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SHAPED CHARGE, ANTITANK, HAND-THROWN

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June 1974

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This program was performed by the US Army Land Warfare Laboratory under LWL Task 02-F-74 in response to a request from US Army units in Germany for a hand-thrown grenade capable of defeating a tank.

Descriptions of proposed designs are included and the results of limited tests recorded.

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INTRODUCTION

Current standard US Army antitank weapons have been designed to provide maximum practical stand-off range. One of the consequences of this is generally a significant signature at the launcher and occasionally along the trajectory of the projectile. Another consequence is a minimum range within which the munition does not function. These characteristics are in direct opposition to those needed for antitank weapons to be used in a confined area such as a city. The signature discourages use and the resultant immediate enemy reaction to the firer. The blast and sound effects in a confined area are likely to cause serious injury to the firer, and the minimum range may preclude functioning on the target. A hand-thrown short-range device appeared to overcome the deficiencies of standard weapons in an urban environment.

A hand deployed device which will give the infantryman in urban warfare the capability to disable a "buttoned-up" tank is desired. This task provides a definition of the type devices needed under three different tactical conditions. Descriptions of a number of proposed designs are presented and the results of limited tests recorded.

While there is a definite need for such a device, no obvious clear cut answer was developed; however, the approach toward several possible designs is described.

DEVELOPMENT AND TESTING

There are three methods of deployment of a hand-thrown, antitank munition which could be used.

These are:

1. Dropping the munition from the window of a building onto the top of a tank in the street.

2. Throwing the munition from a doorway, from the underbrush or from any close range onto the top of the tank.

3. Throwing the munition from as far away as possible and having it impact on the top of the tank.

An investigation of foreign technology indicates that a number of countries have developed grenades which may be used in a manner similar to the second method described above. These grenade designs are described in the Appendix. These grenades have a practical range of 5 - 10 meters. This extremely short range results in a hazard to the individual throwing the grenade unless he has a prepared position into which he can retreat as he throws the grenade.

The third method of deployment would use a grenade which could be thrown a substantial distance. To accomplish this, a small football shaped grenade was considered. Since a regulation size football weighs 14 ounces, it was considered feasible to make a shaped charge grenade within this weight limitation. In addition, most US troops are familiar with throwing footballs. A model of this design may be seen in Figure 1.

TESTING

Tests were made of five different items:

1. Dart with fins
2. Dart with cowling
3. 1 1/2-lb. "potato masher" grenade
4. 2 1/2-lb. "potato masher" grenades
5. 14 oz. "football" device

The tests of the dart with fins showed a very low tendency of the device to impact "nose-on" on a horizontal surface. Initial tests indicated there were no practical results.

The initial tests on the dart with a cowling also indicated a very low tendency of nose-on impact. In addition this particular design was very difficult to throw with any stability and tumbled often.

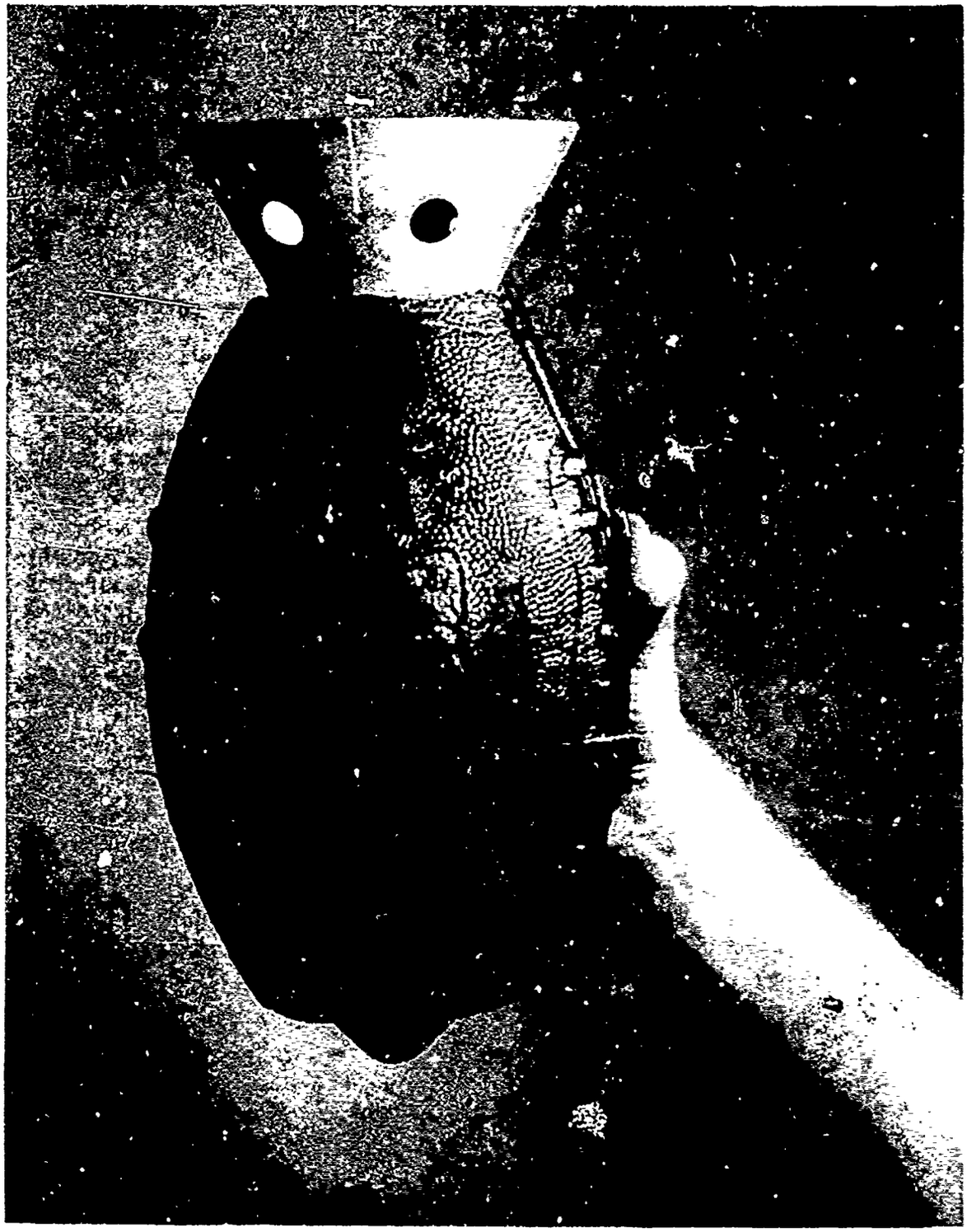


Figure 1. Football Shaped Grenade

The 1 1/2-lb. and 2 1/2-lb. "potato mashers" with parachute showed the highest tendency to impact nose-on. The "potato masher" design tested is shown in Figure 2.

