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FOREIGN FUZE MANUAL, FREE WORLD (U)

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FOREIGN FUZE MANUAL—FREE WORLD (U)

George M. Agamy

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PREFACE

(U) The purpose of this technical handbook on free world fuzes is to provide US Army fuze designers with the foreign state-of-the-art and developmental trends. This handbook should also be of value to other research and development organizations, planners, explosive ordnance disposal personnel, and intelligence staffs throughout the Department of Defense.

(U) Included in this handbook are standard, developmental, and obsolescent foreign Army land service fuzes. Excluded—except for bomb fuzes with artillery, mortar, or rocket ammunition applications—are Navy and Air Force fuzing.

(U) General descriptions; design details; functioning descriptions; material and explosives used; performance, test, and packaging data; status; dimensions; and weights have been provided, if available. In addition, there are many illustrations—contour drawings, full views with markings, section views, and exploded views—of the components of each fuze.

(U) Fuze categories presently treated in this manual are point detonating, point initiating base detonating, base detonating, time, proximity, electric, mine, and grenade; others will be added as new information warrants. Design details and functioning of fuze components such as delayed-arming mechanisms, timers, and safety and arming devices are described. These fuzes have application for bombs, grenades, mines, antitank guided missiles, antiaircraft guided missiles, artillery, small arms (20 through 30 mm), mortars, rockets, and recoilless ammunition.

(U) Requests for information on Army land service free world fuzes not contained in this handbook should be forwarded to the Commander, US Army Foreign Science and Technology Center, Charlottesville, VA 22901 (ATTN: AMXST-PO).

(U) Constructive criticisms, comments, or suggested changes are encouraged and should be forwarded to the Commander, US Army Foreign Science and Technology Center, Charlottesville, VA 22901 (ATTN: AMXST-PO).

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SUMMARY

(U) France, Switzerland, Sweden, Israel, Norway, United Kingdom, Belgium, Italy, Spain and the Netherlands are among the free world countries actively engaged in fuze development. Undertaken primarily to meet specific military requirements of the nations involved, these efforts are directed toward the improvement of fuze safety, reliability, and maintainability as well as the reduction of fuze cost and inventory, by using common parts and by incorporating multipurpose options into a single fuze.

(U) Most point detonating (PD) fuze developments for bombs, artillery, rockets, mortars, small arms (20 through 30 mm), and recoilless ammunition have been in the area of mortars and antiaircraft ammunition. Antiaircraft PD fuze efforts have been concentrated on design refinement to increase arming distance, improve safety and reliability, and reduce cost through parts commonalty and automated production. Mortar PD fuzes are being designed to assure safety against double loading, improve graze-sensitivity features, provide positive safety for parachute delivery, improve bore safety, increase arming distance, and increase ammunition effectiveness.

(C) Most point initiating, base detonating (PIBD) fuze developmental effort has been devoted to shaped-charge munitions for shoulder-fired weapons and/or antitank guided missiles. French achievements in the PIBD area have been most prolific; their technology surpasses the US current state-of-the-art. For example, their use of a piezogenerator function makes unnecessary a graze mechanism and arming delay timer, thereby reducing cost and simplifying fuze design. Their use of rocket motor pressure as an arming sensor coupled with a bore rider technique enhances safety. Their use of an impedance matching transformer that effectively couples a high-impedance piezoid with a low-impedance detonator increases reliability. Their hot-wire bridge detonator technology results in reliable initiation of a booster without the need for a lead charge. The technology of the United Kingdom and Japan, on the other hand, is similar to US technology and reflects current state-of-the-art. Swedish developers use a series of piezocrystals and a diode in the flat of the projectile: the use of a diode is an inexpensive technique to provide brush discrimination; the series of crystals in the flat of the projectile enhances reliability since such a fuze cannot be defeated by unconventional or bar armor.

(U) Most designs for base detonating (BD) fuzes reflect current state-of-the-art, use mechanics or electromechanics principles, and incorporate pyrotechnic delay, self-destruct, graze sensitivity, and/or instantaneous functioning.

(U) Pyrotechnic time train fuzes have been replaced by mechanical time fuzes. Efforts are being directed toward developing an accurate timer and fuze that can be readily set, toward increasing safety and reliability, and toward developing an efficient backup impact function. Although electronic timers offer better accuracy than mechanical timers, there has been no concerted effort to develop them.

(U) Considerable effort is being expended in the development of doppler, infrared, and capacitance-type proximity or VT fuzing. Current proximity fuzing efforts are aimed at improving antennas, infrared techniques, and electronics. Through the use of integrated circuit chips and encapsulation technology, tube types are being converted to transistorized versions, thereby reducing fuze cost and size.

(U) Efforts are also being made to improve battery technology and to develop a mechanical means, via a turbine-generator concept, of powering the fuze.

(C) Although no ECCM techniques are being employed in VT or proximity fuzing, the Netherlands and Sweden are conducting research on these techniques. To date, most countries rely on turning the electronics on as late as possible when the projectile or warhead is in the downward trajectory. Except for Sweden and Israel, very little work is being done on electric fuze development.

(U) There has been little advance in the state-of-the-art of mine and grenade fuzes. Grenade fuzes are still of the pyrotechnic delay type, whereas mine fuzes are pressure activated.

(U) Several years ago West Germany, in conjunction with France, was working on improved conventional munitions (ICM) minelet fuzing and had incurred problems with the self-sterilization feature of the fuzing. There is no evidence to indicate continuing development of this fuze.

LIST OF ABBREVIATIONS

APHEI	armor-piercing, high-explosive incendiary
ATGM	antitank guided missile
AWG	American Wire Gage
BD	base detonating
HE	high explosive
HEAT	high-explosive antitank
HEI	high-explosive incendiary
HEI-T	high-explosive incendiary, with tracer
HEP	high-explosive plastic
HESH	high-explosive squash head
ICM	improved conventional munitions
MT	mechanical time
MTSQ	mechanical time superquick
MV	with delay (German)
OV	without delay (German)
PD	point detonating
PDSD	point detonating, self-destroying
PDU	pressure delay unit
PIBD	point initiating, base detonating
PPO	polyphenylene oxide
RTV	temperature vulcanizing rubber
S&A	safety and arming
SAU	safety arming unit
SQ	superquick
SSQ	super-superquick
SWG	Standard Wire Gage
TPI	threads per inch
UNC	unified coarse (thread)
UNF	unified fine (thread)
UNS	unified special (thread)
VT	variable time (proximity)

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Section I.

INTRODUCTION

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Section I.

INTRODUCTION

1. (U) **Purpose and Organization**

a. **Purpose.** This technical handbook on free world foreign fuzes provides US Army fuze designers with the foreign state-of-the-art and developmental trends. It will also be useful to other research and development organizations, planners, explosive ordnance disposal personnel, and intelligence staffs throughout the Department of Defense.

b. **Organization.**

(1) To facilitate retrieval of information, this handbook is organized as follows:

Section I	Introduction
Section II	Point Detonating Fuzes
Section III	Point Initiating, Base Detonating Fuzes
Section IV	Base Detonating Fuzes
Section V	Time Fuzes
Section VI	Proximity Fuzes
Section VII	Mine and Grenade Fuzes
Section VIII	Delayed Arming Mechanisms, Timers, and S&A Devices
Section IX	Electric Fuzes, Initiators, and Igniters
Section X	Developmental Trends

New sections will be added as information becomes available.

(2) In addition, indexes of all fuzes as well as lists of illustrations are provided at the beginning of sections II through IX.

(3) Except for contour or section drawings of various fuzes, dimensions and weights are in the metric and English systems. Appendix IV contains conversion tables for metric and English units.

2. (U) **Coverage**

a. Included in this handbook are developmental and standard fuzes as well as some obsolescent fuzes for grenades, mines, bombs, antitank guided missiles, antiaircraft guided missiles, artillery, mortars, rockets, small arms (20 through 30 mm), and recoilless ammunition.

b. Technical data sheets are provided for each fuze including, if available, illustrations such as contour drawings, section views, full views, and exploded views. Technical characteristics include general descriptions, design details, functioning descriptions, materials and explosives used, performance data, test data, packaging data, status, dimensions, and weights.

3. (U) **FOM Nos.**

All fuzes, including components such as timers, delayed-arming mechanisms, and safety and arming (S&A) devices, have been assigned Foreign Materiel Catalog Numbers (FOM Nos.) in accordance with existing US Army Foreign Science and Technology procedures.

4. (U) **Data Accuracy and Reliability**

Data presented in this handbook are considered reasonably accurate and reliable. They have been derived from laboratory examination and testing of hardware, company brochures, foreign test reports, and highly reliable intelligence reports.

5. (U) **Fuze Interchangeability**

No attempt should be made to use this handbook as an authoritative source on fuze interchangeability or to test fire fuzes with ammunition other than that for which the fuze was specifically designed.

6. (U) **Production and Testing**

a. Production. Not much information is available on production facilities of the various designers or producers of foreign fuzes. Analyses of available hardware indicate good quality of workmanship with advanced manufacturing techniques used.

b. Testing. Most fuzes produced have undergone jolt, 40-ft drop, transportation, vibration, temperature and humidity, salt spray, waterproofness, fungus resistance, extreme temperature storage, rough handling, static detonator safety, sand and dust, environmental, and climatic testing in accordance with US Military Standard 331.

Section II.

POINT DETONATING FUZES

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Section II.

POINT DETONATING FUZES

GENERAL

(U) Point detonating (PD) fuzes have been designed or are under development for artillery, rocket, mortar, bomb, small arms (20 through 30 mm), and recoilless ammunition applications. These fuzes usually function on mechanical or electrical principles, by contact with the target, and with detonation at the nose end of the projectile or warhead. PD fuzes afford the most direct solution to fuzing problems and, therefore, normally do not require an excessively complex design.

(U) Most fuze developments included in this handbook have been designed for superquick (SQ) or delay functioning upon impact; some of them incorporate a graze-sensitive or self-destruct feature. Most fuzes require either a setback or centrifugal force environmental stimulus for arming; almost all have delayed arming, usually accomplished by mechanical means. With the exception of some older obsolescent types, the fuze designs presented in this handbook are well within the current state-of-the-art and, in some instances, incorporate unique features. The fuzes described in this section are designed for either high- or low-"g" accelerations and for fin- or spin-stabilized projectiles or warheads.

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*All fuze nomenclatures are UNCLASSIFIED.

*All fuze nomenclatures are UNCLASSIFIED

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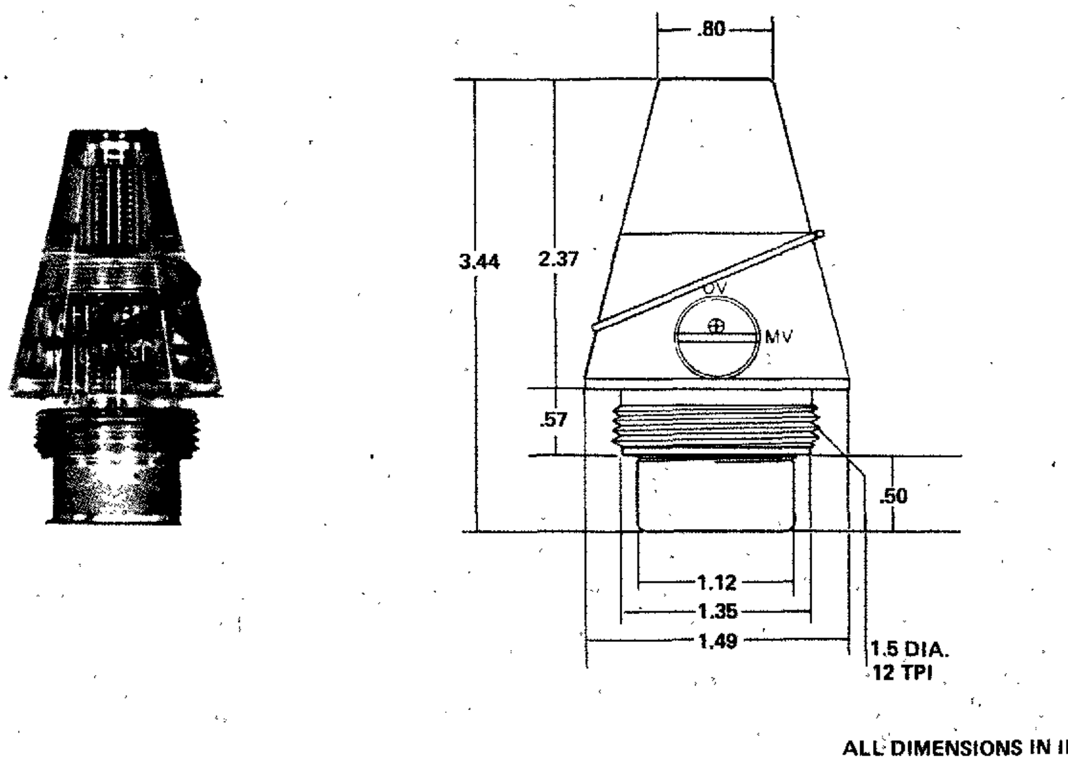

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Figure 2-1. Fuze, PD, Model AZ DM 111, full and contour views (U).

(U) **Description**

The AZ DM 111 PD fuze (fig 2-1) was developed by Junghans of West Germany for use with 81-mm mortar projectiles. It is a setback, delayed-arming type designed for either delay or SQ action upon impact. The fuze is considered detonator safe, muzzle safe, and safe against double loading.

(U) **Unique Features**

- Pull wire providing positive safety handling.
- Escapement mechanism controlling the arming of the rotor.
- Rotor housing out-of-line SQ and delay primer-detonators.

Fuze, PD, Model AZ DM 111
FOM No. 1390-16-1-1

(U) **Characteristics**

Fuze assembly:

Body material	Transparent lucite
Weight	*
Markings	OV; MV
Length	3.44 in (87.5 mm)
Body diam	1.49 in (38.1 mm)
Thread diam	1.50 in (38.1 mm)
TPI	12

Booster:

Body material	Transparent lucite
Body length	0.78 in (19.8 mm)
Body diam	1.12 in (28.6 mm)
Explosive	*
Explosive weight	*

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	**
Arming distance	50 m
Arming time	?
Delay time	?

*No weights available; item examined by Picatinny Arsenal was inert.
**Safety wire, locking ball with two setback pins, and out-of-line detonators.

(U) Design Details

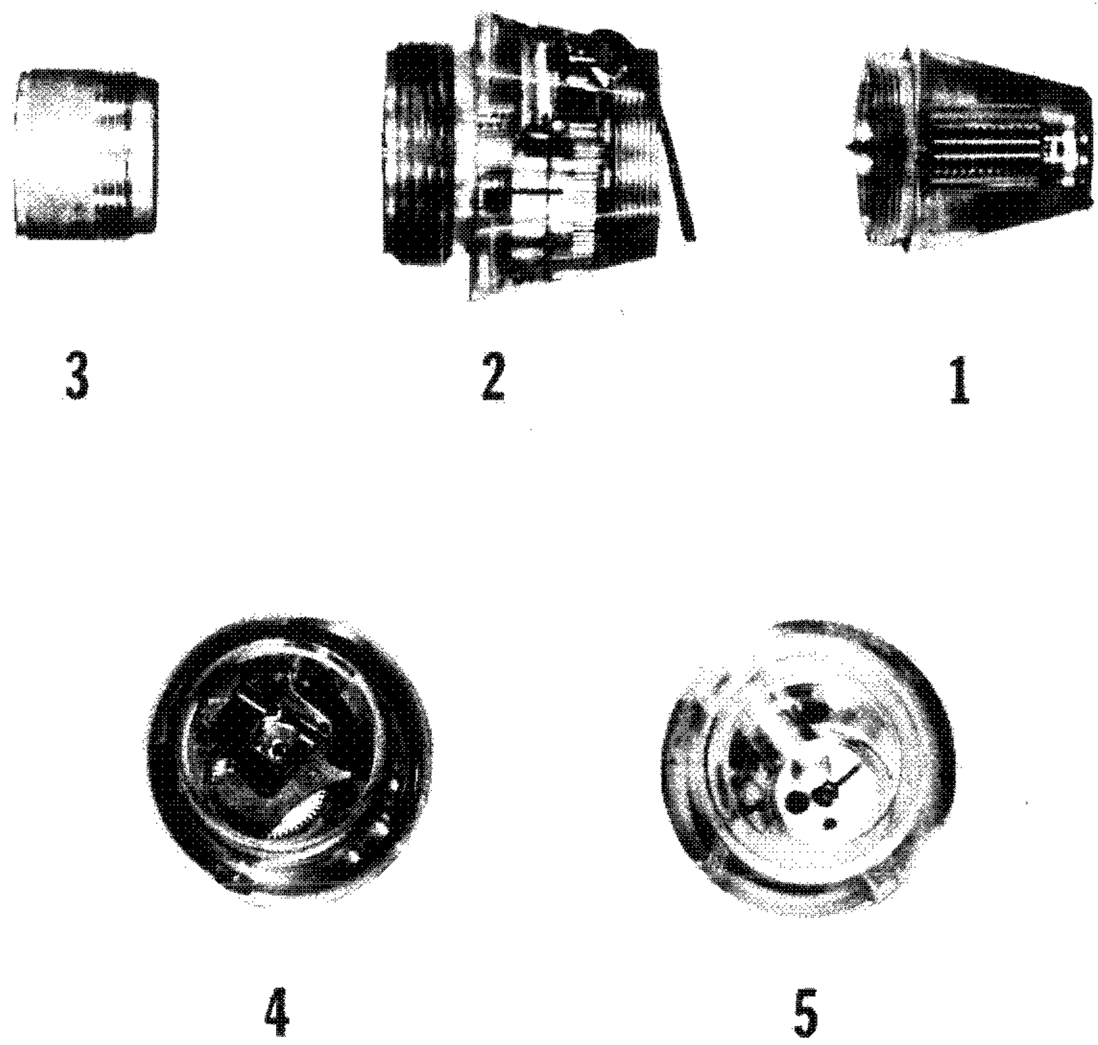

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Figure 2-2. Fuze, PD, Model AZ DM 111, disassembled components (U).

Fuze, PD, Model AZ DM 111
FOM No. 1390-16-1-1

(U) Design Details (Continued)

The AZ DM 111 main components (fig 2-2) consist of a nose section (1), body section (2), and booster assembly (3). Also shown are top and bottom views of the fuze body depicting the rotor and escapement mechanism (4) and the bottom of the rotor (5).

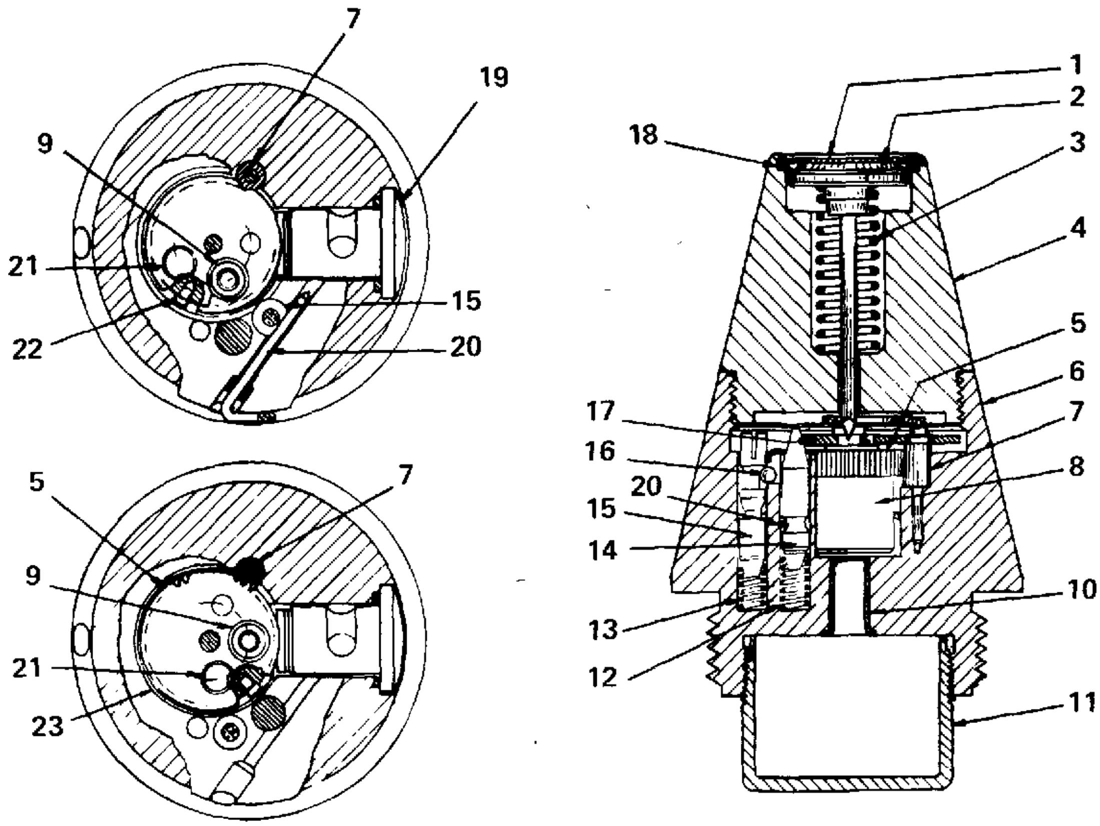

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Figure 2-3. Fuze, PD, Model AZ DM 111, detailed section view (U).

(U) Design Details (Continued)

As illustrated in figure 2-3, the fuze's nose section (4) is bored out to house the firing-pin assembly (2), consisting of a striker head and firing pin as well as its coiled spring (3). A firing-pin retainer (18) is used to keep the firing-pin assembly (2) in place. The fuze's nose section is then sealed by a disk (1), providing a watertight assemblage. The nose section is threaded externally at its base to facilitate screwing into the fuze body (6).

The fuze body is bored out to house the escapement mechanism, which involves an escapement lever (17), pinion-gear (7), and rotor-gear (5) arrangement. The rotor (8) has a locking spring (23) and contains the SQ (21) and delay (9) primer-detonators.

The detent system is contained within holes drilled in the fuze body. This includes the safety pin (15), safety-pin spring (13), locking ball (16), ball-release pin (14), and ball-release-pin spring (12). A safety wire (20) locks the safety pin (15) in place and, in turn, the escapement lever (17) and the rotor (8), providing positive safety during handling.

A hole cut transversely in the fuze body (6) houses the selector (19). The SQ primer-detonator (21) of the rotor (8) is locked by the positioning pin (22) on the selector (19). The fuze body has a central hole drilled at the rear to house the relay (10) and is threaded internally to facilitate assembly of the booster (11). The fuze body is threaded externally to facilitate assembly into 81-mm mortar projectiles.

(U) Functioning

Prior to drop-firing the projectile in the mortar (fig 2-3), the safety wire (20) is removed from the fuze. Upon firing, the ball-release pin (14) moves rearward due to setback. The locking ball (16) is freed, and the safety pin (15) is released and locked in the disengaged position by the locking spring (23). The rotor (8) is released to rotate by the latch in the safety pin (15), which sets back. The same action occurs to the lever (17) of the escapement, which controls the movement of the rotor until armed.

The movement of the rotor is also limited by the positioning pin (22), which in turn is controlled by the position of the selector (19). The SQ (OV) or the delay (MV) primer-detonator (21 or 9, respectively) is brought into the in-line position with the firing pin.

Fuze, PD, Model AZ DM 111
FOM No. 1390-16-1-1

(U) **Functioning (Continued)**

Upon impact, the firing pin is driven into the primer-detonator (21 or 9) and in turn initiates the relay (10) and finally the booster (11), resulting in the detonation of the high-explosive (HE) filler of the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectiles	81-mm mortar

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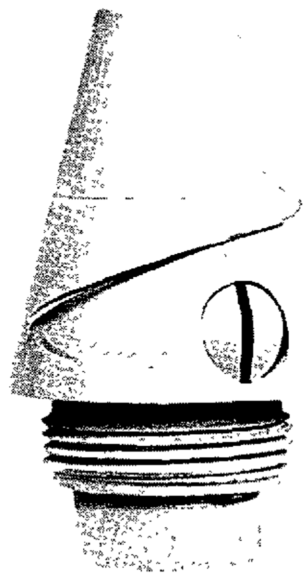

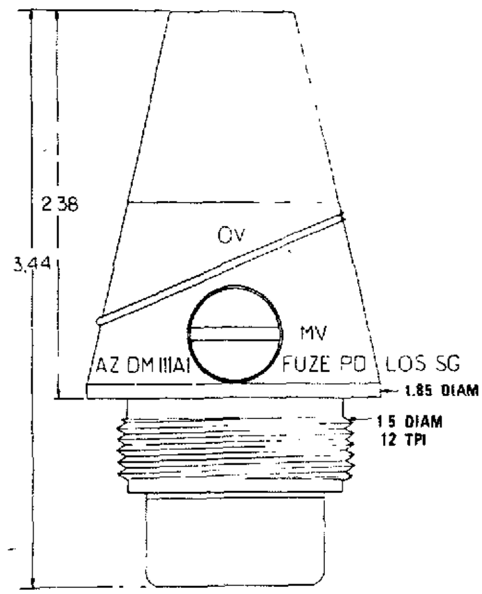

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Figure 2-4. Fuze, PD, Model AZ DM 111A1, full and contour views (U).

(U) Description

The Junghans AZ DM 111A1 (fig 2-4) is similar in design to the AZ DM 111 (FOM No. 1390-16-1-1), except that the fuze body and booster cup are made from aluminum instead of transparent plastic. It is a setback, delayed-arming type designed for either SQ or delay action upon impact. Besides its use with 81-mm mortar projectiles, it can also be used with 120-mm fin-stabilized mortar projectiles.

(U) Unique Features

- Pull wire providing positive safety during handling.
- Escapement mechanism for controlling movement of the rotor.
- Rotor housing the SQ or delay prime-detonators in the out-of-line position.

Fuze, PD, Model AZ DM 111A1
FOM No. 1390-16-1-2

(U) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	0.42 lb (191 g)
Markings	AZ DM 111A1
Length	3.44 in (87.4 mm)
Maj body diam	1.85 in (50 mm)
Maj thread diam	1.50 in (38.1 mm)
TPI	12

Booster:

Body material	Aluminum
Body length	0.805 in (20.45 mm)
Explosive	Tetryl
Explosive weight	?
TPI	20

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	50 m
Arming time	?
Delay time	0.05 s

(U) Functioning

Similar in functioning to the AZ DM 111 (FOM No. 1390-16-1-1).

*Pull wire; locking ball with two setback pins, out-of-line detonators.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectile, Model DM 11	81-mm mortar
120-mm HE projectile, Model DM 11	120-mm mortar

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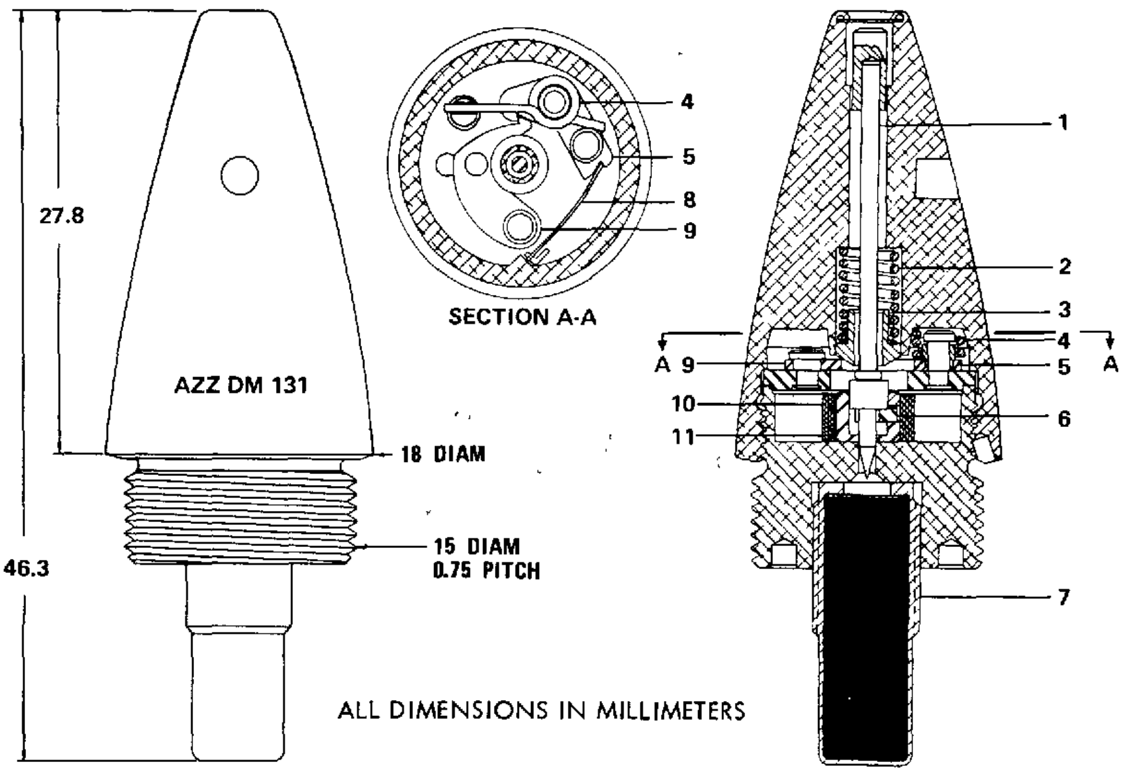

LEGEND

1. FIRING PIN
2. FIRING PIN SPRING
3. FIRING PIN SEAT
4. SELF-DESTRUCT SHUTTER PAWL SPRING
5. SELF-DESTRUCT SHUTTER PAWL
6. FIRING PIN LOCK
7. BOOSTER CUP
8. SELF-DESTRUCT SHUTTER LOCKING PAWL
9. SELF-DESTRUCT SHUTTER
10. ARMING COIL
11. FIRING PIN GUIDE

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Figure 2-5. Fuze, PDSD, Model AZZ DM 131, contour and section views (U).

