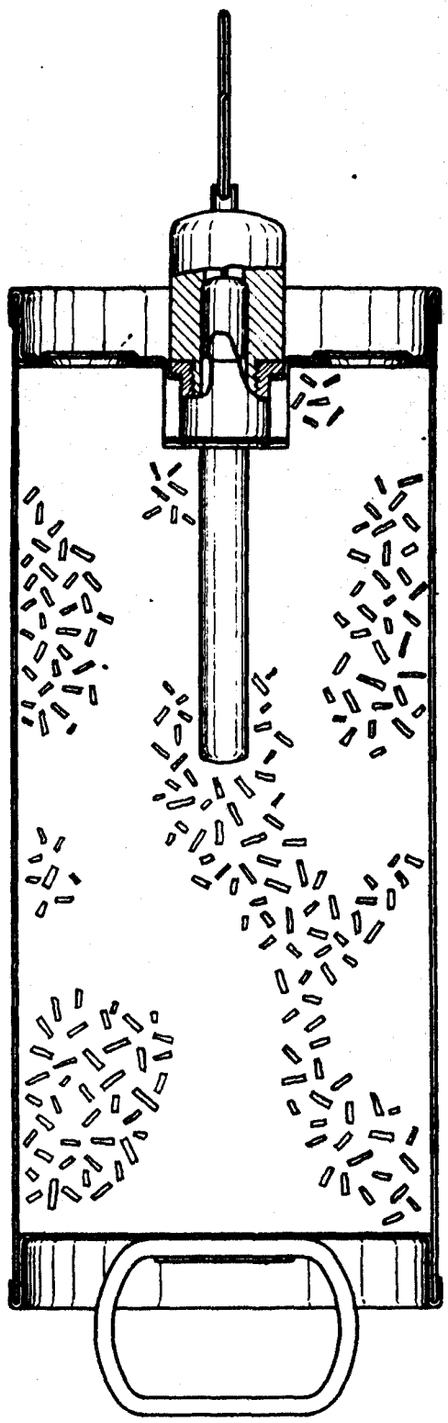


EGG, HAND GRENADE, SMOKE, 42.

DIMENSIONS ARE IN INCHES.

S.D.D. 2/46 PTN

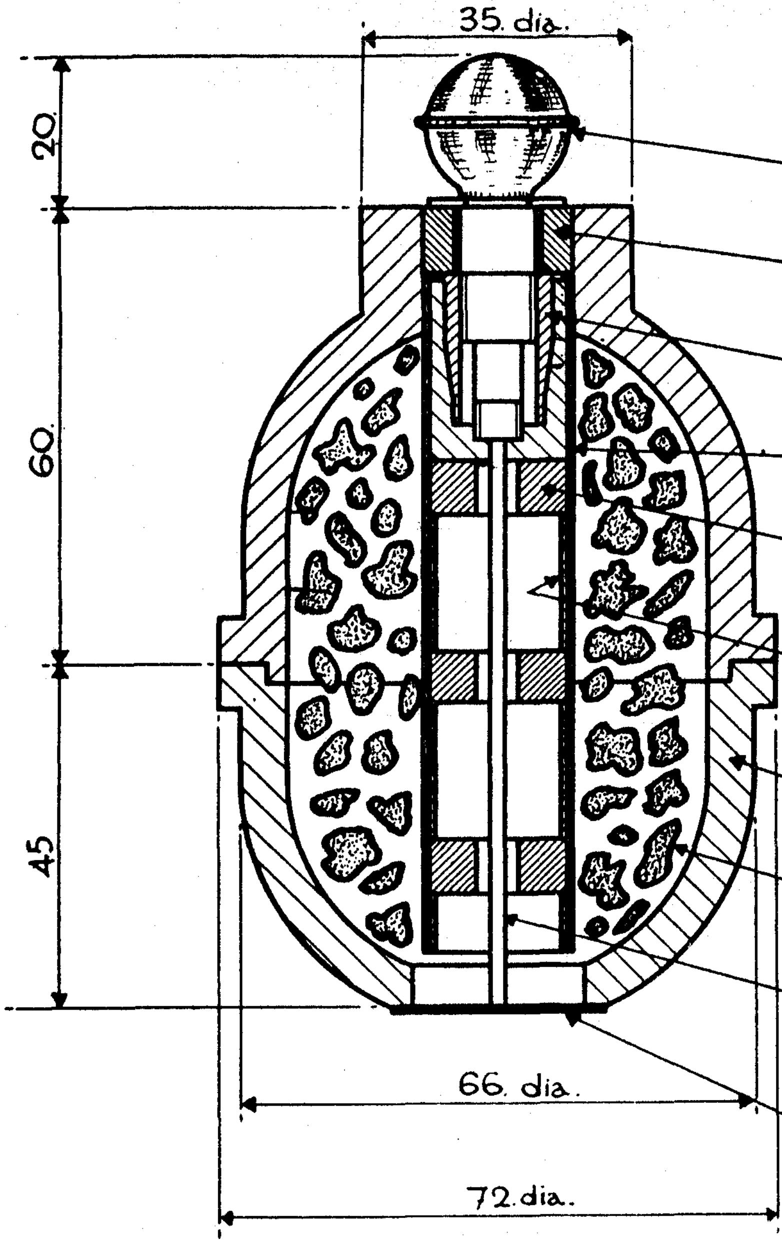
FIG. 23.

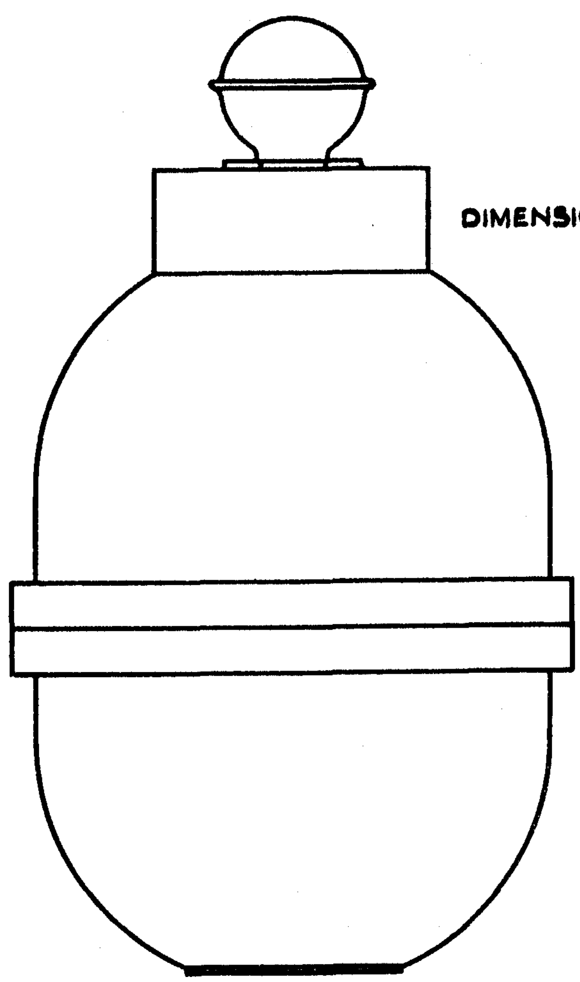


CYLINDRICAL, HAND GRENADE, SMOKE.

A.D. 2/46 P.N.

FIG. 24.



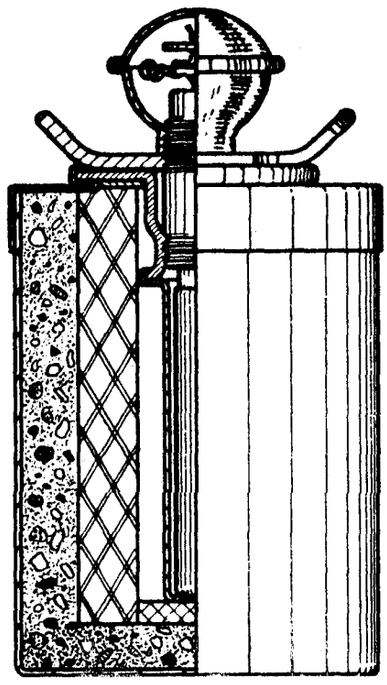


DIMENSIONS ARE IN MM

INCENDIARY, HAND GRENADE.

4 D D 2/46 PT N

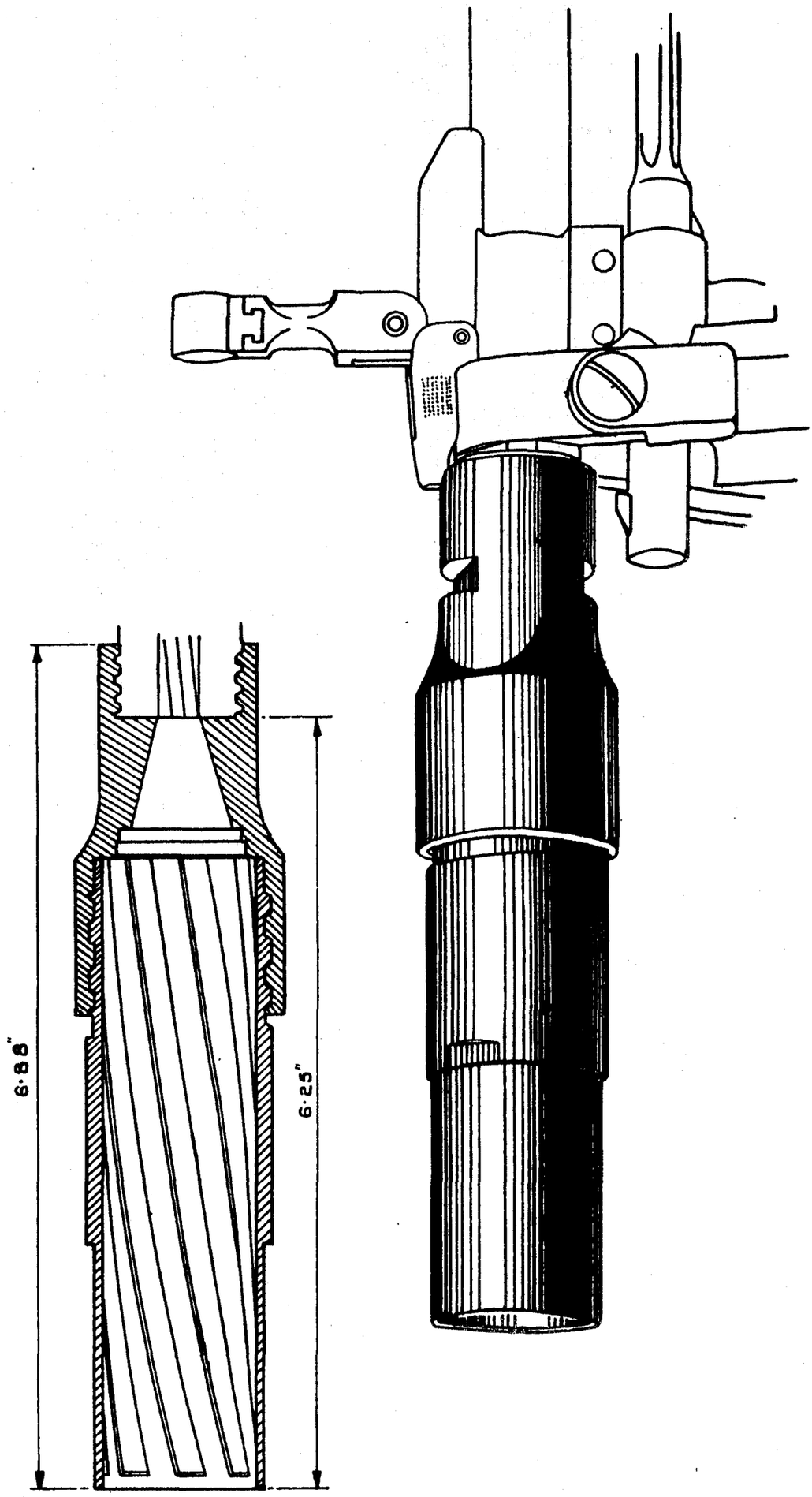
FIG. 25.



CYLINDRICAL, HAND GRENADE,
CONCRETE & NIPOLIT.

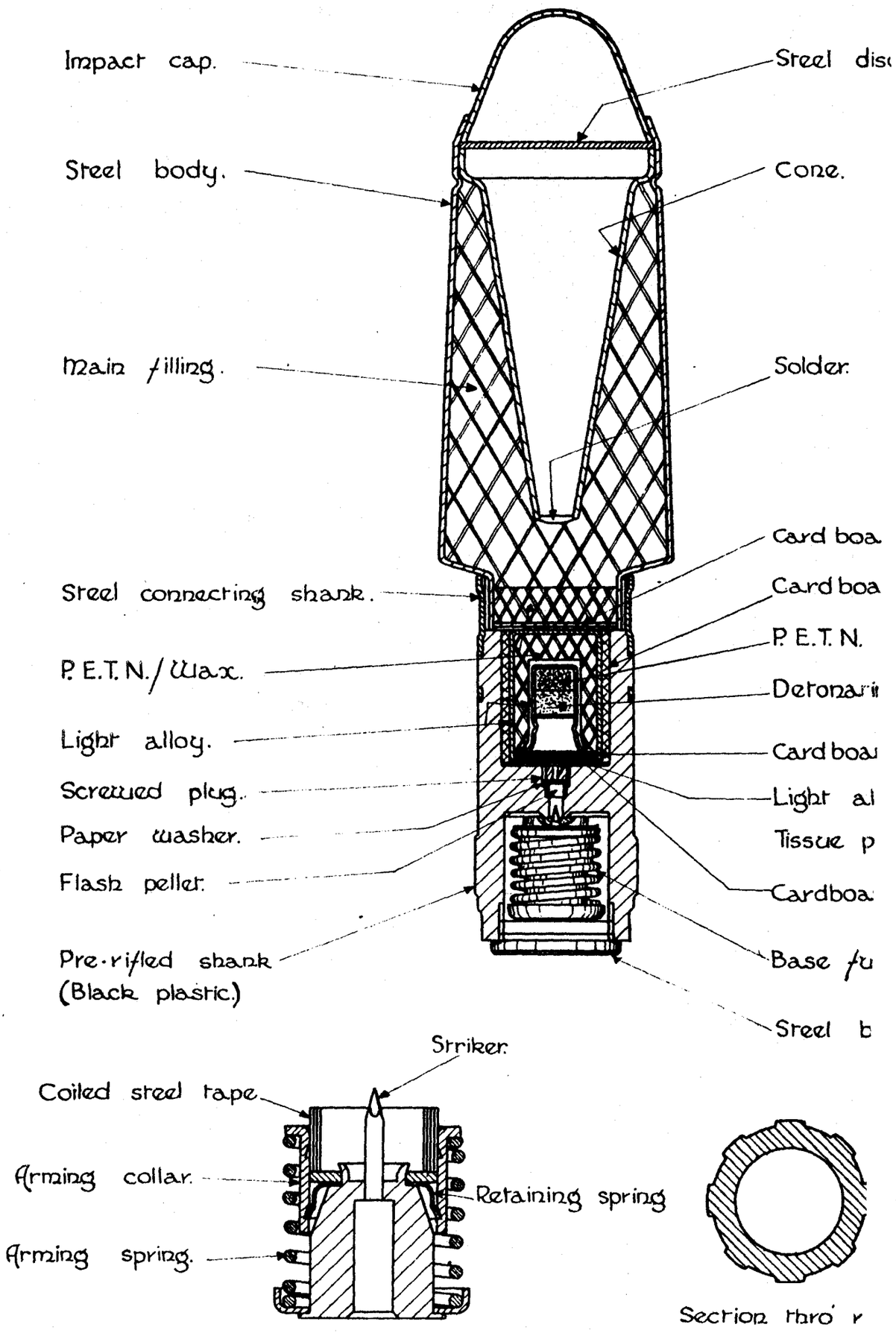
A.D.D. 2/46 PT N

FIG. 26



3CM. GRENADE DISCHARGER
FOR PARACHUTISTS AUTOMATIC RIFLE.

A.O.D. 2/46 PT N



Section thro' Base fuze.

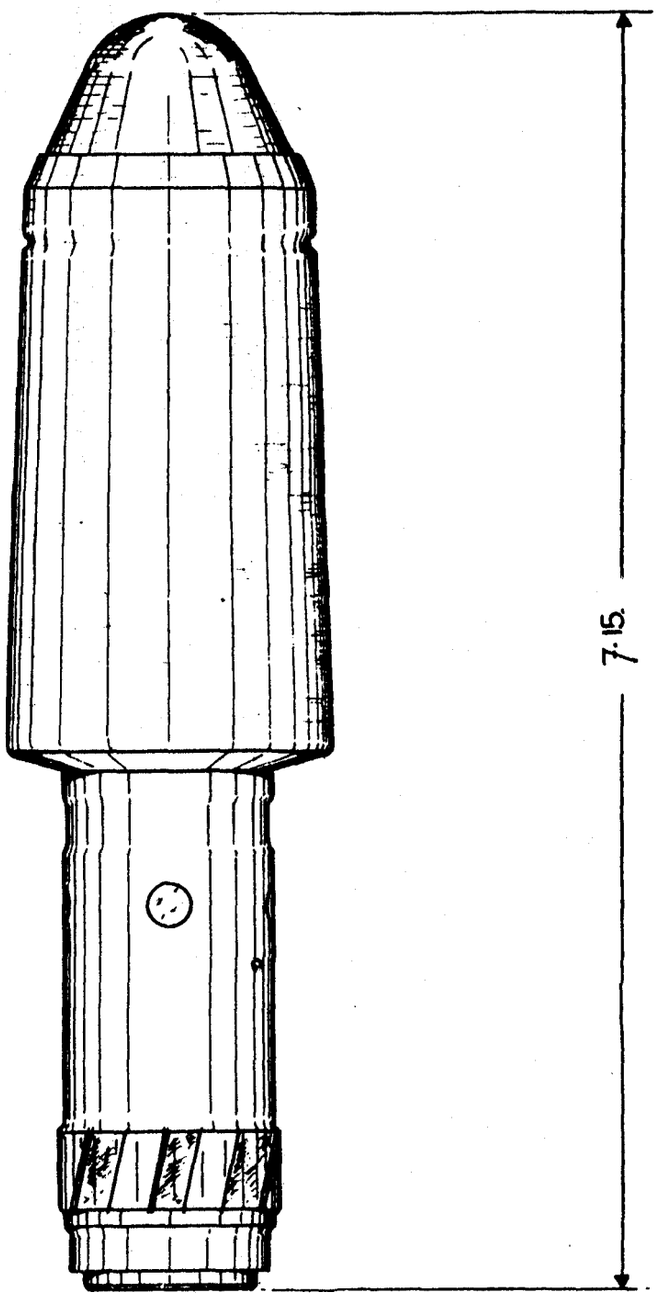
Scale :- 1/1.

RIFLE GRENADE, ANTI·

A.D.D. 2/46 PT N.

FIG. 27

sc.



ard washers.

ard tube

ing composition.

rd washers.

lloy washer.

aper disc.

rd washer.

ize.