Tests of all of these items indicated a maximum practical range of 10 meters.

Test on the football shape indicated it also had a low tendency of nose-on impact. In addition, both the spring wire and soft aluminum placed on the nose to cause the "football" to rotate upon impact, so the nose would be perpendicular to the tank surface, did not work as envisioned. The "football" would bounce away before the nose rotated any significant amount. In addition, the "football" never attained a stable trajectory. This was apparently caused by the mass of the grenade type "football" being near the longitudinal axis while a real football has all its weight in the "skin." The football shape was not considered practical for further development.

Further testing was done on the "potato masher" with a plastic magnetic ring on its front and on the dart with cowling and a parachute.

The "potato masher" with the plastic magnet on its front surface was so heavy that it would bounce two or three times and fall off the test stand. The dart with cowling and parachute was also tested at the same time and no consistency of trajectory was ever achieved.

The Research Analysis Office (RAO), USALWL, conducted an investigation into designs for hand-thrown antitank devices not described in the body of this report. Results of the RAO investigation are included in USALWL Technical Report No. 74-92, "Improved Hand-Launched Antitank Munition for Urban Warfare."

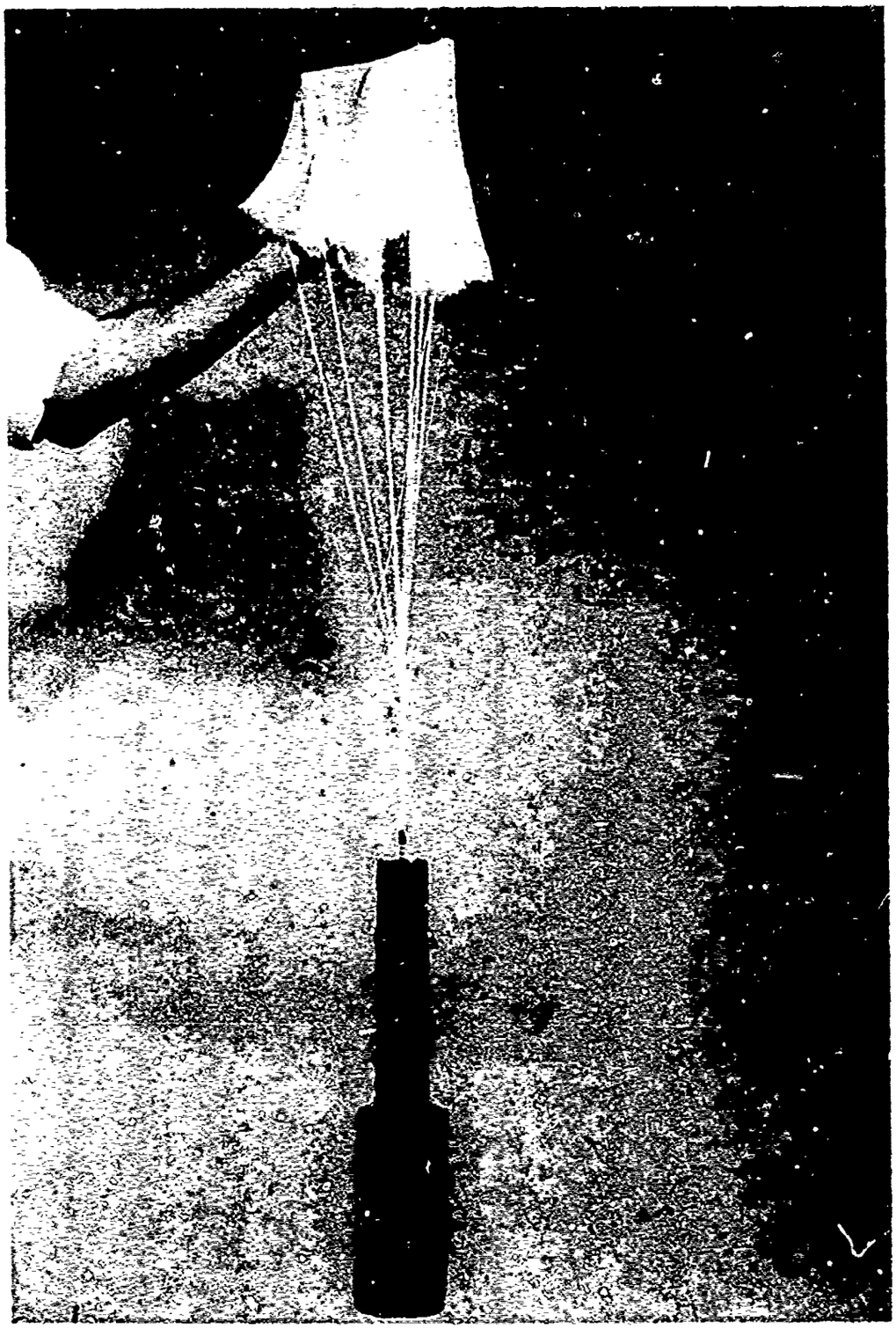


Figure 2. Potato Masher Grenade

CONCLUSIONS

The lightweight (1 1/2-lb.) "potato masher" grenade with parachute showed some promise that it could be developed into a useful antitank weapon if a 10 meter average range could be tolerated.