(U) **Description**

The AZZ DM 131 fuze (fig 2-5) is a PD fuze with a mechanical self-destruct feature initiated by spin decay. The fuze is designed to be bore safe but does not have an out-of-line detonator. It was developed for use in West German-made high-explosive incendiary, with tracer (HEI-T), cartridges for the 20x139-mm automatic gun, Model Rh 202. This fuze has been replaced in service by the DM 281 fuze family.

Fuze, PDSD, Model AZZ DM 131
FOM No. 1390-16-1-4

(U) **Characteristics**

Fuze assembly:

Body material	Anodized aluminum
Weight	18.6 g (0.4 lb)
Markings	AZZ DM 131

Booster:

Body material	Aluminum
Body length	?
Explosive	?
Explosive weight	0.35 g (5.6 gr)

Functional data:

Arming method	Centrifugal force (arming coil)
Firing method	Impact
Safety devices	Firing-pin lock and arming coil
Arming distance	6 m
Arming time	?
Self-destruct time	~8.5 s
Delay time	?

(U) **Functioning**

In storage or transport, an arming coil holds a firing-pin lock in position to prevent the firing pin from moving rearward. A shutter in the self-destruct mechanism restrains the firing-pin spring from acting on the firing pin. Upon firing, centrifugal force resulting from projectile spin causes the arming coil to open and lie against the inner wall of the arming coil recess. Centrifugal force also causes the firing-pin lock to move radially outward, removing any restriction on the rearward movement of the firing pin. This occurs after the projectile has reached a point about 6 meters in front of the muzzle. The fuze is now armed.

Upon impact with a target beyond this distance, the fuze nose and disk are crushed. Force is transmitted to the firing pin, which is driven into the detonator to initiate fuze functioning.

(U) Functioning (Continued)

The self-destruct mechanism consists of a shutter, two pawls, and a pawl spring. In the unarmed (storage or transport) position, the shutter prevents rearward movement of the firing-pin spring seat, against which the firing-pin spring presses. The shutter is held in position by the shutter pawl, which is prevented by the shutter locking pawl from releasing the shutter. Upon firing, centrifugal force acts on both the shutter locking pawl and the shutter pawl, disengaging the shutter locking pawl from the shutter pawl and exerting force on a weight on the shutter pawl, to keep this pawl engaged with the shutter against the tendency of the pawl spring to move the pawl out of engagement with the shutter. If impact does not occur within approximately 8.5 seconds, rotation decays sufficiently for pawl-spring tension to overcome centrifugal force and rotate the shutter pawl out of engagement with the shutter. The firing-pin spring acting on the seat forces the shutter aside, plunging the firing pin into the detonator and initiating fuze functioning.

Several modifications of the DM 131 fuze were developed which were produced only in limited quantities for test: the DM 131 A1, 131 E-2, and 131 E-3A. The DM 131 E3B fuze was redesignated fuze, PDSD, M594, and is described under that designation.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
20-mm (20x139-mm) HEI-T (SD) cartridge, Model DM 51 or DM 51A1	Automatic guns, Models HS 820 and Rh 202

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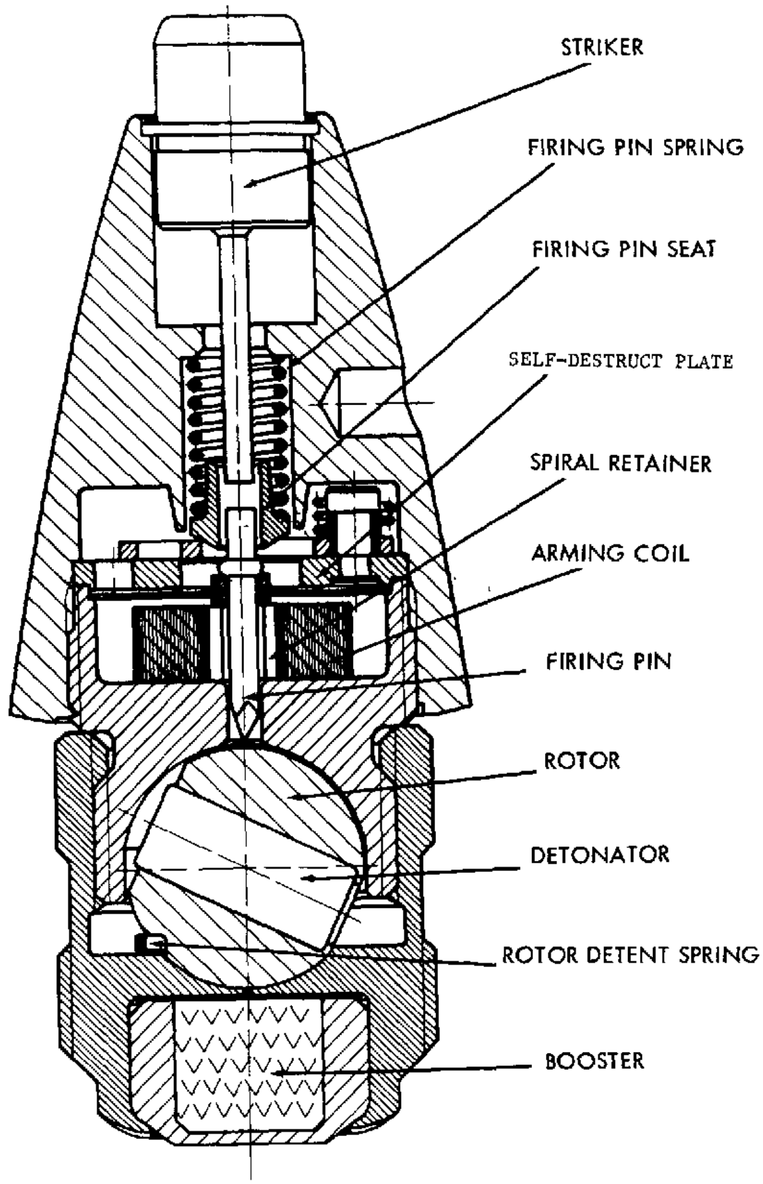

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Figure 2-6. Fuze, PDSD, Model AZZ M594, section view (U).

Fuze, PDSD, Model AZZ M594 (XM594)
FOM No. 1390-16-1-6

(U) Description

The AZZ M594 fuze (fig 2-6) is a PD fuze with an out-of-line detonator and self-destruct mechanism. It self-destructs mechanically upon spin decay. Developed during the mid-1960s by Diehl Wehrtechnik of Roethenback, West Germany, as the AZZ DM 131 E3B fuze, it is similar in design to fuze, PDSD, Model AZZ DM 281 A1 (FOM No. 1390-16-1-21). The United States is licensed to produce this fuze as the M594.

(U) Characteristics

Fuze assembly:

Body material	Steel
Weight	18 to 21 g (0.04 to 0.05 lb)
Markings	M594 (XM594)

Booster:

Body material	Aluminum alloy
Body length	45.5 mm
Explosive	Tetryl
Explosive weight	0.265 g (4.2 gr)

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Arming coil; out-of-line detonator
Arming distance	~22 m
Arming time	?
Self-destruct time	5.5 s ±1.5 s

(All safe at 15 m; all fire at 40 m)

(U) Functioning

During storage and transport, the rotor that contains the out-of-line detonator is restrained by a rotor-detent spring, while a spiral retainer surrounded by the arming coil prevents rearward movement of the firing pin.

(U) **Functioning (Continued)**

Upon firing, centrifugal force causes the rotor-detent spring to break when rotation attains a predetermined value, releasing the ball rotor, which rotates until the detonator is aligned with the firing pin and booster. Centrifugal force also causes the arming coil to open until it lies against the inner wall of the recess. The spiral retainer also moves outward under the influence of centrifugal force, thus removing any restriction on the rearward movement of the firing pin. This occurs between 15 meters and 40 meters in front of the muzzle. The fuze is now armed.

When the armed fuze impacts a target whose resistance equals or exceeds that of 1-mm dural, the flange of the striker is sheared off, allowing the striker to drive the firing pin into the detonator, initiating detonation of the projectile.

If the projectile does not strike a target, self-destruction will occur after about 5.5 seconds, which is beyond the maximum tactical range. The mechanical self-destruct mechanism is like that of fuze, PDSD, Model AZZ DM 281 A1 (FOM No. 1390-16-1-21). It consists of a shutter, two pawls, and a pawl spring. In the unarmed state, the shutter prevents rearward movement of the firing-pin spring seat, against which the firing-pin spring presses. The shutter is held in position by the shutter pawl, which is prevented by the shutter locking pawl from releasing the shutter. Upon firing, centrifugal force acts on both the shutter locking pawl and the shutter pawl, disengaging the shutter locking pawl from the shutter pawl and exerting force on a weight on the shutter pawl, to keep this pawl engaged with the shutter against the tendency of the pawl spring to move the pawl out of engagement with the shutter. If impact does not occur within the maximum tactical range, rotation decays sufficiently for the pawl-spring tension to overcome centrifugal force and rotate the shutter pawl out of engagement with the shutter. The firing-pin spring acting on the seat forces the shutter aside, plunging the firing pin into the detonator and initiating fuze functioning. The relationship between self-destruct time, range, velocity, and spin decay is shown in figure 2-7. The fuze is rain safe and will not function on impact with grass or thin brush.

Fuze, PDSD, Model AZZ M594 (XM594)
FOM No. 1390-16-1-6

(U) Functioning (Continued)

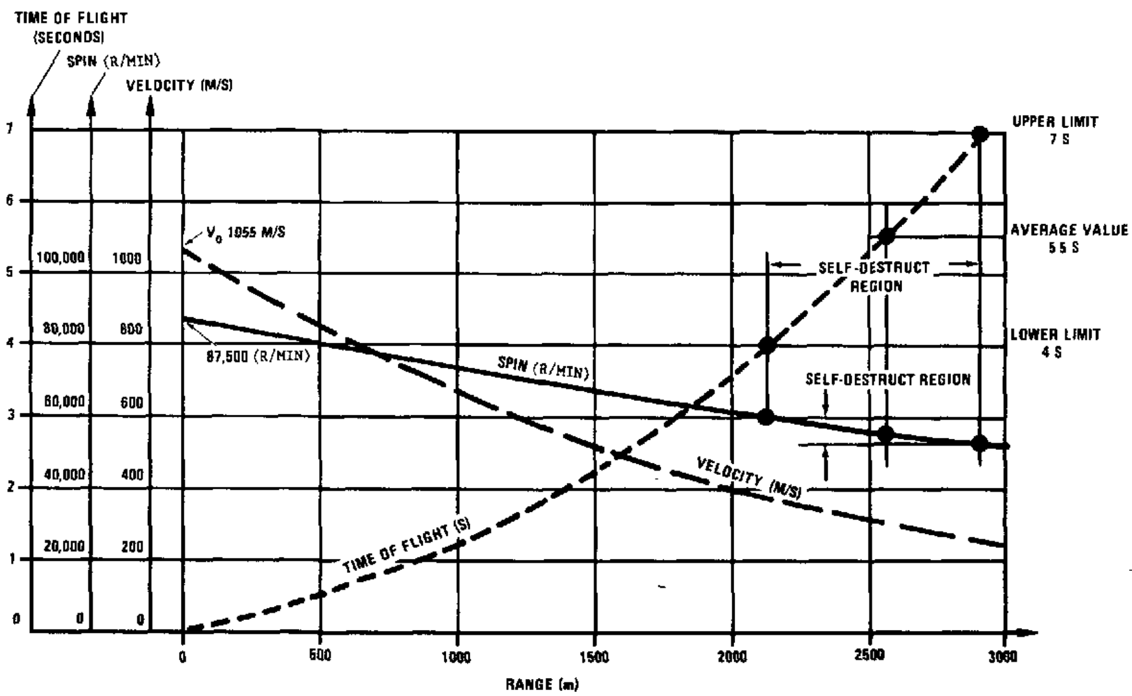

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Figure 2-7. Fuze, PDSD, Model AZZ M594, performance curves (U).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
20-mm (20x139-mm) HEI (HEI-T) cartridge	Hispano-Suiza HS-820 series; Rheinmetall Rh 206
20-mm HEI-T cartridge, M599, with fuze, PDSD, M594	20-mm automatic gun, Model M139

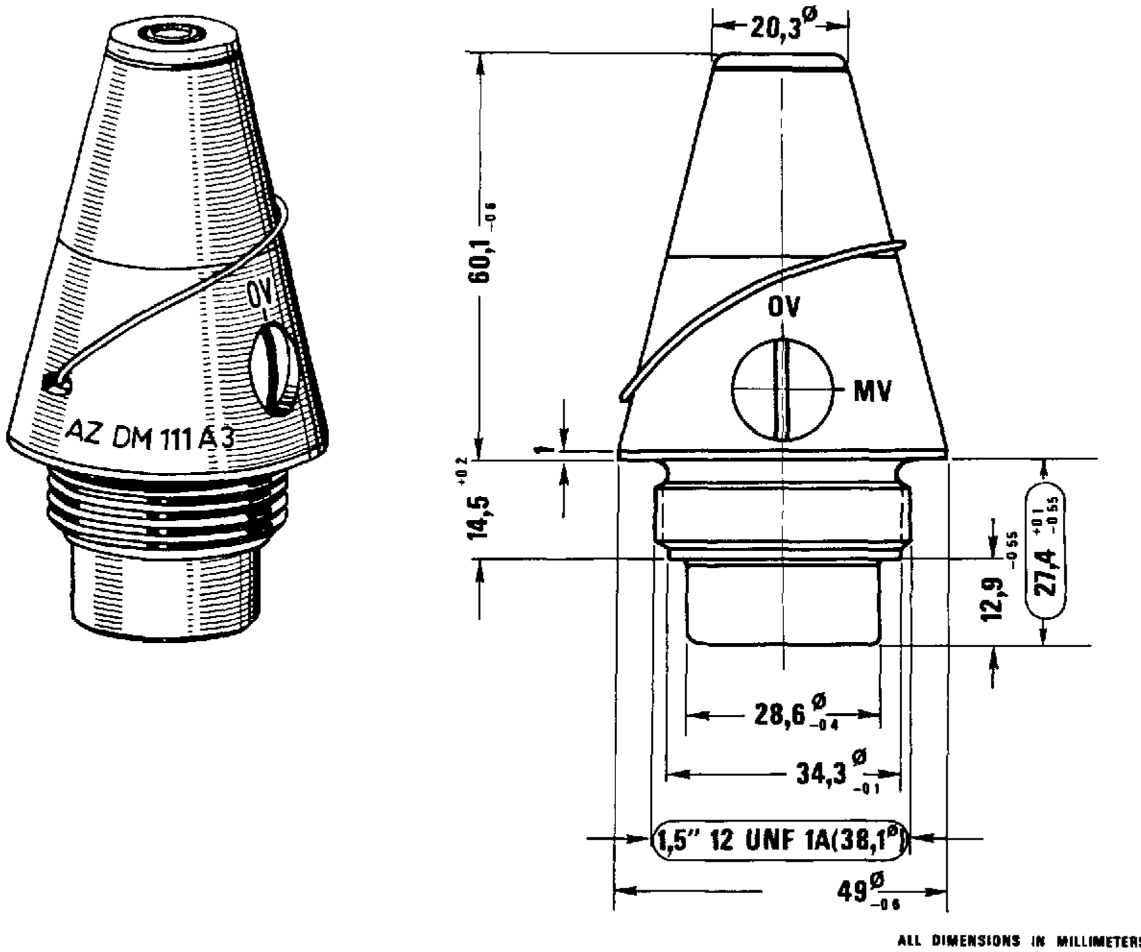

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Figure 2-8. Fuze, PD, Model AZ DM 111A3 (U).

(U) Description

The AZ DM 111A3 PD fuze (fig 2-8) was developed by Junghans of West Germany for use with 81-mm and 120-mm mortar projectiles. The fuze thread employed is a 1.5-in (38-mm) diameter D12 UNF-1A. The AZ DM 111A3 is a setback, delayed-arming type designed for either super-sensitivity action upon impact or delayed action. It is similar in design to that of the AZ DM 111 and AZ DM 111A1 fuzes except for a protruded striker head providing a graze-sensitivity feature.

Fuze, PD, Model AZ DM 111A3
FOM No. 1390-16-1-9-1

(U) **Unique Features**

- Protruding striker head.
- Pull wire providing positive safety during handling.
- Escapement mechanism for delaying or controlling the movement of the rotor.
- Rotor housing out-of-line SQ and delay detonators.

(U) **Characteristics**

Fuze assembly :

Body material	Aluminum
Weight	0.45 lb (204 g)
Markings	AZ DM 111A3
Length	87.5 mm (3.44 in)
Thread diam	38.1 mm (1.5 in)

Booster :

Body material	Aluminum
Body length	0.81 in (20.6 mm)
Explosive	Tetryl
Explosive weight	?
Body diam	28.6 mm (1.13 in)

Functional data :

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	50 m
Arming time	1.01 s
Delay time	0.05 s

*Pull wire, two detent pins and locking ball, out-of-line detonators.

(U) Design Details and Functioning

See technical data sheets FOM No. 1390-16-1-1, Fuze, PD, AZ DM 111 and FOM No. 1390-16-1-2. For further design details depicting the interface of the firing-pin assembly, escapement, rotor-selector, stud, and detent system, see section VIII, Delay-Arming Mechanism, etc.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles, 81-mm smoke (WP) projectiles	81-mm mortar
120-mm HE projectiles, 120-mm smoke (WP) projectiles	120-mm mortar

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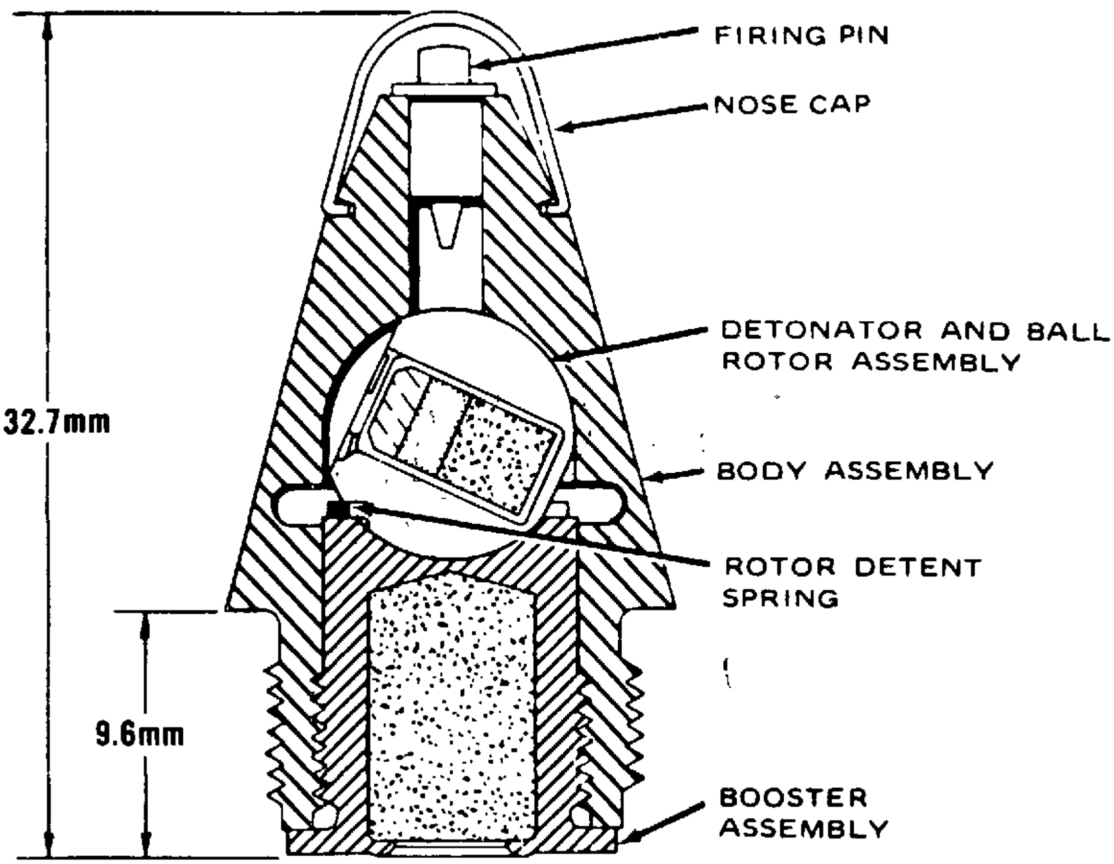

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Figure 2-9. Fuze, PD, Model AZ DM 221, section view (U).

(U) Description

Fuze, PD, Model AZ DM 221 (fig 2-9), is a PD fuze with an out-of-line detonator mounted in a ball rotor. It has no self-destruct mechanism. This fuze is a copy of the US M505 A-3 fuze; like the latter, it is intended for use in 20x102-mm ammunition.

Fuze, PD, Model AZ DM 221
FOM No. 1390-16-1-13

(U) Characteristics

Fuze assembly:

Body material	Steel
Weight	21.7 g ? (0.048 lb)
Markings	AZ DM 221

Booster:

Body material	Steel
Body length	32.7 mm (1.29 in)
Explosive	HMX
Explosive weight	~0.4 g (2.5 gr)

Functional data:

Arming method	Centrifugal force
Firing method	Impact
Safety devices	Out-of-line detonator (ball rotor)
Arming distance	6 to 11 m
Arming time	?
Self-destruct time	?
Delay time	?

(U) Functioning

Prior to firing, the rotor containing the detonator is locked out of line by the rotor detent spring. Upon firing, centrifugal force due to projectile rotation causes the spring to open, allowing the rotor to move in line with the firing pin. The fuze is now armed. The firing pin is restrained from movement by a thin shoulder. Upon impact, the nose cap is crushed against the firing pin, forcing the latter against the detonator. The detonator initiates the booster, which in turn detonates the main explosive charge of the projectile. There is no self-destruct feature.

Fuze, PD, Model AZ DM 221
FOM No. 1390-16-1-13

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
20x102-mm HE projectile, Model DM 61	Automatic gun (Vulcan), Model M 61

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Fuze, PD, Model AZ DM 51
FOM No. 1390-16-1-15

(FOUO) **Description**

AZ DM 51 is the West German designation for a copy of US fuze, PD, M48A3. This fuze is manufactured by Diehl, West Germany, and is standard in the West German Armed Forces. See Department of Army TM 9-1300-203 for details.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
76x578-mm smoke ("Fog") cartridge, Model ?	76-mm guns
90x602-mm smoke ("Fog") cartridge, Model ?	90-mm guns

(FOUO) **Interchangeability**

Fuze AZ DM 51 is redesignated fuze AZ DM 211 when utilizing German booster ZDL DM 42. Fuze AZ DM 51 is redesignated fuze AZ DM 41 when utilizing US booster M21A4. Fuze AZ DM 51 is redesignated fuze AZ DM 151 when utilizing US booster M125A1 (German booster ZDL DM 32). Fuze AZ DM 51 is designated fuze AZ DM 241 when a rain safety device and booster ZDL DM 42 are added and the fuze nose portion is filled with epoxy.

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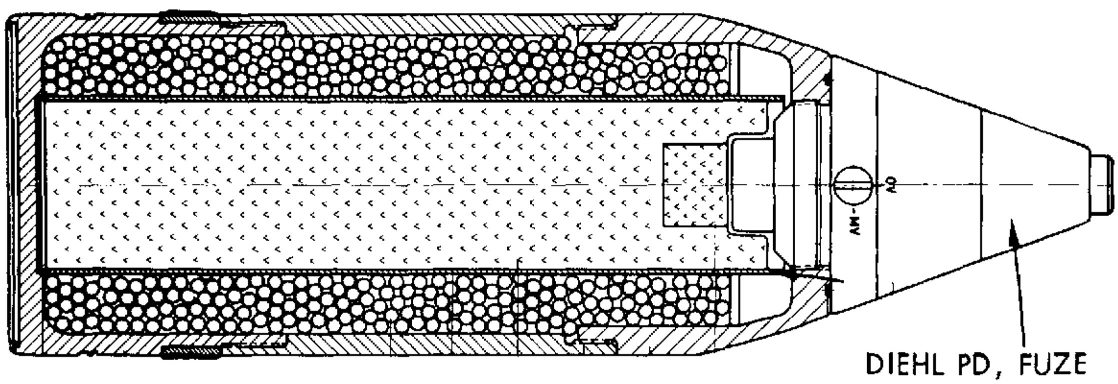

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Figure 2-10. Fuze, PD, Model Diehl with 106-mm fragmentation projectile (U).

(C) Description

This West German PD fuze (fig 2-10) was developed by Diehl for use with 106-mm fragmentation projectiles fired from the M40 RCL rifle. It is a setback, delayed-arming fuze designed for either SQ or delay action upon impact. The fuze is considered detonator safe for handling, transporting, and air delivery. It is also rainproof and waterproof. It is expected to function reliably under temperatures from -40 to +60°C.

(U) Unique Features

- Escapement mechanism for delay arming.
- Detent system on firing pin.
- Rotor housing out-of-line explosives detented by two setback pins.
- Graze-functioning feature via booster lead plunger.

Fuze, PD, Model Diehl
FOM No. 1390-16-1-16

(C) **Characteristics**

Fuze assembly:
- Body material . . . . ?
- Weight . . . . 400 g (0.881 lb)
- Markings . . . . ?

Booster:
- Body material . . . . ?
- Body length . . . . ?
- Explosive . . . . ?
- Explosive weight . . . . 15 g (0.033 lb)

Functional data:
- Arming method . . . . Setback
- Firing method . . . . Impact
- Safety devices . . . . *
- Arming distance . . . . 100 m
- Arming time . . . . ?
- Delay time . . . . 0.6 s

Fuze sensitivity:
Functions reliably on 2-mm dural or 10-mm pine wood

*Locking balls (2), locking spring, setback pins (2), out-of-line detonators of S&A device.