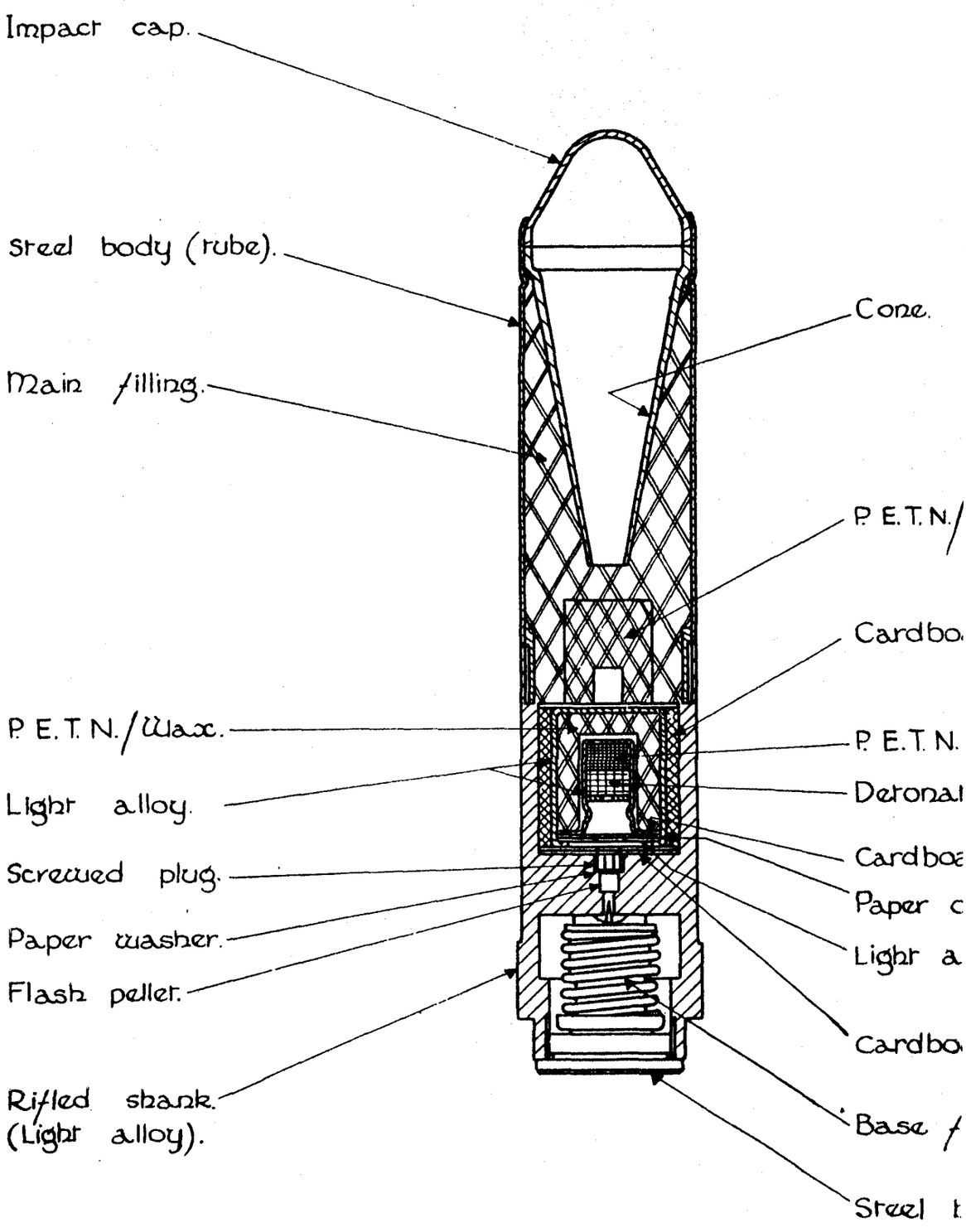
ase plug.

Rifling R.H.,
1 turn in 9 inches.

ifling.

-TANK, LARGE.

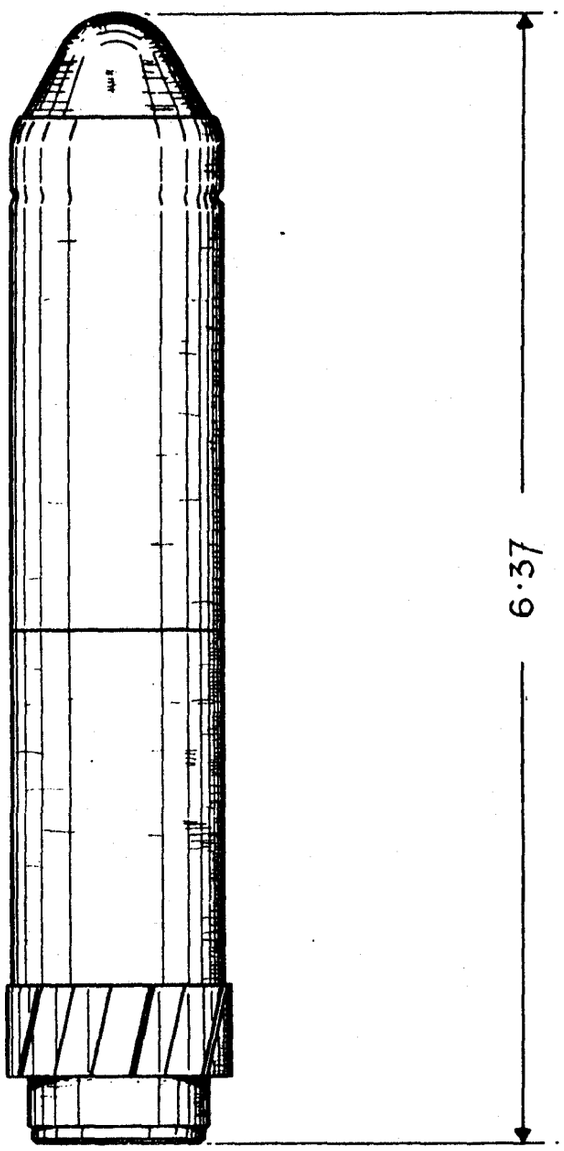
DIMENSIONS ARE IN INCHES.



Scale. :- 1/1.

RIFLE GRENADE,

FIG. 28



'Wax exploder

ard sleeve.

ring composition.

ard washer

disc.

lloy washer.

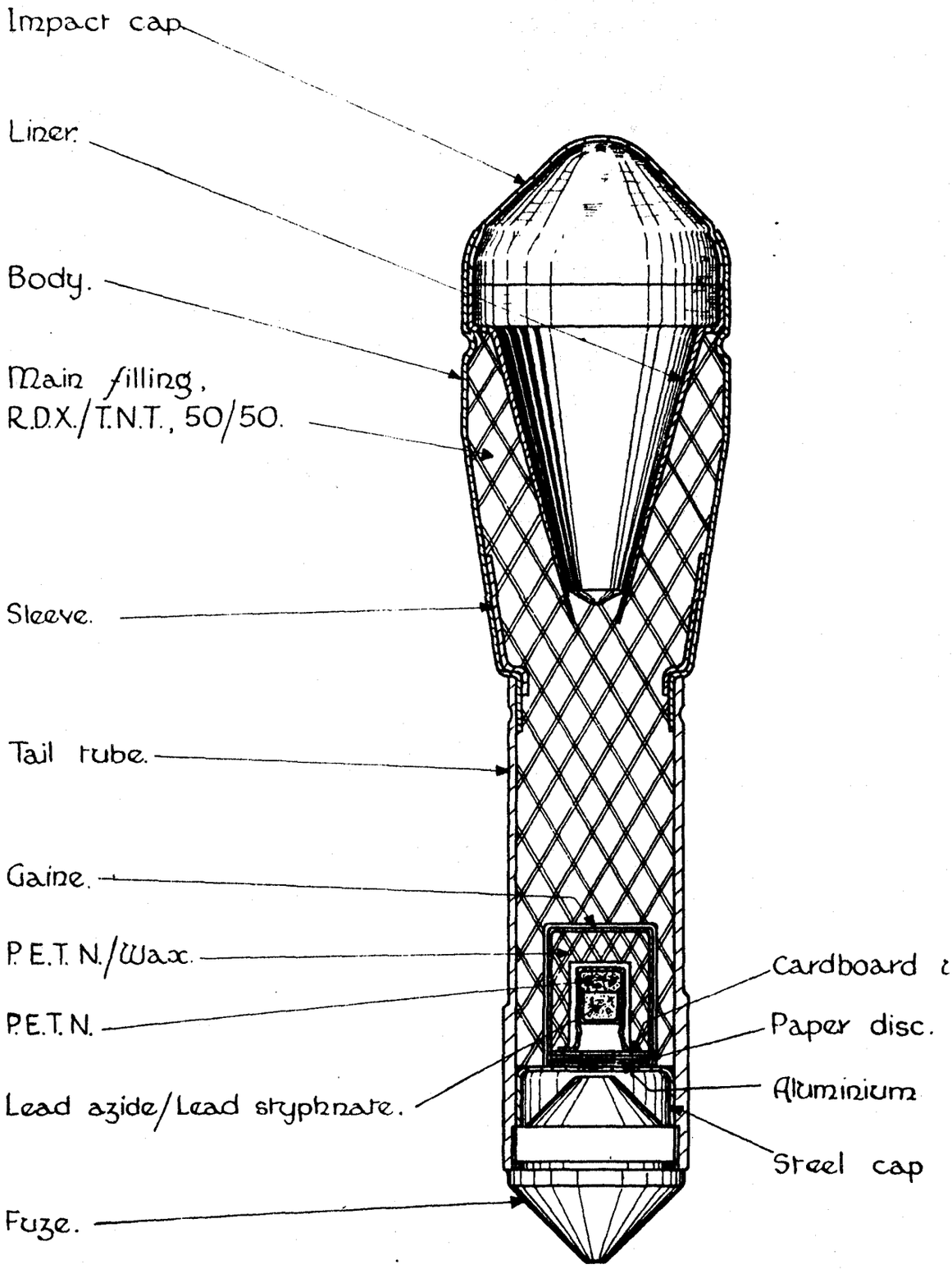
ard washers.

'uze

base plug.

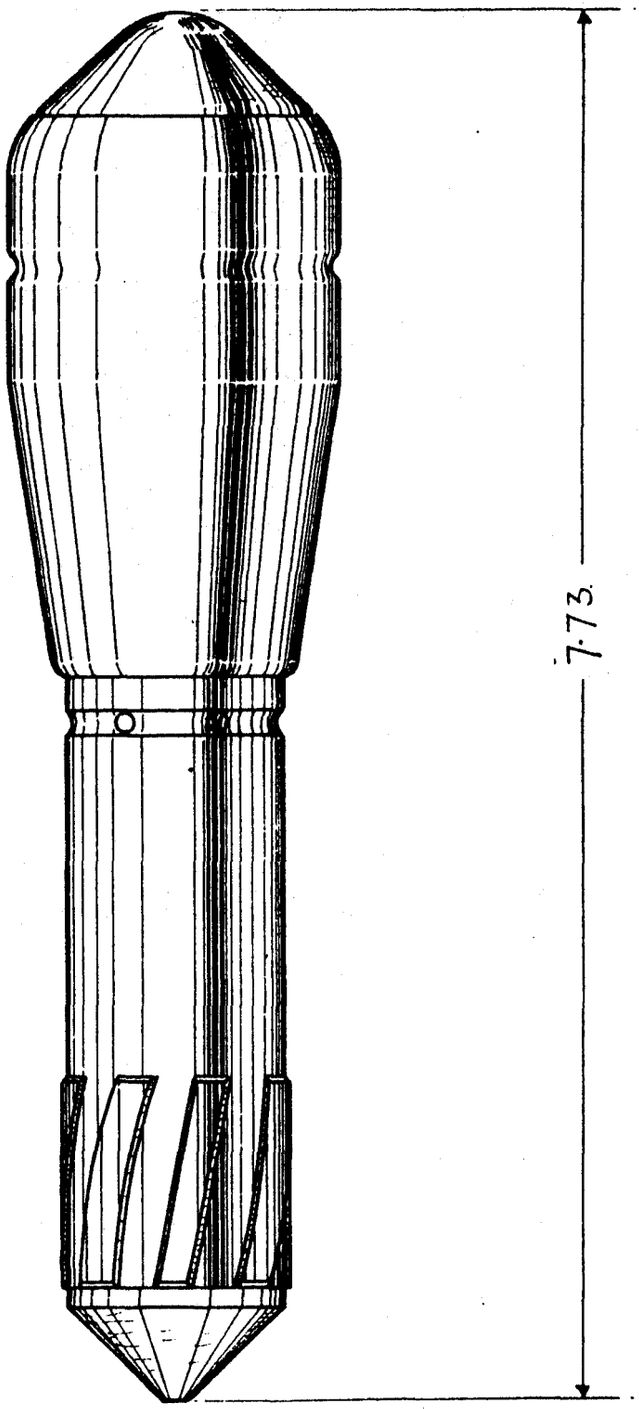
, ANTI – TANK, (SMALL.)

DIMENSIONS ARE IN INCHES.



RIFLE GRENADE, HOLLO\

FIG. 29

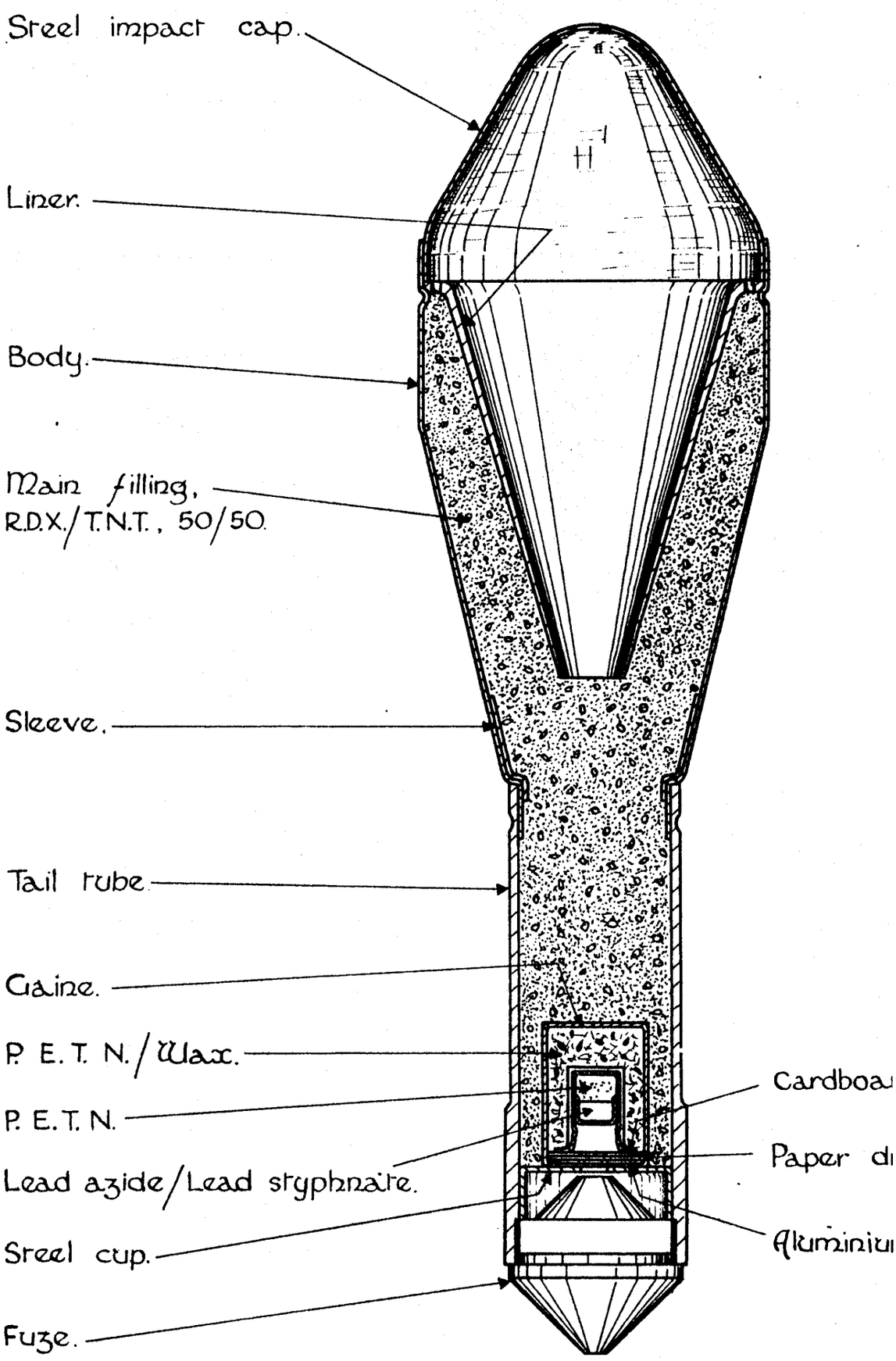


washer.

washer.

W · CHARGE, ANTI – TANK, 46, S.S.

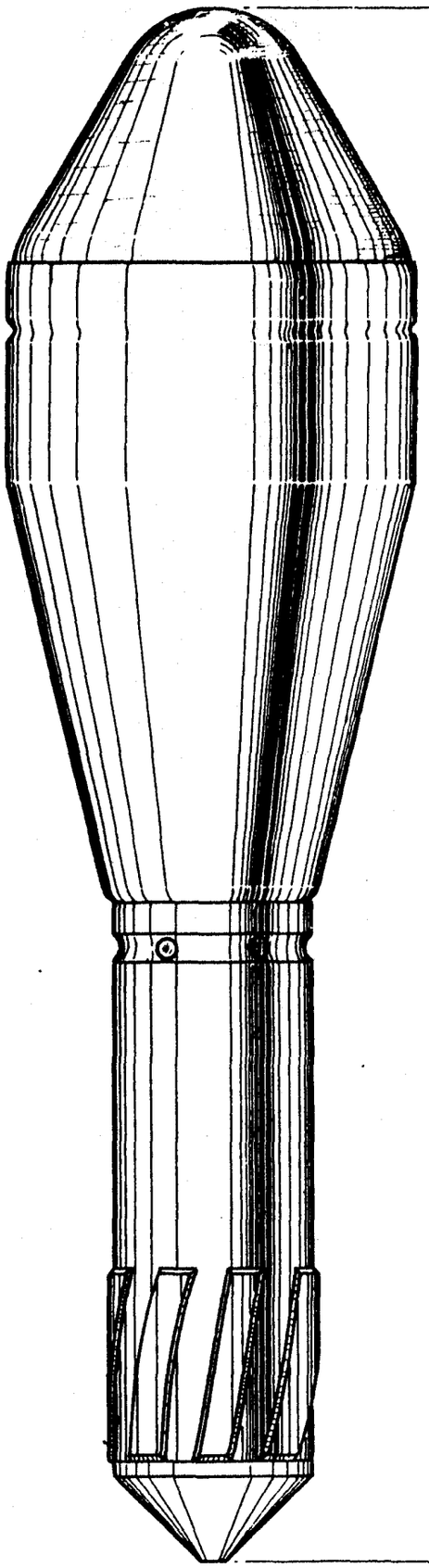
DIMENSIONS ARE IN INCHES.



Scale :- ½.

RIFLE GRENADE, HOLLO

FIG. 30



9·45.

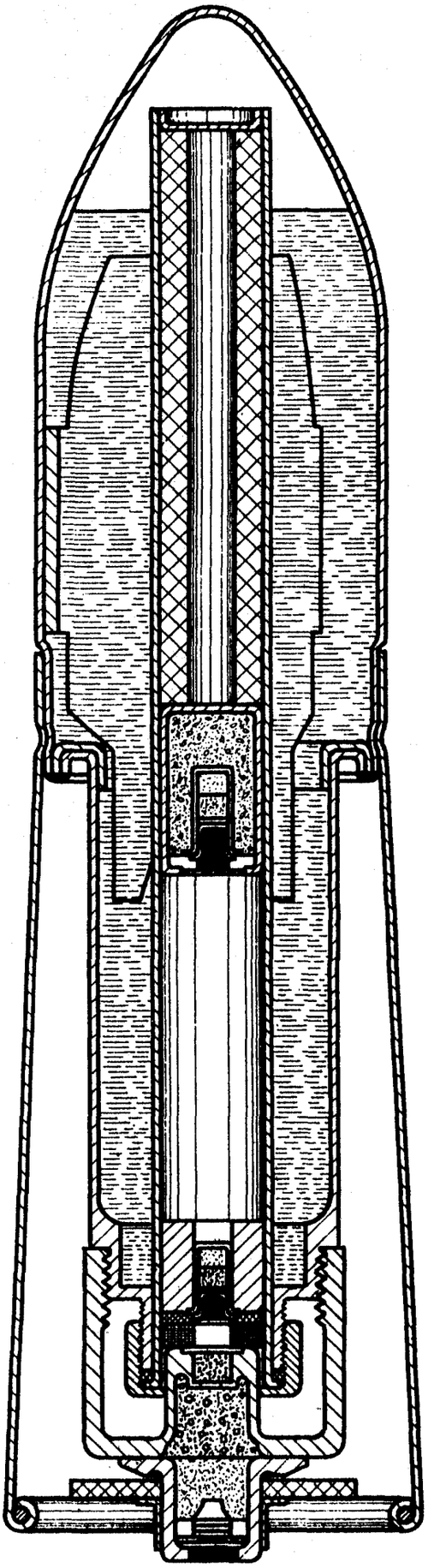
rd washer.

isc.

m washer.