APPENDIX

FOREIGN TECHNOLOGY GRENADES

TB 381-5-1, C3

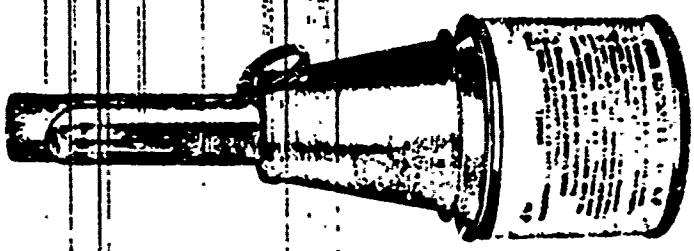
ITEM: FTM-2-1330-1-2

NOMENCLATURE: Grenade, Hand, HEAT, Model RPG-43

COUNTRY: U.S.S.R.

NATIVE DESIGNATION: РУЧНАЯ ПРОТИВОТАНКОВАЯ ГРАНАТА ОБР. 1943 Г. (РПГ-43)

DATE: 1943



The RPG-43 is the earliest of the HEAT hand grenades used in the Soviet and Satellite Forces. It incorporates an impact fuze and a shaped charge to achieve its penetration effect against the armor of its primary targets--tanks and other vehicles, and armor-protected pillboxes--and is capable of penetrating approximately [illegible] inches of armor. Because of its secondary fragmentation effect, the grenade should be thrown only from cover.

The design of the RPG-43 is unusual in that a stabilizing device is incorporated to insure that the shaped charge in the head of the grenade strikes the target head-on for maximum effectiveness. The device consists of two cloth strips attached to the handle of the grenade as well as to a metal collar fitted over the handle. The collar and safety lever are forced off the grenade by a compressed spring when the grenade leaves the hand, and the trailing cloth strips and collar stabilize the grenade by keeping its head foremost in flight.

The RPG-43 can be recognized by its large-diameter cylindrical head, the projecting wooden handle, and the stabilizer collar, shaped like a truncated cone, which fits over the handle and against the rear of the head.

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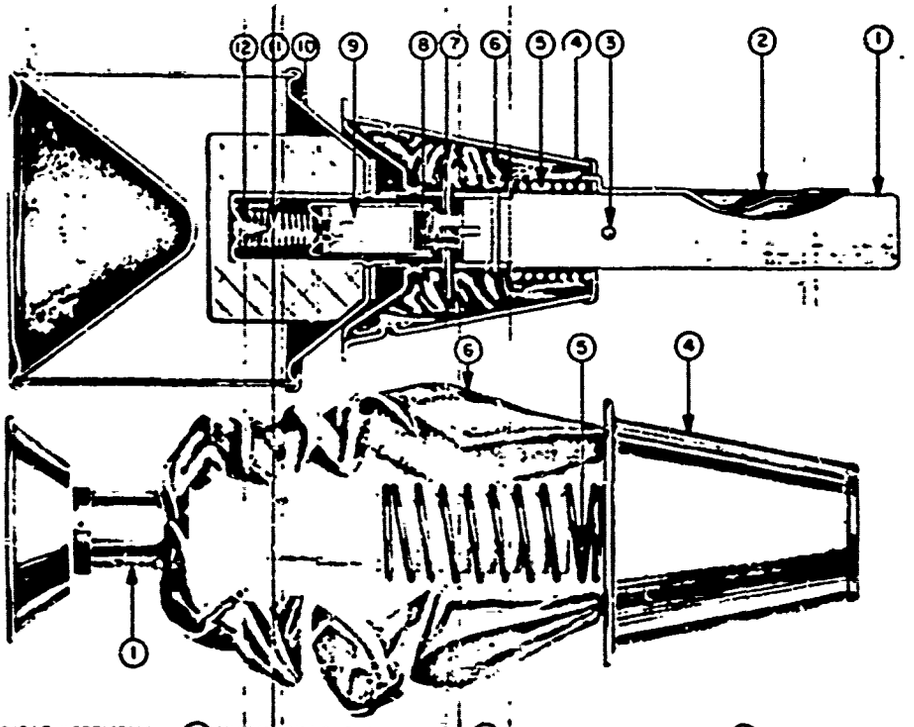
April 1966

C3-11

NOMENCLATURE: Grenade, Hand, HEAT, Model RPG-43

1	CURRENT STATUS: -------- Ltd standard		3	PERFORMANCE:
			a	Average range thrown ----- 20 m
2	CHARACTERISTICS:		b	Effective frag. radius --- Does not apply
a	Type ----------	HEAT	c	Penetration ---------- 2.95 in
b	Weight ----------	2.65 lb	d	Burning time ---------- Does not apply
c	Length ----------	11.76 in		
d	Maximum diameter -------	3.73 in		
e	Body material ----------	Sheet steel		
f	Filler-weight ----------	21.6 oz		
g	-material ----------	TNT		
h	Fuze-type ----------	Impact		
i	-delay time ----------	None		
j	Fins-Nr. ----------	None		
k	Identifying markings ---	PHT-43		



1 HANDLE ASSEMBLY
2 SAFETY LEVER
3 PULL PIN AND RING
4 STABILIZING CAP
5 STABILIZING CAP SPRING
6 FABRIC
7 SAFETY PIN
8 SAFETY SCREW
9 DETONATOR BOOSTER ASSEMBLY
10 GRENADE BODY
11 SAFETY SPRING
12 FIRING PIN

C3-12

MAGNETIC ANTITANK GRENADE, HOFT HOHL LADUNG 3 kg

DATA:

Over-all Length: 4⅜ inches.
Maximum Diameter: 3 1/16 inches.
Color: Field grey.
Total Weight: 7 pounds 11 ounces.
Filler: RDX/TNT.
Weight of Filler: 3 pounds 5 ounces.
Igniter: B. Z. 24.
Delay: 4.5 or 7 seconds.

DESCRIPTION. This grenade is painted field grey and is fitted with magnets which are sufficiently powerful to cause it to adhere to a vertical surface. The main filling is contained in a pressed metal container which is conical in shape with an elongated apex serving the dual purpose of forming a hand-grip and accommodating the exploder pellet of PETN/Wax. This latter is housed in a metal tube protruding from the underside of the screw-threaded closing cap. The metal tube is screw-threaded internally to receive the igniter. (See fig. 288.)

Attached to the base of the conical portion by means of six bolts protruding through the container is a plywood framework carrying three horseshoe type magnets. During transit these magnets are fitted with a keeper which must, of course, be removed before using the charge. A brass chain terminating in a hook is attached to the frame.

This charge is reported to penetrate as much as 110 mm. of armor. The penetration is acquired through the use of the shaped charge formed around the 60° angle cone.