(C) Design Details

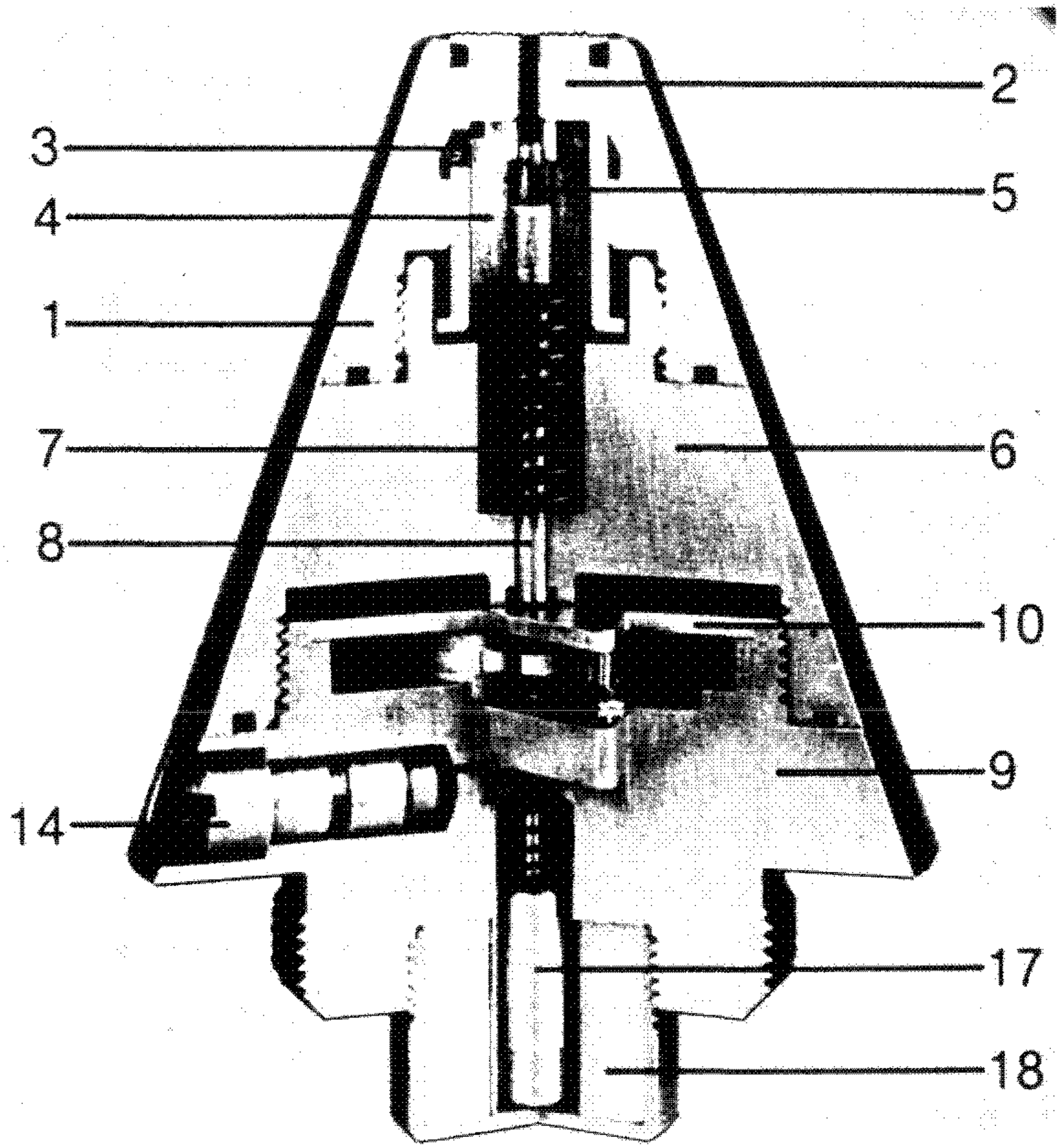

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Figure 2-11. Fuze, PD, Model Diehl, section view (U).

Fuze, PD, Model Diehl
FOM No. 1390-16-1-16

(C) Design Details (Continued)

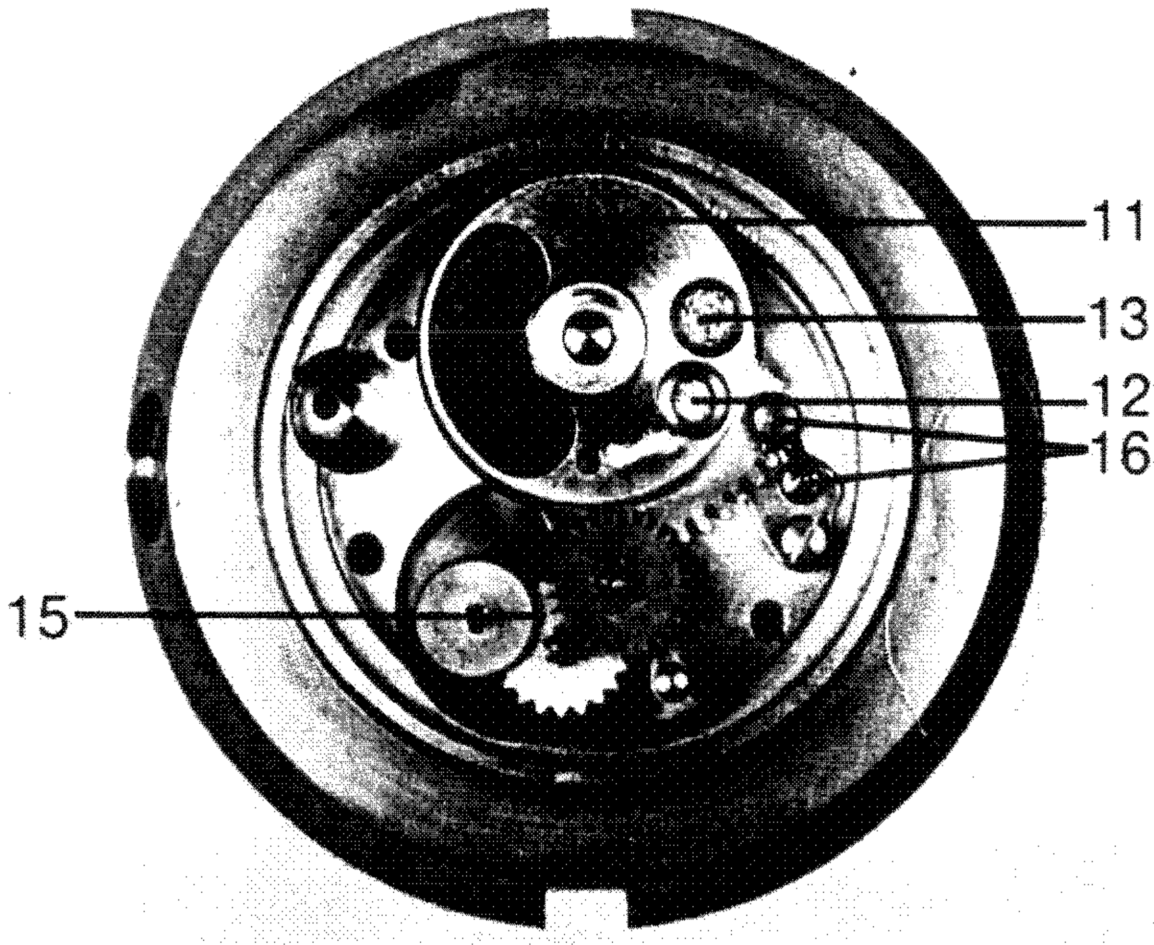

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Figure 2-12. Fuze, PD, Model Diehl, section view of delay-arming mechanism (U).

The Diehl PD fuze (fig 2-11) is a four-piece construction consisting of the fuze nose or top (1), upper fuze body (6), lower fuze body (9), and booster assemblage (17, 18).

The firing-pin assembly includes the firing-pin head (2), its spring, and the firing pin (8).

(C) Design Details (Continued)

The detent system on the firing pin includes two locking balls (3), setback sleeve (4), its locking spring (5), and setback or pressure spring (7).

The lower fuze body (9) houses the safety and arming (S&A) mechanism (10) and the setting stud or pin (14). In addition, the lower fuze body has a central hole drilled into it at the base and is threaded internally to facilitate assembly of the inertial-type booster lead charge (17), its spring, and the booster (18).

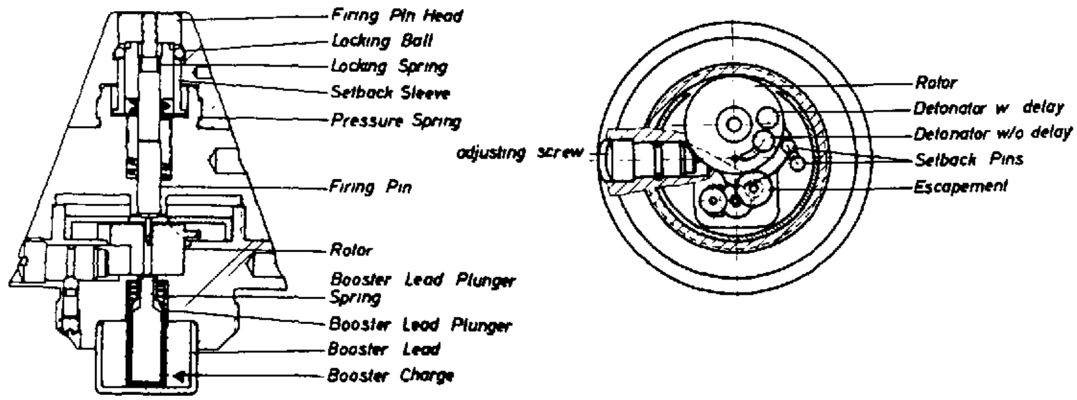
The S&A mechanism (10) (fig 2-12) includes the spring-loaded slider (11) housing the OV (instantaneous) detonator (12) and the MV (delay) detonator (13). The slider housing is detented by two setback pins (16) and contains a tooth sector that meshes with the escape wheel (15) of the escapement.

The upper fuze body (6), which is threaded internally, screws into the fuze top (1). An "O" ring is used to provide a watertight seal.

The lower fuze body (9), which is threaded externally, screws into the base of the upper fuze body (6). An "O" ring is also used to provide a watertight seal. The lower fuze body is threaded internally at its base to facilitate assembly of the booster lead plunger (17) and booster (18) housing. The lower fuze body is also threaded externally to facilitate assembly into the 106-mm controlled fragmentation projectile.

Fuze, PD, Model Diehl
FOM No. 1390-16-1-16

(C) Functioning



Safe Position

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Figure 2-13. Fuze, PD, Model Diehl, section view of components in safe position (U).

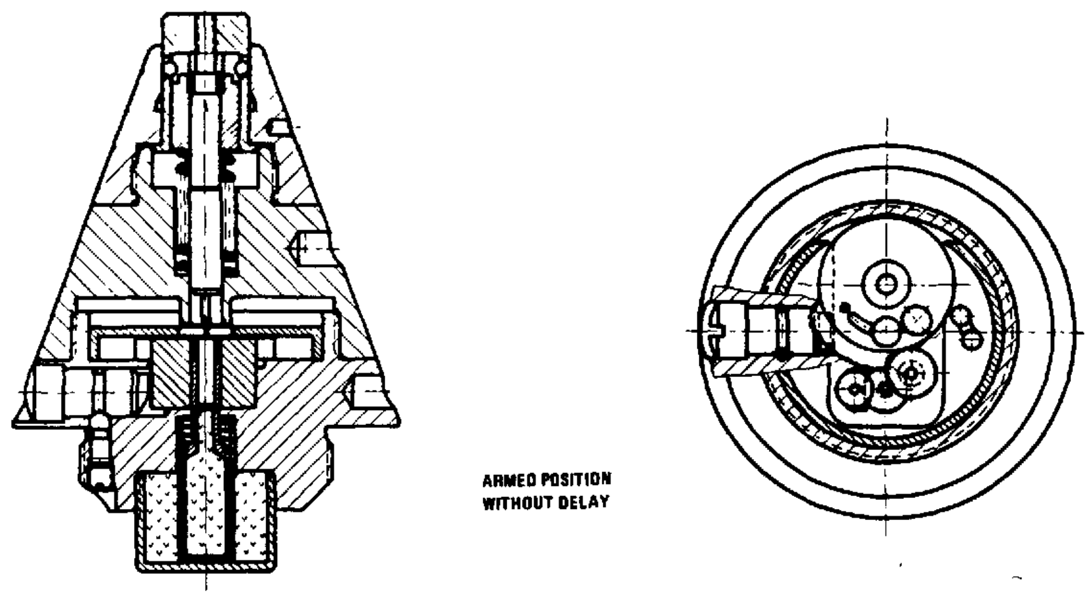

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Figure 2-14. Fuze, PD, Model Diehl, section view of components in armed position (U).

(C) Functioning (Continued)

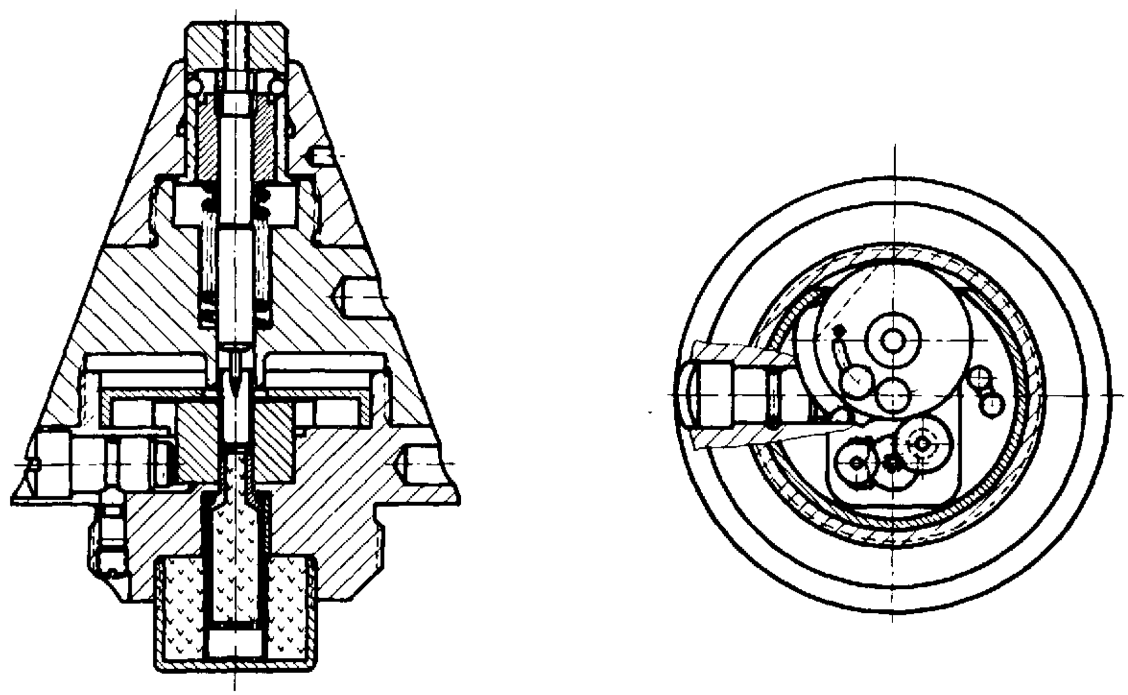

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Figure 2-15. Fuze, Model Diehl, inertial ignition with delay action (U).

Setting (fig 2-13). The slot in the setting stud is aligned with either the OV or the MV detonator. After firing, the setting stud will stop rotation of the spring-loaded rotor at the desired point.

Arming (fig 2-13). On firing, inertia forces the setback sleeve to fall back. In this position it is locked by the locking spring. The rotor, kept in safe position by the two setback pins, is released simultaneously, but still kept in safe position by the firing pin. The locking balls, up to now having locked the firing-pin head sleeve to the fuze top, enter the space cleared by the setback sleeve. After acceleration has ceased, the compressed pressure spring expands and moves the locked setback sleeve, the locking balls, and the firing pin with its screwed-on head forward and out of the fuze top. This movement simultaneously lifts the firing pin out of its bore in the rotor, releasing it. An escapement delays the rotation of the spring-loaded rotor, providing delayed arming.

Fuze, PD, Model Diehl
FOM No. 1390-16-1-16

(C) Functioning (Continued)

Impact ignition (fig 2-14). On impact, the firing pin is thrust either into the OV or into the MV detonator, according to the setting of the fuze.

Graze functioning (fig 2-15). Shoulder impact causes deceleration of the projectile. Inertia forces the booster lead plunger to fall forward, pushing the detonator towards the point of the firing pin.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
106-mm FRAG projectile	M40 106-mm RCL rifle

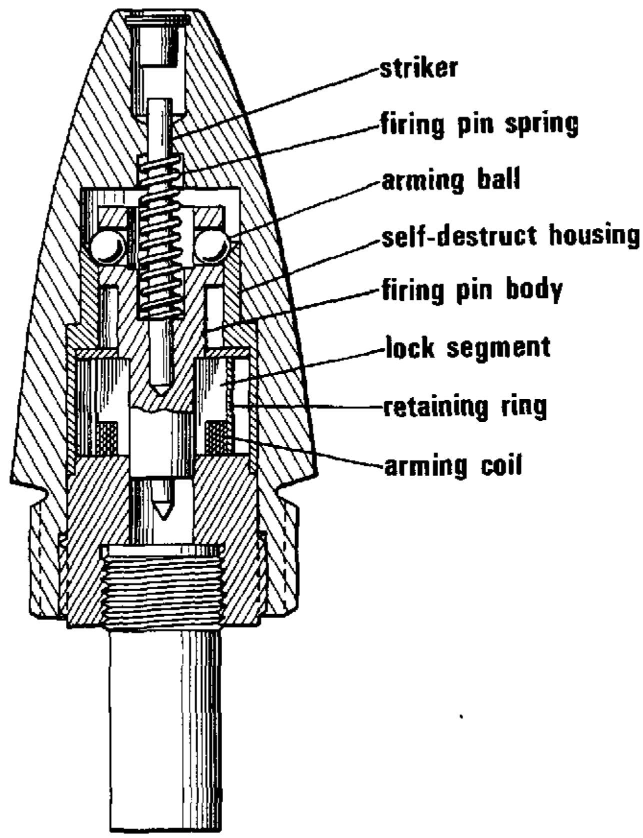

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Figure 2-16. Fuze, PDSD, Model AZZ DM 31, section view (U).

(U) Description

This PDSD fuze (fig 2-16) is similar in design and function to fuze, PDSD, Model FDPA 1502 (FOM No. 1390-17-1-18). It is obsolete in the Federal Republic of Germany.

Arming is accomplished by means of an arming coil, opening under the influence of spin, that releases firing-pin lock segments. Mechanical self-destruct occurs when spin has dropped below a predetermined rate. This fuze does not have an out-of-line detonator.

Fuze, PDSD, Model AZZ DM 31
FOM No. 1390-16-1-20

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	?
Markings	AZZ DM 31

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Arming coil-lock segments
Arming distance	?
Arming time	?
Self-destruct time	?
Delay time	?

(U) **Functioning**

In storage and transport, the firing pin is restrained from contact with the detonator by several lock segments, held in position by a retaining ring and an arming coil. Upon firing, setback forces increase the pressure exerted against the lock segments by a shoulder on the firing-pin body. This pressure prevents the lock segments from moving radially under the influence of centrifugal force. The lock segments in turn press against the arming coil and keep the latter from uncoiling. At the same time, centrifugal force opens the retaining ring so that it lies against the inner wall of the self-destruct housing. As acceleration ceases and setback pressure is removed, centrifugal force causes the four steel arming balls to move radially outward against the conical inner lip of the self-destruct housing, lifting the firing-pin body and further compressing the firing-pin spring. As the firing-pin body is lifted and pressure on the lock segments is removed, the arming coil is freed. Centrifugal force causes the arming coil to unwind, permitting the lock segments to move radially, clearing the shoulder on the firing-pin body. The time required for the arming coil to open after setback ceases provides bore and muzzle safety. At this point the fuze is armed.

(U) Functioning (Continued)

Upon striking a target, impact is transmitted through the striker to the firing-pin body, overcoming the centrifugal force that causes the four steel balls to restrain the firing pin body. The firing-pin spring thrusts the firing-pin body against the detonator to initiate detonation.

If the projectile fails to hit a target, centrifugal force weakens as spin drops with time of flight, until the pressure of the firing-pin spring overcomes the centrifugal force acting on the four steel balls. At this point, the firing-pin spring drives the firing-pin body against the detonator to initiate self-destruct.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
20x139-mm, HEI cartridge, Model DM 131	Automatic gun, Model Rh-202

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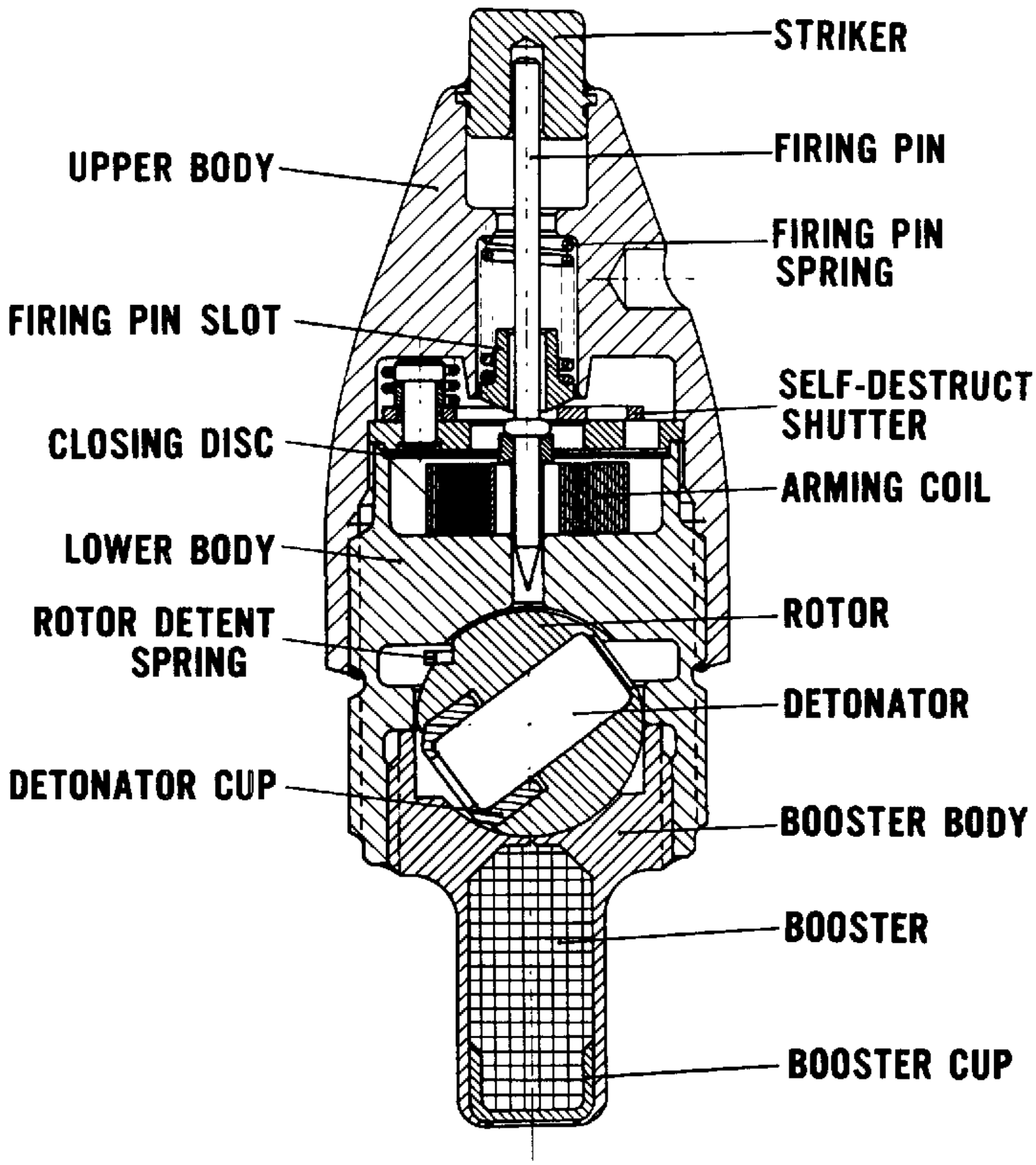

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Figure 2-17. Fuze, PDSD, Model AZZ DM 281A1, section view (U).

Fuze, PDSD, Model AZZ DM 281A1
FOM No. 1390-16-1-21

(U) **Description**

The AZZ DM 281A1 (fig 2-17) is a PDSD fuze with out-of-line detonator designed for 20x139-mm HEI cartridges. It is similar in design to fuze, PDSD, Model AZZ DM 131, but with the addition of a ball rotor and increased muzzle safety.

(U) **Characteristics**

Standard 20x139-mm fuze, replacing DM 131 series fuzes.

Fuze assembly:	
Body material	Aluminum alloy anodized
Weight	17.6 g (0.038 lb)
Markings	AZZ DM 281A1
Booster:	
Body material	Cadmium-plated steel
Body length	19.0 mm (0.75 in)
Explosive	Tetryl
Explosive weight	0 35 g (5.4 gr)
Self-destruct time:	
5° barrel twist	2.6±0.5 s
6° barrel twist	5.8±0.5 s
Self-destruct distance:	
5° barrel twist	Over 1500 m
6° barrel twist	Over 2500 m
Functional data:	
Arming method	Spin
Firing method	Impact
Safety devices	Out-of-line detonator; arming coil
Arming distance	20 m
Arming time	?
Delay time	?

(U) **Functioning**

During storage and transport, the detonator rotor is held 64° out of line with the firing pin and booster by a rotor-detent spring, while a spiral retainer surrounded by an arming coil prevents rearward movement of the firing pin.

Upon firing, centrifugal force acts on the rotor-detent spring to move it out of engagement with the ball rotor, which rotates until the detonator is aligned with the firing pin and booster. Centrifugal force also causes the arming coil to open until it lies against the inner wall of the recess. The spiral retainer also opens under the influence of centrifugal force, thus removing any restriction on the rearward movement of the firing pin. This occurs about 20 meters in front of the muzzle. The fuze is now armed.

When the armed fuze impacts a target whose resistance equals or exceeds that of 1-mm dural, the flange of the striker is sheared off, allowing the striker to drive the firing pin into the detonator, initiating detonation of the projectile.

If the projectile does not strike a target, self-destruction will occur at a point about 500 meters beyond the maximum tactical range. The mechanical self-destruct mechanism consists of a shutter, two pawls, and a pawl spring. In the unarmed state, the shutter prevents rearward movement of the firing-pin spring seat, against which the firing-pin spring presses. The shutter is held in position by the shutter pawl, which is prevented by the shutter locking pawl from releasing the shutter. Upon firing, centrifugal force acts on both the shutter locking pawl and the shutter pawl, disengaging the shutter locking pawl from the shutter pawl, and exerting force on a weight on the shutter pawl, to keep this pawl engaged with the shutter against the tendency of the pawl spring to move the pawl out of engagement with the shutter. If impact does not occur within the maximum tactical range, rotation decays sufficiently for the pawl-spring tension to overcome centrifugal force and rotate the shutter pawl out of engagement with the shutter. The firing pin spring acting on the seat forces the shutter aside, plunging the firing pin into the detonator and initiating fuze functioning. Figure 2-18 shows the self-destruct region when fuzed projectiles are fired from barrels having a 5° and a 6° rifling pitch.

Fuze, PDSD, Model AZZ DM 281A1
FOM No. 1390-16-1-21

(U) Functioning (Continued)

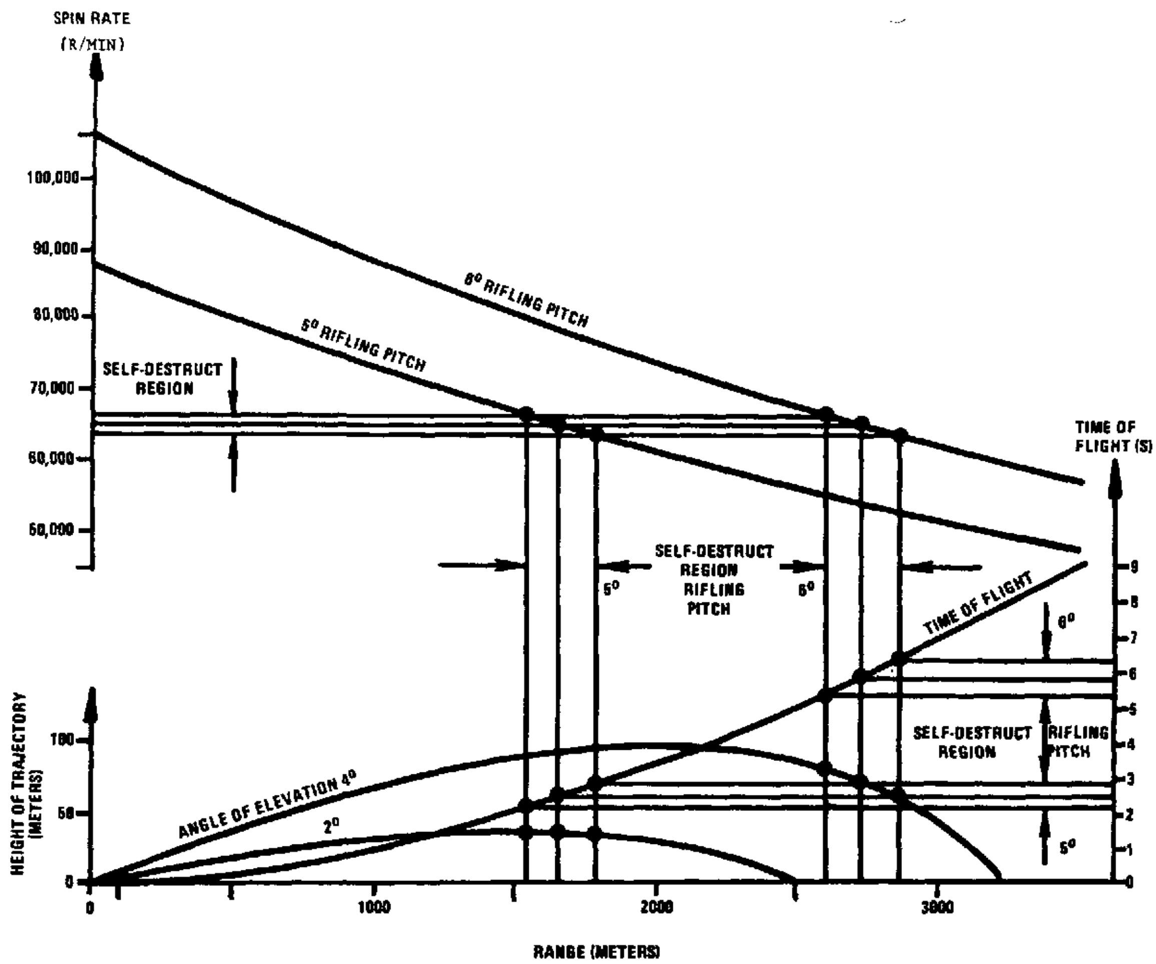

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Figure 2-18. Fuze, PDSD, Model AZZ DM 281A1, self-destruct as a function of range (U).