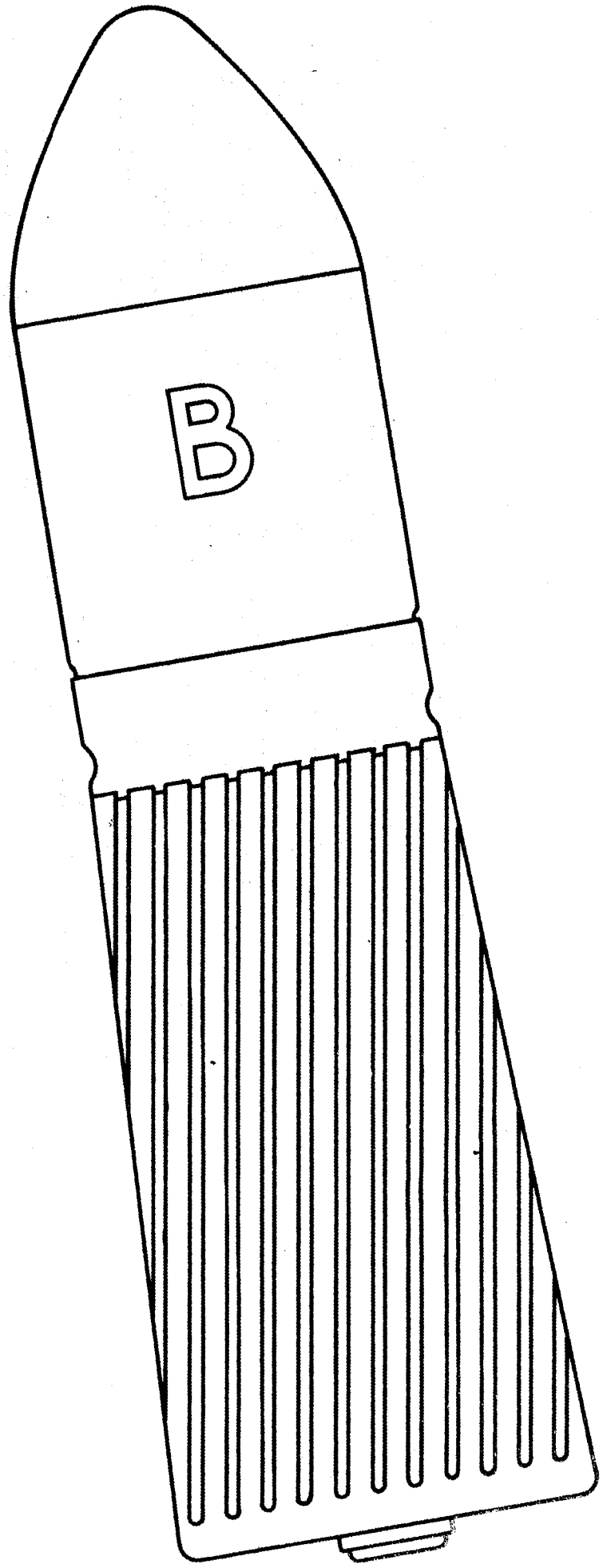
W · CHARGE, ANTI – TANK, 61, S.S.

DIMENSIONS ARE IN INCHES.



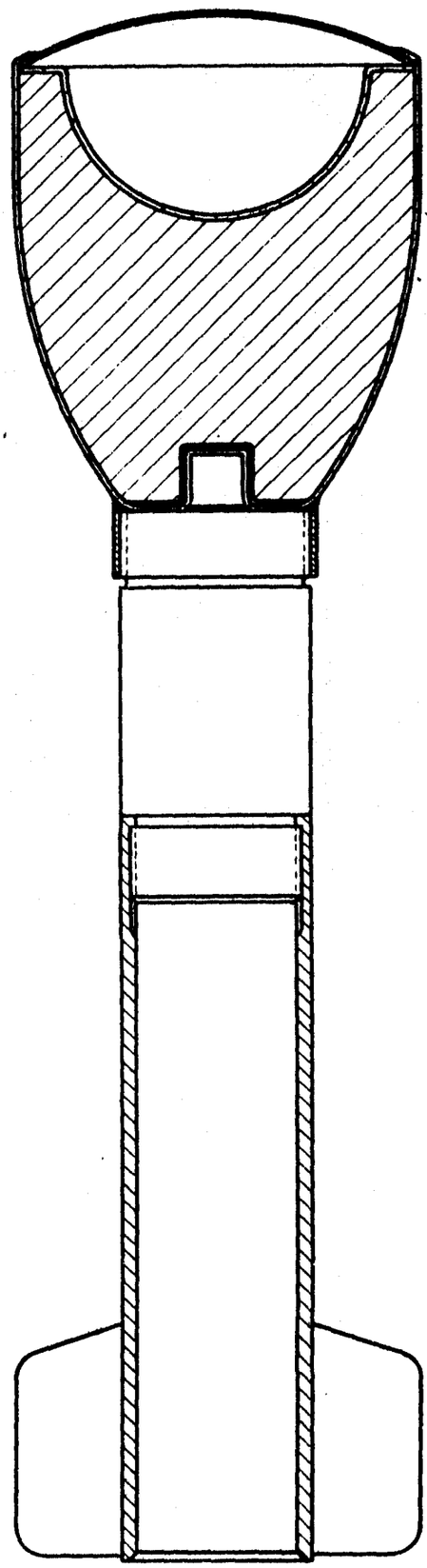
RIFLE GRENADE, BURS

FIG. 31



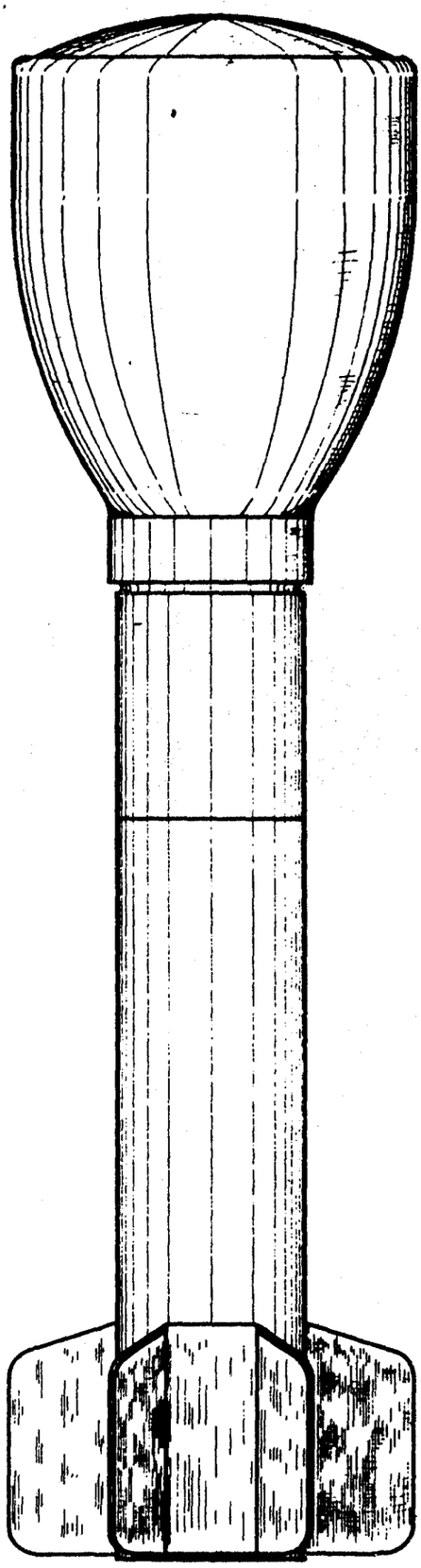
;TING · SMOKE , 42.

w.f.a.



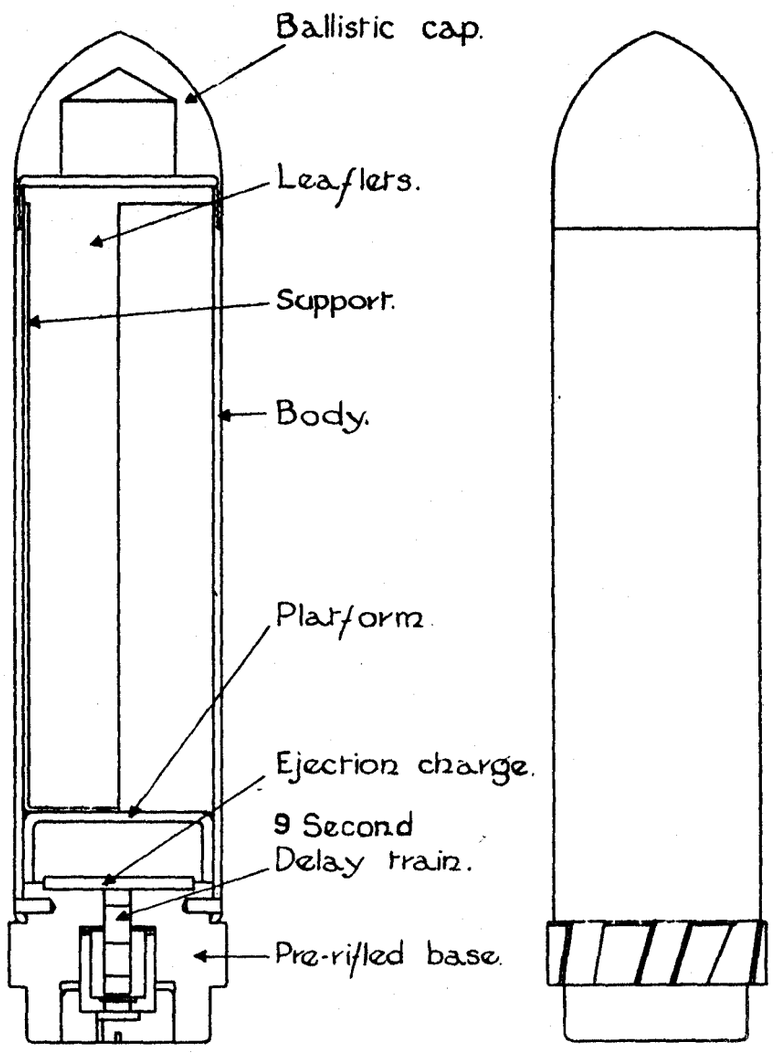
RIFLE GRENADE ANTI-T

FIG. 32



TANK, 40.

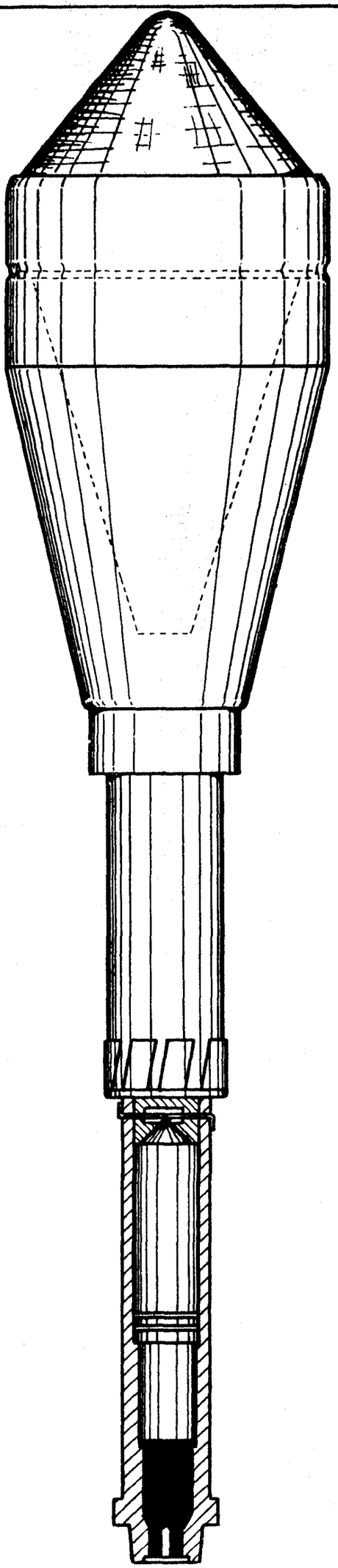
FIG. 33



RIFLE GRENADE, PROPAGANDA.

A.D.D. 2/46 PT N.

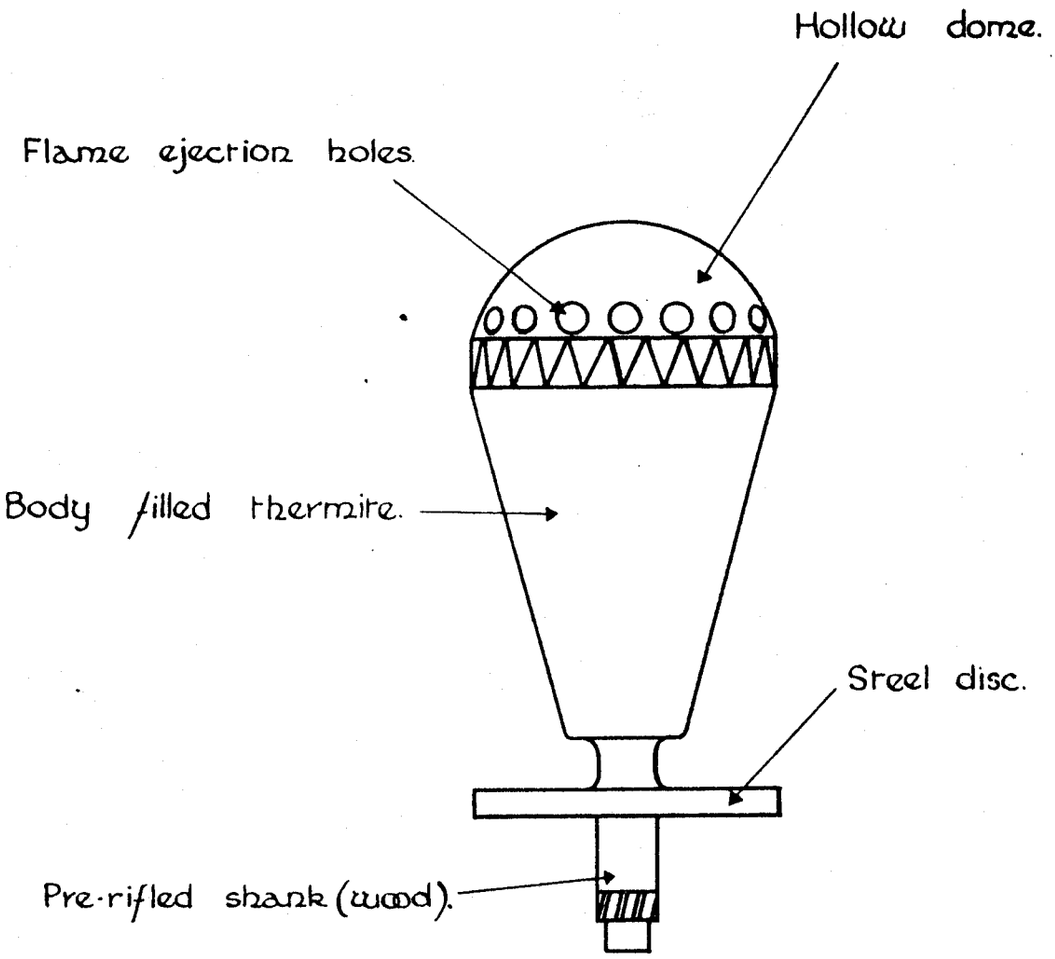
FIG. 34



RIFLE GRENADE, ANTI - TANK, 23MM L.P

A.D.D. 2/46 PT N.

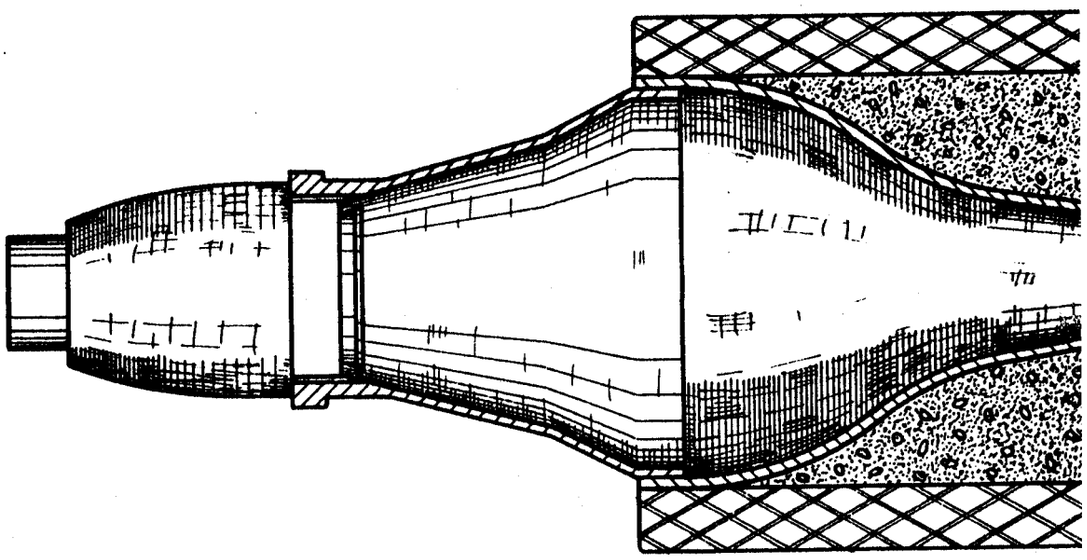
FIG. 35



Not to scale.

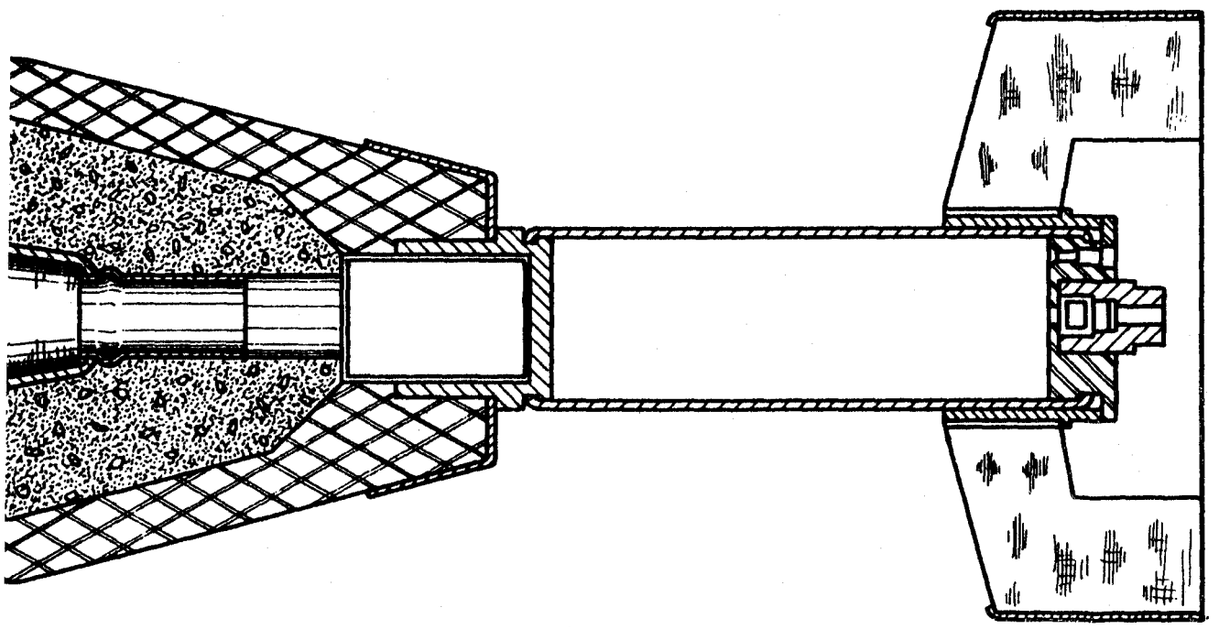
RIFLE GRENADE, INCENDIARY.

A.D.D. 2/46 PT N.