There are two igniters used in this grenade: one having a delay of 4½ seconds and the other having a delay of 7 seconds. The first igniter has a blue cap and the second has a yellow cap.

OPERATION. The friction igniter is pulled and this will ignite the delay element. When the grenade strikes a tank the magnets cause it to cling to the side and at the end of the delay time the igniter will detonate the exploder pellet and main filling.

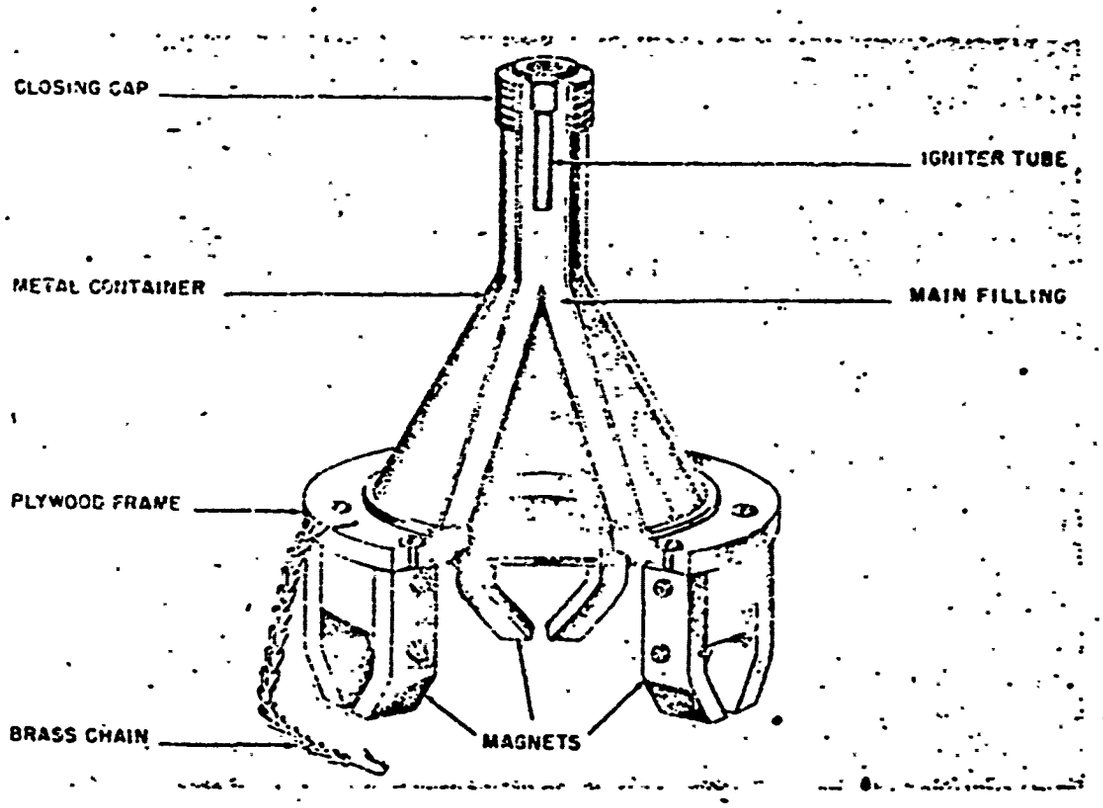


Figure 288—Magnetic Antitank Hand Grenade

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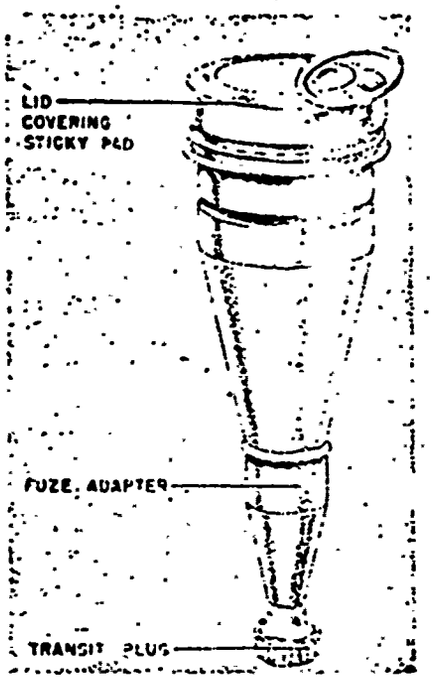

Figure 289—Hollow Charge Sticky Hand Grenade

HOLLOW CHARGE GRENADE (STICKY TYPE)

DESCRIPTION. The grenade consists of a tapering steel body containing the hollow charge with a flat sticky pad at the nose covered by a press-on lid with a small handle. The base of the grenade is fitted with a tapering fuze adapter terminating in an internally threaded hole for an igniter. This hole is covered by a black plastic plug in transit. It is presumed that the standard egg grenade igniter is used with this grenade employing a 4½-second delay and used with a No. 8 detonator. (See fig. 289.)

REMARKS. No information is available as to whether this grenade is thrown or placed against the target. It is possible that it may be lobbed for short distances.

ANTITANK GRENADE (PANZERWURFMINE)

DATA:

Over-all Length: 21 inches.
Length or Body: 9 inches.
Length of Fins: 11 inches.
Diameter of Body: 4½ inches.
Color of Body: Grey.
Markings: P. W. M. 1 (L).
Weight: 1 kg.
Filling: Cast TNT.