Fuze, PDSD, Model AZZ DM 281A1
FOM No. 1390-16-1-21

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
20x139-mm HEI cartridge, Model DM 131	Automatic gun, Model Rh-202

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Fuze, PDSD, Model AZZ DM 121
FOM No. 1390-16-1-23

(FOUO) **Description**

The West German PDSD fuze, Model AZZ DM 121, is a copy of the Italian fuze, Model M6, produced by Bombrini-Parodi-Delfino (B.P.D.) of Rome, Italy. This fuze is standard for use in the West German Armed Forces. Details on this fuze (FOM No. 1390-23-1-6) appear on page 2-227.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
40x311-mm HEI-T cartridge, Model (?)	40-mm antiaircraft gun, Model L/60 (Bofors)

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Fuze, PD, Model AZ DM 21
FOM No. 1390-16-1-24

(FOUO) Description

The AZ DM 21 West German fuze is a copy of the US Navy fuze Mk27/1 discussed in TM 9-1300-203. The fuzes are identical in design except the detents on the AZ DM 21's striker have been modified so their movement is parallel to the rotation of the detonator rotor. This fuze is standard in the West German Armed Forces.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
40-mm HEI-T cartridge, Model ?	40-mm antiaircraft gun, Model L/60 (Bofors)

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(FOUO) Description

AZ DM 41 is the West German designation for US fuze, PD, M51A5, whether imported or manufactured in Germany. It is standard in the West German Armed Forces. For data on the M51A5 fuze, see US TM 9-1300-203.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
76x578-mm HE cartridge, Model ?; 76x578-mm practice cartridge, Model ?	76-mm guns
76.2x583-mm (Naval) tracer (?) cartridge, Model ?	76.2-mm Naval antiaircraft guns
90x602-mm HE cartridge, Model ?; 90x602-mm practice cartridge, Model ?	90-mm guns
105x373-mm HE cartridge, Model ?; 105x373-mm smoke (WP) cartridge, Model ?	105-mm guns and howitzers
155-mm HE projectiles, Model ? 155-mm smoke (WP) projectiles, Model ?	155-mm howitzers
175-mm practice projectiles, Model ?	175-mm gun, Model M107 (US)
203-mm HE projectiles, Model ?	203-mm howitzers (US)

Fuze, PD, Model AZ DM 41
FOM No. 1390-16-1-25

(FOUO) **Interchangeability**

When reassembled with the West German booster ZDL DM 42, this fuze is designated AZ DM 211. When used without a booster, this fuze is designated AZ DM 51.

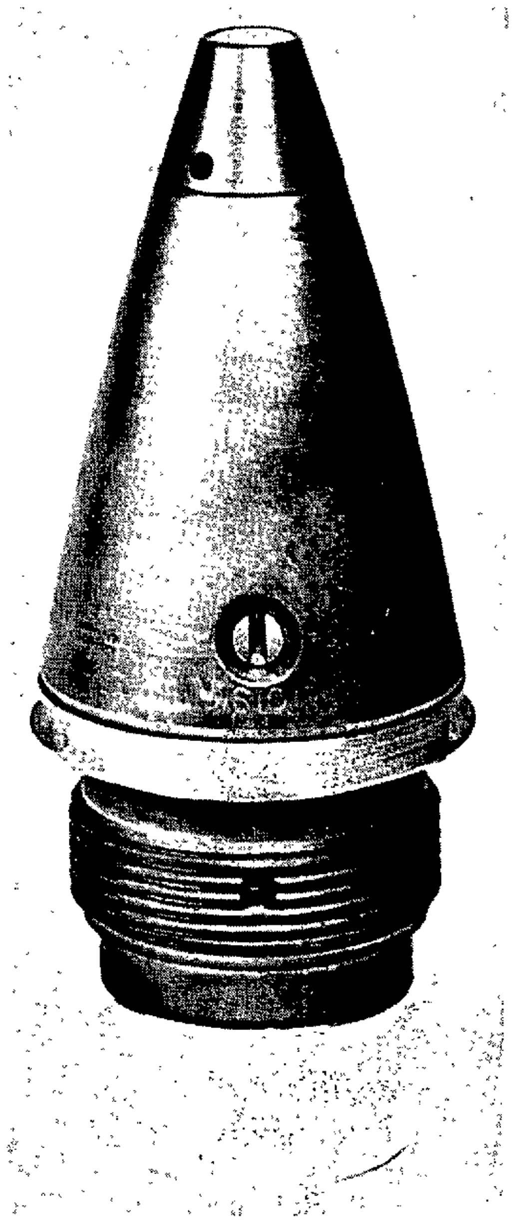

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Figure 2-19. Fuze, PD, Model AZ DM 211, full view (U).

Fuze, PD, Model AZ DM 211
FOM No. 1390-16-1-26

(FOUO) **Description**

Fuze AZ DM 211 (fig 2-19) is a West German-made copy of US fuze M48A3 (German Model AZ DM 51) with a German-designed booster assembly (Model ZDL DM 42) attached. Booster ZDL DM 42 employs an escapement mechanism as a safety device to insure delayed arming. A mechanical switch allows selection of either SQ functioning or 0.05-second delay. All metal parts used in this fuze appear to be of brass, aluminum, or brass-coated steel. Manufactured by Diehl, fuze AZ DM 211 was standard in the West German Armed Forces, at least as late as 1969. For technical details of this fuze (except for the booster), see pertinent US publications (e.g., TM 9-1300-203). The only information presently available on booster ZDL DM 42 is whatever can be deduced from the section view of this fuze shown in figure 2-20.

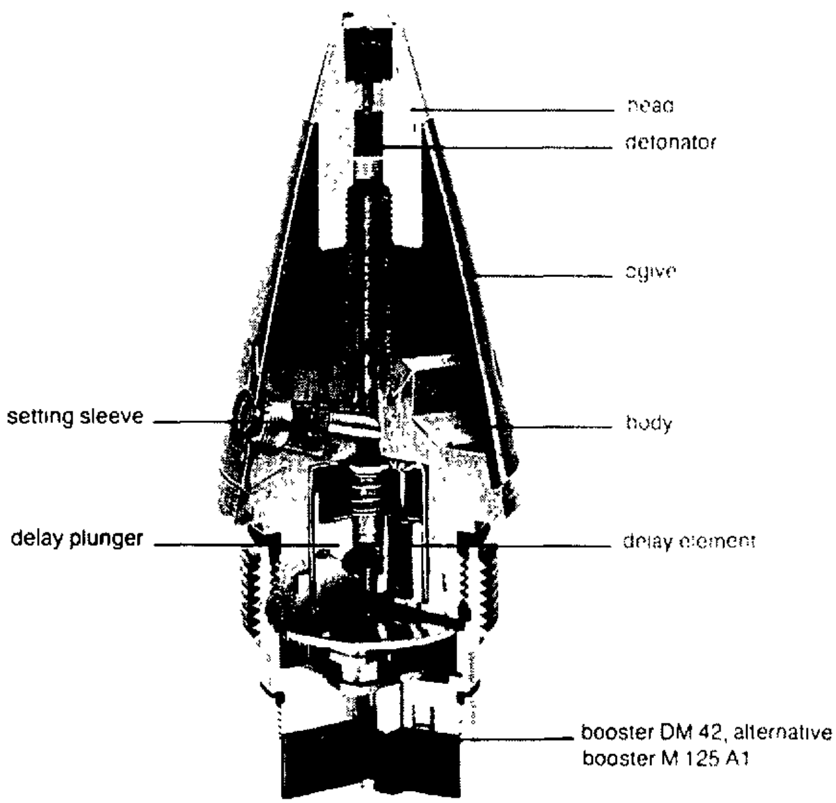

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Figure 2-20. Fuze, PD, Model AZ DM 211, section view (U).

Fuze, PD, Model AZ DM 211
FOM No. 1390-16-1-26

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
76x578-mm HE cartridge, Model ?; 76x578-mm practice cartridge, Model ?	76-mm guns
76.2x583-mm tracer (?) cartridge, Model ?	76.2-mm Naval antiaircraft gun
90x602-mm HE cartridge, Model ?; 90x602-mm practice cartridge, Model ?	90-mm guns
105x373-mm HE cartridge, Model ? 105x373-mm smoke (WP) cartridge, Model ?	105-mm guns or howitzers
155-mm HE projectile, Model ?; 155-mm smoke (WP) projectile, Model ?	155-mm howitzers
203-mm HE projectile, Model ?	203-mm howitzers (Definitely not usable in 175-mm guns)

(FOUO) **Interchangeability**

(U) Fuze AZ DM 211 is redesignated AZ DM 41 when US booster M21A4 (or a German copy of M21A4) is used. Fuze AZ DM 211 is redesignated AZ DM 51 when used without a booster. Fuze AZ DM 211 is redesignated AZ DM 151 when booster ZDL DM 32 (German designation for US booster M125A1) is used.

Fuze, PD, Model AZ DM 211
FOM No. 1390-16-1-26

(FOUO) **Interchangeability (Continued)**

(FOUO) Fuze AZ DM 211 is redesignated AZ DM 241 when a rain safety device is added and the fuze nose portion is filled with epoxy.

Fuze, PD, Model AZ DM 71
FOM No. 1390-16-1-27

(FOUO) Description

The AZ DM 71 is the West German designation for the US fuze, PDCP M78A1. This fuze was standard in the West German Armed Forces at least as late as 1969. Technical details on this fuze are covered in US TM 9-1300-203.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
105x373-mm HE ctg., Model (?)	105-mm guns or howitzers
155-mm HE projectile, Model (?)	155-mm howitzers
203-mm HE projectile, Model (?)	203-mm howitzers

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Fuze, PD, Model AZ DM 151
FOM No. 1390-16-1-28

(FOUO) **Description**

According to an official West German publication, AZ DM 151 is the West German designation for US fuze, PD, M557. This fuze, manufactured by Diehl, was standard in the West German Armed Forces at least as late as 1969. The AZ DM 151 includes booster ZDL DM 32, a German model number for US booster M125A1, possibly manufactured in Germany. For technical details on the M557 fuze and the M125A1 booster, refer to US TM 9-1300-203.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90x602-mm practice cartridge, Model (?)	90-mm guns
105x373-mm HE cartridge, Model (?); 105x373-mm smoke (WP) cartridge, Model (?)	105-mm guns or howitzers
155-mm HE projectile, Model (?); 155-mm smoke (WP) projectile, Model (?)	155-mm howitzers
175-mm practice projectile, Model (?)	175-mm guns, Model M107 (US)

(FOUO) **Interchangeability**

(U) Fuze AZ DM 151 is redesignated AZ DM 41 when US booster M21A4, (or a German copy of it) is used instead of booster ZDL DM 32. Fuze AZ DM 151 is redesignated AZ DM 51 when no booster is used. Fuze AZ DM 151 is redesignated AZ DM 211 when booster ZDL DM 42 is used.

Fuze, PD; Model AZ DM 151
FOM No. 1390-16-1-28

(FOUO) **Interchangeability (Continued)**

(FOUO) Fuze AZ DM 151 is redesignated AZ DM 241 when booster ZDL DM 42 is used, the fuze nose is filled with epoxy, and a rain safety device is added.

Fuze, PD, Model AZ DM 241
FOM No. 1390-16-1-29

(FOUO) Description

Fuze AZ DM 241 is a PD fuze with either SQ or delay (0.05 seconds) functioning (selectable). This fuze was designed specifically for use with 175-mm guns. AZ DM 241 is essentially a US fuze, PD, M572 with a rain safety device and German booster ZDL DM 42. Booster ZDL DM 42 is apparently designed in Germany, not copied from a foreign design. ZDL DM 42 employs an escapement mechanism to insure delayed arming. This fuze, manufactured by Diehl, was standard in the West German Armed Forces at least as late as 1969. Technical details pertinent to the booster mechanism and functioning of the rain safety device are unknown.

(FOUO) Applications (Ammunition and Weapons)

Ammunition	Weapons
175-mm HE projectile, Model (?)	175-mm guns (US M107)

(U) Interchangeability

Fuze AZ DM 241 uses many components also used in fuzes AZ DM 41, AZ DM 51, AZ DM 151, and AZ DM 211.

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Fuze, PDSD, Model AZZ DM 91
FOM No. 1390-16-1-40

(U) **Description**

AZZ DM 91 is apparently the West German designation for fuze FZ 104 M2, designed by Bofors of Sweden and produced by a German manufacturer under license to Bofors. The FZ 104 M2 is a sensitive, reliable fuze with a pyrotechnic self-destruct element and contains a rain safety device developed by Bofors. For technical details relative to the FZ 104 fuze (FOM No. 1390-19-1-2) refer to page 2-199.

(U) **Characteristics**

Functional data:

Arming method	Setback and spin
Firing method	Impact or pyrotechnic self-destruct
Safety devices	Out-of-line detonator
Arming distance	60 m
Arming time	0.06 s (approx)
Self-destruct time	6.5 to 10.5 s
Delay time	0.1 to 0.2 ms

(FOUO) **Status**

This fuze was standard in the West German Armed Forces at least as late as 1969.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
40x365-mm HEI-T cartridge, Model SB-LS-Z	40-mm antiaircraft gun, Model L/70 (Bofors)

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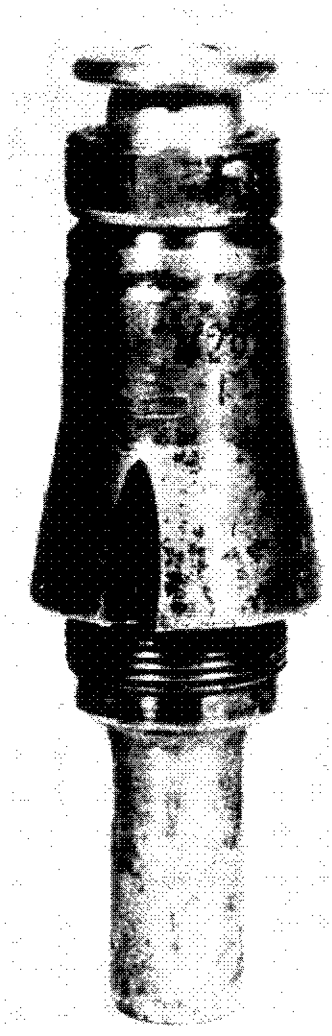

Neg. 507928 (UNCLASSIFIED)

Figure 2-21. Fuze, PD, Model 21/28, full view (U).

Fuze, PD, Model 21/28
FOM No. 1390-17-1-1

(U) Description

The Model 21/28 PD fuze (fig 2-21) was developed by Brandt of France for use in mortar projectiles. Although considered obsolete, the fuze is included in this manual because of its design simplicity. The 21/28 is a simple setback-armed fuze designed for instantaneous action upon impact. The "21" indicates the major thread diameter, while the "28" of the model number indicates major body diameter of the fuze—both in millimeters.

(U) Characteristics

Fuze assembly:

Body material	Brass
Weight	?
Markings	21/28 B-35
Length overall	87.1 mm (3.43 in)
Max diam	27.9 mm (1.10 in)
Maj thread diam	20.8 mm (0.82 in)

Booster:

Body material	Brass
Body length	35.3 mm (1.39 in)
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	7 m
Arming time	?

*Safety collar, safety spring, and primer locking ball

(U) Functioning (fig 2-22)

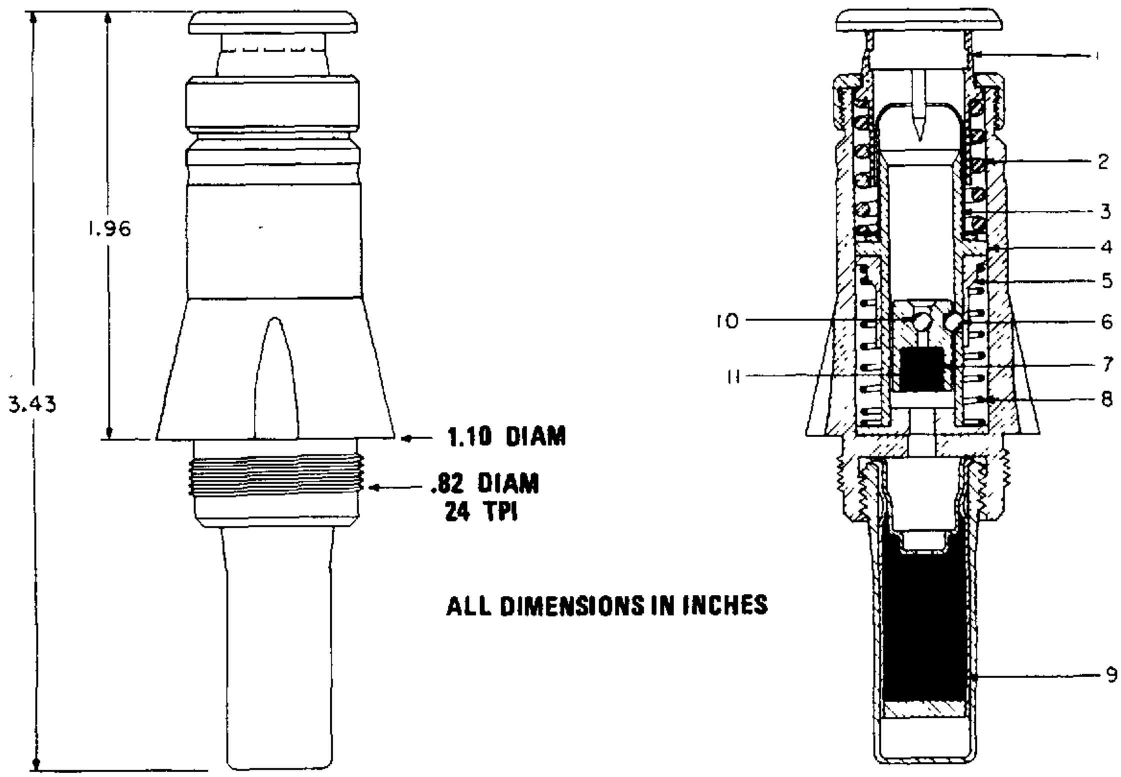

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Figure 2-22. Fuze, PD, Model 21/28, section view (U).

Upon firing, setback forces cause the safety collar (5) to move rearward against the safety spring (8). The primer locking ball (6) is thus released so that it can move outwards and free the primer holder assembly (7). In flight, the primer holder assembly can move forward under the influence of creep forces until it contacts the firing-pin spring guide (3). Movement of the inertial element is restrained by the spring (2).

On impact, the firing pin (1) is pushed rearward, while the inertial element assembly moves forward. The unrestrained primer holder assembly moves forward relatively more rapidly than the inertial element and its associated components. As the firing pin enters the

Fuze, PD, Model 21/28
FOM No. 1390-17-1-1

(U) **Functioning (Continued)**

primer body cavity, the two primer detent balls (10) are pushed outwards to protrude into the cavity between the forward lip of the inertial element assembly (4), the firing-pin spring guide, and the firing pin. This locks the primer assembly to the forward moving inertial element. The momentum of the entire inertial assembly, rather than only that of the primer assembly, impales the primer (11) on the firing-pin point. The flash from the primer then initiates the booster (9).

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars

Fuze, PD, Model V-18-I
FOM No. 1390-17-1-2

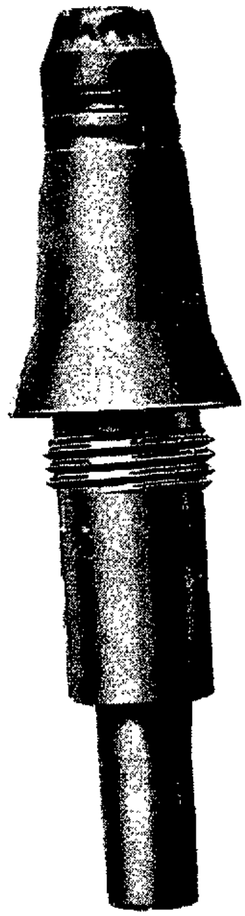

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Figure 2-23. Fuze, PD, Model V-18-I, full view (U).

(U) Description

The French V-18-I PD fuze (fig 2-23) was developed by Hotchkiss-Brandt for use with mortar projectiles. It is a setback-armed type designed for SQ functioning upon impact.

Fuze, PD, Model V-18-I
FOM No. 1390-17-1-2

(U) Characteristics

Fuze assembly:

Body material	Brass
Weight	?
Markings	V-18-I
Length	4.50 in (114.3 mm)
Maj diam	1.25 in (31.7 mm)

Booster:

Body material	Brass
Body length	1.30 in (33 mm)
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Safety spring, locking ball
Arming distance	10 m
Arming time	?

(U) Functioning (fig 2-24)

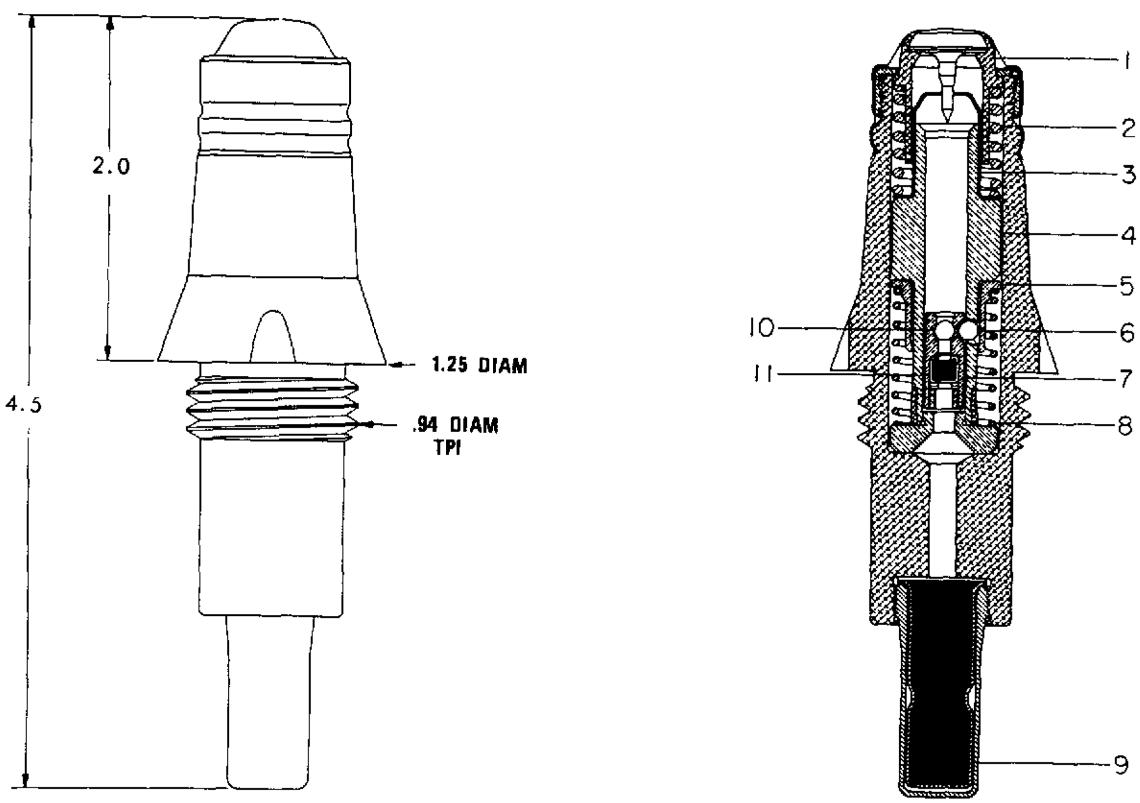

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Figure 2-24. Fuze, PD, Model V-18-I, contour and section views (U).

On firing, setback forces cause the setback sleeve or safety collar (5) to move rearward against the safety spring or setback spring (8). The collar becomes wedged on the tapered surface at the rear end of the inertial-element assembly (4). The primer locking ball (6) is thus released so that it can move outwards and free the primer-holder assembly (7). In flight, the primer-holder assembly can then move forward under the influence of creep forces until its forward end contacts the firing-pin spring guide (3). Movement of the inertial element is restrained by the spring (2).

Fuze, PD, Model V-18-I
FOM No. 1390-17-1-2

(U) Functioning (Continued)

On impact the firing pin and striker assembly (1) is pushed rearward, while the inertial element assembly moves forward. The unrestrained primer-holder assembly moves forward relatively more rapidly than the inertial element and its associated components. As the firing pin enters the primer body cavity, the two primer detent balls (10) are pushed outwards to protrude into the cavity between the forward lip of the inertial element, the firing-pin spring guide, and the firing pin. This locks the primer assembly to the forward-moving inertial element. The momentum of the entire inertial assembly, rather than only that of the primer assembly, impales the primer (11) on the firing-pin point. The shock wave from the detonation ignites the booster (9).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectile M32, 81-mm HE projectile M35, 81-mm smoke projectile M32	81-mm mortar, Model 44
120-mm HE projectile M44	120-mm mortar, Models AM49 and M1951

Fuze, PD, Model V-19
FOM No. 1390-17-1-3

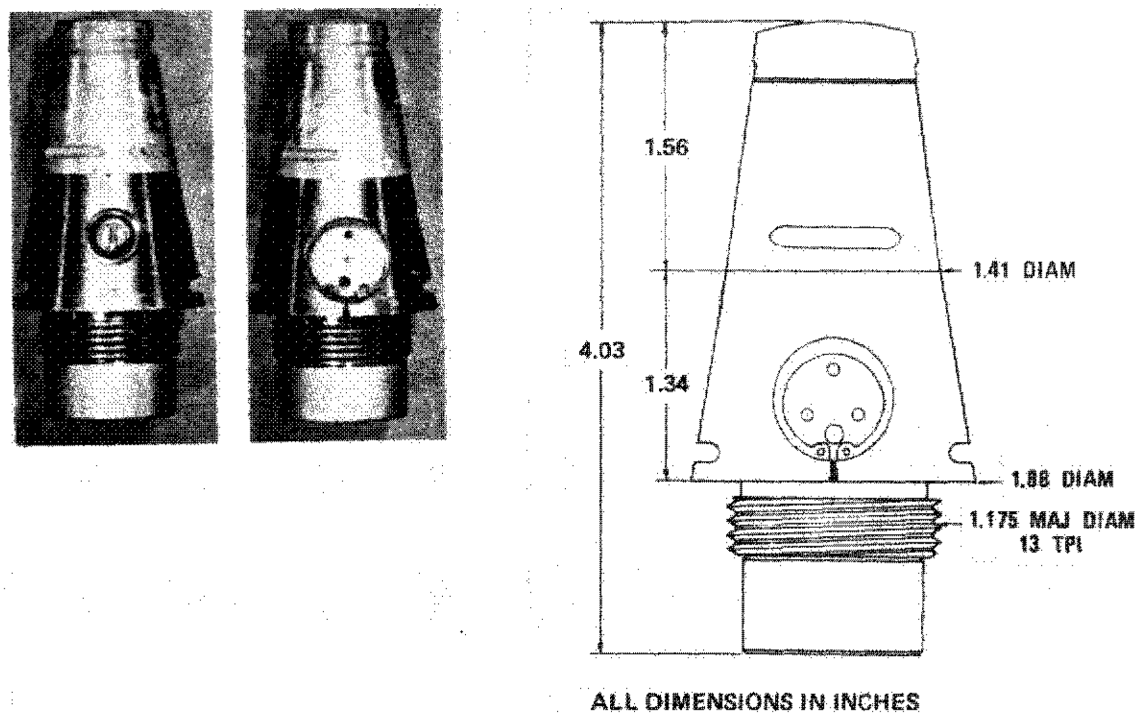

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Figure 2-25. Fuze, PD, Model V-19, full and contour views (U).