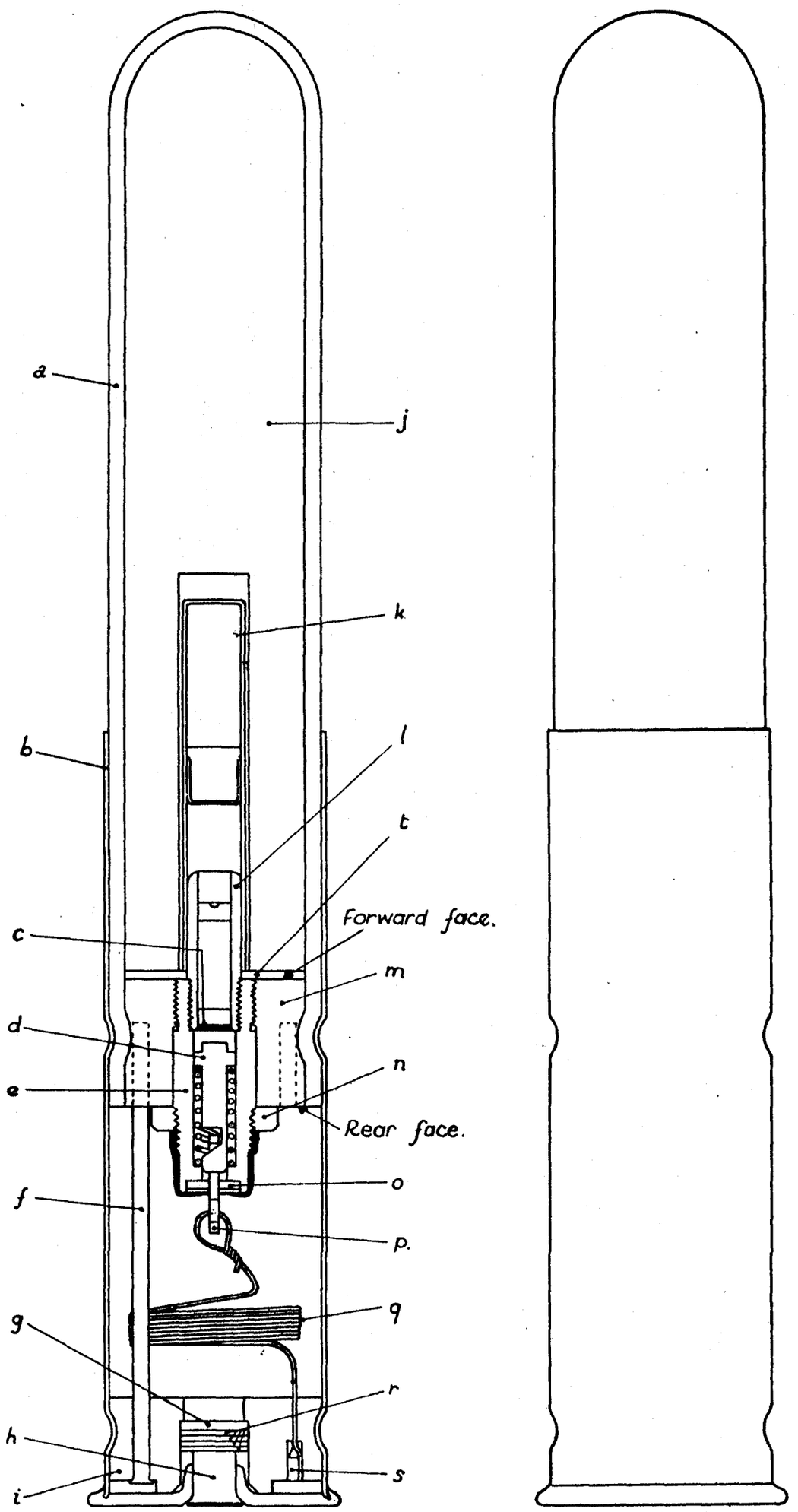
RIFLE GRENADE

FIG. 36



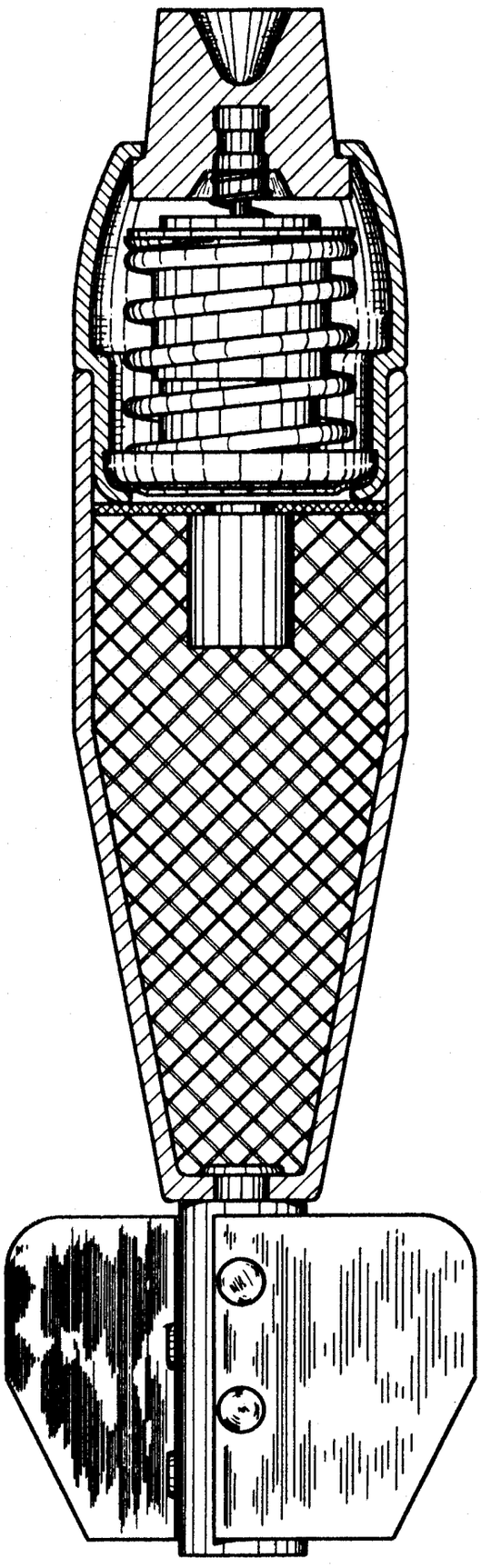
., ROCKET-ASSISTED.

FIG. 37



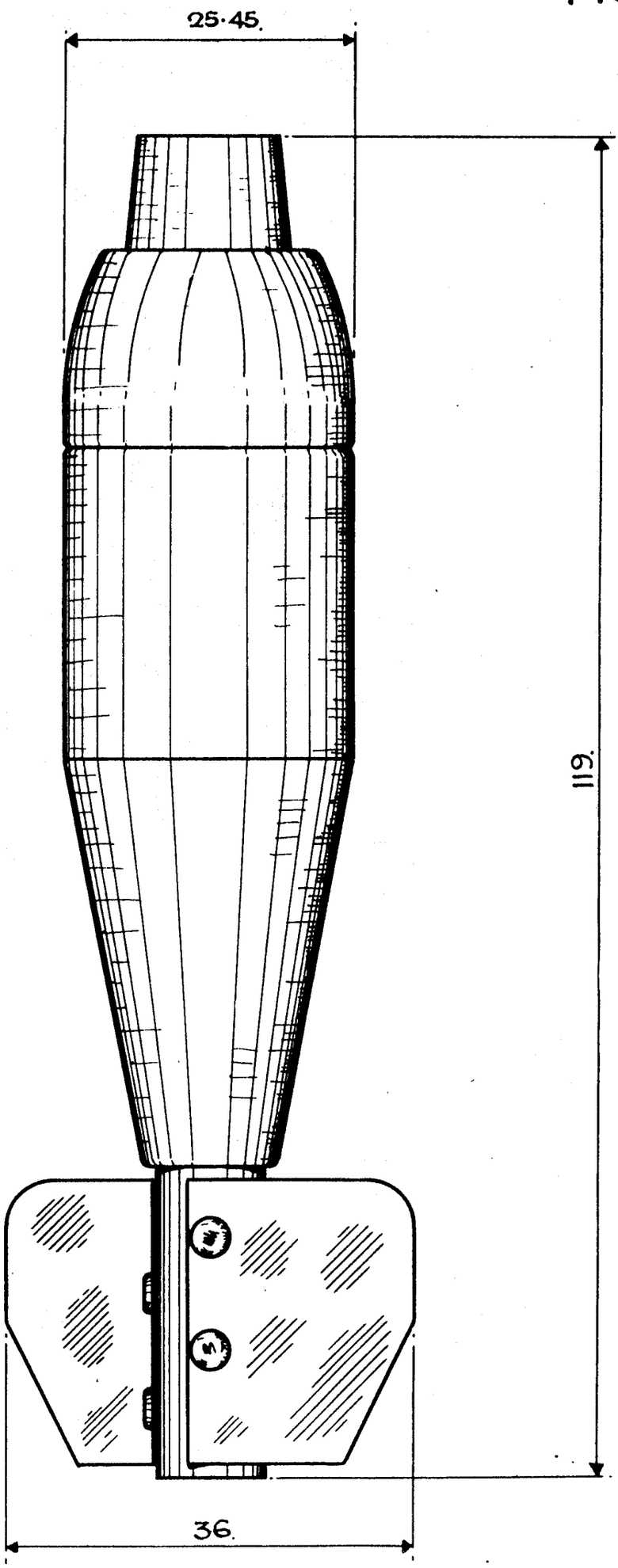
SIGNAL-PISTOL, 26MM. GRENADE.

A.D.D. 2/46 PT N.



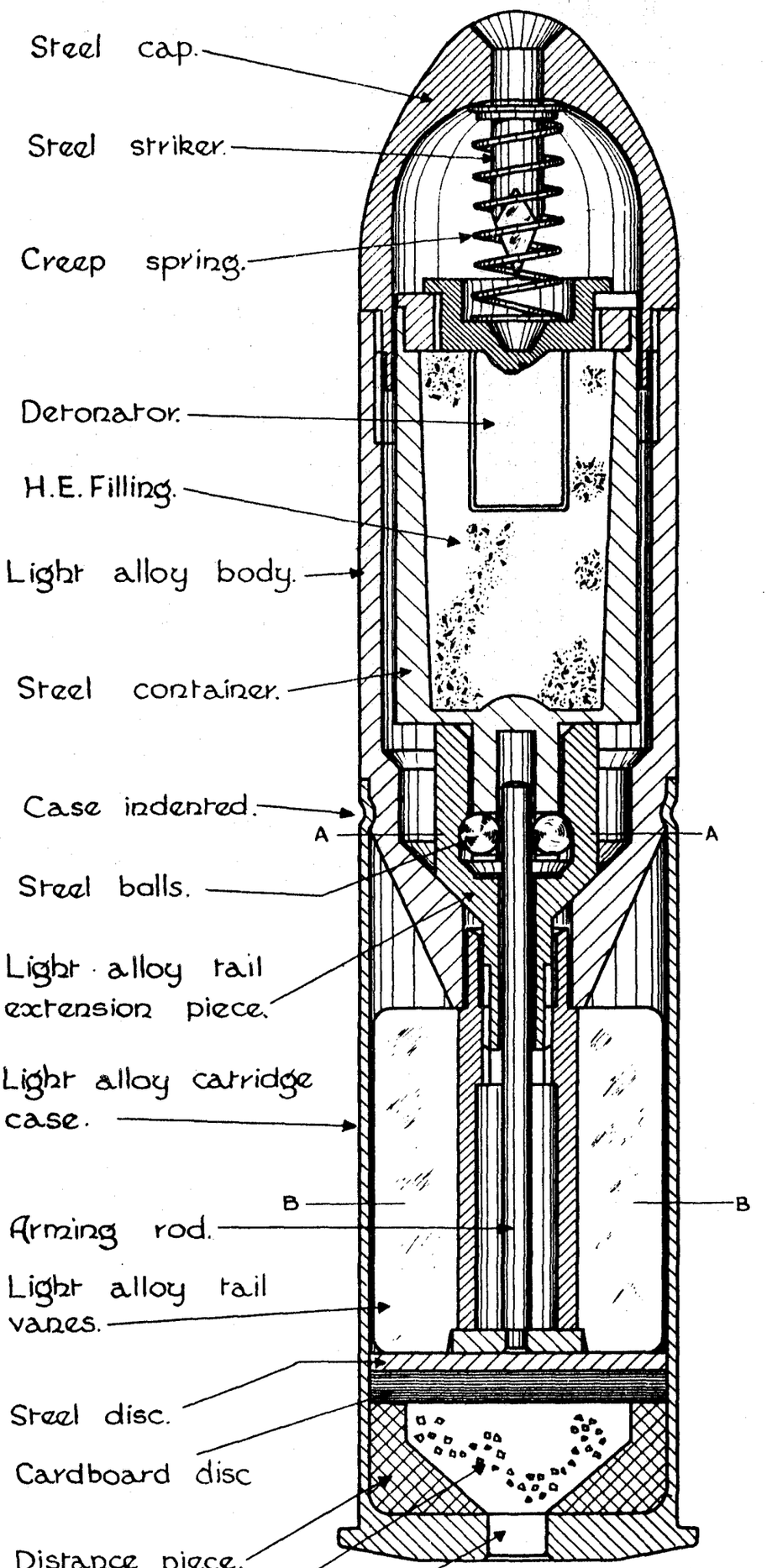
H.E., SIGNAL - PIST

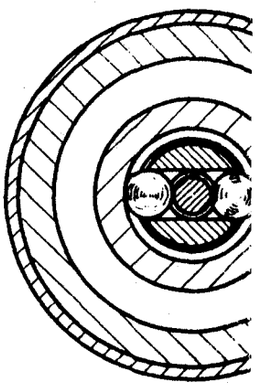
FIG. 38



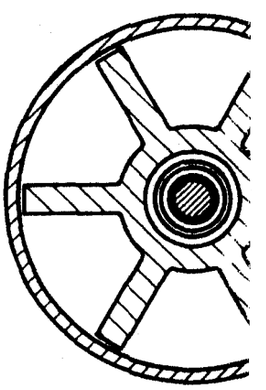
TOL, 326 GRENADE.

DIMENSIONS ARE IN MM.





Section on



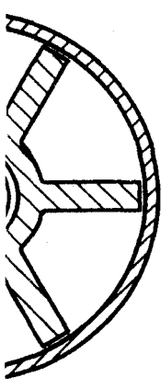
Section on

Scal

H.E., SIGNAL - PISTOL 3

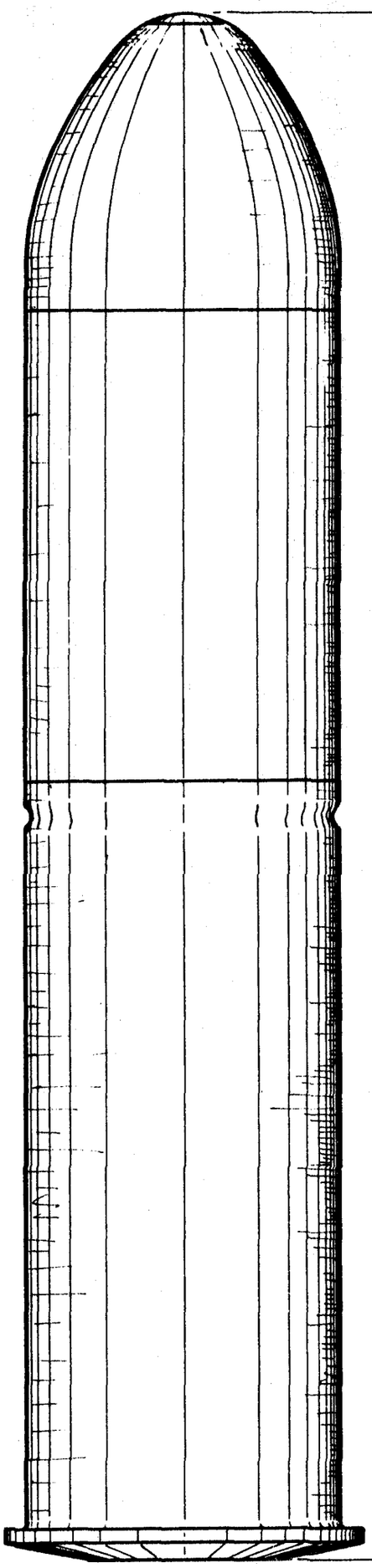
FIG.39

2 A.A.



on 2 B.B.

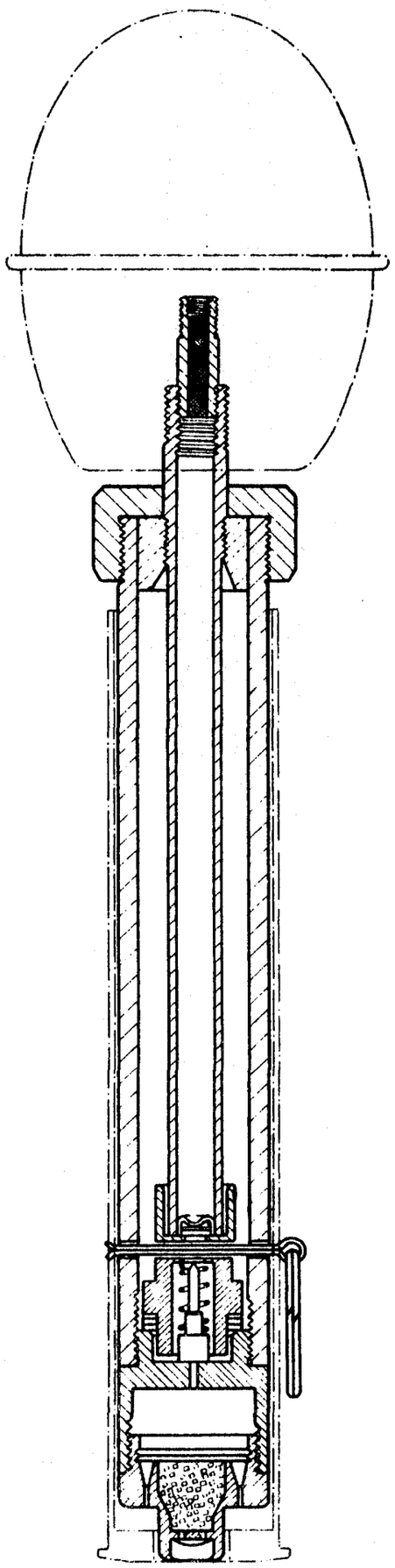
ale :- 2/1.



326. GRENADE, (EARLY TYPE).

DIMENSIONS ARE IN INCHES

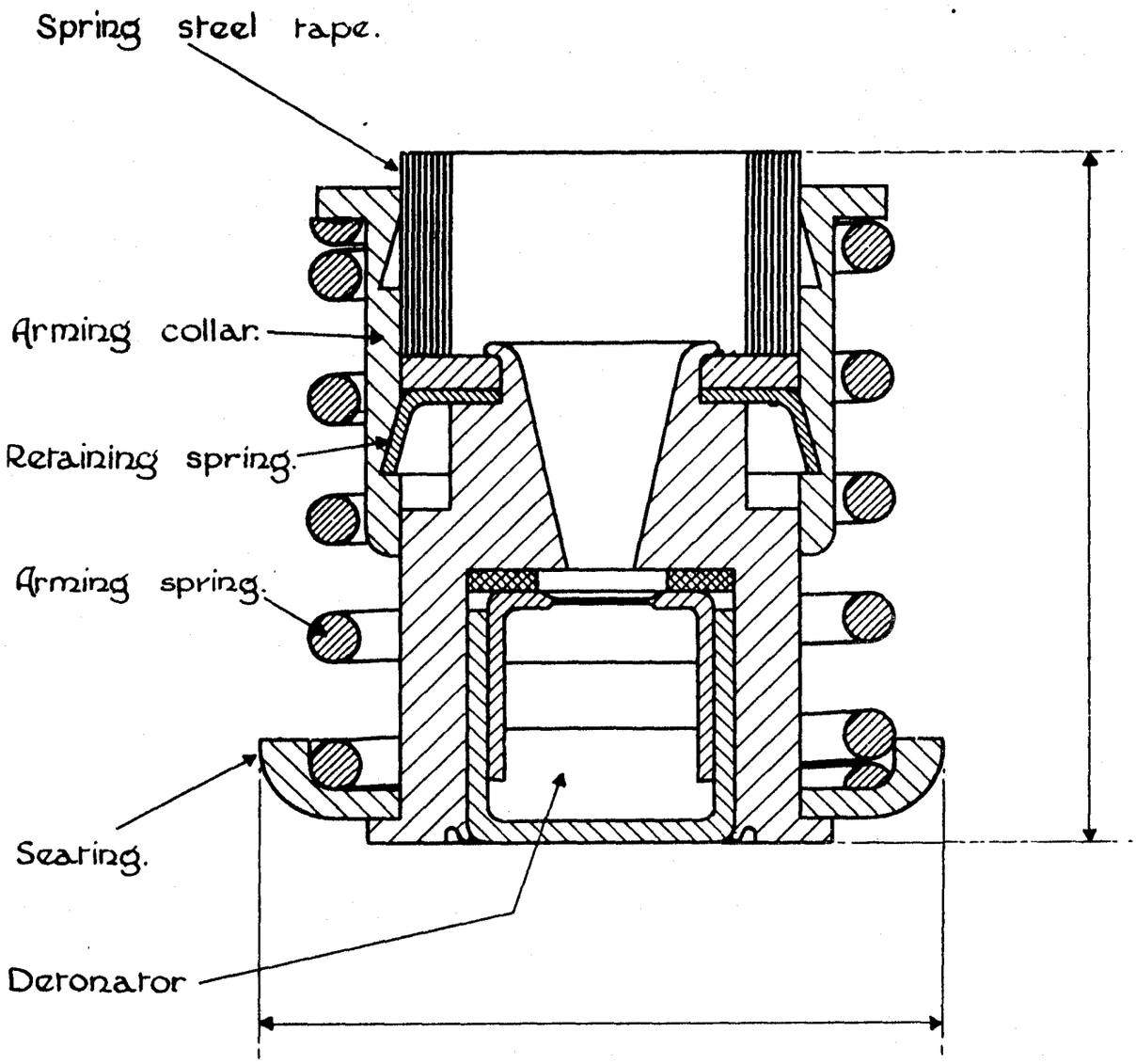
FIG. 40



EGG HAND GRENADE, H.E., ON STEM, 361,
FOR SIGNAL PISTOL (EARLY TYPE).