DESCRIPTION. The grenade consists of a metal body and a wooden handle to which are attached four canvas fins. The fins are held against

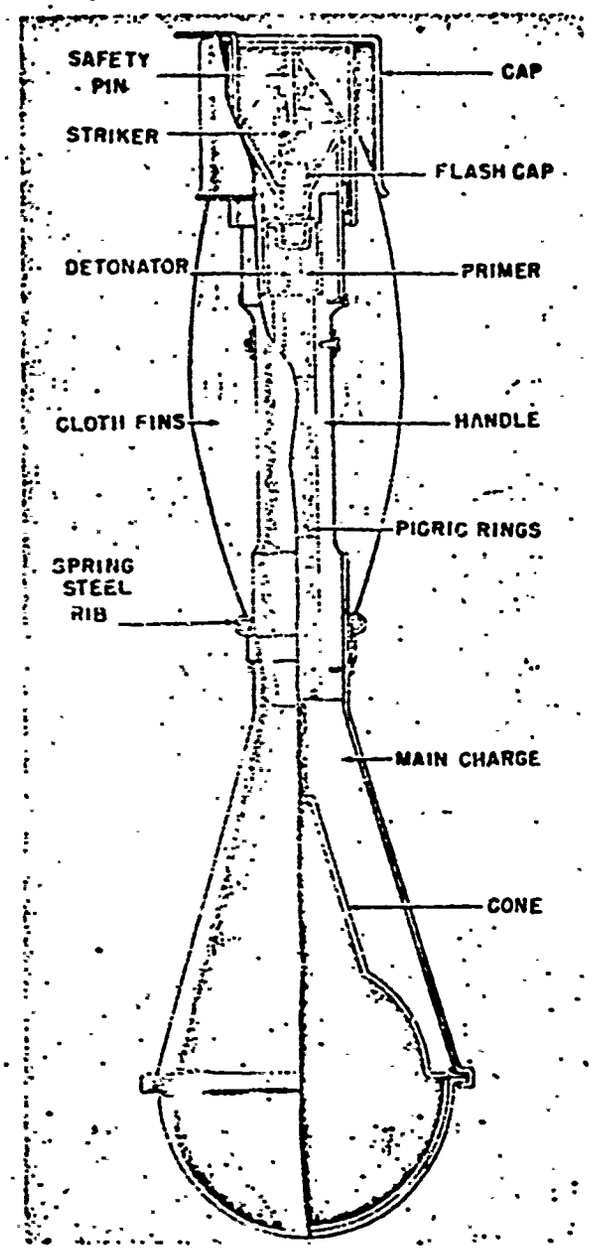

Figure 290—Panzerwurfmine Hollow Charge Hand Grenade

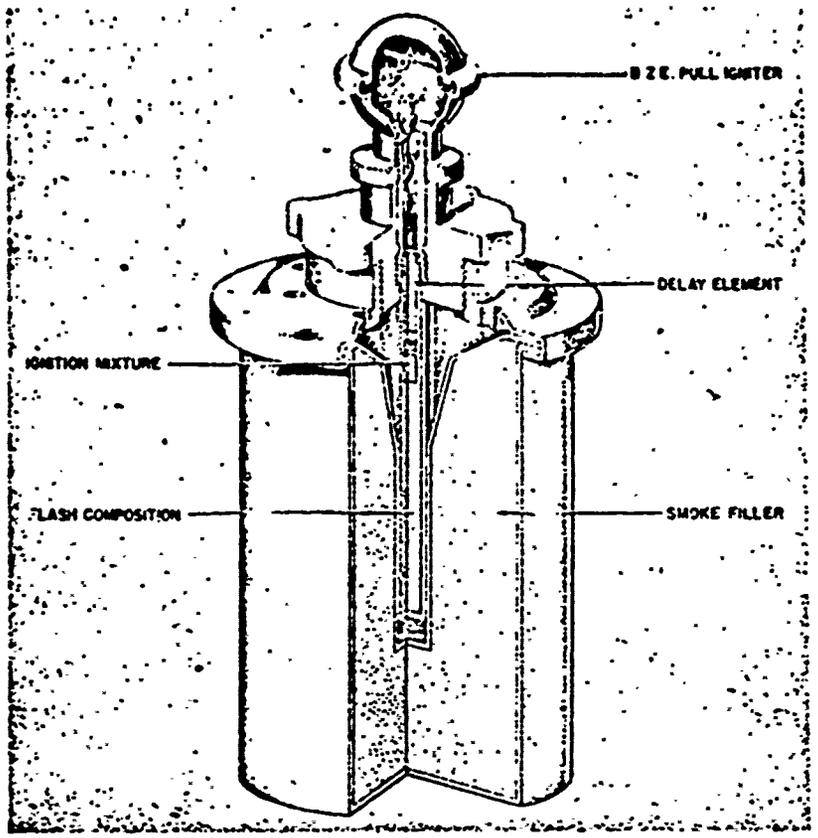

Figure 291—Type 41 Smoke Hand Grenade

the handle, before throwing, by a metal cap at the base of the handle. The body is made in two pieces crimped together and attached to the handle by a metal band. (See fig. 290.)

The fuze is located at the top of the handle and consists of a striker which is held away from the primer by a creep spring and two steel balls. The two balls fit into a recess in the striker and are held outward by a safety pin fitting between them, thus causing them to bear against the top of the striker housing and prevent the striker from moving down. Attached to the safety pin is a small length of tape which is held in by the metal cap and a semicircular clip attached to one fin and fitting around the handle.

Beneath the primer and in the base of the handle is a detonator and a picric acid gaine. The main filler is cast around a cone in the body to give a hollow-charge effect.

OPERATION. Before throwing, the cap over the end of the handle is pulled off and the fins held against the handle.

When the grenade is thrown, the four fins fly out because of their spring ribs. When the clip attached to one fin is pulled away from the housing, this releases the tape which unwinds and pulls the safety pin out of the striker. During flight the safety balls move in freeing the striker which compresses the creep spring on impact setting off the primer, detonator, gaine and main filling.

SMOKE HAND GRENADE 41 AND PROTOTYPE NEBELHANDGRANATE 41

DATA:

Over-all Length: 4.7 inches.
Maximum Diameter: 2.3 inches.
Color: Olive drab.
Total Weight: 21 ounces.
Filling: (HC) Berger type mixture. Zinc and Hexachlorethane.
Ignition: B. Z. E.
Delay: N4 Ignition Tube: 4½ seconds.