(U) Description

The V-19 PD fuze (fig 2-25) was developed by Hotchkiss-Brandt of France for use with 81-mm and 120-mm mortar projectiles. It is a setback, delayed-arming type designed for either instantaneous or delayed action upon impact. The fuze is considered bore safe as well as providing muzzle or trajectory safety 45 to 245 meters from the weapon. It takes a force of 500 g's to arm the fuze.

(U) Unique Features

- Employs a detent system on the primer contained in a movable piston-like assembly.

Fuze, PD, Model V-19
FOM No. 1390-17-1-3

(U) Unique Features (Continued)

- Employs a torqued spring-loaded cylinder with a V-shaped channeling that houses the delay charge.

- The piston assembly detents the torqued cylinder that has to rotate 60° and 120° to line one of the V-channels with the primer flash channel.

(U) Characteristics

Fuze assembly:	
Body material	Brass
Weight	476.4 g (1.05 lb)
Markings	R and I
Length	4.03 in (102.4 mm)
Max body diam	1.88 in (47.8 mm)
Thread diam	1.18 in (30 mm)
TPI	13
Booster:	
Explosive type	Tetryl
Explosive weight	16.73 g (0.037 lb)
Detonator type	Tetryl
Delay charge	Black powder
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	Detent on primer & torqued cylinder
Arming distance	40 to 245 m
Arming time	1 to 1.2 s
Delay time	0.05 s

(U) Design Details

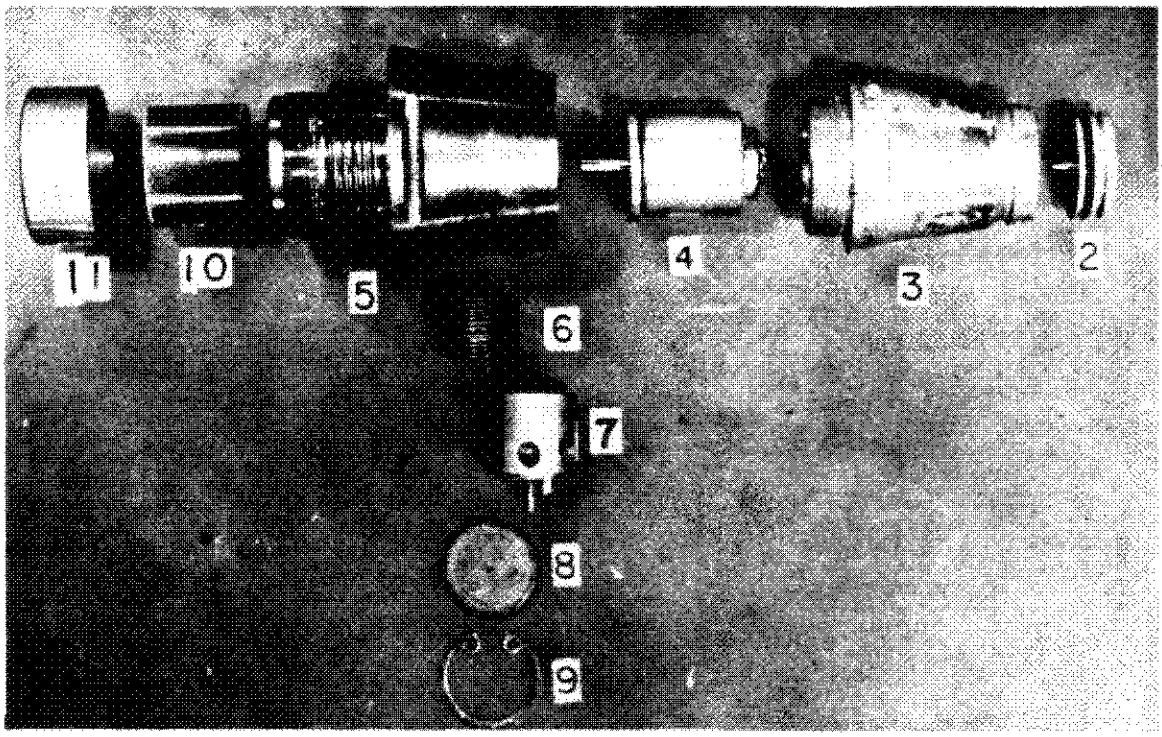

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Figure 2-26. Fuze, PD, Model V-19, exploded view (U).

The V-19 (fig 2-26) consists essentially of a nose (3), body (5), and booster (10). The nose houses the firing-pin assembly (2) and piston assembly (4). The body (5) has a transverse cavity into which a cylindrical selector (7) with a V-shaped channel housing a delay charge and its torsion spring (6) is located. It is sealed by the closing disk (8) and a lock ring (9). The booster (10) with the detonator located above is placed in the base of the fuze body (5). The closing cup (11) retains the booster, sealing it in place.

Fuze, PD, Model V-19
FOM No. 1390-17-1-3

(U) Functioning (fig 2-27)

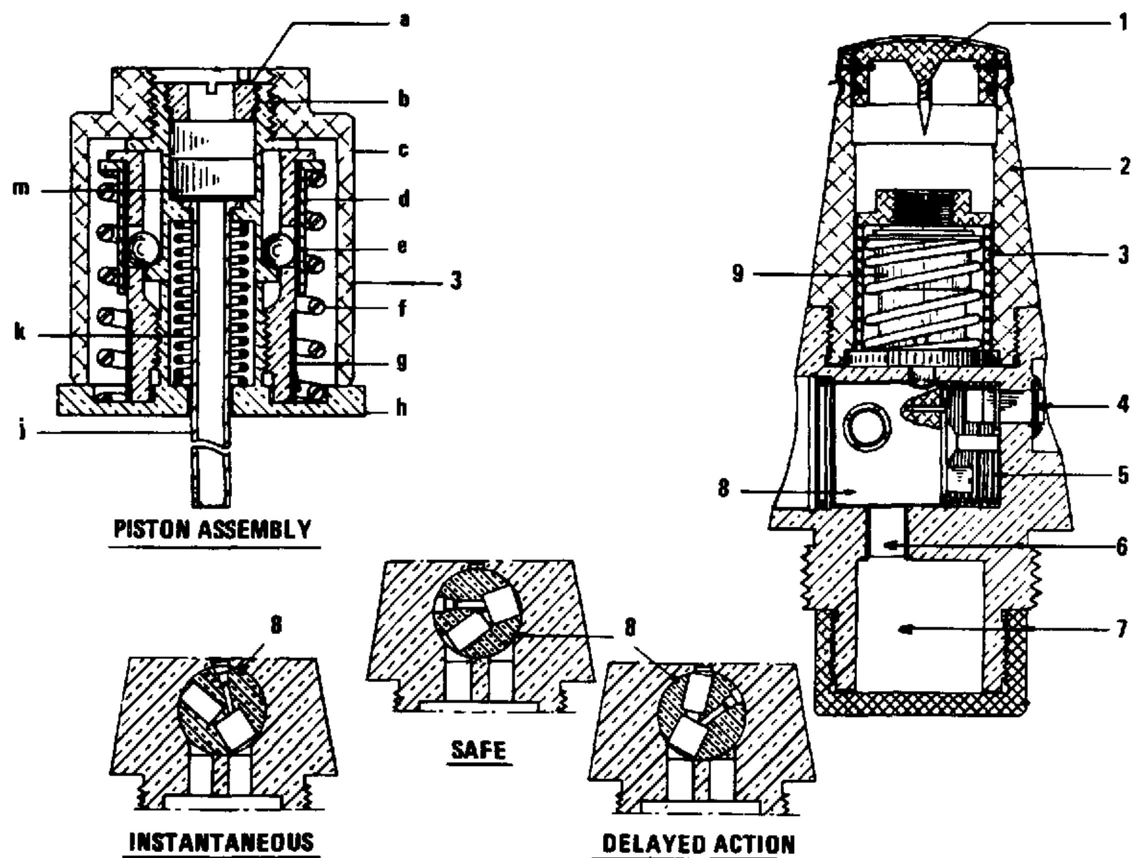

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Figure 2-27. Fuze, PD, Model V-19, section view (U).

Prior to firing, the setting stud is turned to either delay or instantaneous mode. The setting is provided by the eccentric pin of the cylinder (8), which is stopped by the stud when the fuze is armed. See instantaneous, delayed action, and safe position of the cylinder (8) illustrated in figure 2-27. The cylinder (8) is torqued by its torsion spring (5).

The arming mechanism of the piston assembly (3) is located in the nose portion (2) of the fuze. Arming of the fuze occurs as follows: Within the piston sleeve (c) is a setback

(U) Functioning (Continued)

spring (f) which holds a brass safety sleeve (d) away from a brass plug (h). This prevents two steel locking balls (e) from moving outward and disengaging the primer housing (b). A locking sleeve (g), containing four prongs near its base, engages the safety sleeve (d) when setback force, resulting from the firing of the weapon, causes the locking sleeve to compress the spring. With the removal of the balls, the piston spring (k), assembled under compression, expands forcing the piston (c) to move forward toward the firing pin. Upon impact with the target, the firing pin (1) is driven downward against the primer(m) at the same time set-forward force moves the primer holder (g) towards the firing pin, causing the charge to initiate. The resultant flash is directed through a flash tube (j) into the charges of the selector cylinder (8).

The selector cylinder (8), locked in the safe condition by the flash tube (j), serves in this position as an obturator. When the flash tube is withdrawn from the selector cylinder by the rising of the piston as described above, it is free to be positioned by means of the setting stud (4) and the action of the torsion spring (5) to produce either instantaneous "I" or delay "R" action of the fuze.

The instantaneous or delayed action is thus controlled as follows: When in the "safe" position, the selector is locked from rotating by the flash tube. In this condition, a red dot can be seen through the transparent closing disk at the lower extremity of its vertical diameter. This will coincide with a red index on the lower fuze body.

In the instantaneous action condition, the setting stud (4) is turned so that the torsion spring, one end of which is imbedded in the selector cylinder, rotates the cylinder until a passage is aligned with the flash tube to cause functioning of the relay into a detonator imbedded in the web of the lower fuze body directly over the booster cavity. Positioning the setting plug for delayed action (R) permits the selector cylinder to revolve until the flash tube directs the primer gases into a delay charge followed by a relay charge (6) before initiating a tetryl detonator pellet. Action of this pellet then functions the booster charge (7).

Fuze, PD, Model V-19
FOM No. 1390-17-1-3

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles, Models M57 and M59	81-mm Brandt mortar, Model 1944
120-mm HE projectiles, Models PEPA ED II, PEPA L-P and 1944	120-mm Brandt mortars, both lightweight and heavyweight models

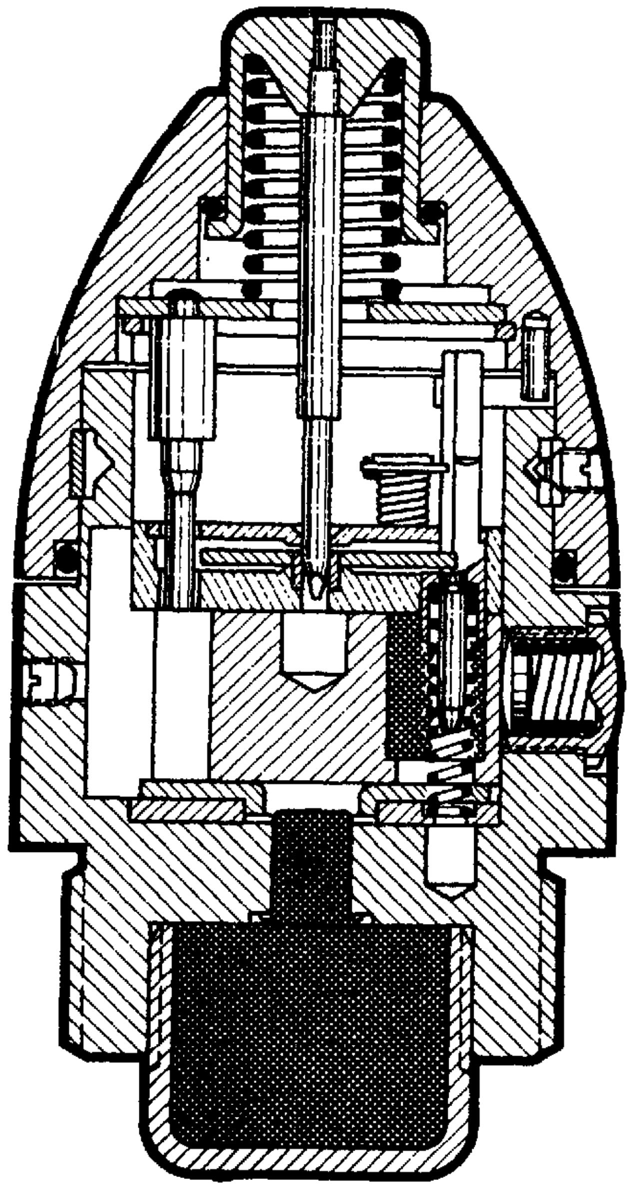

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Figure 2-28. Fuze, PD, Model SC-12, section view (U).

Fuze, PD, Model SC-12
FOM No. 1390-17-1-4

(U) Description

The French SC-12 PD fuze (fig 2-28) is a setback, delayed-arming-type design for a long or short delay, depending on the setting. It was developed by Societe Nouvelle d'Etudes et de Mechanique (SNEM) of Romainville, France, for use on 60-mm mortar projectiles. The fuze has been sealed to assure waterproofness and tightness of assemblage.

(U) Unique Features

- Clockwork mechanism for controlling the delayed arming.
- Rotatable cap for positioning the rack (i.e., slider).
- An inertial lock or setback device for detenting the balance wheel of the clockwork mechanism coupled to the rack or slider.

(U) Characteristics

Fuze assembly:

Body material	?
Weight	148 g (0.326 lb)
Markings	SC-12
Length	72 mm (2.83 in)

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback; clockwork mechanism
Firing method	Impact
Safety devices	Inertial lock*
Arming distance	?
Arming time	?
Delay time	?

*The inertial lock detents the balance wheel. The cap or nose portion of the fuze can be moved by hand to the secure position setting. This moves the rack or slider between the two spring-loaded knobs as illustrated in figure 2-29

(U) Characteristics (Continued)

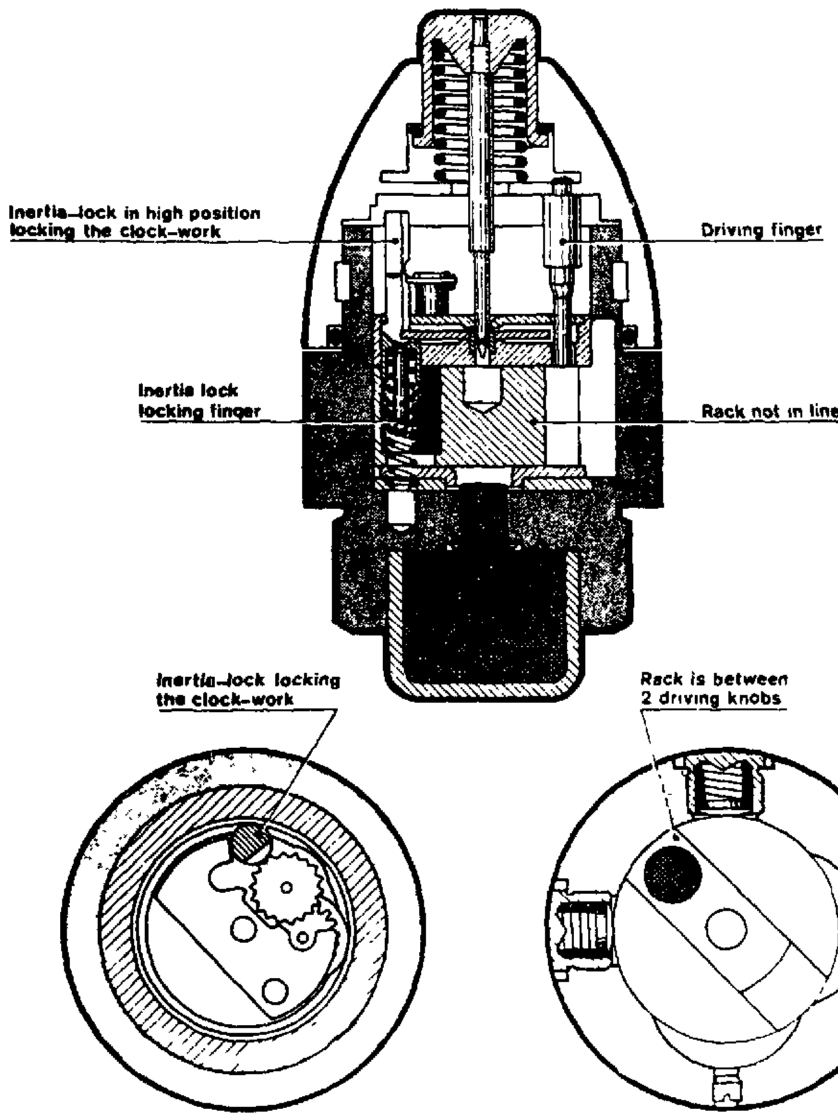

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Figure 2-29. Fuze, PD, Model SC-12, section view depicting components in safe position (U).

Fuze, PD, Model SC-12
FOM No. 1390-17-1-4

(U) **Design Details**

The SC-12 fuze consists of a cap (i.e., nose portion), fuze body, and booster assemblage.

The nose portion is bored out to facilitate assembly of the firing-pin assembly and the escapement mechanism. The firing-pin assembly includes the striker head, coil spring, and firing pin. An "O" ring seals the striker head, assuring tightness between striker head and forward portion of the nose.

The clockwork mechanism includes the driving gears, balance wheel, and pinion (called a driving finger by SNEM) that engages the rack or slider that houses an out-of-line primer-detonator.

The balance wheel is detented by a setback device that includes an inertial lock coupled to a setback spring and a locking finger (i.e., setback pin) with another setback spring. A driving finger is fixed to the cap and coupled to the gearing of the clockwork mechanism which controls the movement of the rack or slider.

The fuze body, which is fitted to the nose portion or cap, is sealed by an "O" ring to assure tightness of assemblage.

The nose portion or cap can be rotated by hand to three different settings. These are "TC" for short trajectory security, "S" for security position, and "TL" for long trajectory security. The marks or lines on the cap portion are aligned with a scribe mark on the fuze body. When the setting is on "S," the rack (i.e., slider) is rotated so it is between two spring-driven knobs located 90° apart.

The lower portion of the fuze body is counterbored and threaded internally to facilitate assembly of the relay and booster cups.

(U) **Functioning**

Prior to firing, the cap is rotated by hand to either the short (TC) or long (TL) delay arming setting. This brings the rack or slider opposite to one of two spring-loaded knobs, as illustrated in figure 2-30.

(U) Functioning (Continued)

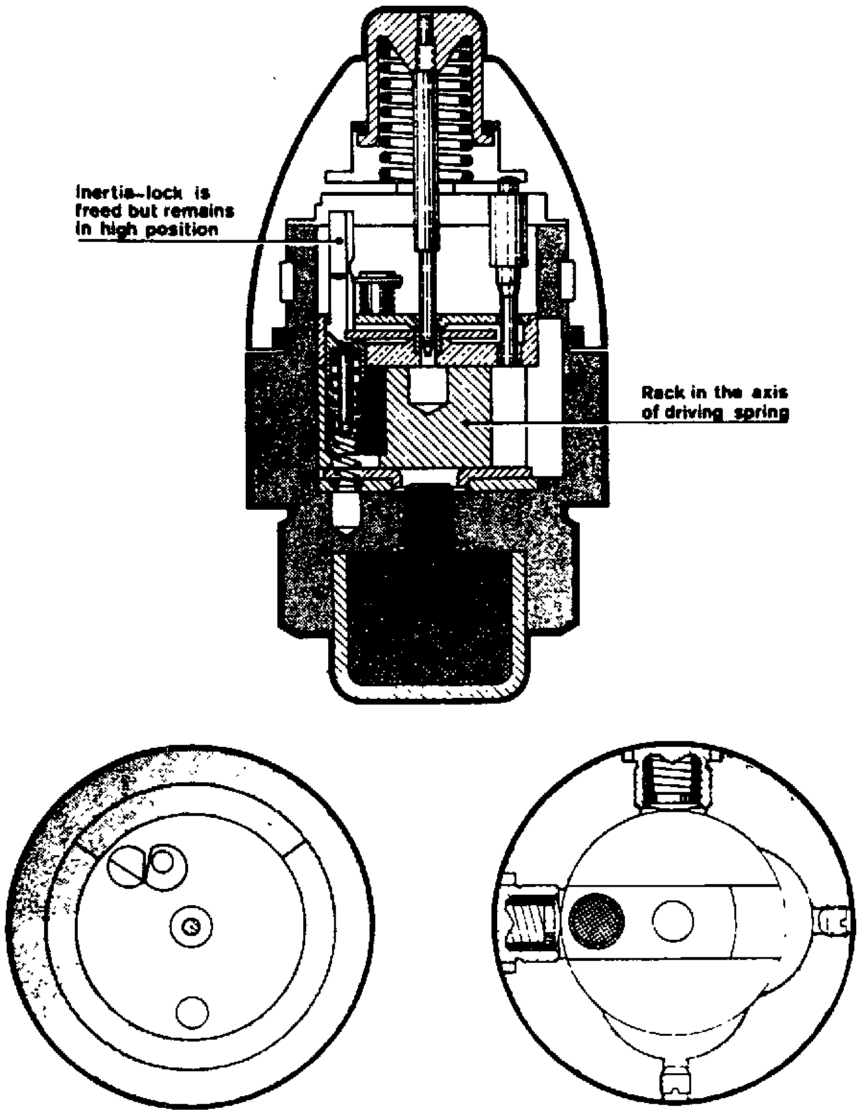

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Figure 2-30. Fuze, PD, Model SC-12, section view depicting delay-arming selection (U).

Fuze, PD, Model SC-12
FOM No. 1390-17-1-4

(U) Functioning (Continued)

Upon firing, setback forces moves the inertial lock and locking pin rearward, compressing their springs as illustrated in figure 2-31. The inertial-lock is kept locked on setback by its locking finger. With the balance wheel released, the clockwork now functions along with the spring-loaded knobs, which moves the rack, delayed only by the clockwork, dependent on setting. After the prescribed delay time, the primer-detonator lines up with the firing pin, as illustrated in figure 2-32. The fuze is now armed.

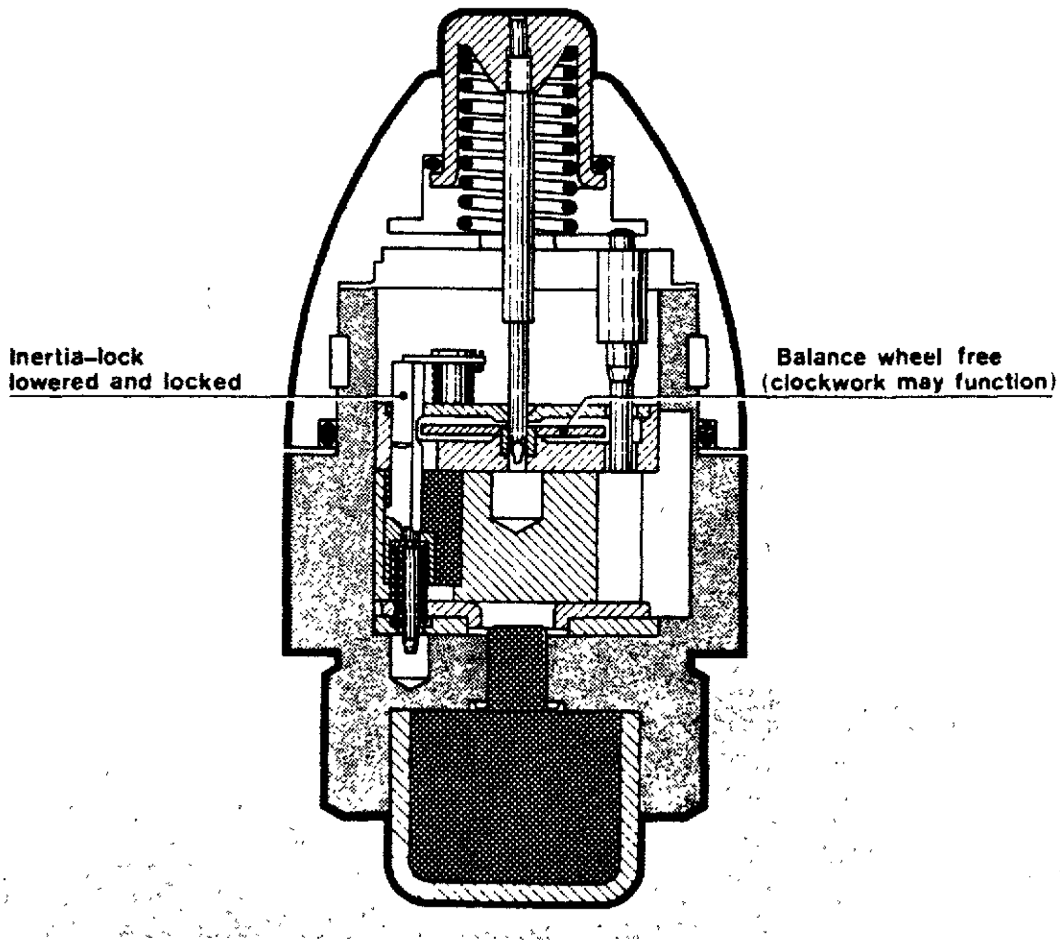

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Figure 2-31. Fuze, PD, Model SC-12, section view depicting inertial lock in rearward position (U).

(U) Functioning (Continued)

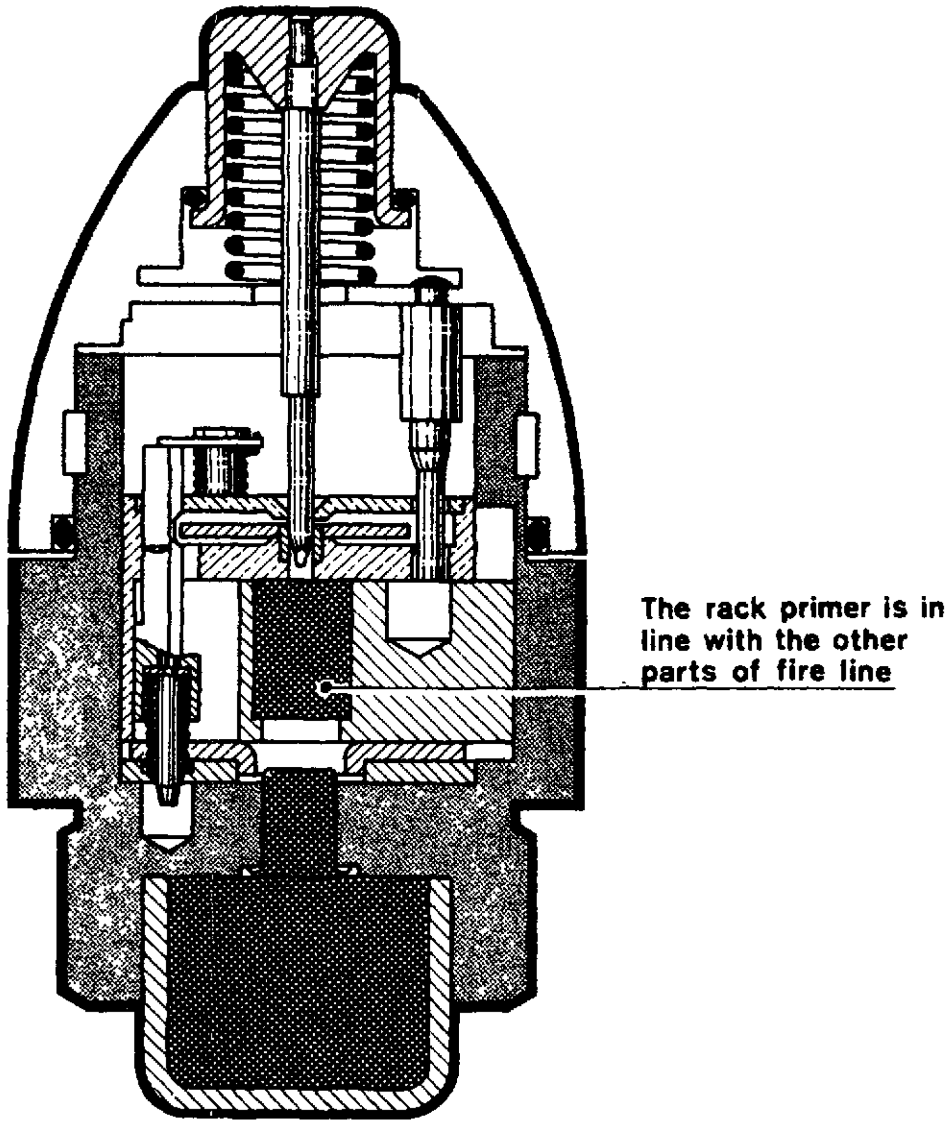

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Figure 2-32. Fuze, PD, Model SC-12, section view depicting fuze in armed position (U).