A.U.U. 4/46 PI N.

FIG. 41



Scale :- 5/1.

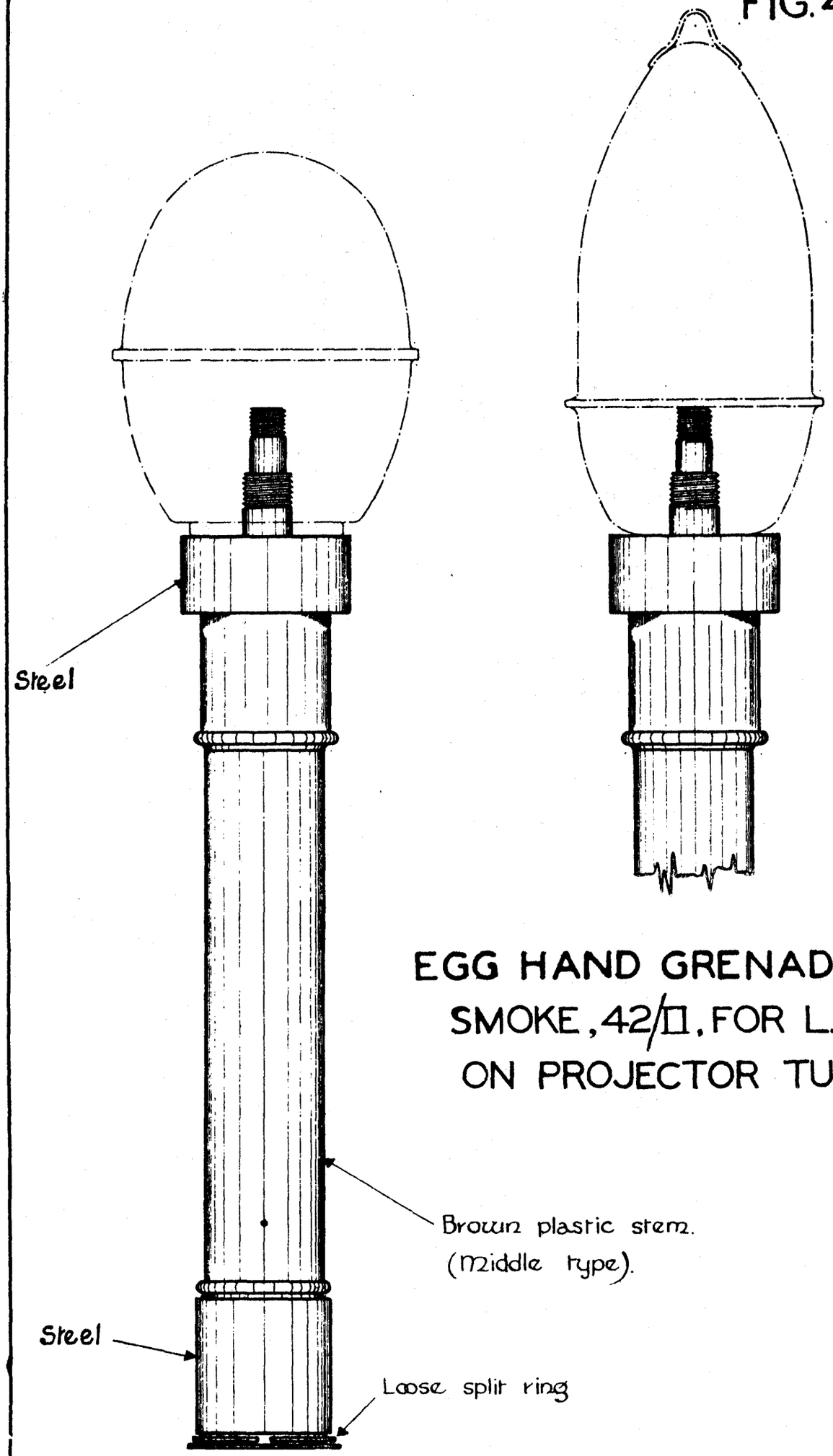
H.E., PISTOL GRENADE FUZE.

TYPICAL.

DIMENSIONS ARE IN MM.

ADD 2/46 PT. N.

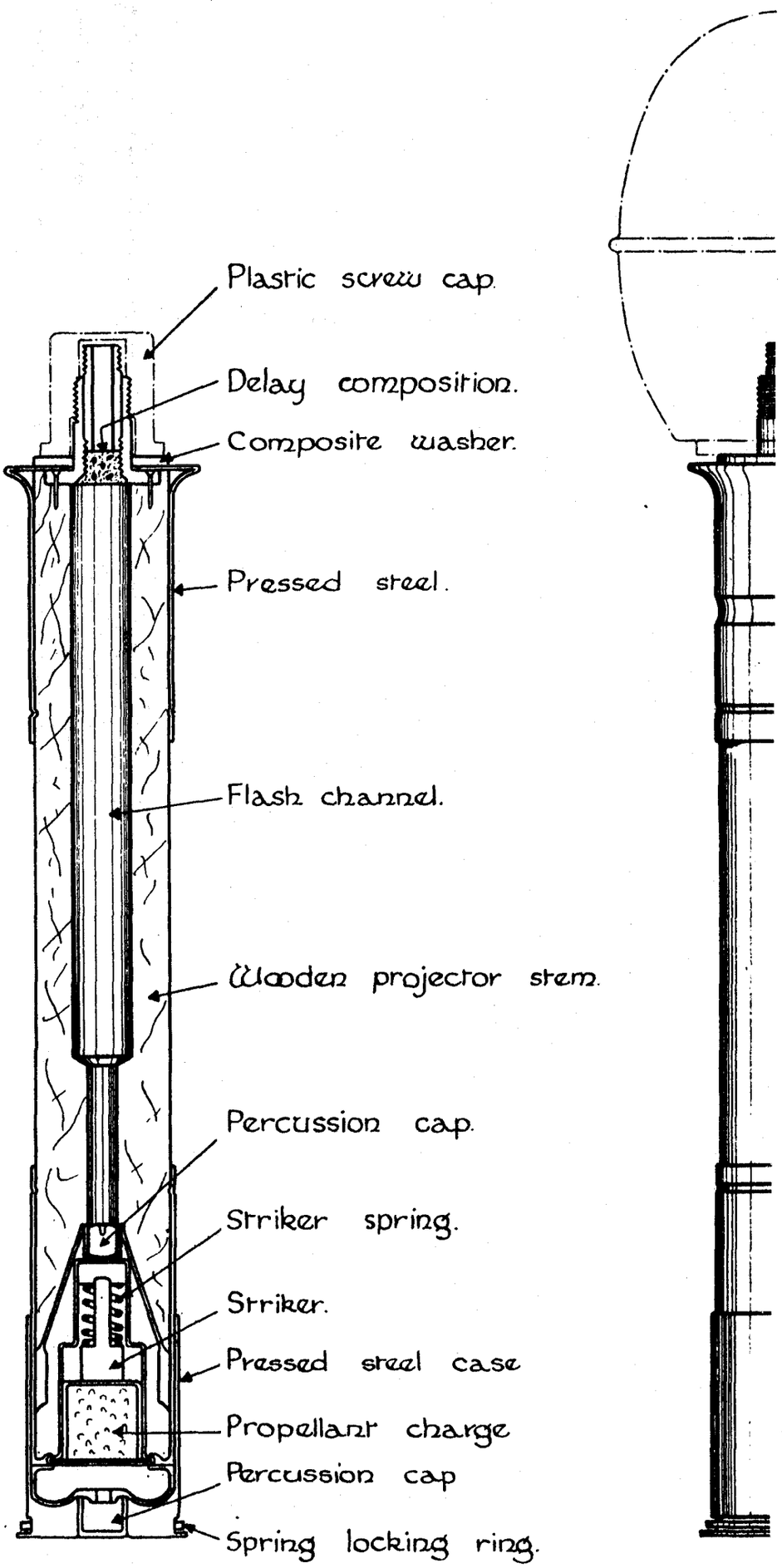
FIG. 42



EGG HAND GRENADE, SMOKE, 42/II, FOR L.P., ON PROJECTOR TUBE.

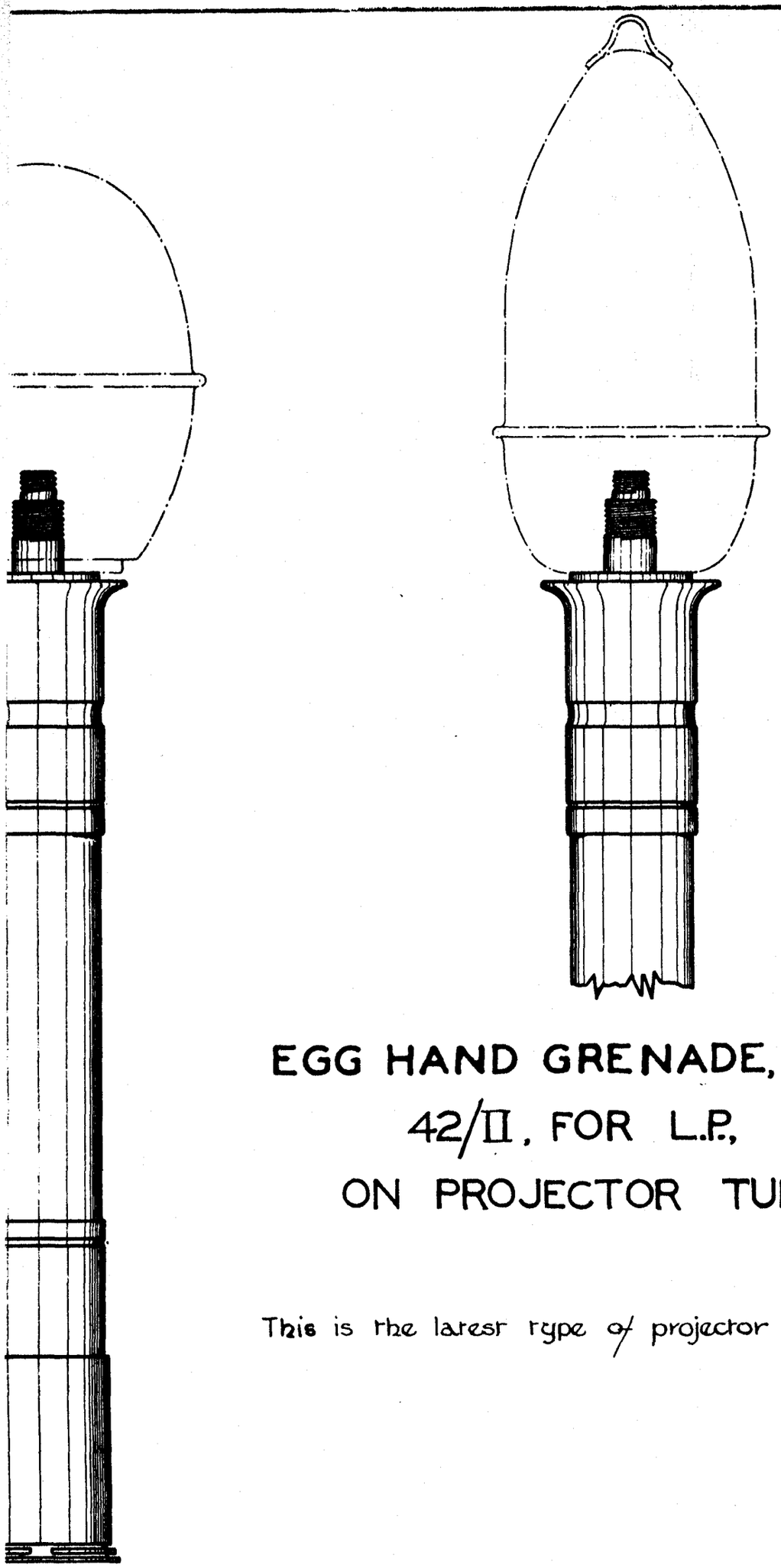
EGG HAND GRENADE, H.E. 39, FOR L.P., ON PROJECTOR TUBE.

A.D.D. 2/46 PT N.



EGG HAND GRENADE, H.E., 39, FOR L.P. ON PROJECTOR TUBE.

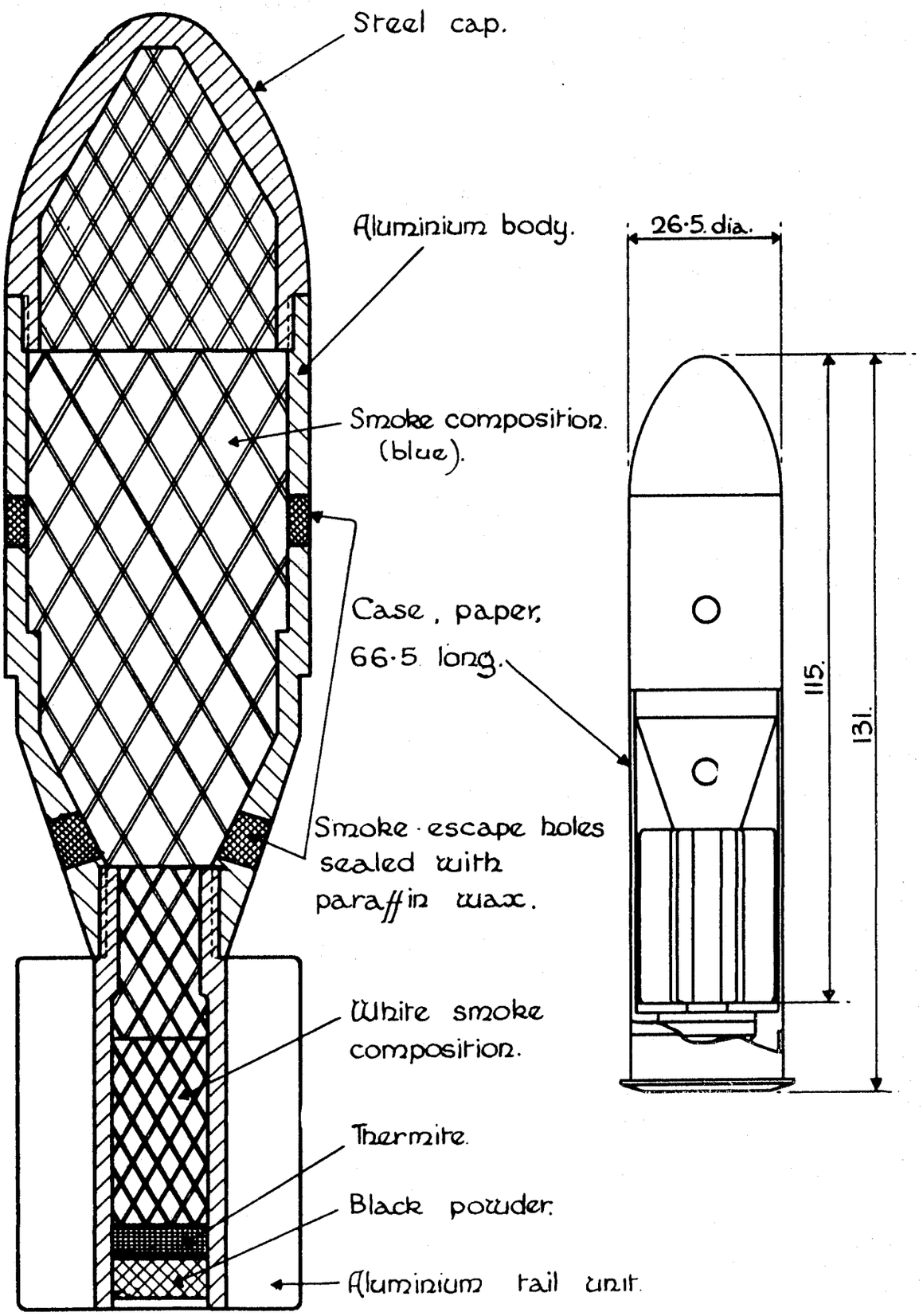
FIG. 43



EGG HAND GRENADE, SMOKE, 42/II, FOR L.P., ON PROJECTOR TUBE.

This is the latest type of projector tube.

FIG. 44

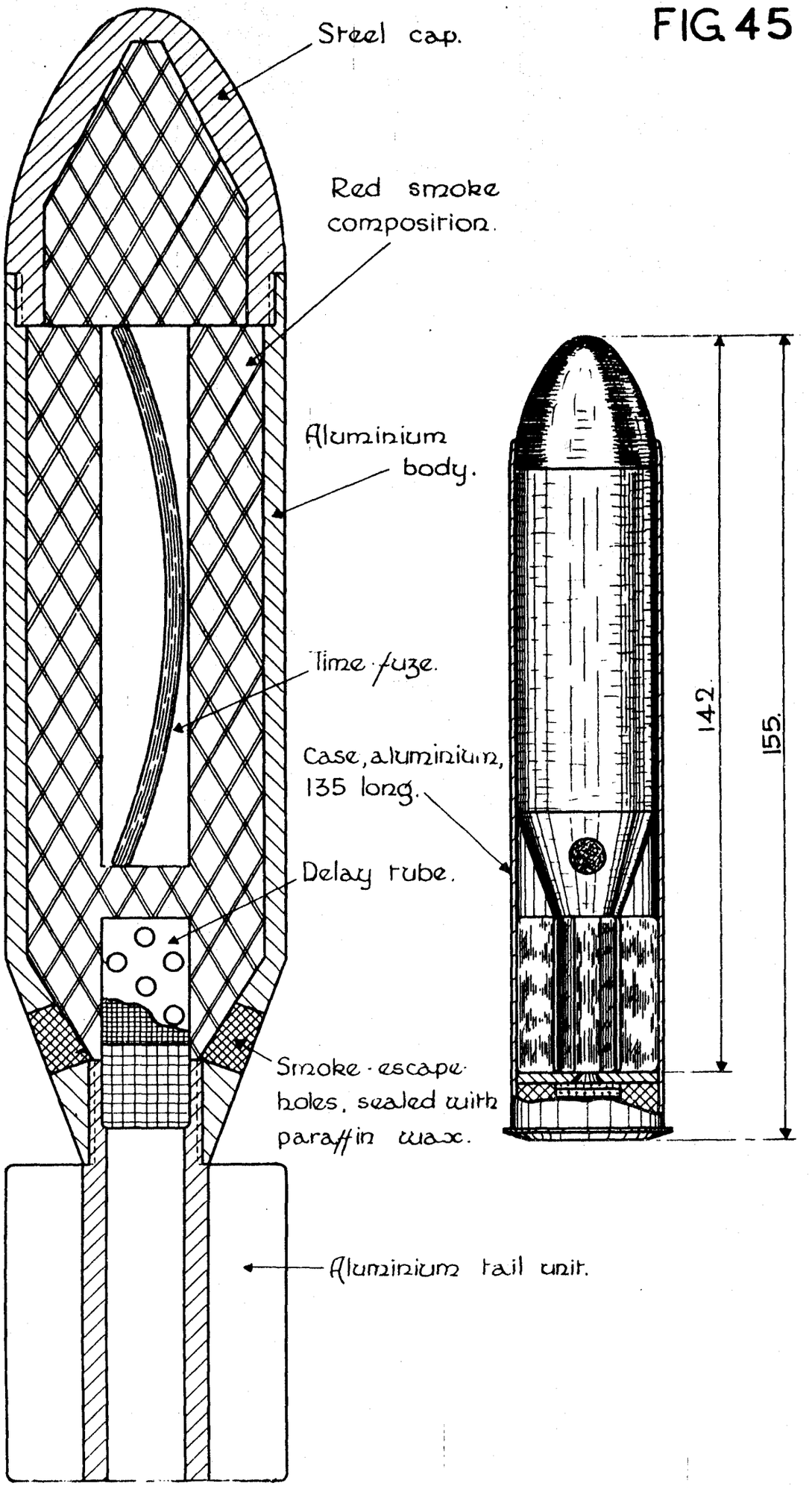


SMOKE GRENADE TARGET-INDICATING. TYPE 1.