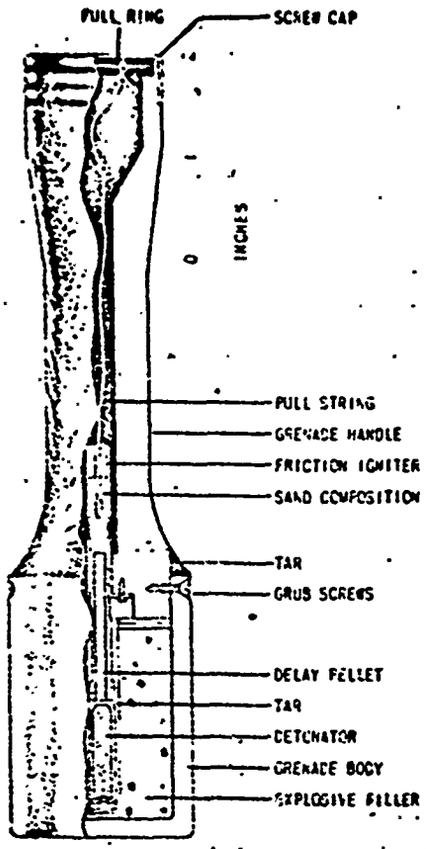

Figure 174—Type 98 Stick Grenade.

Type 98 Stick Grenade

Over-all length: 7¾ inches.
Maximum diameter: 1 1/16 inches.
Color: Body, black; handle, unpainted.
Total weight: 1 lb. 3 ounces.
Filling: Cast picric acid.
Weight of filling: 3 ounces.
Delay: 4–5 seconds.

Description: The body is cylindrical in shape and is made of cast steel ⅛-inch thick. The handle is turned from soft wood and slips into the steel body where it is held by three screws. This joint is sealed with a coating of tar. The screw cap at the pull end of the handle is of light, tin-plated steel.

The fuze consists of a friction ignition composition with a sanded string running through it. This string extends up the hollow handle and is connected to a pull ring which is exposed by removing the screw cap at the top of the handle.

Operation: The screw cap is removed from the top of the handle. The ring inside the handle is then pulled. This draws the sanded string through the ignition composition igniting the 4 or 5 second delay. The delay train detonates a cap which detonates the main charge.

This grenade has more fragmentation effect than the German high explosive stick grenade.

Type 3 Conical Antitank Hand Grenade

	Large Grenade	Small Grenade
Length of grenade	6¾ inches	5¾ inches.
Length of tail	14 inches	14 inches.
Diameter at base	4¾ inches	4 inches.
Length of fuze	1⅞ inches	1⅞ inches.
Length of cone	3¾ inches	2¾ inches.
Diameter of cone	2⅜ inches	2 inches.
Cone angle, apex	30°	38°.
Total weight	1.25 kg	.84 kg.
Thickness of cone	3 mm	3 mm.
Material of cone	Steel	Aluminum.

Description: This grenade is manufactured in two sizes. The basic principles of construction are the same in both sizes, but variations occur in weights, measurements and the explosive charge. The grenade consists of a cone-shaped explosive charge, a metal cone and a wooden base all contained in a silk bag. A fuze is inserted and a tail attached to the apex of the charge.

The explosive charge is cast in the form of a truncated cone. A metal cone is inserted in the base and in the upper end is a well which receives the gaine of the fuze. Surrounding the gaine is a cast ring pellet. In the large size grenade the explosive is type 94, and in the small size grenade it is Pentolite (50/50 TNT and PETN). A thin layer of waxed paper surrounds the charge.

At the bottom of the explosive charge is a wooden base which is flat on the top and rounded on the bottom. The hole in the base has a slightly smaller diameter than the hole in the cone.

Covering the charge and base is a silk bag either white or olive drab in color. When the grenade is assembled, a drawstring closes the bottom. A metal ring is inserted over the top of the bag. Inside the top of the explosive charge is fitted an adapter ring which is threaded to receive the fuze. Four screws hold the parts together.

Tied around the top of the grenade is a tail made of hemp to provide stability in flight and to make the grenade strike the tank base first.

The fuze is constructed in two parts which are threaded together. The lower body has external threads for screwing into the adapter ring and internal threads for receiving the gaine. The striker is held in position by a safety pin and creep spring. The under side of the upper body and the top of the striker are curved so that if the grenade strikes at a slight angle the striker will be cammed down.

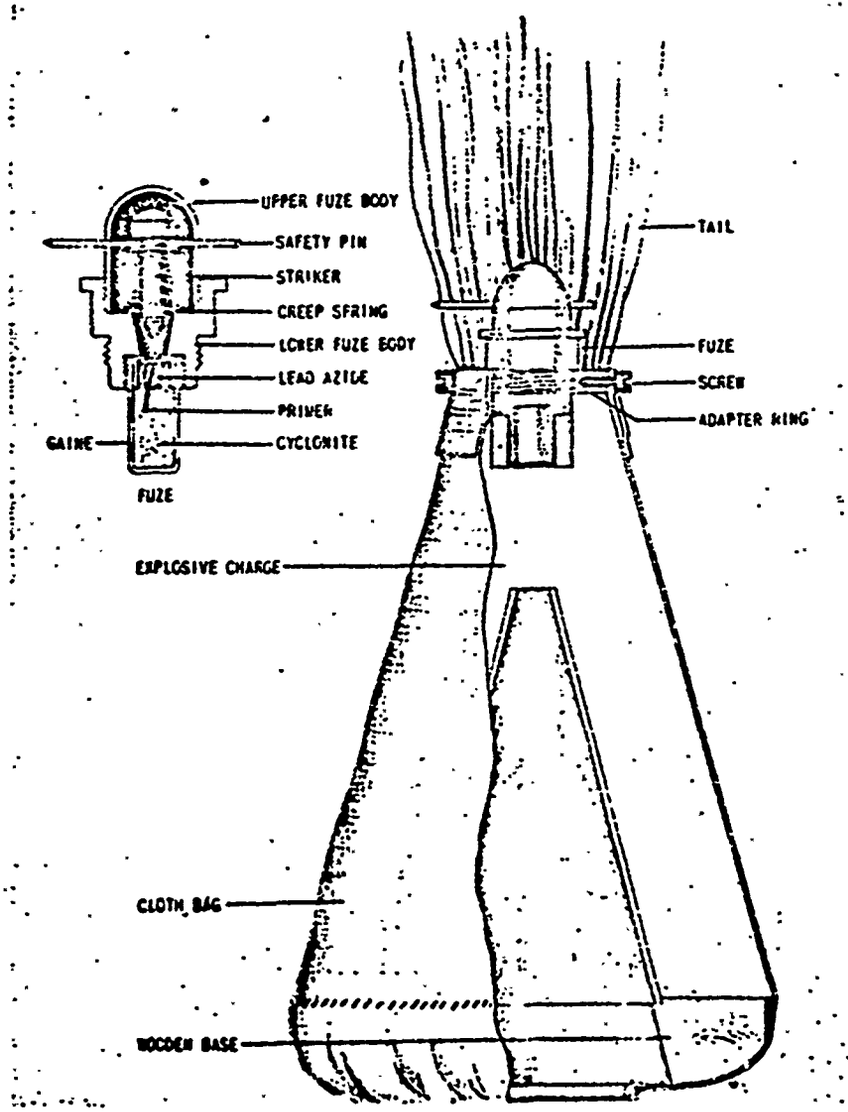

Figure 175—Type 3 Conical Antitank Hand Grenade.