Fuze, PD, Model SC-12
FOM No. 1390-17-1-4

(U) Functioning (Continued)

Upon impact, setback moves the striker head rearward, compressing its spring and allowing the firing pin to stab the primer (as illustrated in figure 2-33). This in turn ignites the relay and booster, resulting in instantaneous detonation of the projectile.

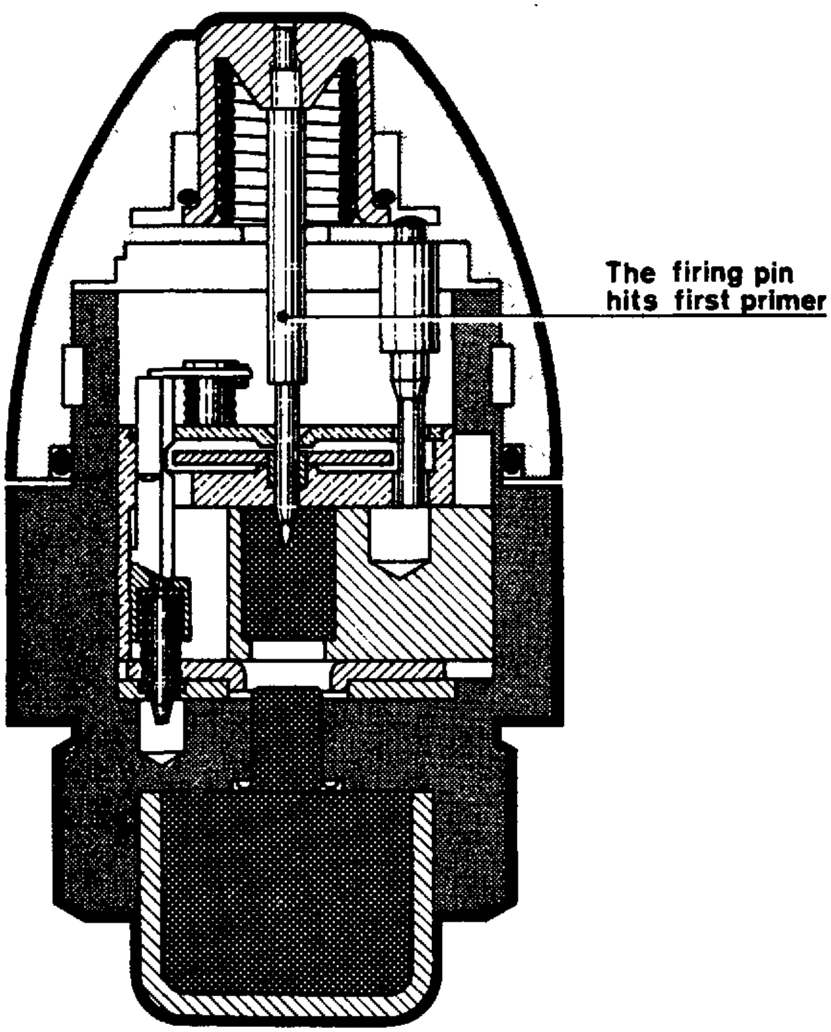

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Figure 2-33. Fuze, PD, Model SC-12, section view depicting firing pin action upon impact (U).

(U) **Functioning (Continued)**

If the projectile grazes the ground upon impact, the primer-detonator moves forward through inertia, striking the firing pin (as illustrated in fig 2-34) and instantaneously detonating the projectile.

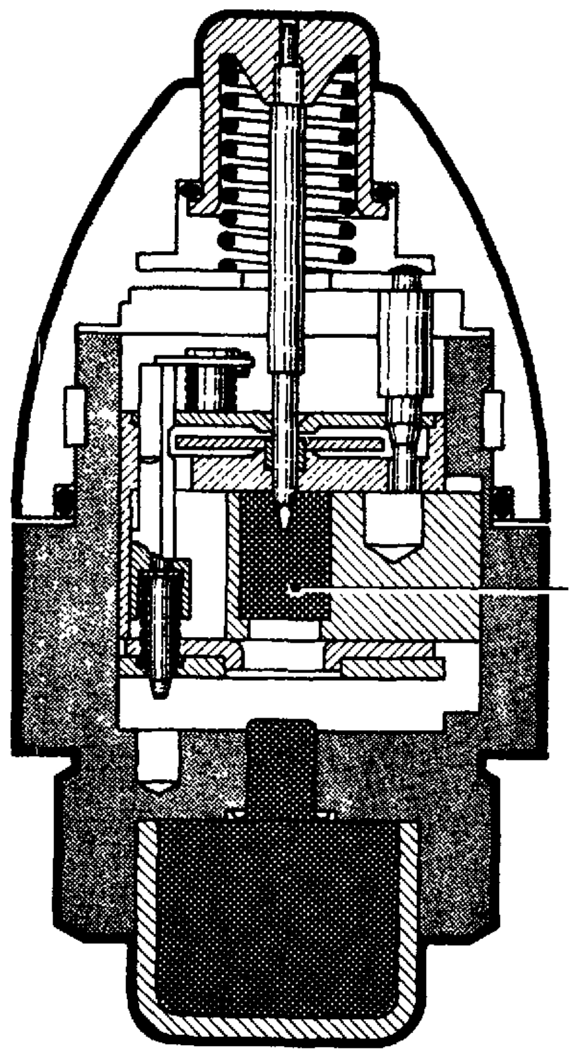

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Figure 2-34. Fuze, PD, Model SC-12, section view depicting action upon graze impact (U).

Fuze, PD, Model SC-12
FOM No. 1390-17-1-4

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
60-mm HE projectile, Model FA-MK 47	60-mm mortars, Model 1961

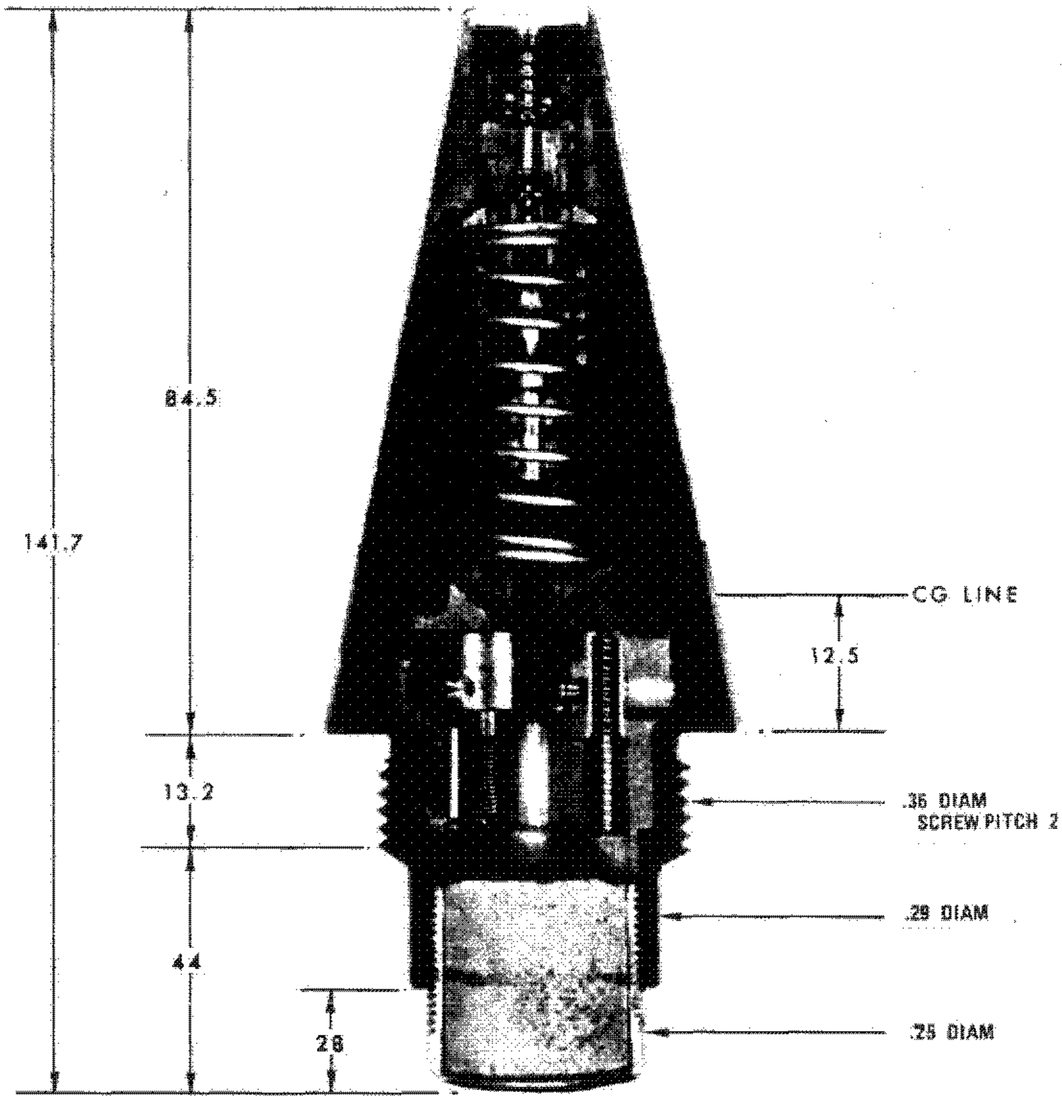

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Figure 2-35. Fuze, PD, Model FUI-F2, dimensioned cutaway view (U).

Fuze, PD, Model FUI-F2
FOM No. 1390-17-1-11

(U) Description

The FUI-F2 (fig 2-35) is a setback-armed PD fuze designed for use on fin-stabilized projectiles with a slow spin. It is restricted to use on projectiles having a spin rate of less than 50 r/s. The FUI-F2 is designed for graze functioning at angles of 1° to 1½°, regardless of terrain.

(U) Unique Features

- Employs a conical-shaped block permitting an all-ways acting camming action for graze functioning.

- Also features a torqued-spring rotor housing an out-of-line detonator which is detented by a locking ball and setback device.

(U) Characteristics

Fuze assembly:

Body material	?
Weight	530 g (1.17 lb)
Markings	FUI-F2

Booster:

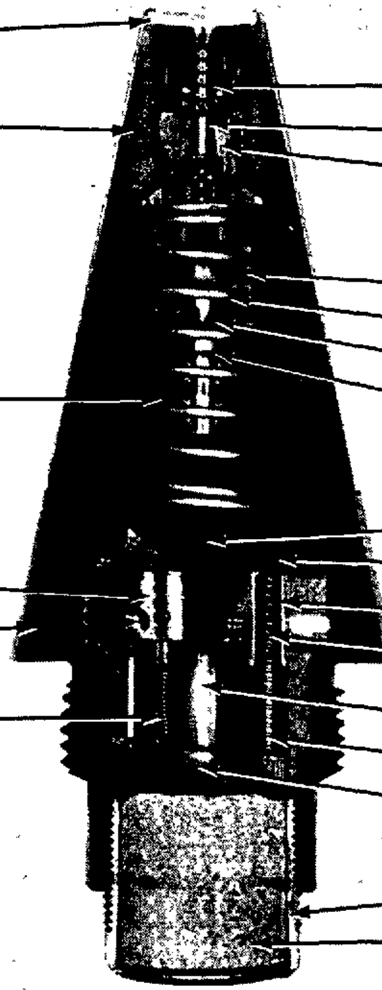
Body material	?
Body length	28 mm (1.10 in)
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	6 m
Arming time	?

*Detent (two-locking balls) on primer-holder and detent (locking ball) on rotor assembly

(U) Design Details



Neg. 516543 **(UNCLASSIFIED)**

Figure 2-36. Fuze, PD, Model FUI-F2, cutaway with components (U).

The FUI-F2 fuze (fig 2-36) consists of a nose, body, and booster assemblage. The nose portion of the fuze is sealed by a closure disk providing rain safety. It contains the firing-pin and primer assemblies. The firing-pin assembly consists of the firing pin, its spring, and a socket that plugs into the primer-holder guide of the primer assembly. This assembly includes the primer-holder guide, primer holder, primer, central tube, and split collar.

(U) Design Details (Continued)

The primer-holder guide and primer holder are recessed to hold two locking balls that provide a detent on the primer. The two locking balls are held in place by a setback sleeve and spring. The nose portion of the fuze is threaded externally. Positioned internally at this threaded area is a conical-shaped block for mating with the conical-shaped head of the primer-holder guide, providing an always acting camming action.

The fuze body, which screws on to the externally threaded nose portion, houses a torqued spring rotor containing the out-of-line detonator. The rotor is detented by a locking ball held in place by a setback device consisting of the setback cup, setback spring, and fixed pin.

Beneath the central tube is a pentrite relay positioned over the booster. The booster assembly is then screwed onto the fuze body, completing the fuze assembly.

(U) **Functioning** (fig 2-37)

Upon firing, the setback sleeve (1) moves its spring (2) rearward, freeing the two locking balls (3) which fall into the cavity (4) of the nose portion of the fuze. Simultaneously, the firing pin (10) moves against its spring (11) while the setback cup (5) moves rearward against its spring, releasing the locking ball (7) undetenting the rotor (8). The rotor, by virtue of its spring, now moves the detonator in line, arming the fuze.

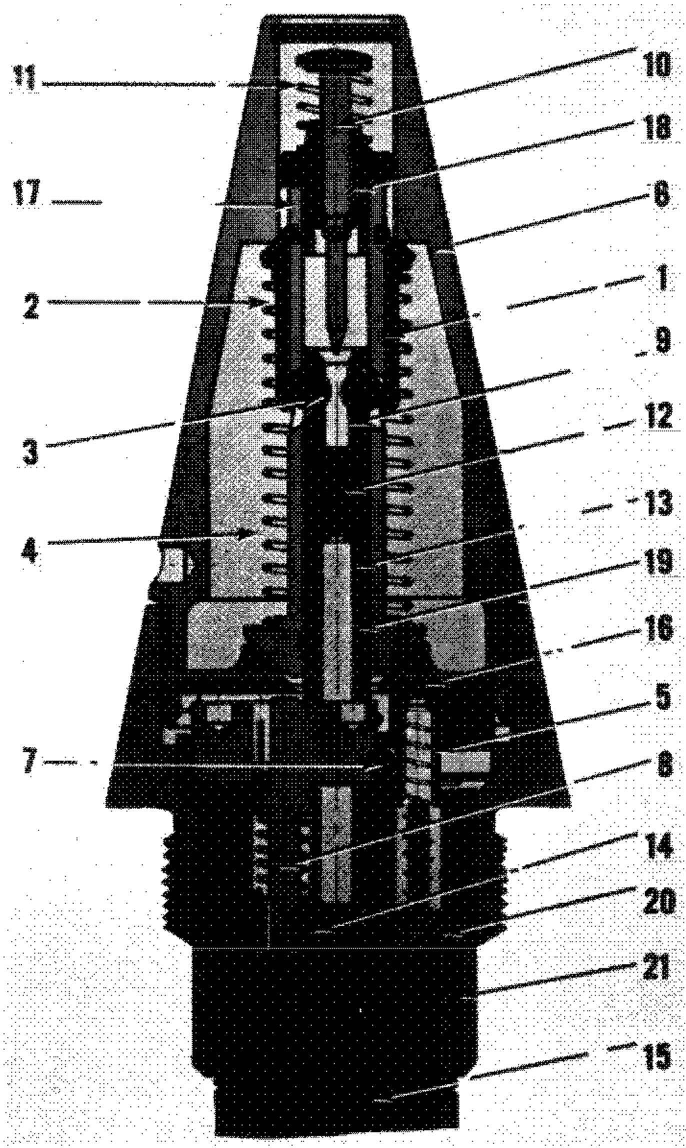
Upon dissipation of setback forces, the primer holder (9) and firing pin (10) move forward against a closure disk by expansion of springs (2 and 11).

Upon impact, the firing pin (10) stabs the primer (12) which flashes through the central tube (13) to the detonator which in turn ignites relay (14), setting off the booster (15), resulting in the detonation of the high explosive filler of the projectile.

If the projectile strikes at angles of 1° to 1.5°, grazing functioning is provided by the all-way camming action provided by the conical-shaped block (16).

Figure 2-38 depicts component movement during firing, in the armed position, and upon graze functioning.

(U) Functioning (Continued)



Neg. 516541 (UNCLASSIFIED)

Figure 2-37. Fuze, PD, Model FUI-F2, section view (U).

Fuze, PD, Model FUI-F2
FOM No. 1390-17-1-11

(U) Functioning (Continued)

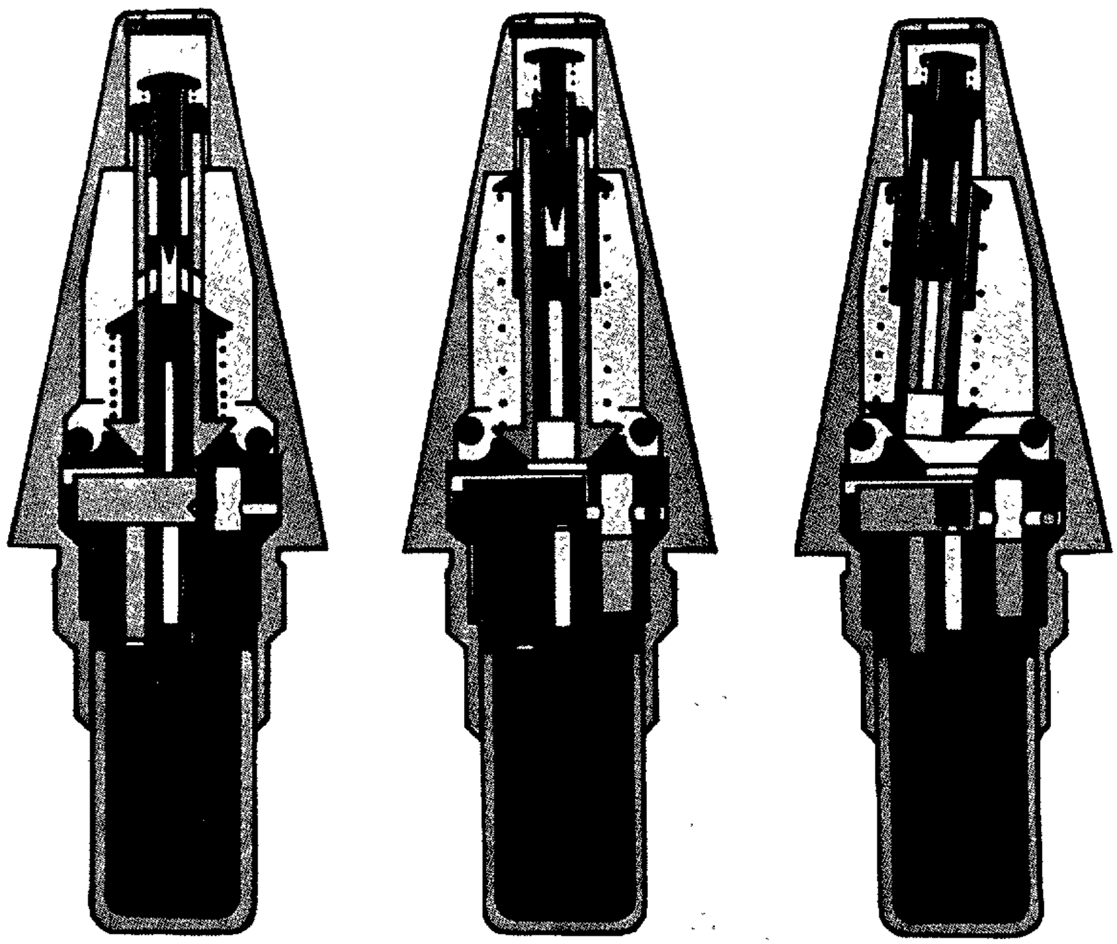


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Figure 2-38. Fuze, PD, Model FUI-F2, functioning views (U).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
90-mm HE projectiles, Model OE-90-F1	90-mm gun, Model CN-90-61, on ELC Even LT tank and modified AML Panhard

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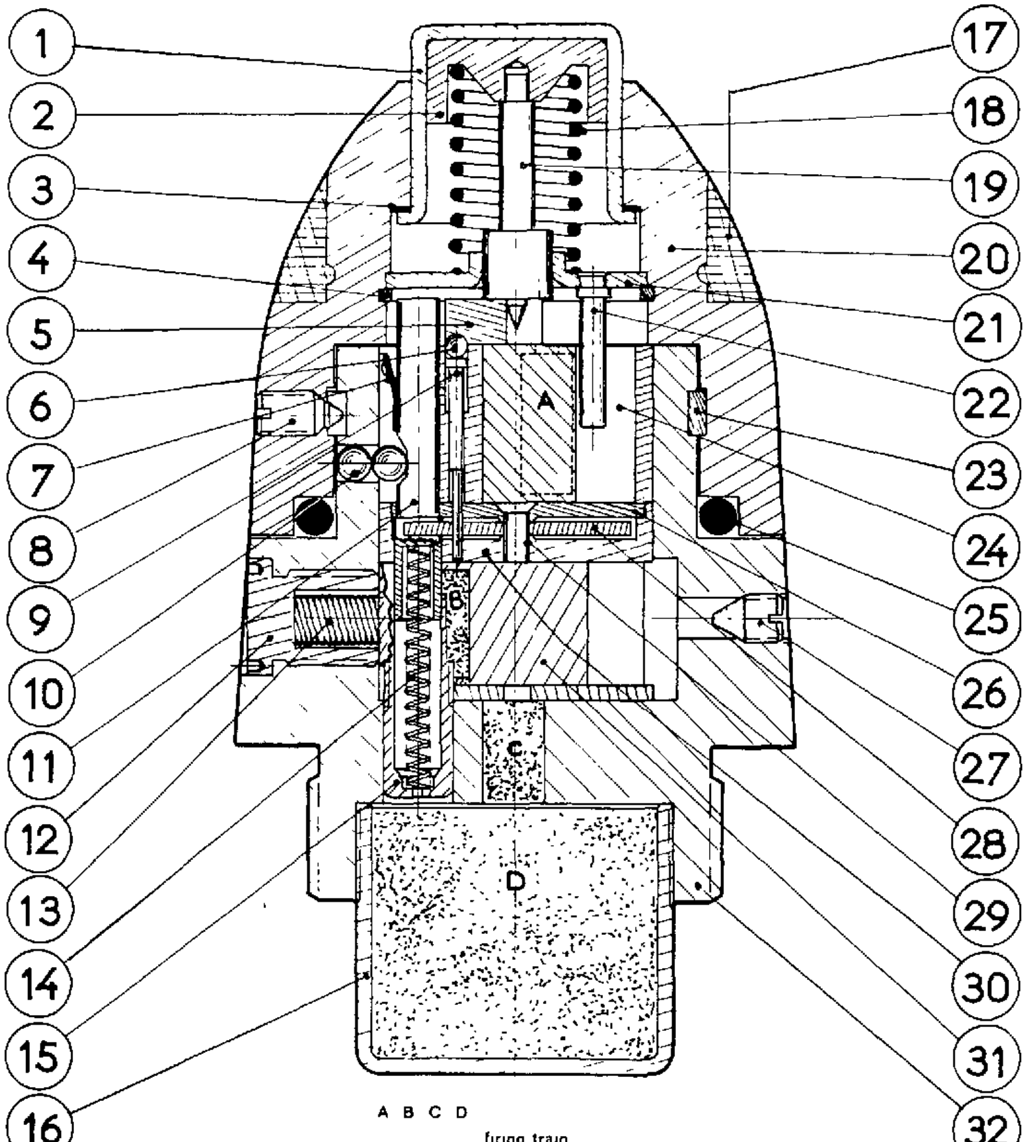

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Figure 2-39. Fuze, PD, Model V-5, section view (U).

Fuze, PD, Model V-5
FOM No. 1390-17-1-12

(U) **Description**

The V-5 PD fuze (fig 2-39) is a setback, delayed-arming type designed for either instantaneous or delay action upon impact. The fuze was developed by Societe Nouvelle d'Etudes et de Mecanique (SNEM) for use with 81-mm and 120-mm mortar projectiles. It was designed to meet NATO specifications to assure total security against double-loading dangers and premature explosions within a minimum distance of 50 meters from the muzzle of the weapon.

(U) **Unique Features**

- Employs out-of-line primers and detonator.
- Employs detents on firing pin and balance wheel of clockwork mechanism.
- Employs clockwork for delayed arming of fuze.
- Employs a cap (i.e., upper fuze body) coupled to a driving pin for selection of either instantaneous or delay action mode.
- Employs a rubber shock absorber.

(U) **Characteristics**

Fuze assembly:
- Body material . . . . ?
- Weight . . . . ?
- Markings . . . . ?

Booster:
- Body material . . . . ?
- Body length . . . . ?
- Explosive . . . . ?
- Explosive weight . . . . ?

(U) **Characteristics (Continued)**

Functional data:

Arming method	setback
Firing method	Impact
Safety devices	*
Arming distance	50 m
Arming time	1.00 s
Delay time	0.05 s

(U) **Design Details**

The V-5 fuze (fig 2-39) consists of movable cap (i.e., upper fuze body), a lower fuze body, and a booster assemblage.

The movable cap (20) is bored out to house the firing-pin assembly consisting of the striker cup (1), striker head (2), coil spring (18), and the firing pin (19). The firing-pin guide or flange (21) is locked in place by a snap ring (4). A driving pin (22) is fastened to the flange and fits into a slot cut into the primer drum (24), which is in an offset position from the firing pin. The primer drum (24) houses the instantaneous and delay primers (A), which are in the out-of-line position when the arrow on the movable cap or upper fuze body (20) is aligned with the letter "S" located on the lower fuze body (32). When the arrow lines up with the letter "R" on the lower fuze body, the delay primer (A) is positioned directly beneath the firing pin (19). When the arrow lines up with the letter "I," the instantaneous primer lines up with the firing pin and the central tube (29).

The forward portion of the upper fuze body or cap (20) is sealed by an "O" ring (3). At the internal shoulder where the striker cap (1) seats, an external portion of the cap (20) is cut out to facilitate assembly of a rubber shock absorber (17) to dampen the effect of the fuze upon impact.

A set screw (8), ring (23), and O-ring (25) assure tightness of the assembly of the lower fuze body (32) to the upper fuze body or cap (20).

*Two detent balls and inertial lock detenting balance wheel and a detent ball and lever detenting firing pin.

Fuze, PD, Model V-5
FOM No. 1390-17-1-12

(U) Design Details (Continued)

The detent on the firing pin (19) consists of a lever (5), pivotable lever pin (9), lever spring (7), and a lock ball (6). The detent on the balance wheel (28) of the clockwork mechanism (30) mounted on plate (26) consists of two lock balls (10), an inertial lock pin (11), and a setback spring (14) contained in a spring housing (15).

The lower fuze body has two openings cut transversally, one to house the spring plug (12), rack (i.e., slider) spring (13), and the other for insertion of an inspection plug (27). The rack or slider (31) houses the detonator "B," which is kept in the out-of-line position until the fuze is armed.

The booster assembly (16) containing the booster "D" located beneath the relay charge "C" is fitted to the lower fuze body completing the assemblage.

Design details of the clockwork mechanism and its interface with other fuze components are illustrated in figure 2-40. The clockwork consists of a main wheel or gear (35), an escapement wheel (36), the balance wheel (28), the clockwork frame (30), and mounting plate (26).