DIMENSIONS ARE IN MM.

ADD 2/46 PT N.

FIG 45

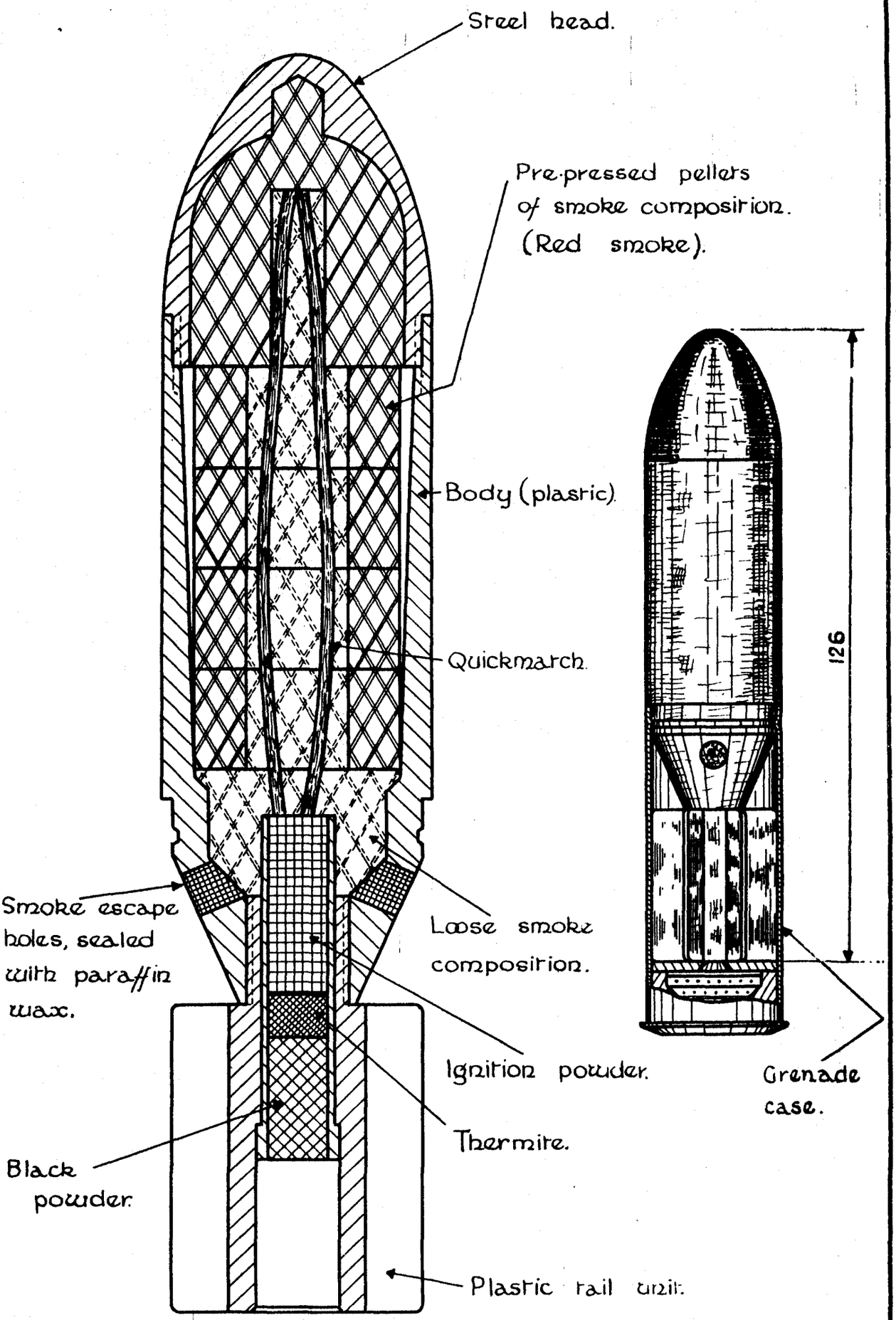


SMOKE GRENADE, TARGET-INDICATING. TYPE 2.

DIMENSIONS ARE IN MM

A00 2/46 PT N

FIG. 46

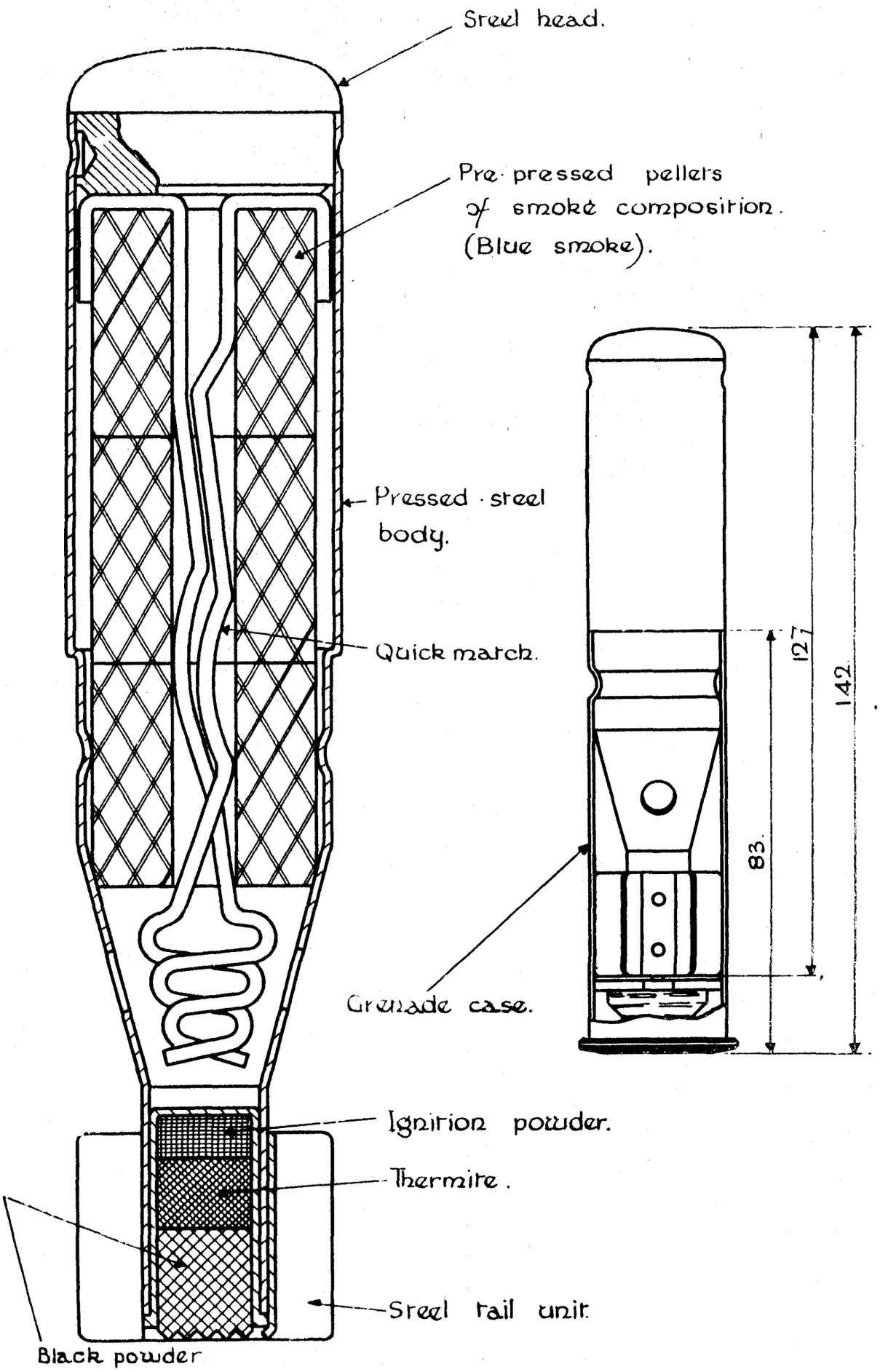


SMOKE GRENADE, TARGET INDICATING. TYPE 3.

DIMENSIONS ARE IN MM.

A.D.D. 2/46 PT. N.

FIG. 47



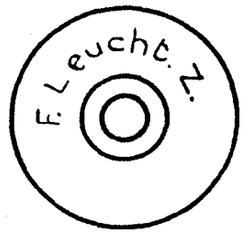
SMOKE GRENADE, TARGET INDICATING.

TYPE 4.

DIMENSIONS ARE IN MM

ADD 2/46 PTN

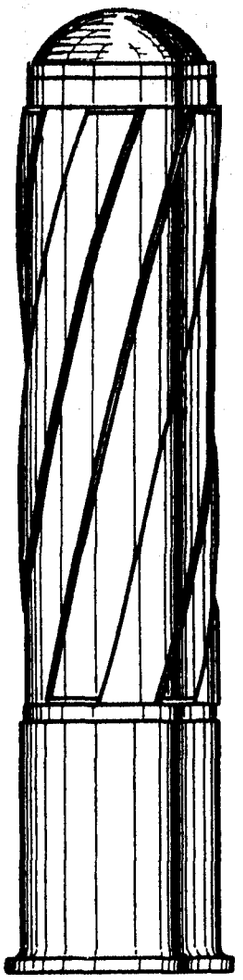
FIG.48



GRENADE, ILLUMINATING STAR ON PARACHUTE, FOR BATTLE PISTOL.

A.D.D. 2/46 PT N.

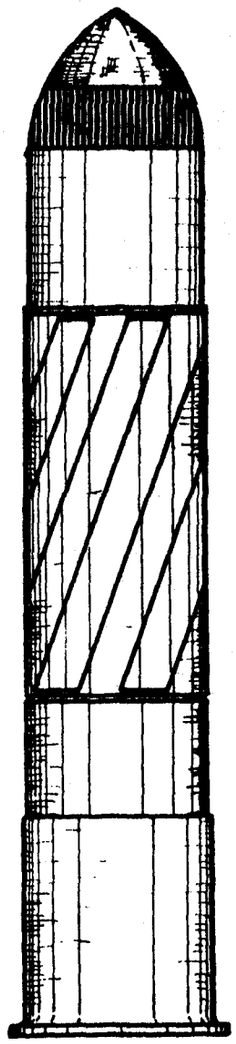
FIG. 49



GRENADE, GREEN FLARE ON PARACHUTE, FOR BATTLE PISTOL.

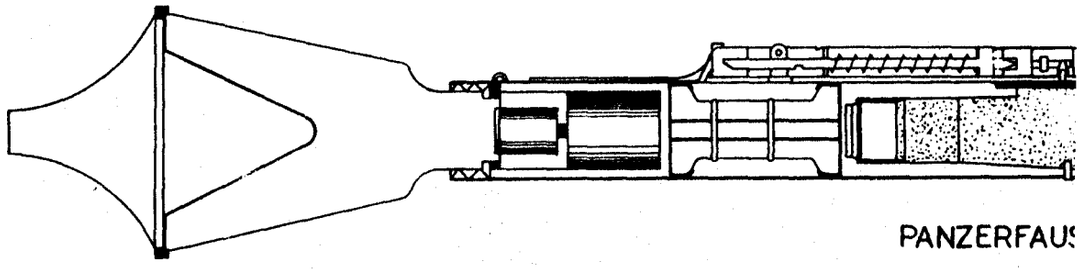
A.D.D. 2/46 PT N.

FIG. 50

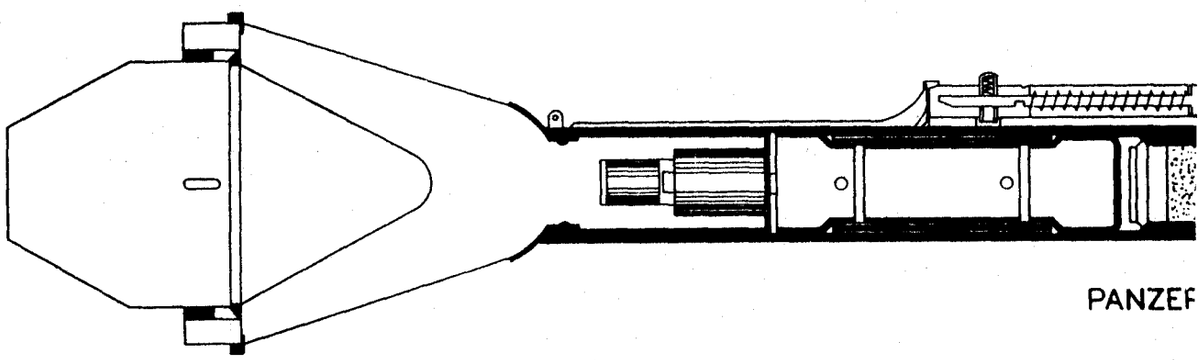


MESSAGE CARRYING GRENADE, 26MM., L.F

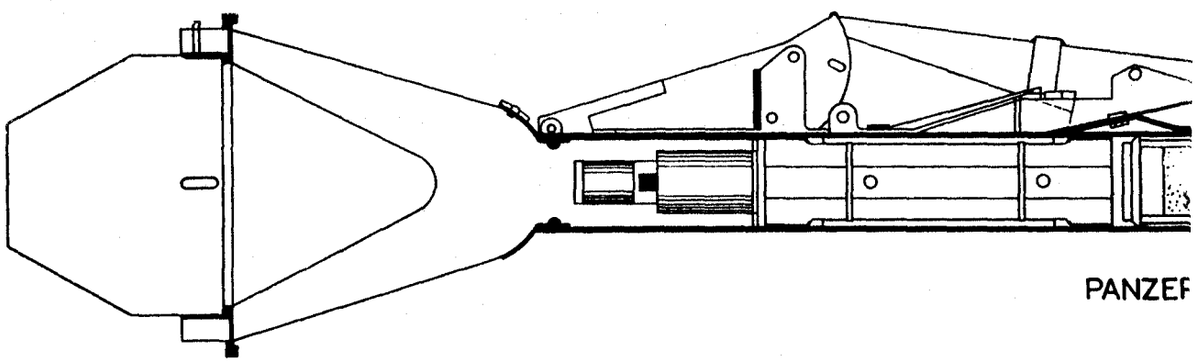
A.D.D. 2/46 PT. N



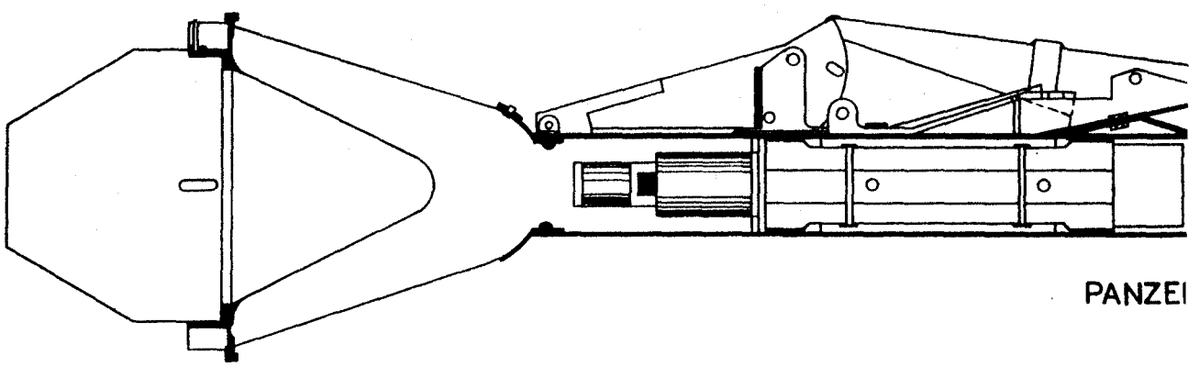
PANZERFAUS



PANZEF



PANZEF

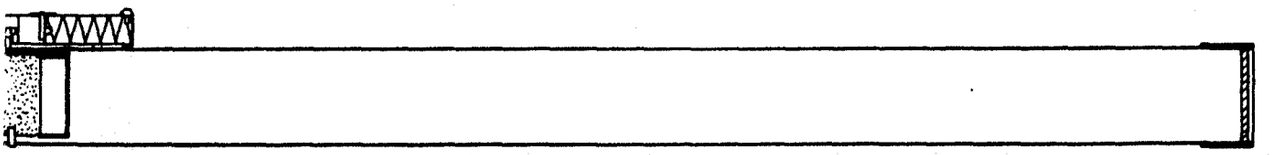


PANZEI

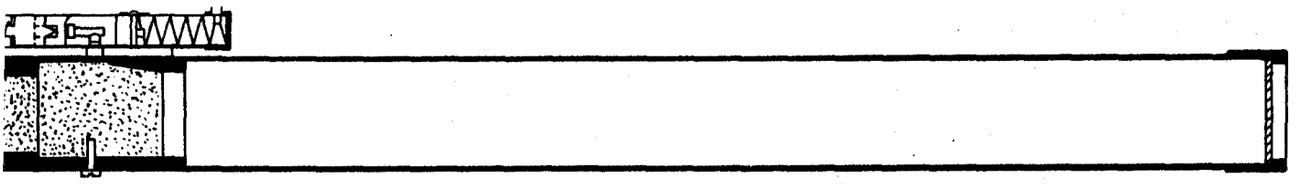
DEVELOPMENT SEQUENCE OF RECOILLES

ADD 2/46 PT.N.

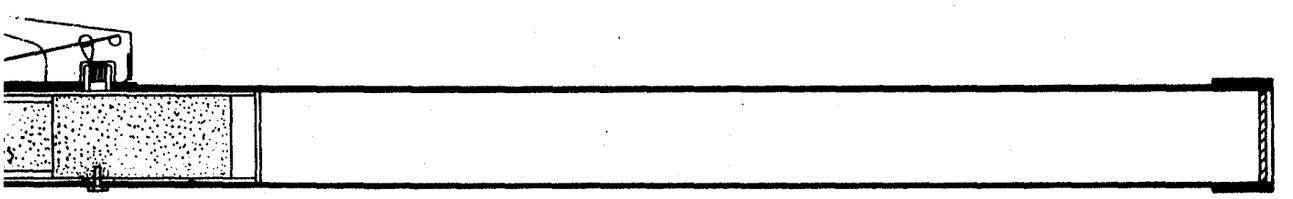
FIG. 51.



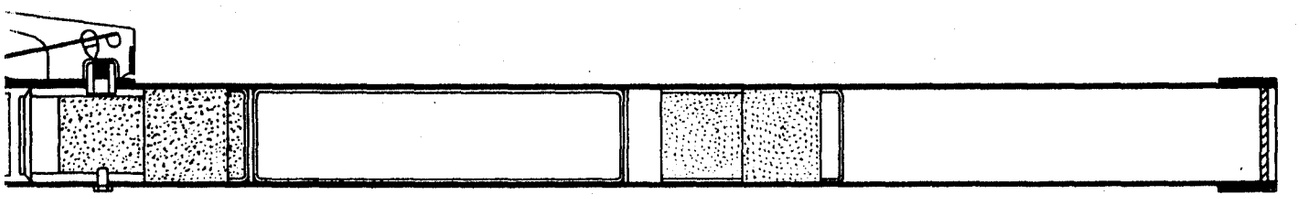
JST (KLEIN) - 30M.



RFAUST - 30M.