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Operation: Before the grenade is thrown the safety pin is pulled out. On impact the firing pin overcomes the spring and moves down to pierce the primer. The fuze is not "all-ways action", but will probably function on a slight angle of impact.

A second small grenade has been recovered which is identical to the previously described small grenade in measurements and type of construction but differs in the following details. The silk bag which covers the charge of the second grenade is made of bright yellow finished silk. The main explosive charge is picric acid with a small R. D. X. booster. The adapter ring is bakelite instead of metal, while a straw tail is used in place of hemp. The fuze of the second grenade has a black finish, a single safety pin, and a gaine which is crimped to the fuze body, but otherwise is similar in construction and operation to the fuze of the first grenade.

Sling Hand Grenade

Over-all length: 5⅞ inches.
Maximum diameter: 1 13/16 inches.
Color: Black.

Total weight: 1 pound, 3 ounces.
Filling: TNT.
Weight of filling: 1 ounce.
Delay: 4 or 5 seconds.

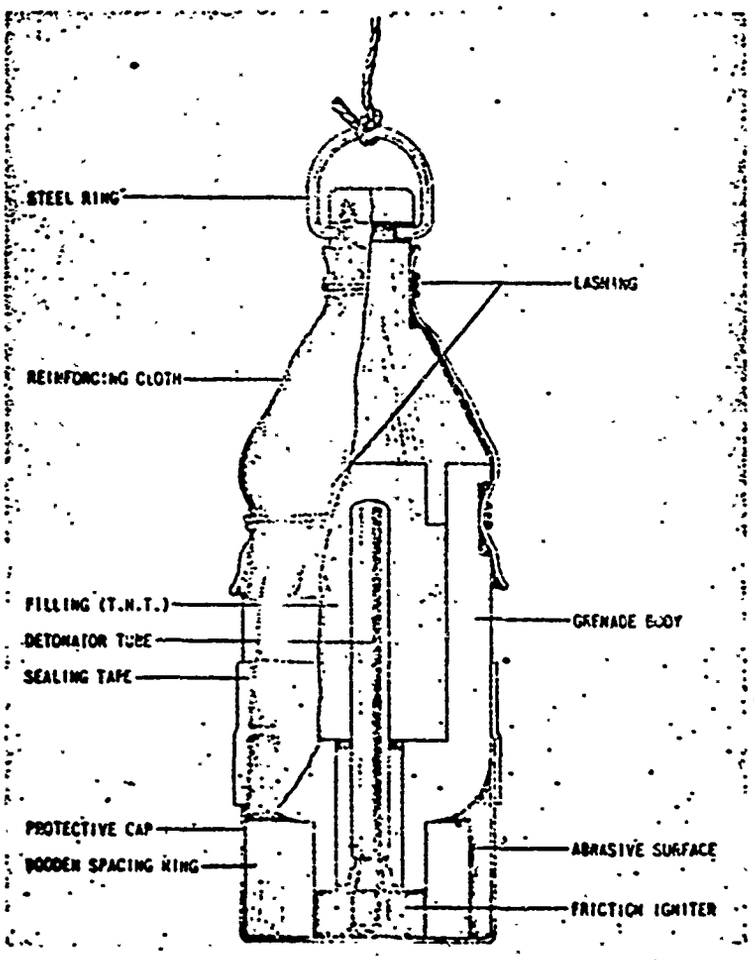


Figure 176—Sling Hand Grenade.

TB 381-5-1, C3

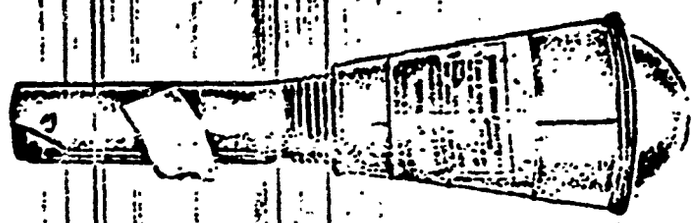
ITEM: FOM-2-1930-1-4

NOMENCLATURE: Grenade, Hand, HEAT, Model RPG-6

COUNTRY: U.S.S.R.

NATIVE DESIGNATION: РУЧНАЯ ПРОТИВОТАНКОВАЯ ГРАНАТА РПГ-6

ADOPTED: Prior to 1945



The RPG-6 high-explosive antitank hand grenade is limited standard in the Soviet Army. Like its predecessor, the RPG-43, it uses an impact fuze with a shaped charge to penetrate armored targets, and is stabilized in flight by trailing cloth strips. It differs from the RPG-43 in that the head is conical, the top surface of the head is hemispherical rather than flat, there is no collar over the handle, and the latter is of metal rather than wood. It has a somewhat greater armor penetration, approximately 4 inches. Because of its secondary fragmentation effect, the grenade should be thrown only from cover.

The stabilizing device of the RPG-6 consists of four cloth strips which are coiled inside the handle and fastened to the handle and to the safety lever. When the grenade is thrown, the ejected safety lever acts as a pilot chute and draws the cloth strips out of the handle.