(U) Design Details (Continued)

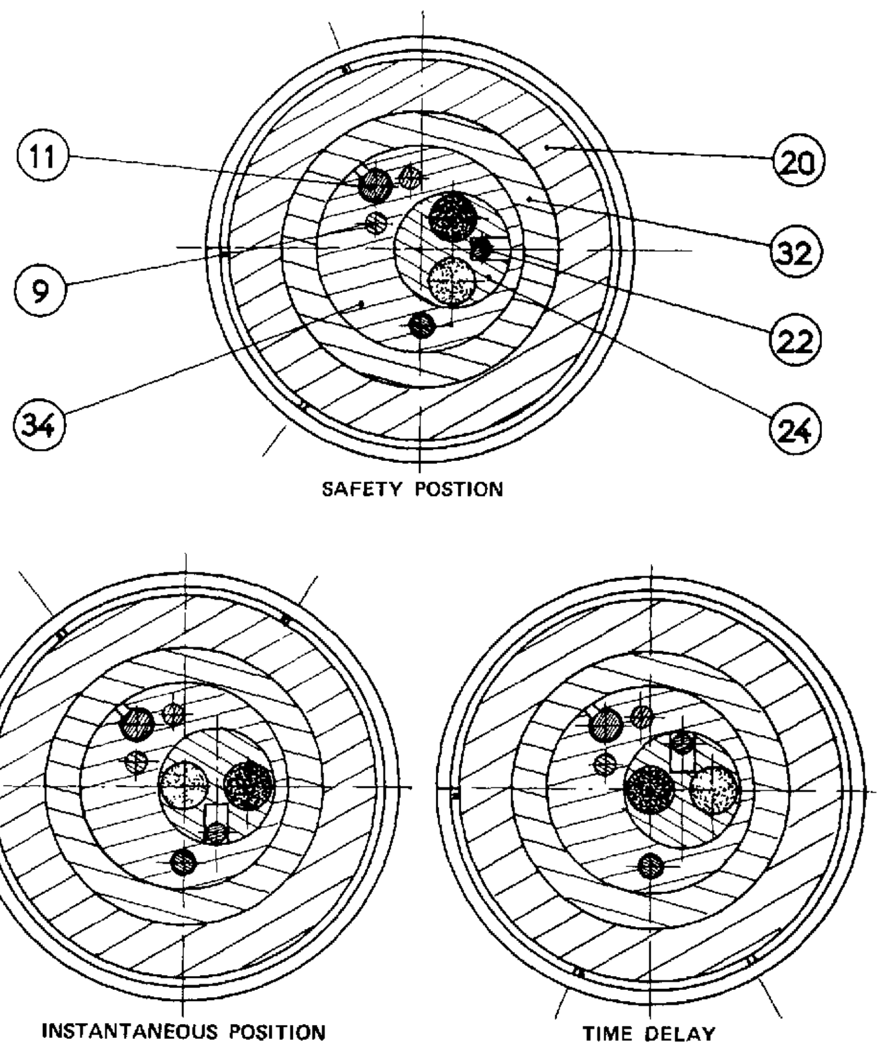

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Figure 2-40. Fuze, PD, Model V-5, details of clockwork (U).

Fuze, PD, Model V-5
FOM No. 1390-17-1-12

(U) Design Details (Continued)

Design details of the rack or slider (31) housing the detonator in the armed and unarmed position are illustrated in figure 2-41. The rack (31) interfaces with the clockwork (30). The spring-loaded slider consists of the spring plug (12) and spring (13).

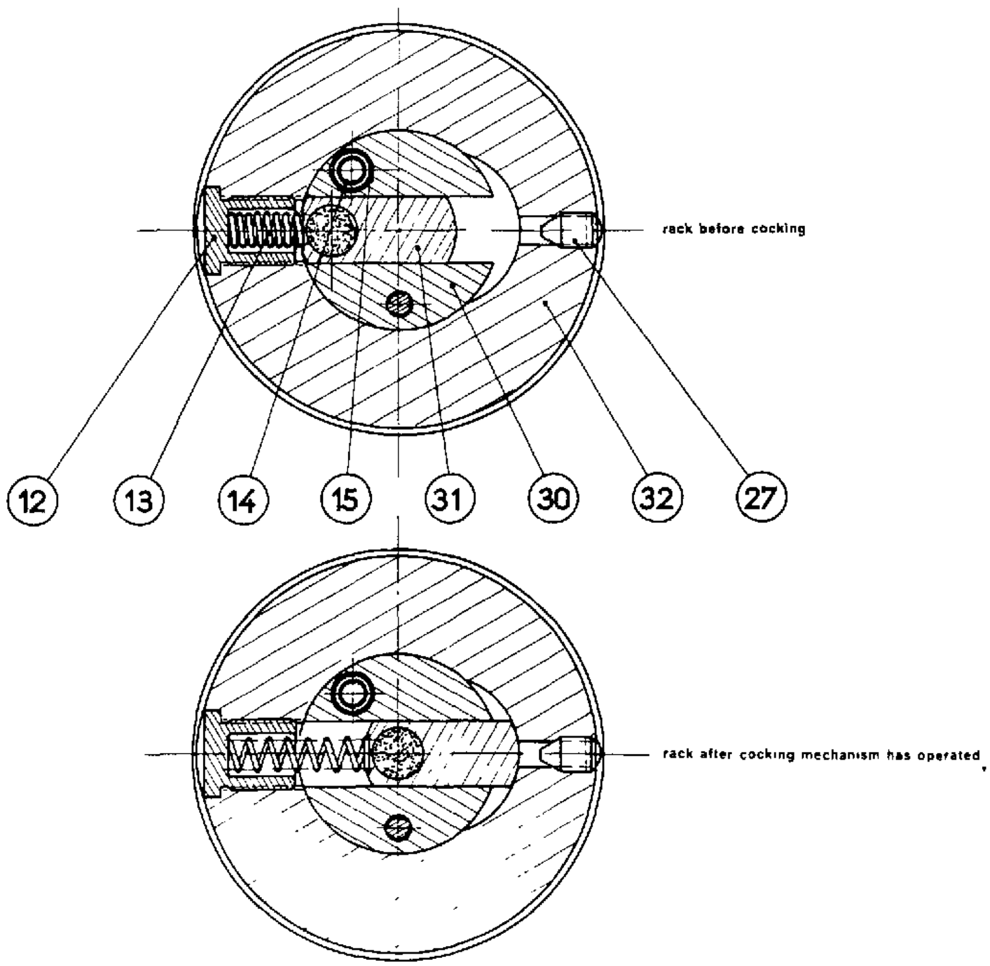

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Figure 2-41. Fuze, PD, Model V-5, details of rack (U).

(U) Design Details (Continued)

Design details of primer drum (24) and its interface with other fuze components are illustrated in figure 2-42. This view depicts the safety, instantaneous, and delay positions of the primers.

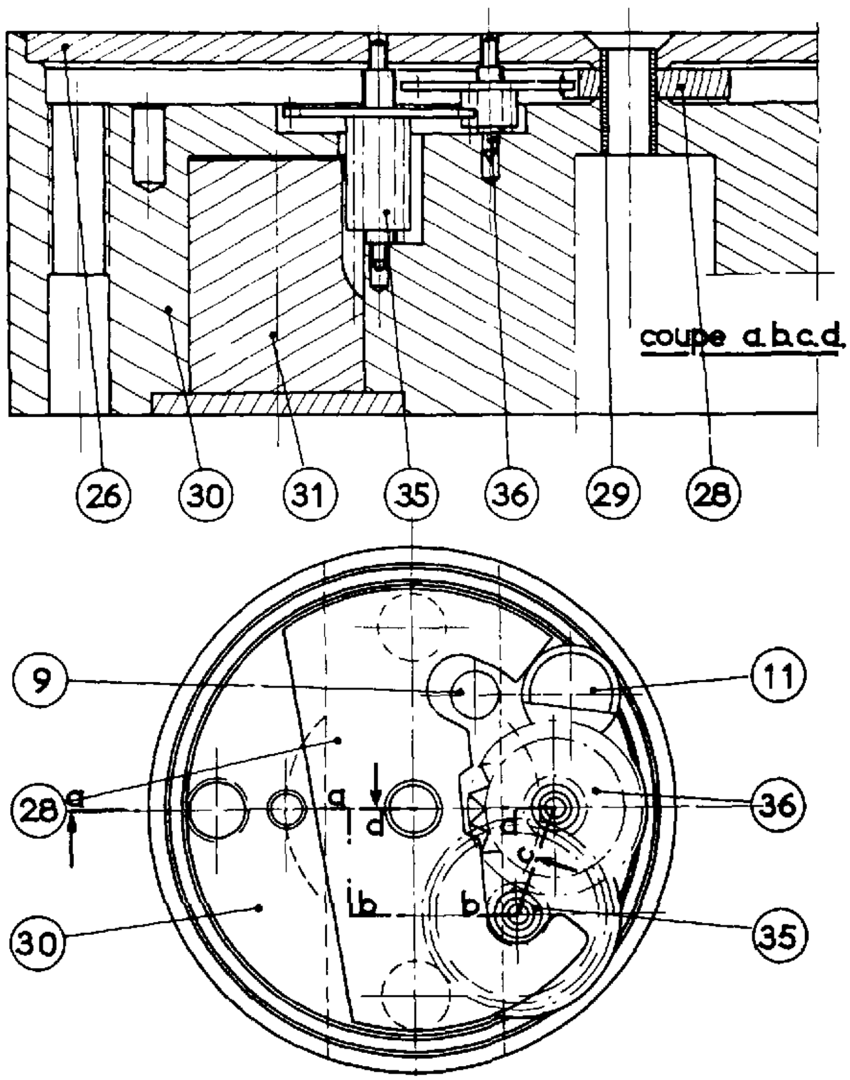

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Figure 2-42. Fuze, PD, Model V-5, details of primer drum (U).

Fuze, PD, Model V-5
FOM No. 1390-17-1-12

(U) **Functioning** (fig 2-43)

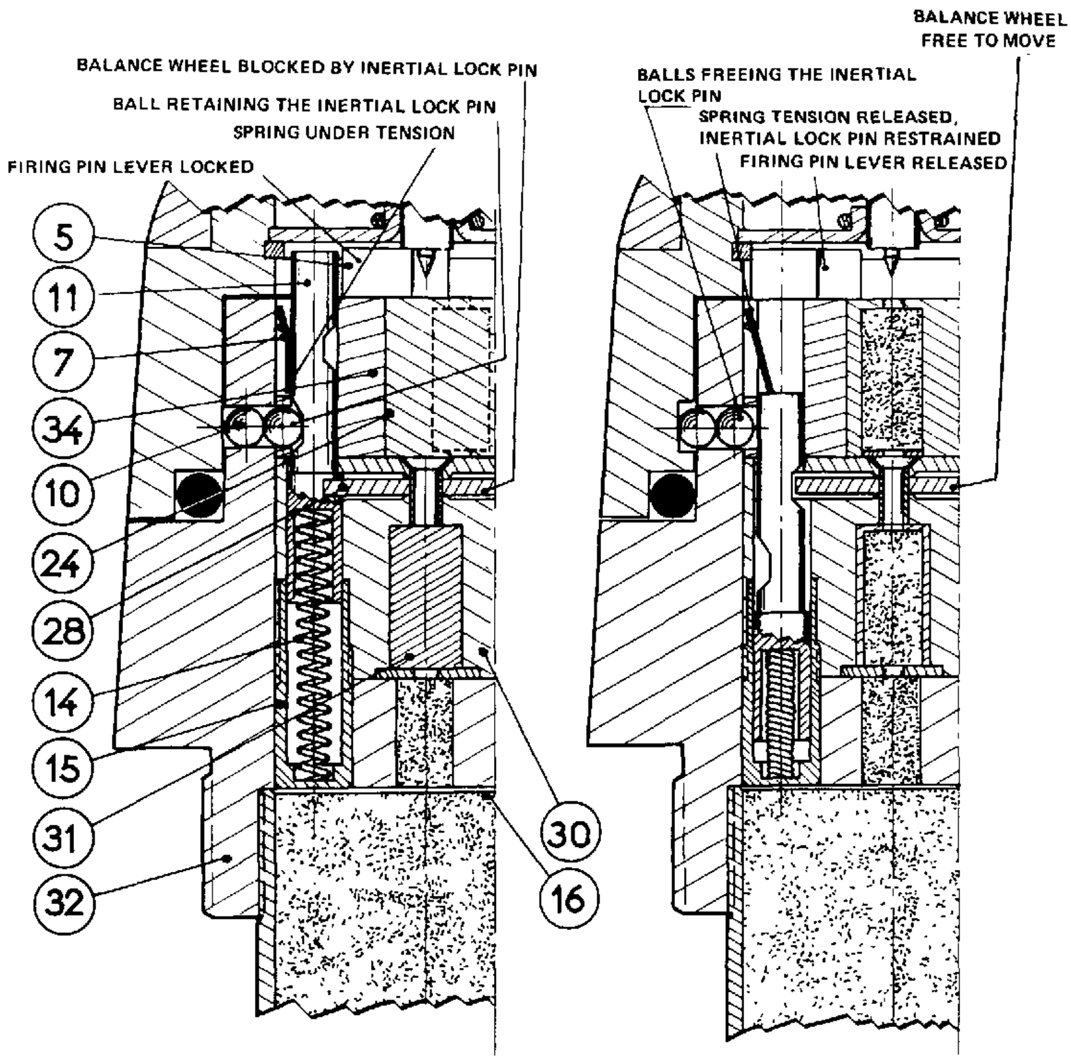

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Figure 2-43. Fuze, PD, Model V-5, section view, armed and unarmed positions (U).

(U) **Functioning (Continued)**

In the safety position no functioning parts can move, all parts being locked or detented. The detent on the firing pin is provided by a firing-pin lever (5), a lock ball, and a pivot pin. The detent on the balance wheel (28) is locked by two balls (10), a setback inertial-lock pin (11), and a setback spring (14). This detent is then put under tension by the lever spring (7).

For delay or instantaneous action, the movable cap is rotated to either the "R" or the "I" setting on the lower fuze body. This moves the delay or the instantaneous primer in line with the firing pin.

Upon firing, setback forces the inertial lock (11) rearward against its spring (14), releasing the lock ball (10). Instantaneously the firing-pin lock ball is released, allowing the lever (5) to pivot on its pin freeing the firing pin. The inertial lock is prevented from moving forward by lever spring (7).

Upon impact, the firing pin stabs the primer, initiating the detonator and in turn the relay charge and booster (16), resulting in the detonation of the high explosive charge of the projectile.

If the projectile grazes the ground, the primer drum (24) moves forward and the primer stabs the firing pin, resulting in initiation of the explosive train as indicated above.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars
120-mm HE projectiles	120-mm mortars

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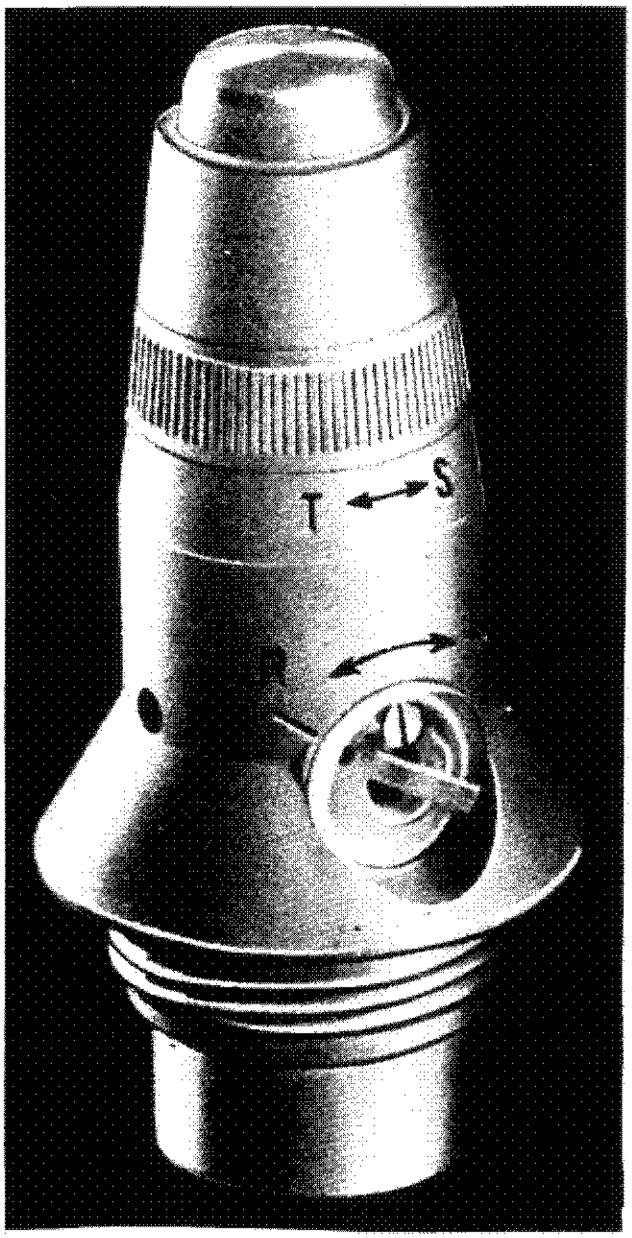

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Figure 2-44. Fuze, PD, Model V-19-P, full view (U).

Fuze, PD, Model V-19-P
FOM No. 1390-17-1-17

(U) Description

The V-19-P fuze (fig 2-44) is an improved version of the V-19 fuze (FOM No. 1390-17-1-3). Like the V-19, it is a setback, delayed-arming type intended for use with fin-stabilized 81-mm and 120-mm mortar projectiles. It is designed to assure bore safety and muzzle safety as well as to withstand parachute delivery.

(U) Unique Features

- Movable nose to permit setting of fuze from safe to fire position.
- The use of locking plate pinned to the nose of the fuze for detenting the setback sleeve when fuze is set in a safe position.
- Unique piston assembly which detents a torqued cylinder housing an out-of-line detonator.

(U) **Characteristics**

Fuze assembly:

Body material	Brass*
Weight	390 g (0.86 lb)
Markings	T S R I

Booster:

Body material	Aluminum
Body length	?
Explosive	Tetryl
Explosive weight	16.23 g (0.036 lb)

*Another model, the V-19-Pa, is manufactured with a light aluminum alloy body instead of brass, reducing the weight to 200 grams (0.44 lb). This version is intended for 81-mm projectiles only.

(U) Characteristics (Continued)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	50 to 250 m
Arming time	1 to 2 s
Delay time	0.05 s

(U) Design Details

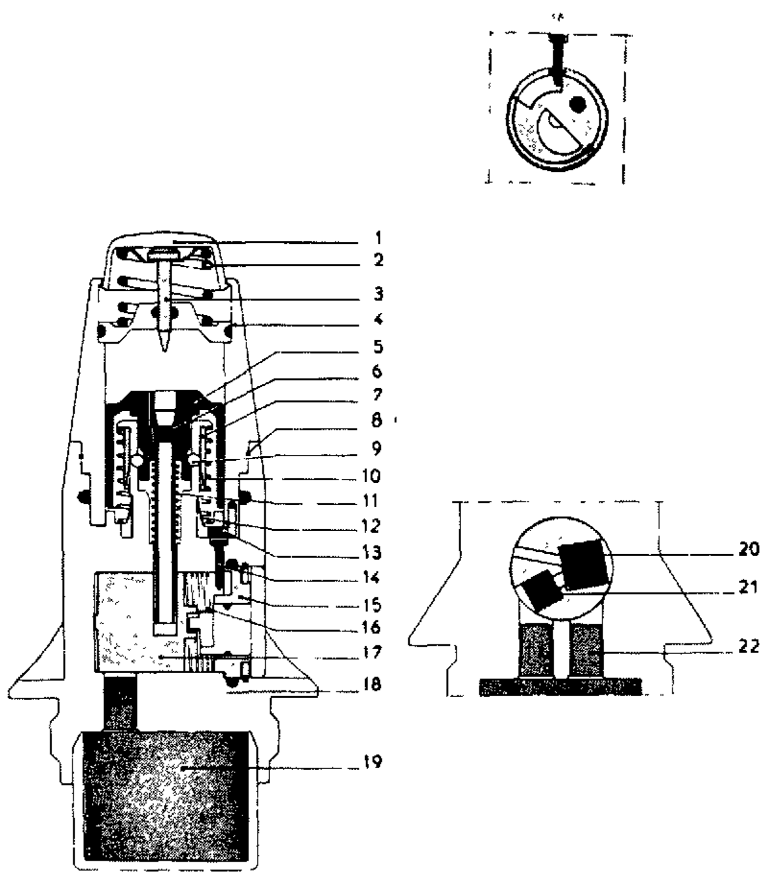

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Figure 2-45. Fuze, PD, Model V-19-P, section view, safe position (U).

*Two detent balls, detenting piston assembly having a central tube that detents cylinder housing out-of-line detonator, and a safety locking plate detenting the locking balls.

Fuze, PD, Model V-19-P
FOM No. 1390-17-1-17

(U) Design Details (Continued)

The fuze (fig 2-45) consists of a movable nose (4), brass fuze body (18), and booster (19) assembly.

The movable nose (4) is bored out to house the firing pin and unique piston assembly (5). The firing-pin assembly includes a firing-pin cup (1), its spring (2), a nail-like firing pin (3), and a flange that acts as a seat for the spring (2). The assembly is sealed by an "O" ring to assure tightness of assemblage.

Fitted into the rear of the nose is the piston assembly (5) which houses the primer (6) positioned in a central flash tube that locks the cylinder (17) to prevent its moving.

The detent system on the piston (5) includes two metal balls (9) held in place by a setback sleeve (7), a setback spring (10), and a locking plate (13) pinned to the movable nose which has a slot for camming the plate under the setback sleeve (7). This happens when the fuze nose is turned by hand to the safe position. The locking plate detents the sleeve (7) and precludes movement of the detent balls, (10) assuring safe delivery by parachute drop. Additionally, a safety retainer ring (12) with four prongs is positioned under the sleeve (7) and held in place by the setback spring (10). Upon setback during firing, the ring (12) latches onto the sleeve (7) and prevents the spring (10), which is compressed, from expanding when setback forces are dissipated. This allows the piston (5) housing the primer to move forward towards the firing pin (3) by expansion of a spring (11) assembled in a compressed state. This simultaneously moves the central tube forward undetenting or releasing the torqued cylinder (17).

The brass fuze body (18) is fitted to the movable nose (4) by a retaining ring (8).

A hole transversally cut through the fuze body (18) houses the cylinder (17) which has an eccentric pin or stud.

The cylinder also has two bored holes forming a "V." In one of the legs there is a delay charge (21); the other leg is empty. Both legs terminate on the detonator (20). The cylinder assembled under torsion by a spring (16) is retained by a stop (14) and a transparent selector (15). The selector with its stop can be turned to either instantaneous (I) or delay action (R) by the eccentric pin of the cylinder (17).

(U) Design Details (Continued)

Directly beneath the cylinder are two openings drilled through the base of the fuze body for housing two tetryl relays (22). In addition, the interior of the fuze body is bored and threaded to facilitate assembly of the tetryl booster pellet (19) which is sealed by a closing cup.

The exterior of the rear portion of the fuze body (18) is threaded for assembling into either an 81-mm or 120-mm mortar projectile.

(U) Functioning

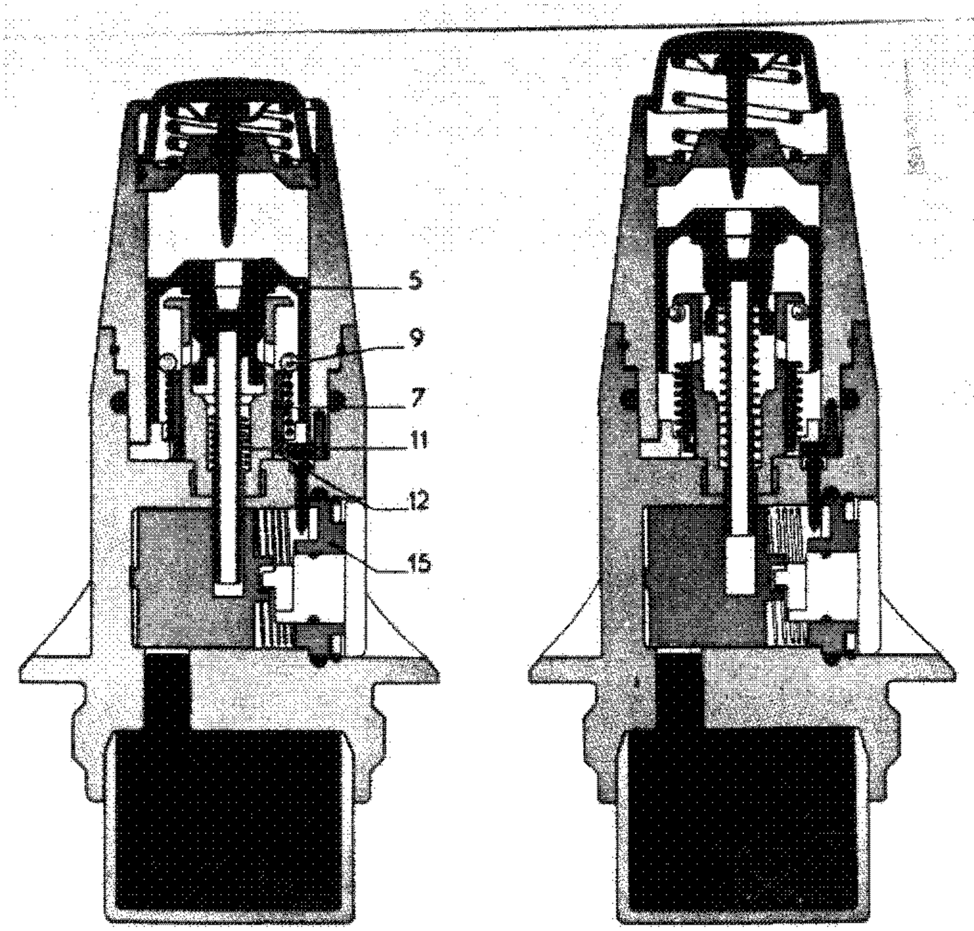

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Figure 2-46. Fuze, PD, Model V-19-P, section view depicting setback action (U).

Fuze, PD, Model V-19-P
FOM No. 1390-17-1-17

(U) Functioning (Continued)

Prior to functioning (fig 2-46), the selector (15) is moved to either the instantaneous (I) or delay (R) mode of functioning. The movable nose is placed in the "T" position, indicating ready for firing.

Upon firing, setback causes the setback sleeve (7) to move rearward compressing its spring and the sleeve is locked in place by four prongs of the safety retainer ring (12). Simultaneously, the piston (5) housing these components moves rearward, further compressing the spring (11). The detent ball (9) now moves out into a cavity of the piston assembly (5). This releases the piston containing the primer and central tube which is pushed toward the firing pin by expansion of a spring (11) when setback forces dissipate. The central tube detenting the cylinder is moved forward, undetenting the torqued cylinder. When the piston has stopped moving forward, the cylinder (fig 2-47) is released and rotates 60° or 120°, depending on the position of the selector (15) which rests against the eccentric pin of the cylinder. The fuze is now armed. (See both delayed and instantaneous positions of the cylinder.)

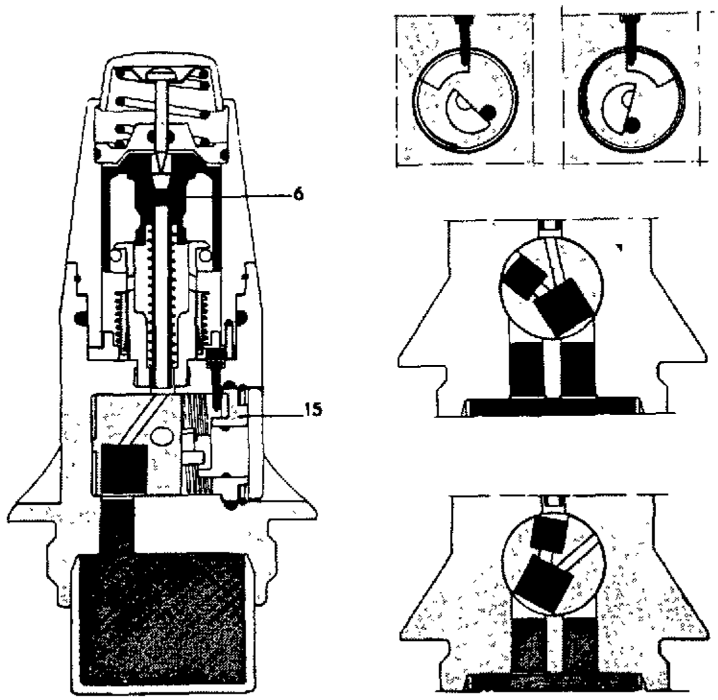

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Figure 2-47. Fuze, PD, Model V-19-P, section view depicting components in armed position (U).