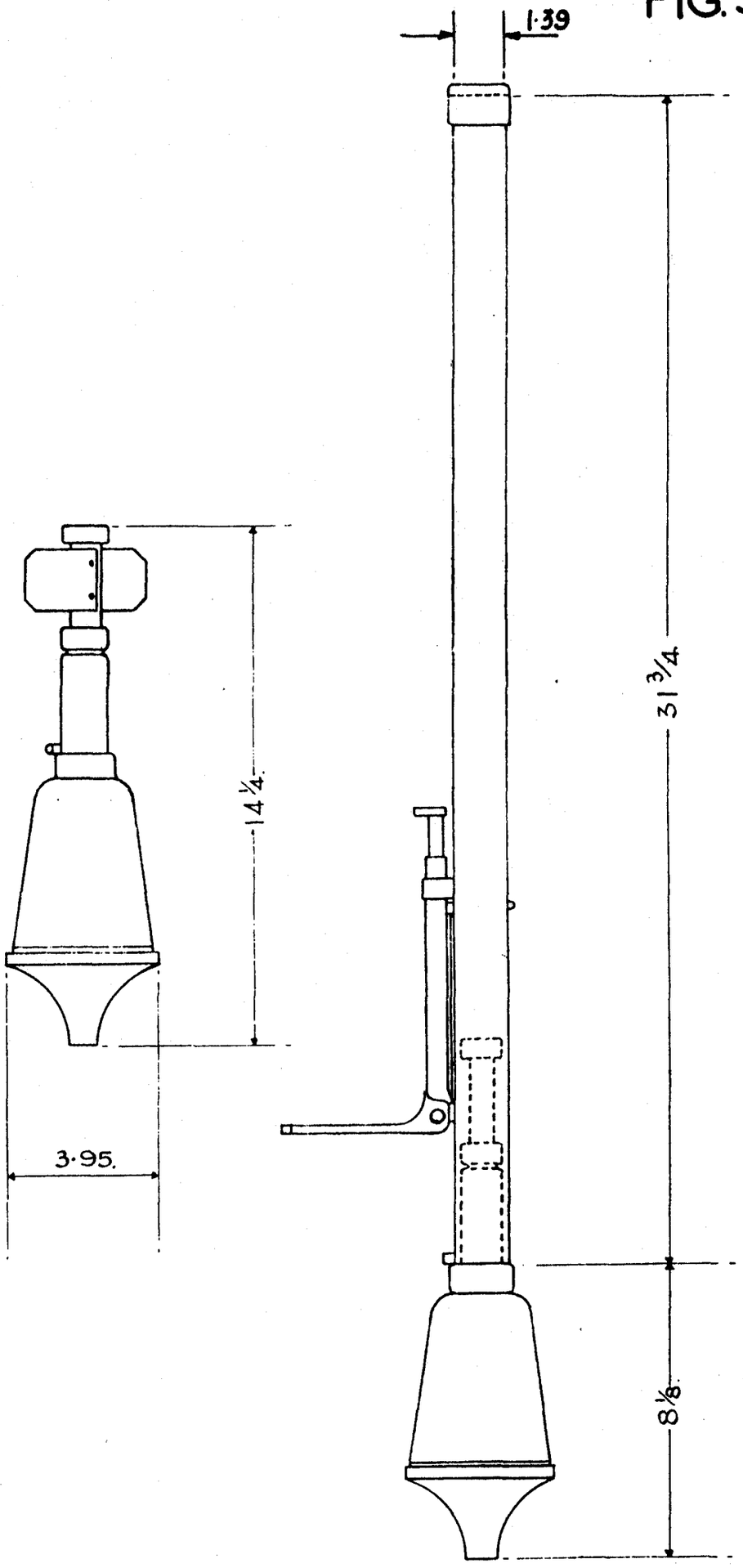
RFAUST 60M.



RFAUST - 100M.

SS A. TK. BOMB DISCHARGERS (PANZERFAUST.)

FIG. 52

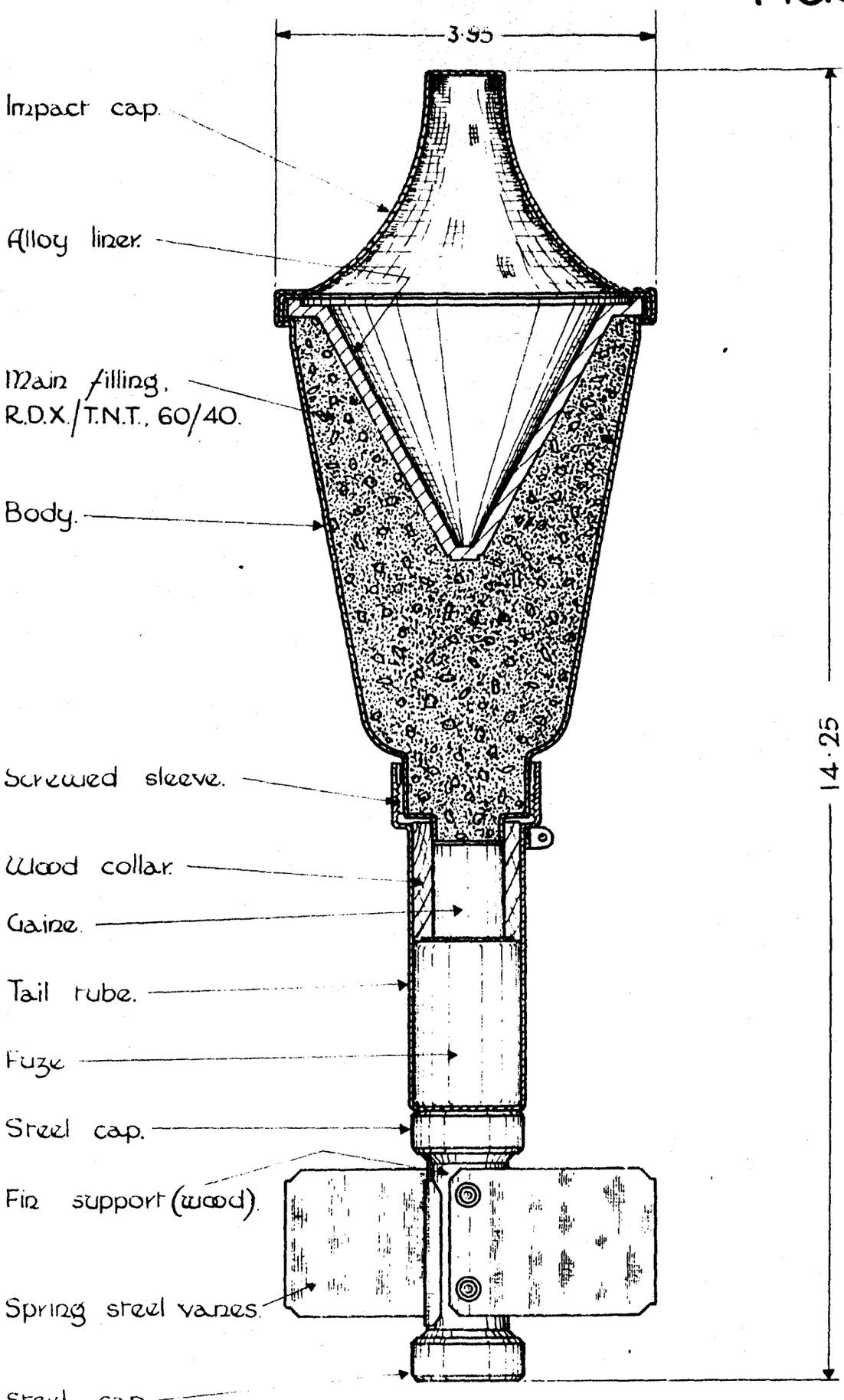


PANZERFAUST 30 (SMALL).

DIMENSIONS ARE IN INCHES.

A.D.D. 2/46 PT N.

FIG.53

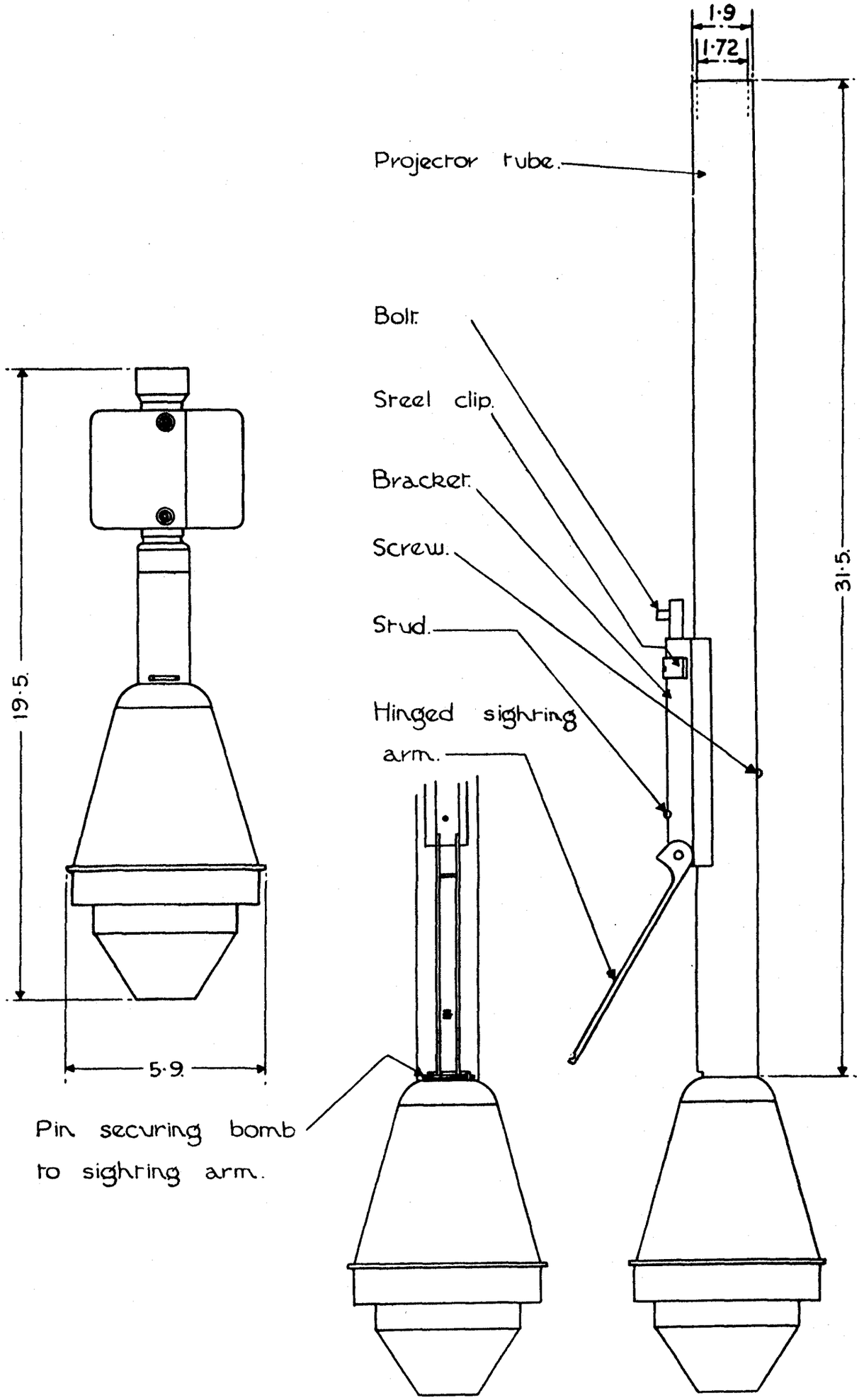


PANZERFAUST 30 (SMALL).

DIMENSIONS ARE IN INCHES

A.D.D. 2/46 PT N.

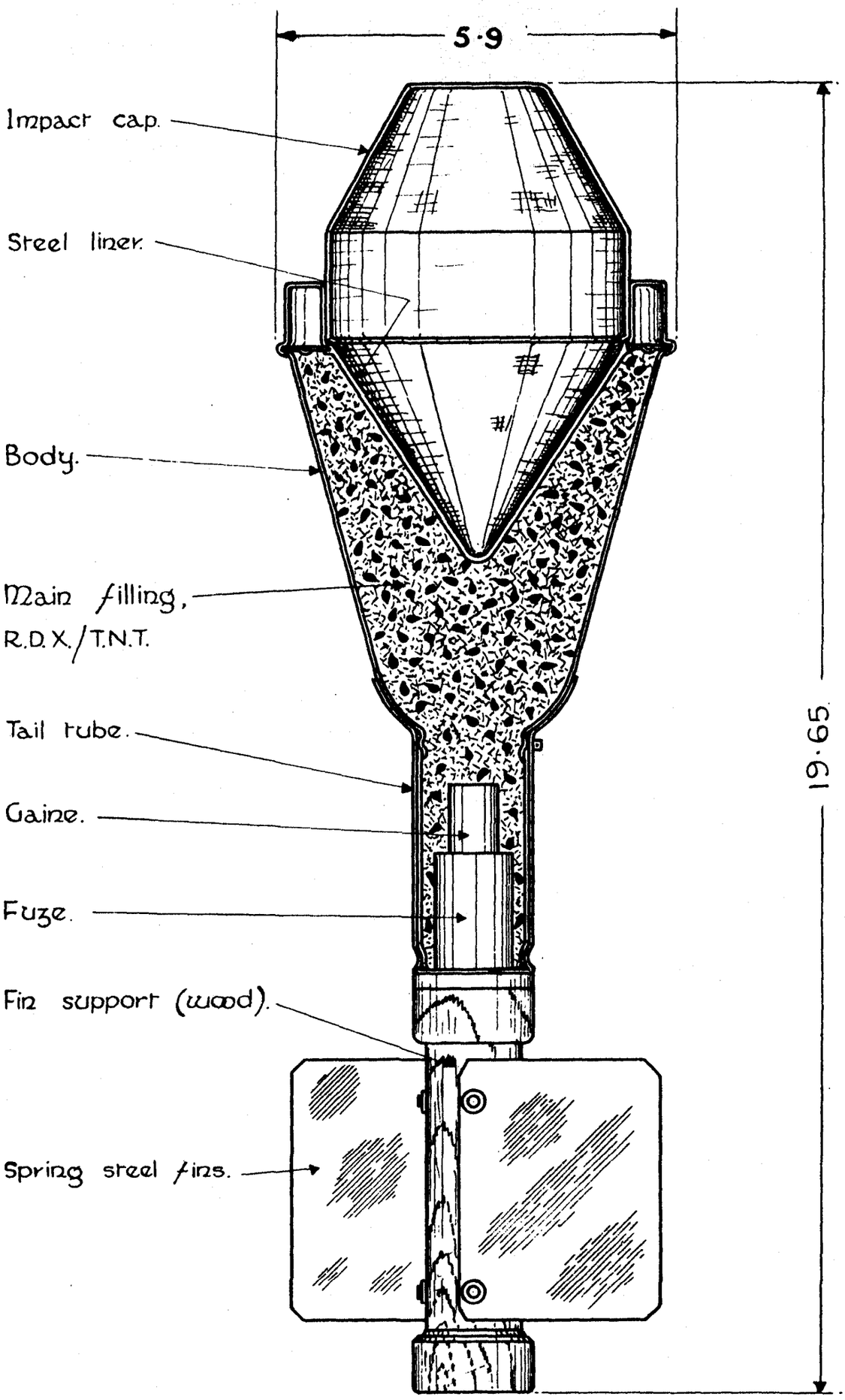
FIG.54



PANZERFAUST 30.

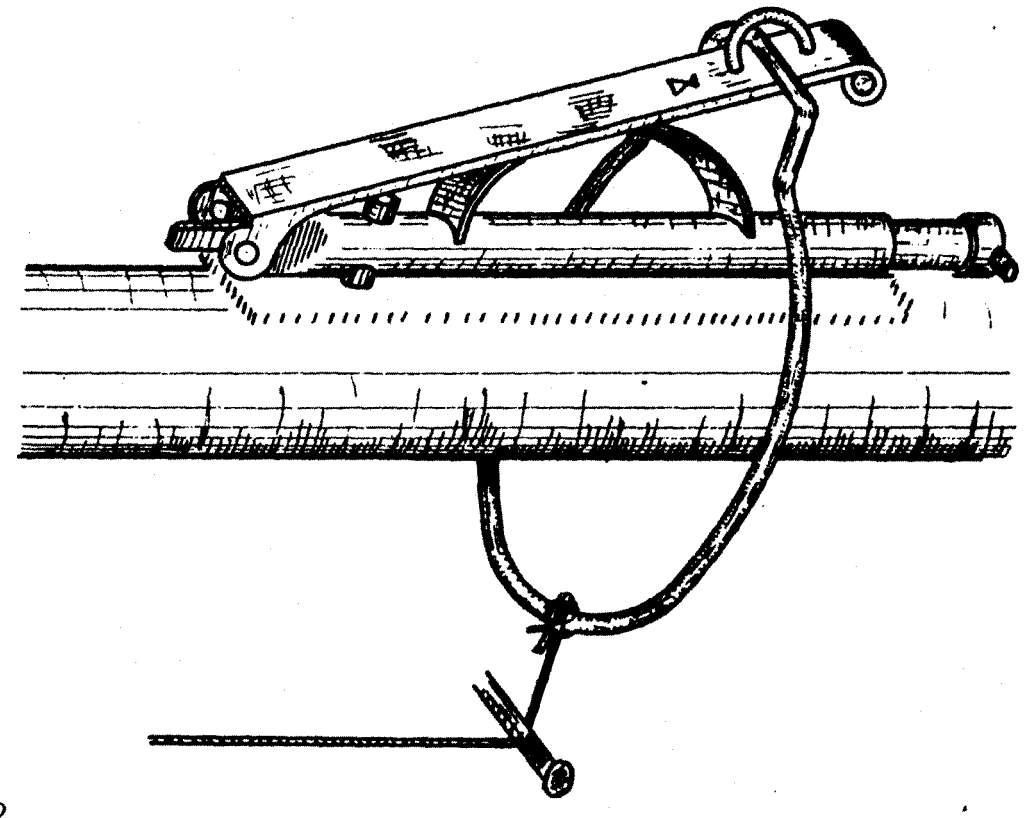
DIMENSIONS ARE IN INCHES

A.D.D. 2/46 PT. N.



PANZERFAUST 30.

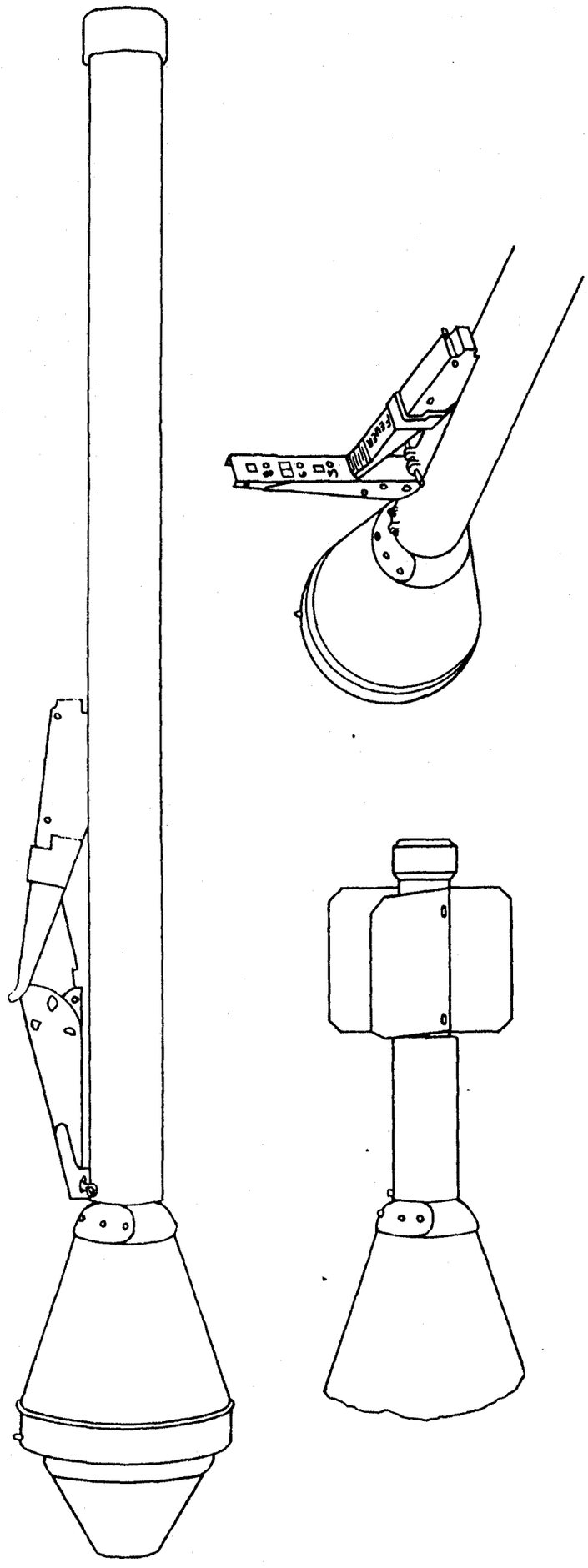
FIG. 55



Sketch showing how Panzerfaust 30 projector tube may be modified to enable weapon to be fired by means of a trip-wire.