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C3-15

NOMENCLATURE: Grenade, Hand, HEAT, Model RPG-6

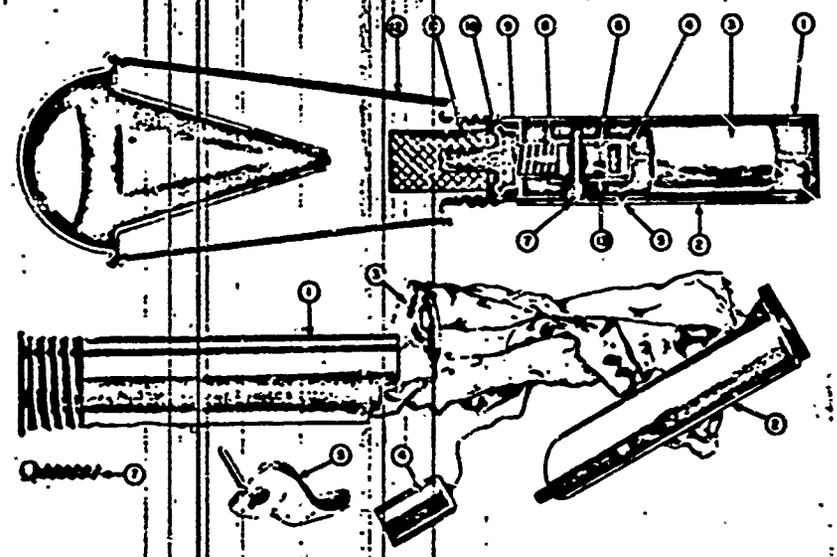
1 CURRENT STATUS: -------- Lta standard

2 CHARACTERISTICS:

a Type ---------- HEAT
b Weight ---------- 2.[illegible]3 lb
c Length ---------- 17.21 in
d Maximum diameter -------- 3.[illegible] in
e Body material ---------- Sheet steel
f Filler-weight ---------- 19.84 oz
g Filler material ---------- TNT
h Fuze-type ---------- Impact
i Fuze-delay time ---------- None
j Fuze-Nr. ---------- None
k Identifying markings ---- PG-6

3 PERFORMANCE:

a Average range thrown ------ 20 m
b Effective frag. radius --- Does not apply
c Penetration ---------- 3.94 in
d Burning time ---------- Does not apply



1. HANDLE ASSEMBLY
2. SAFETY LEVER
3. STABILIZING RUDDER
4. SAFETY CAP (CHECK BALL RETAINED LOCK)
5. PULL PIN AND TAB
6. STRIKER
7. STRIKER RETAINING PIN AND SPRING
8. ANTI-CREEP SPRING
9. STRIKER BODY
10. STRIKER LOCK
11. DETONATOR BOOSTER ASSEMBLY
12. GRENADE BODY
13. CHECK BALL

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C3-16

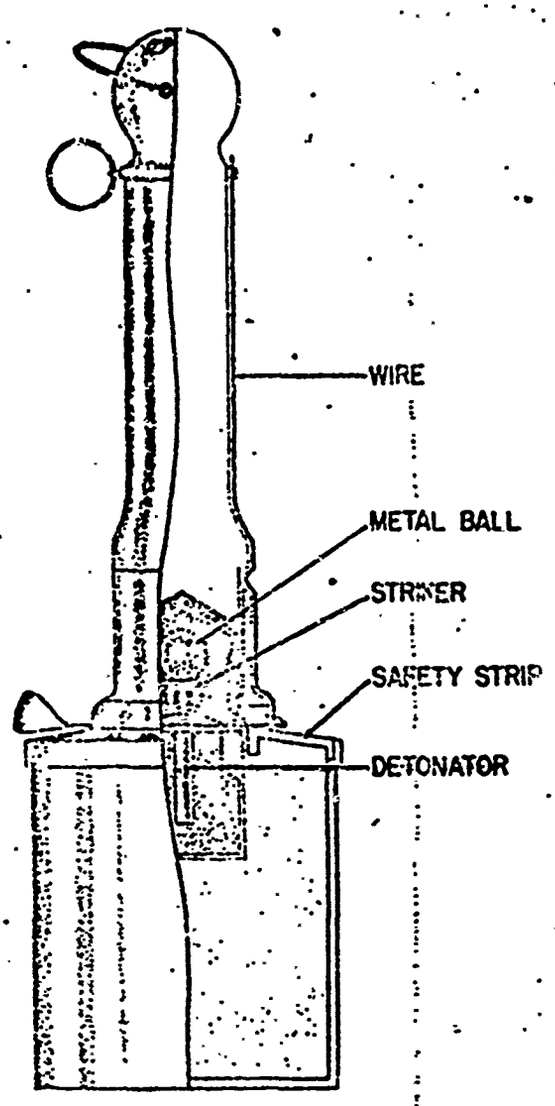

Figure 230 – "L" Type Anti-Tank Hand Grenade

"L" Type Anti-Tank Hand Grenade

Data

Over-all length	15 in.
Maximum circumference	14¼ in.
Color	Body red; handle unpainted
Total weight	4½ lb.
Length of handle	10¾ in.

Description

This grenade consists of a metal casing with a wooden throwing handle. A tab protrudes from the top of the casing. Pulling this tab removes a safety strip which, while in, blocks the striker from the detonator. There is also a small metal strip protruding from the base of the handle. This strip is held in position by a wire in the side of the handle. The wire is held in position by a piece of tape secured by a pin. The firing mechanism is always-acting, much like the O. T. O. Mod 35 Hand Grenade.

Operation

Before throwing this grenade, remove the safety strip attached to the tab. Then, holding the handle firmly, remove the pin. Be sure that the wire is held securely. When the grenade is thrown, the wire is released; this releases the small metal strip, which then moves over into a position so that the hole in it is in alignment with the striker and detonator. On impact, the striker and detonator are brought together, firing the grenade.

Remarks

This grenade was designed for use against vehicles and tanks. The grenade should be thrown at a distance of 15 to 20 meters from the target, and cover should be taken as protection against fragmentation. In the armed position, the grenade is very sensitive.

Breda Mortar Grenade

Data

Over-all length	5¼ in.
Maximum diameter	1¾ in.
Color	Body black; tail red
Type of filling	TNT

Description

The body of this grenade is steel, while the tail is of aluminum alloy. The two are screwed together. The steel cap is attached to a steel strip, and a double brass safety strip holds the cap in place. The safety strip passes through two slots near the head of the grenade, and lies in the recess of the zinc striker holder. The tail of the H. E. grenade is painted red to distinguish it from practice and instructional grenades, which have yellow and unpainted aluminum tails, respectively. It is fired from the 45-mm Light Mortar, Model 35—Brixia.

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