DIMENSIONS ARE IN INCHES.

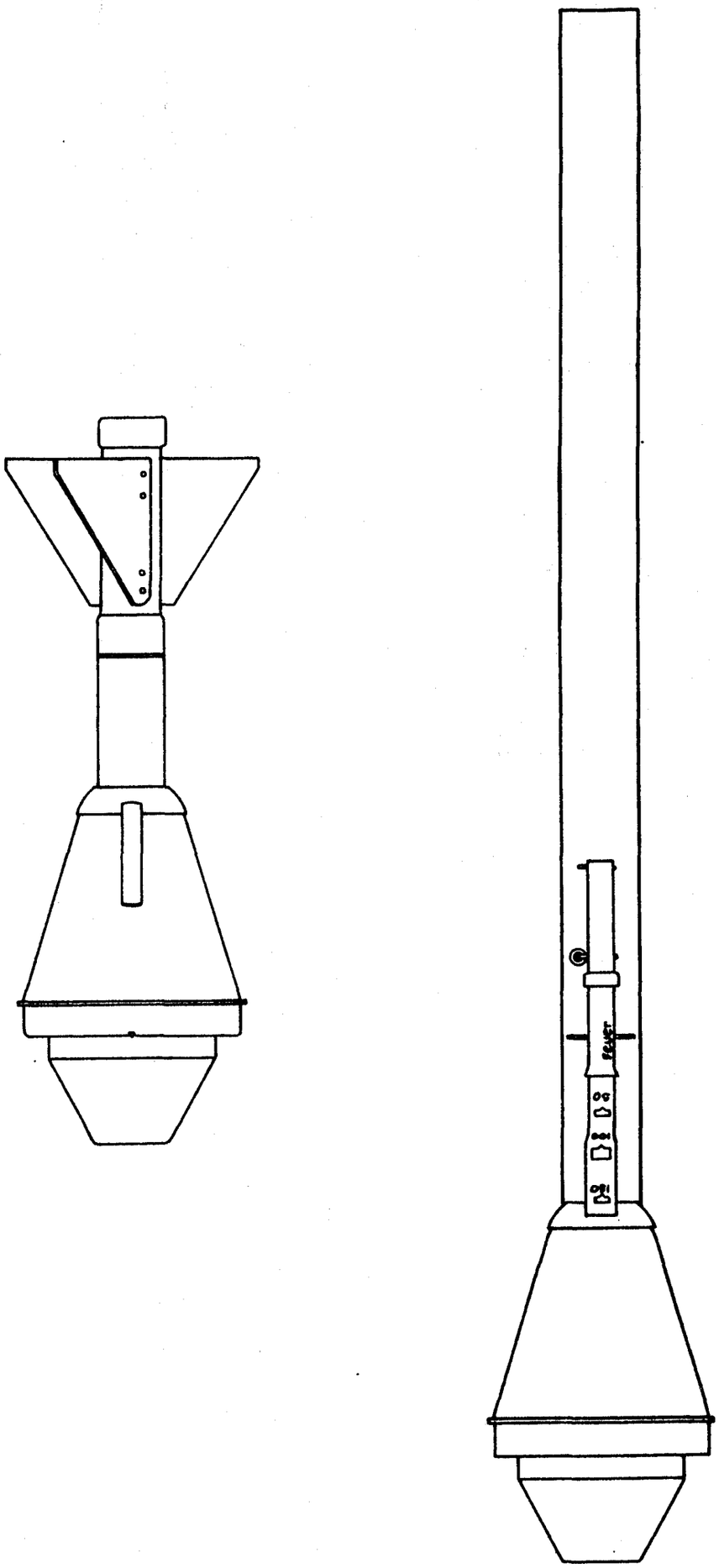
FIG. 56



PANZERFAUST 60.

A.D.D. 2/46 PTN.

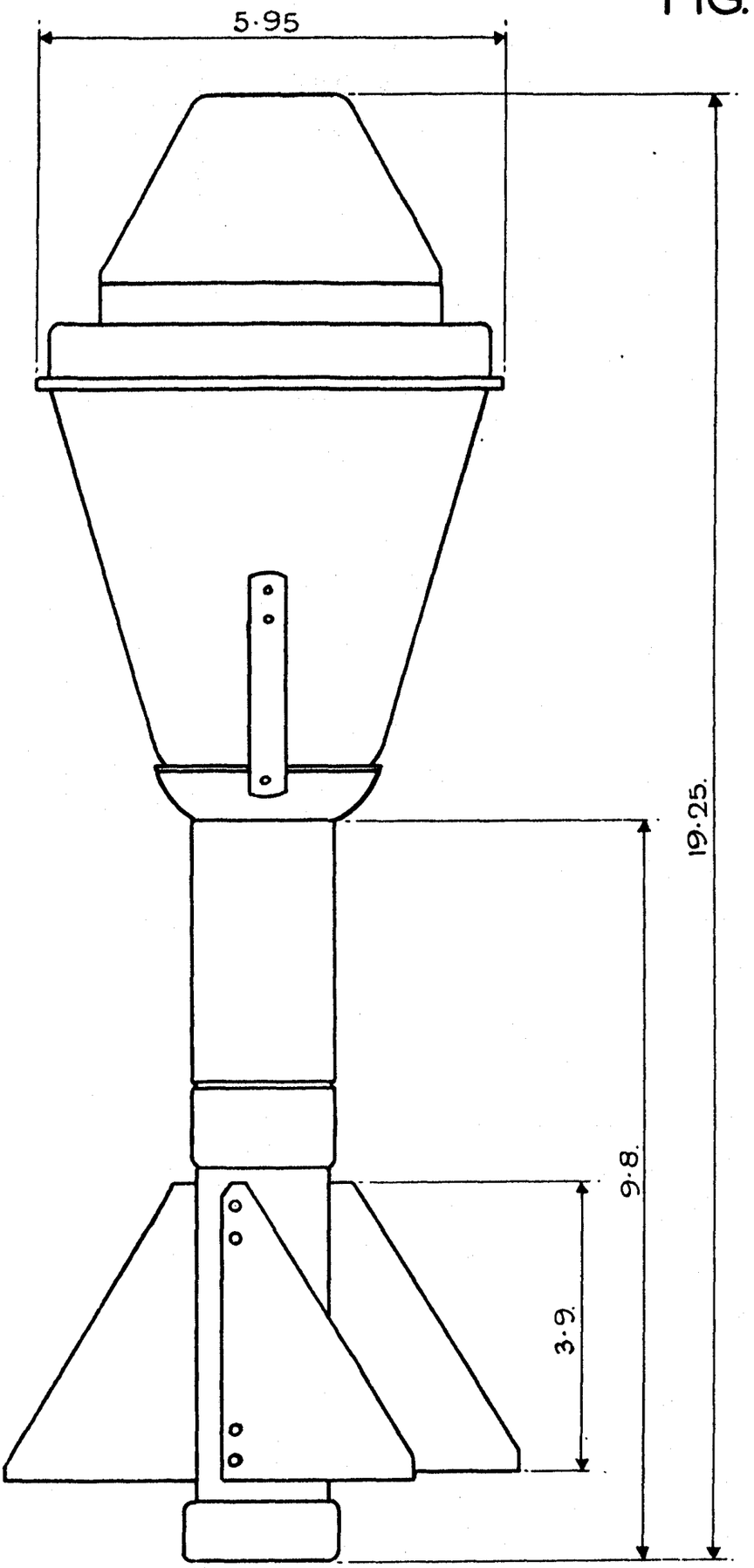
FIG. 57



PANZERFAUST 100

A.D.D. 2/46 PT.N

FIG. 58

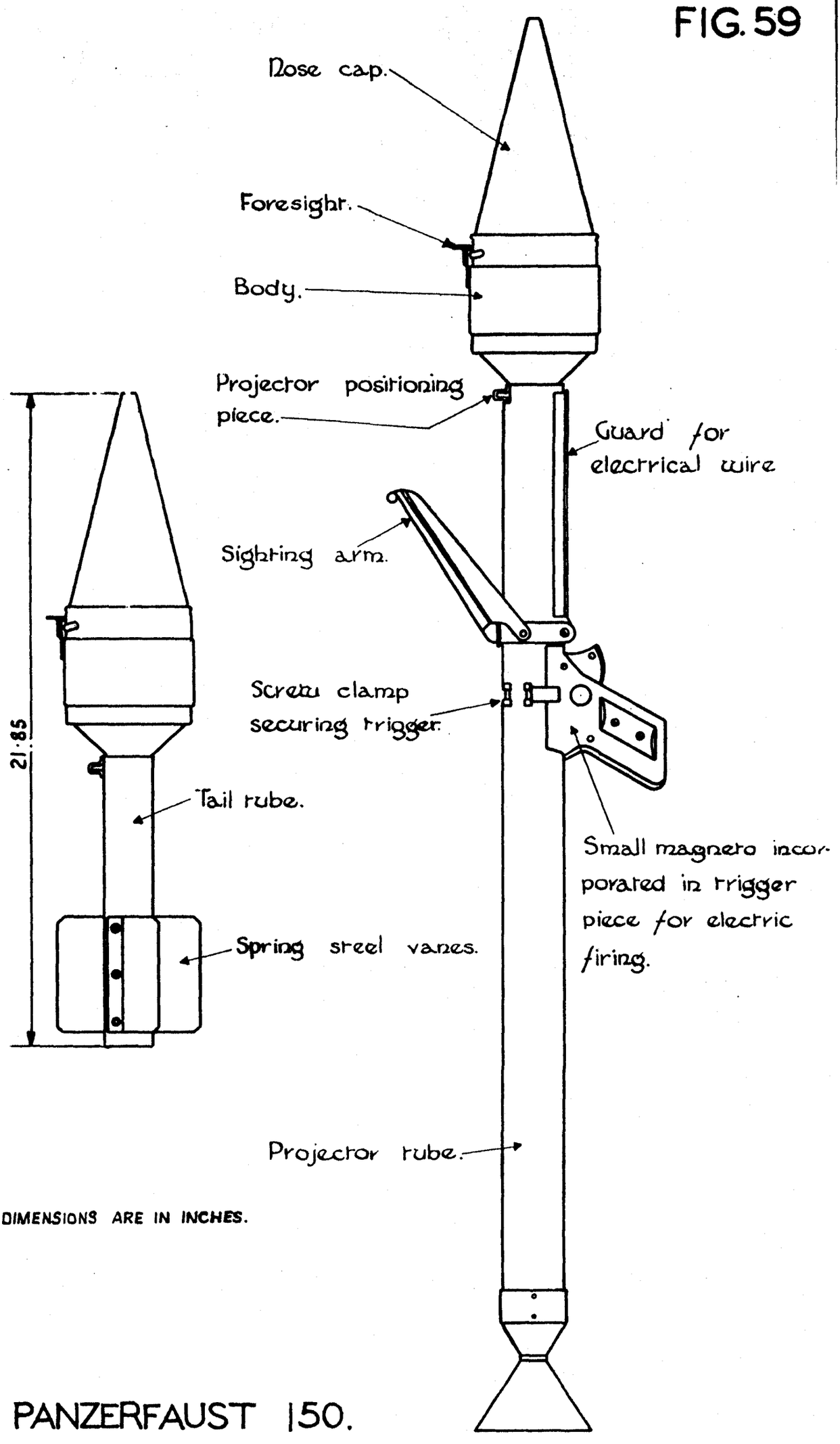


PANZERFAUST 100.

DIMENSIONS ARE IN INCHES.

A.D.D. 2/46 PT K.

FIG. 59

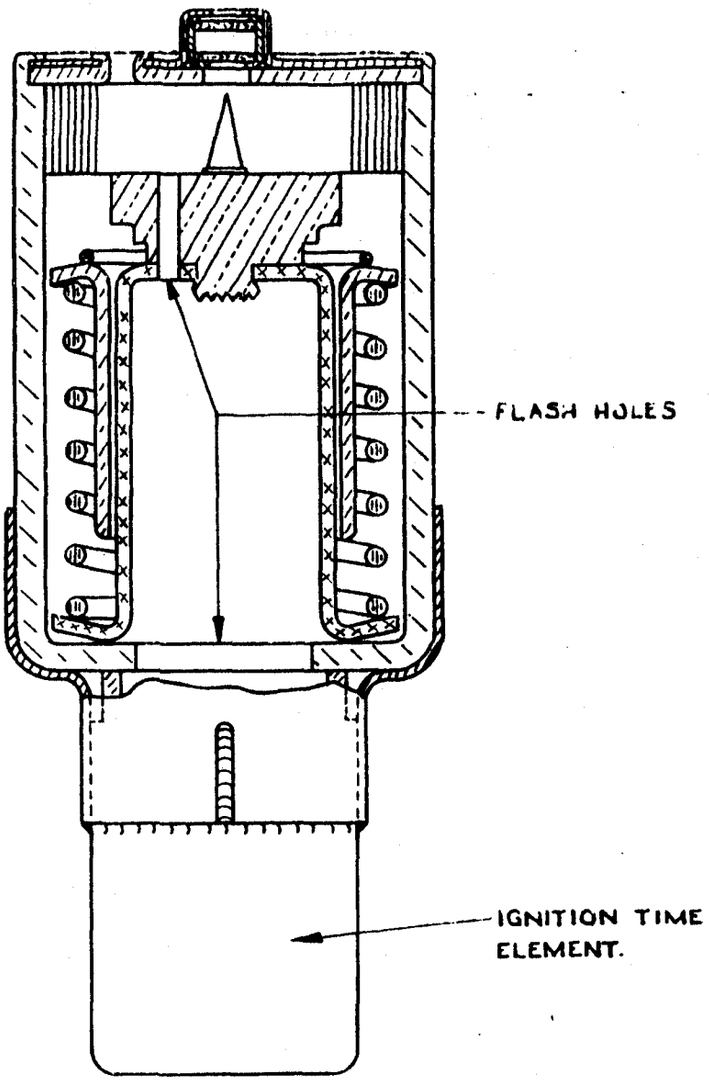


DIMENSIONS ARE IN INCHES.

PANZERFAUST 150.

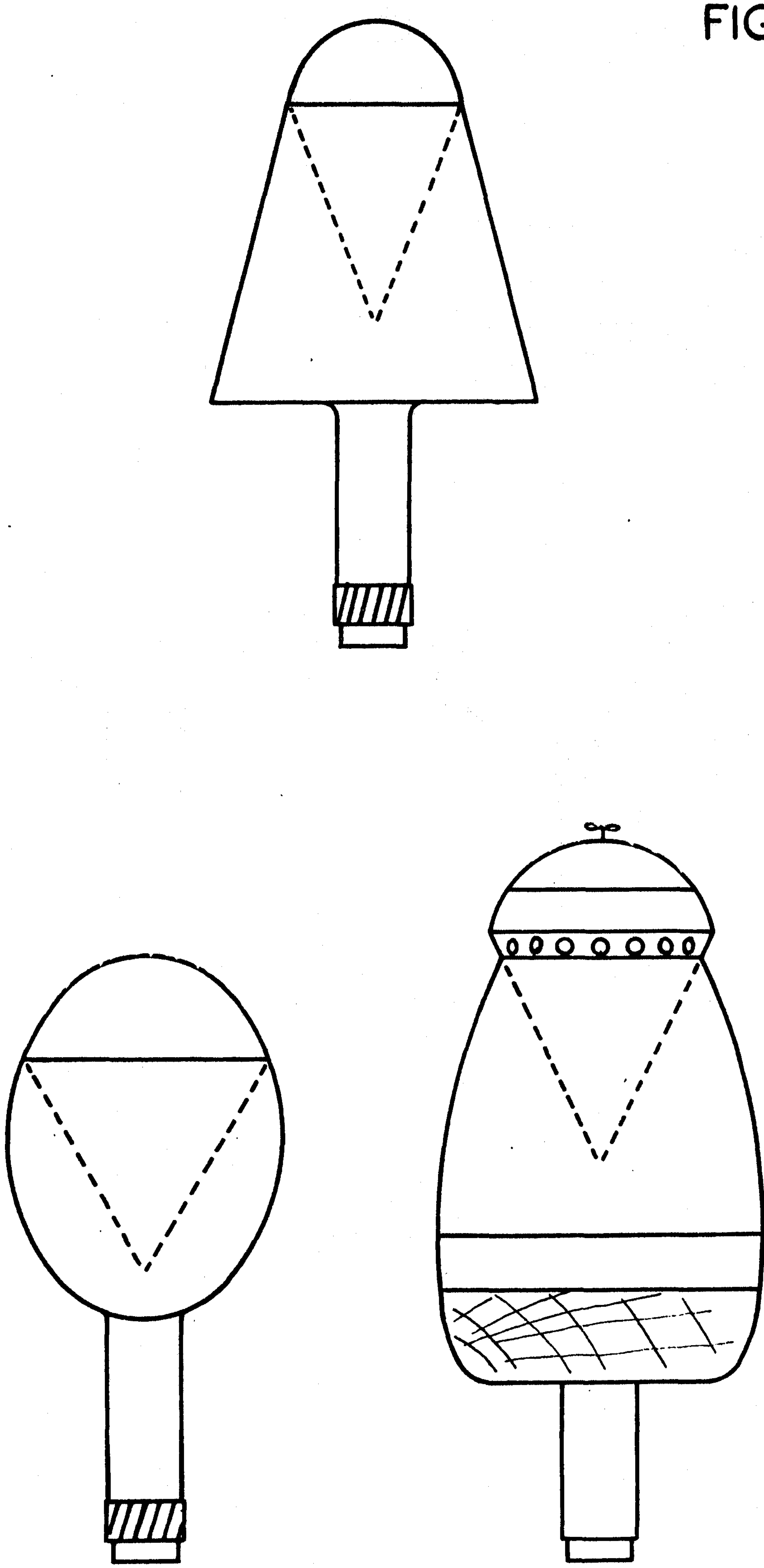
A.D.D. 2/46 P.T.N.

FIG. 60



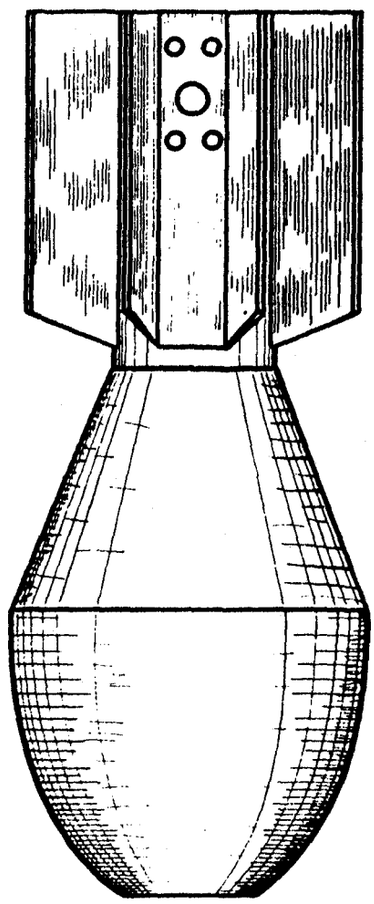
FUZES FOR PANZERFAUST.

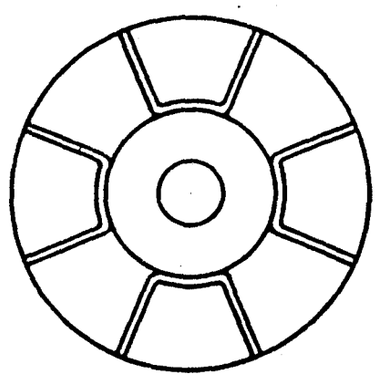
FIG. 61



RIFLE, GRENADE, ROCKET.

FIG. 62





RIFLE GRENADE, H.E., 50MM.
WITH CENTRAL CHANNEL.

A.D.O. 2/46 PT N.