(U) Functioning (Continued)

In the armed position, the firing pin enters the central flash tube directly above the primer (6). Upon impact (fig 2-48), the firing-pin cup compresses a spring (2) while the piston (5) is flung forward. The point of the firing pin stabs the primer which flashes through the central tube, one of the legs of the V in the cylinder, depending on the setting. If set for instantaneous, it flashes through the V-leg housing the instantaneous charge, initiating the detonator which in turn is relayed by charge (22), resulting in the detonator of booster (19).

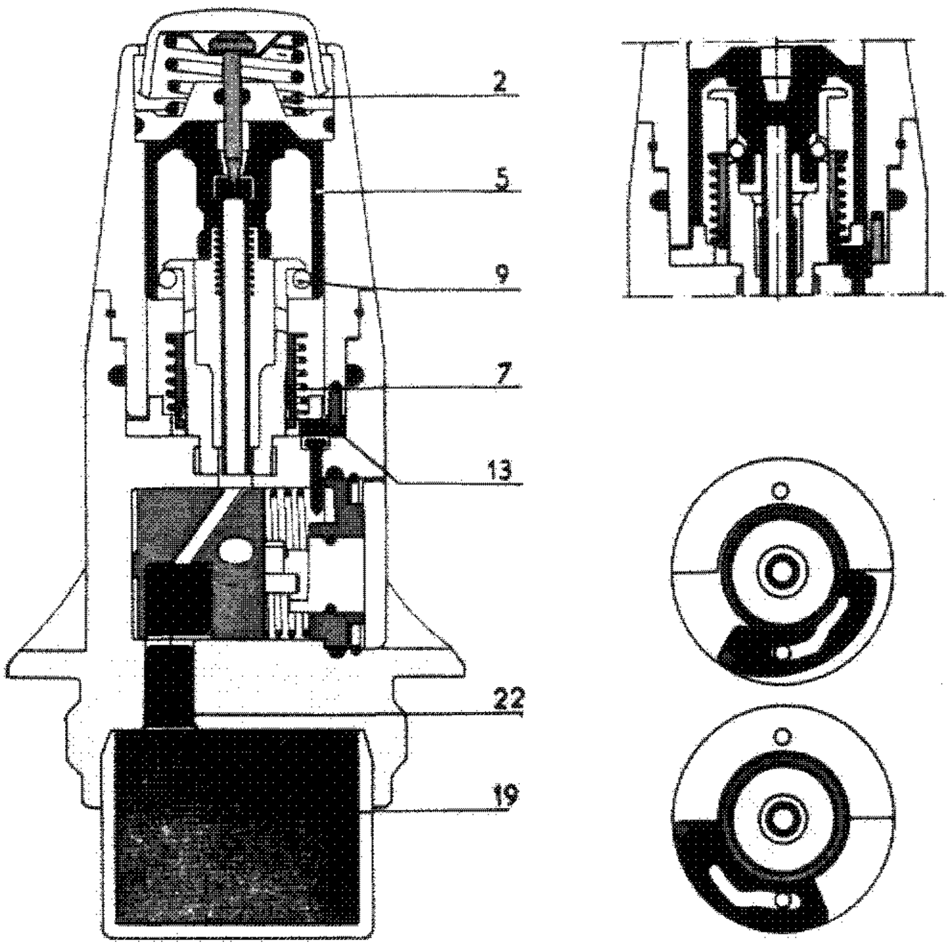

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Figure 2-48. Fuze, PD, Model V-19-P, section view depicting firing-pin and locking-plate camming action (U).

Fuze, PD, Model V-19-P
FOM No. 1390-17-1-17

(U) Functioning (Continued)

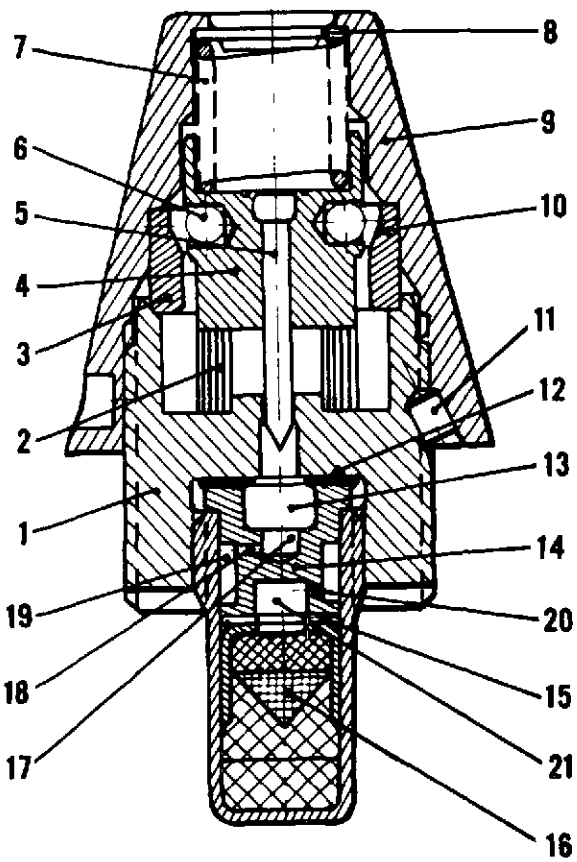
If set for delay, it flashes through the V-leg housing the delay charge, which burns for 0.05-second delay, then initiates the detonator and in turn the relay charge and booster.

The camming of the locking plate with the fuze nose in the safe position is shown in figure 2-48. The locking plate is positioned under the setback sleeve and precludes movement of the metal balls, making the fuze safe for dropping by parachute.

When in the fire position, the locking plate is cammed away from the setback sleeve, which now allows the sleeve to lock onto the four prongs of the safety retainer ring, releasing the balls.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm projectiles	81-mm Brandt mortar
120-mm projectiles	120-mm Brandt mortar



1. Lower body (aluminum alloy)
2. Arming coil (annealed brass)
3. Self-destruct housing (steel)
4. Firing pin body (aluminum alloy)
5. Firing pin (stainless steel)
6. Self-destruct balls (6) (steel)
7. Firing pin spring (spring steel)
8. Closing disk (aluminum alloys)
9. Upper body (aluminum alloy)
10. Conical surface of self-destruct housing
11. Lock pin (steel)
12. Closing washer (cardboard)
13. Primer
14. Primer holder (aluminum alloy)
15. Closing washer (cardboard)
16. Delay detonator
17., 18., 19., 20., and 21. Flash channels in primer holder providing delay in fuze functioning

Neg. 517009 (UNCLASSIFIED)

Figure 2-49. Fuze, PDSD, Model FDPA 1502, section view (U).

(U) Description

The French PDSD fuze FDPA 1502 (fig 2-49) is designed for 30x97-mm ammunition for automatic aircraft cannon, Types 3 CGF and DEFA 540 and 541. The fuze does not have an out-of-line detonator.

Fuze, PDSD, Model FDPA 1502
FOM No. 1390-17-1-18

(U) Characteristics

Fuze assembly:

Body material	Aluminum alloy
Weight	?
Markings	?

Booster:

Body material	?
Body length	?
Explosive	Hexal 85/15
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Arming coil
Arming distance	?
Arming time	?
Self-destruct time	0.05 s
Delay time	?

(U) **Functioning**

This fuze is similar in design and function to the West German fuze, PDSD, Model AZZ DM 31. In storage and transport, the firing-pin body is restrained from contact with the detonator by an arming coil. Upon firing, setback forces acting on the closing disk and firing-pin spring press the firing-pin body against the arming coil, preventing it from uncoiling. As acceleration ceases and setback pressure is removed, centrifugal force moves the six steel balls radially outward against the conical surface of the self-destruct housing, raising the firing-pin body against the pressure of the firing-pin spring. Released from restraint, the arming coil unwinds until it lies against the inner wall of the lower body. The time required for the arming coil to unwind after setback ends provides bore and muzzle safety. At this point the fuze is armed.

Upon striking a target, impact on the closing disk is transmitted through the firing-pin spring, increasing the pressure against the firing-pin body and overcoming the centrifugal

(U) **Functioning (Continued)**

force that causes the six steel balls to restrain the firing pin, until the firing-pin spring forces the firing-pin body against the primer to initiate detonation. The flash from the primer passes through channels in the primer holder before reaching the delay detonator, which in itself has a 0.001-second pyrotechnic delay. The overall delay is believed to be about 10 ms.

If the fuze fails to hit a target, centrifugal force weakens as rotation decays until the pressure of the firing-pin spring overcomes centrifugal force. At this point, the firing-pin spring drives the firing pin into the detonator to initiate self-destruction. This fuze does not have an out-of-line detonator.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
30x97-mm B HEI or HEI-T cartridge, Model ?	30-mm automatic gun, Model 3 CGF; DEFA Models 540 and 541

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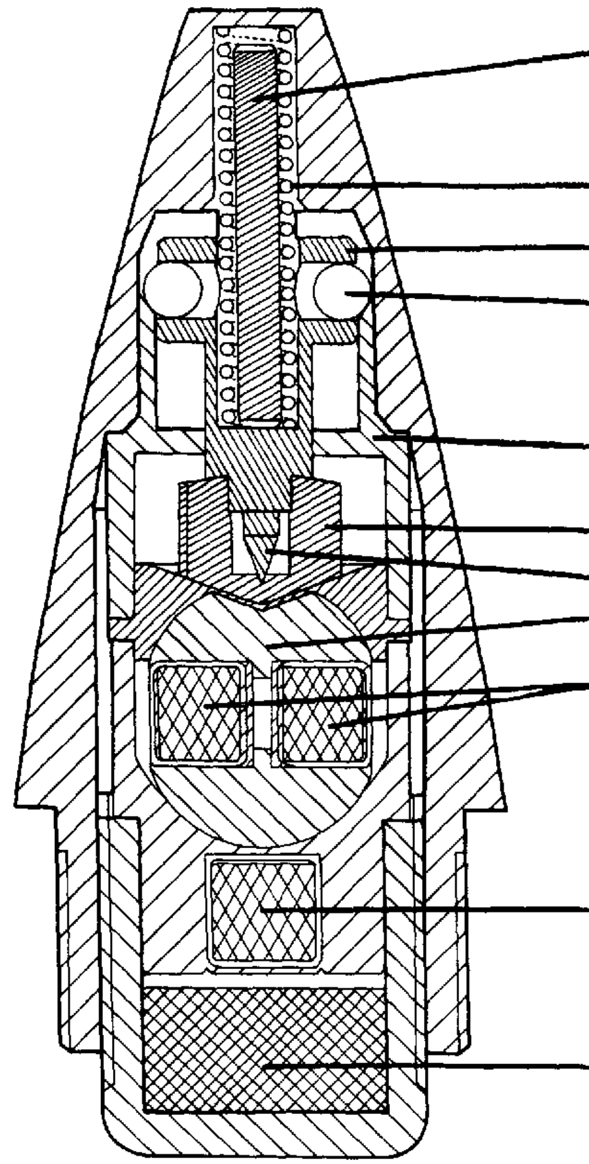

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Figure 2-50. Fuze, PDSD, Model FUA 723, section view (U).

Fuze, PDSD, Model FUA 723 (France)
FOM No. 1390-17-1-21

(U) Description

The FUA 723 fuze (fig 2-50) represents one of the most recent developments of a detonator-safe fuze for small-caliber projectiles. It combines a mechanical self-destruct mechanism with an out-of-line detonator in a ball rotor to provide a muzzle safety distance of 15 meters.

(U) Unique Features

The fuze has several unusual features: (1) a highly-finished ball rotor surface, which increases arming time; (2) a split safety-ring that retains the rotor in safe position until setback ceases; (3) two detonators in ball rotor, to insure functioning regardless of which detonator is adjacent to the firing pin; (4) a fuze design that emphasizes simplicity, for automated assembly and low cost.

(U) Characteristics

Fuze assembly:

Body material	?
Weight	?
Markings	?

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Detonator rotor; safety ring
Arming distance	~15 m
Arming time	?
Self-destruct time	6 s
Delay time	?

(U) **Characteristics (Continued)**

The fuze is composed of a one-piece, watertight fuze body bored out from the rear to receive components. A striker body containing four steel arming balls is located in a self-destruct housing. A split safety-ring retains the ball rotor and striker body in safe (unarmed) position. The ball rotor contains two detonators, 180° apart; in safe position the rotor is 90° out-of-line with the firing pin. A lower detonator insures high-order detonation of the booster. Detailed data on the fuze are not available.

(U) **Functioning**

During storage and transport, the striker spring forces the striker body against the split safety-ring, which secures the ball rotor in an out-of-line position.

Upon firing, setback forces augment the pressure of the setback spring to prevent centrifugal force from acting on the arming balls and split safety-ring. The ball rotor is thus held in its out-of-line position until setback ceases and deceleration commences. At this point, centrifugal force acts simultaneously on the four arming balls and the split safety-ring, forcing the striker body forward and further compressing the striker spring. The sections of the safety-ring move outward until they lie against the wall of the recess in the self-destruct housing. This leaves the ball rotor free to move. Because of its inertia and the reduced friction of its polished surface, the ball rotor acquires rotational velocity only gradually from the projectile. At a point approximately 15 meters from the gun muzzle, the rotor has reached the projectile's spin rate, and its two detonators are aligned with the firing pin and the lower detonator. It is immaterial which of the two rotor detonators is adjacent to the firing pin; either one will function on impact, while the other serves to transmit the detonation to the booster. At this point the fuze is fully armed.

Upon impact with a target, the thin fuze nose is crushed, and the plunger transmits the impact to the striker body. This shock, added to pressure of the striker spring, overcomes the centrifugal force of the arming balls that has restrained rearward motion of the striker body; the striker body is forced to the rear and thrusts the firing pin into the detonator to initiate functioning.

Should the projectile fail to strike a target, projectile spin will continue to decay with time and range until the centrifugal force acting on the arming balls becomes weaker than the pressure of the compressed striker spring. At this point the striker spring forces the striker body rearward; the firing pin is thrust into the detonator, and self-destruct is initiated.

Fuze, PDSD, Model FUA 723 (France)
FOM No. 1390-17-1-21

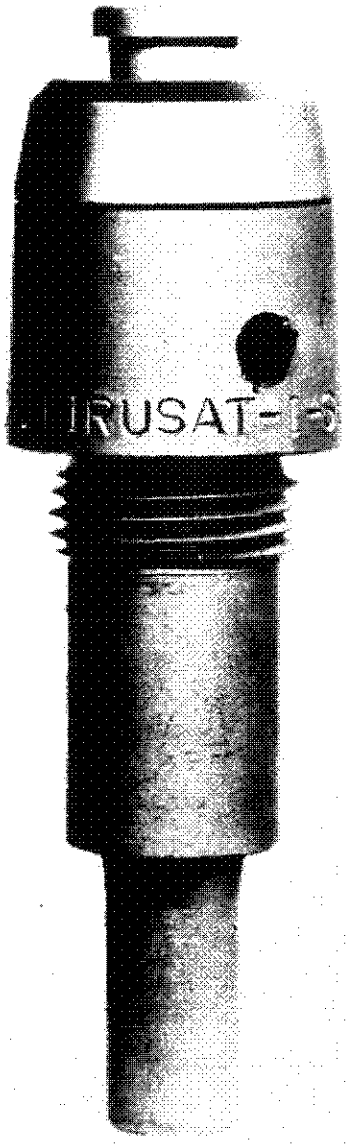
(U) **Functioning (Continued)**

The 723 fuze functions instantaneously, with no delay on impact, with material equal to or greater than 0.5-mm aluminum, or paperboard of a weight of 1 kg/m^2, at angles of obliquity up to 85°. It will not function against paperboard weighing 200 g/m^2, which corresponds to a large (2-mm diameter) raindrop.

The 723 fuze is designed for use in gun barrels with 7° rifling, but can be used in barrels with 5° or 6° rifling; under these conditions self-destruct will occur after a time of flight somewhat less than 6 seconds, depending on the muzzle velocity and pitch of rifling.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
HEI, HEI-T projectiles	20x139-mm HS 820-type gun, 20x102-mm M 56-type gun



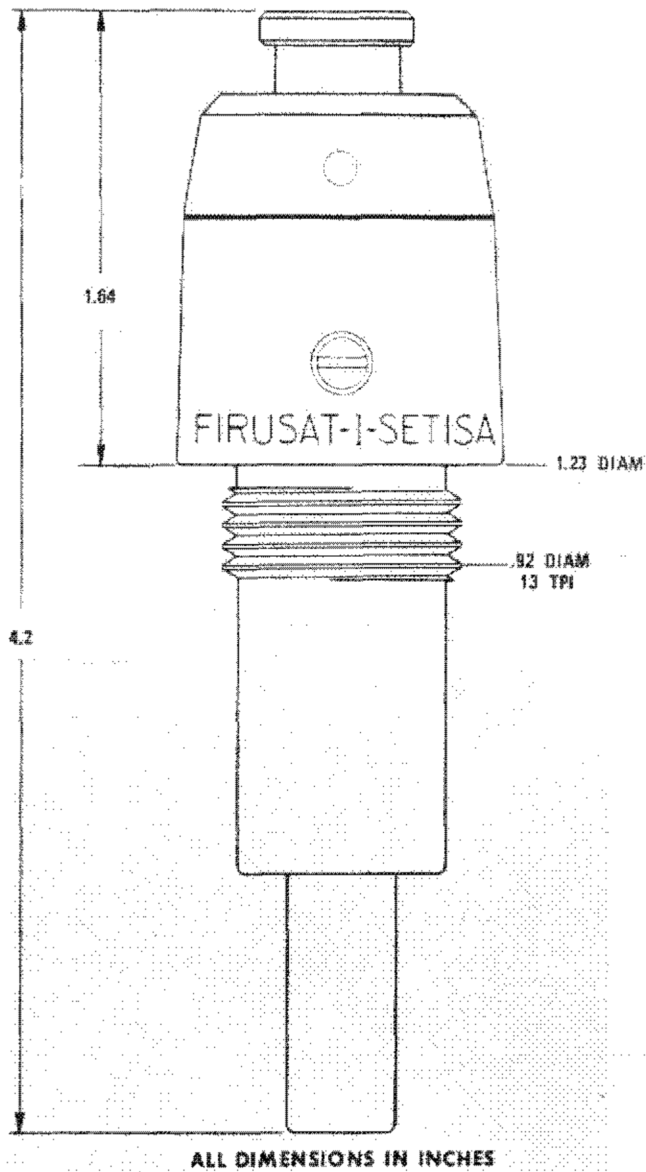


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Figure 2-51. Fuze, PD, Model FIRUSAT, contour and section views (U).

Fuze, PD, Model FIRUSAT
FOM No. 1390-18-1-6

(U) **Description**

The Swiss PD fuze, Model FIRUSAT (fig 2-51), was developed by Setisa S.A. of Geneva, Switzerland, for use with 81-mm and 120-mm mortar projectiles. It is a setback, delayed-arming type designed for instantaneous action with a graze-sensitivity feature. It has been tested for jolt, primer safety, double loading, and muzzle security.

(U) **Unique Features**

- Runaway escapement mechanism detenting firing pin.
- Locking pin detenting spring-loaded slider blocking detonator.
- Inertial-type primer holder providing graze feature.
- Plunger-type striker head permitting instantaneous action.

(U) **Characteristics**

Fuze assembly:	
Body material	Nickel-plated brass
Weight	9.04 oz (256.3 g)
Markings	FIRUSAT-1
Length	4.2 in (106.6 mm)
Max diameter	1.23 in (31.2 mm)
Thread diam	0.92 in (23.4 mm)
Primer:	
Explosive:	
1st charge	Potassium chlorate, antimony, sulfide, and mercury fulminate
2nd charge	Black powder
Explosive weight	0.06 g (0.92 gr)

(U) **Characteristics (Continued)**

Detonator:

Explosive type	Lead styphanate, lead azide, PETN
Length	0.91 in (23.1 mm)
Max diam	0.61 in (15.5 mm)
Min diam	0.38 in (9.7 mm)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	25 m, min charge; 40 m, full charge
Arming time	?
Self-destruct time	DNA
Delay time	DNA
Frequency (for VT fuze only)	DNA

Sensitivity of functioning:

At 100 m	Upon impact 2-mm cardboard
Sand (including desert sand)	Upon impact
Fresh snow	Upon impact
Swamp lands	Upon impact

*Locking pin detenting slider blocking detonator and runaway escapement detenting firing pin.

Fuze, PD, Model FIRUSAT
FOM No. 1390-18-1-6

(U) Design Details

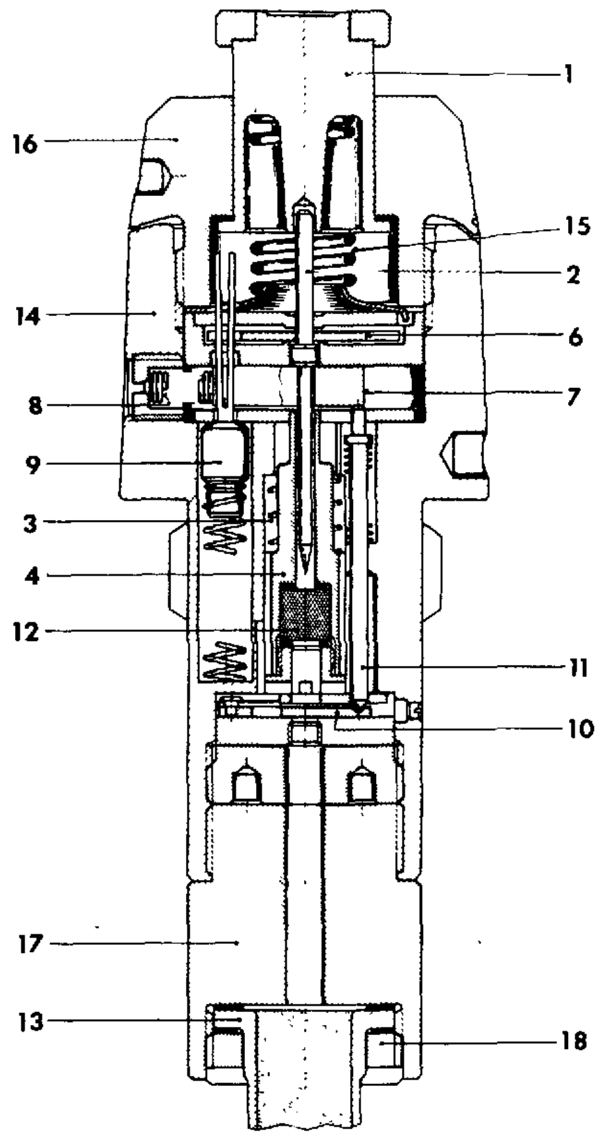

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Figure 2-52. Fuze, PD, Model FIRUSAT, section view (U).

(U) Design Details (Continued)

The FIRUSAT fuze (fig 2-52) consists primarily of a nickel-plated brass fuze body (14) bored out to house the firing-pin assembly, runaway escapement mechanism, primer holder (4), primer (12), spring-loaded slider (10), and detonator cup (13).

The firing-pin assembly includes a plunger-type striker head (1), its spring (15), and the firing pin (2). The assembly is secured at the forward end of the fuze by a retainer plug (16) which screws into the fuze body.

The runaway escapement mechanism consists primarily of a pallet (6), escape wheel, rack, gear and pinion, and a spring-loaded rack (7).

Figure 2-53 illustrates the interface of the rack (7) with the firing pin (2), primer holder (4), and spring-loaded slider (10). The firing pin (2) rests on the shoulder of the rack in the safe position. The pallet (6) is detented by a swivel-type cotter pin (9). This keeps the escapement locked and thus prevents the firing pin from hitting the primer (12).

The spring-loaded slider consists of a slider, its spring, a cover, and a housing. The slider is detented by a spring-loaded locking pin (11). This also prevents movement of the inertial-type primer holder (4) held in place by its spring.

A plug (17) (fig 2-53) with a flash hole drilled through it is screwed into the base of the fuze body.

The detonator assembly (13) is then placed in position followed by a rubber gasket to provide a seal. The detonator assembly is locked in place by a retainer nut (18), which screws into the fuze body, completing the assembly.

Fuze, PD, Model FIRUSAT
FOM No. 1390-18-1-6

(U) **Functioning** (fig 2-53)

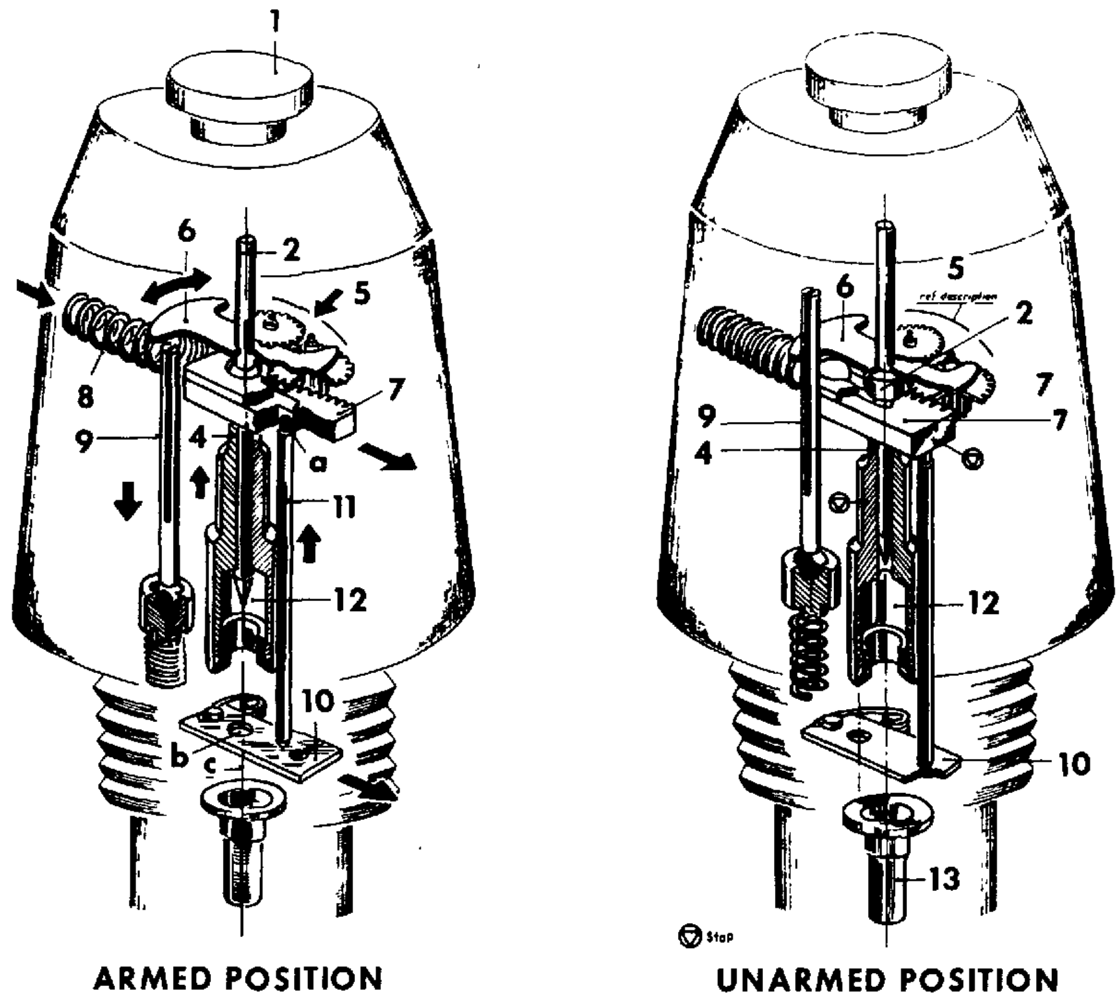

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Figure 2-53. Fuze, PD, Model FIRUSAT, runaway escapement interface view (U).

Upon firing, setback moves the swivel cotter pin (9) to the rear undetenting the verge or pallet (6) of the runaway-type escapement. The timing wheel (5) via a pinion-gear arrangement now controls the movement of the spring-loaded rack (7), and at the end of its travel, a clearance hole in the rack aligns with the firing pin (2).

(U) **Functioning (Continued)**

The flash path of primer (12) located in the primer holder (4) is blocked by the spring-loaded slider (10). When the rack has completed its travel, the spring-loaded locking pin moves forward into a void created by the rack, releasing the slider. The spring-loaded slider moves until the hole in it and the flash path are in line. This also frees the primer holder (4). The fuze is fully armed. Upon impact, the plunger-type striker head (1) compresses its spring, driving the firing pin (2) into the primer (12) which flashes to the detonator (13), resulting in the initiation of the high explosive filler of the projectile.

In case of oblique impact or graze action, the primer holder (4) due to inertia is thrust against the fuze firing pin (2), initiating the primer.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars
120-mm HE projectiles	120-mm mortars

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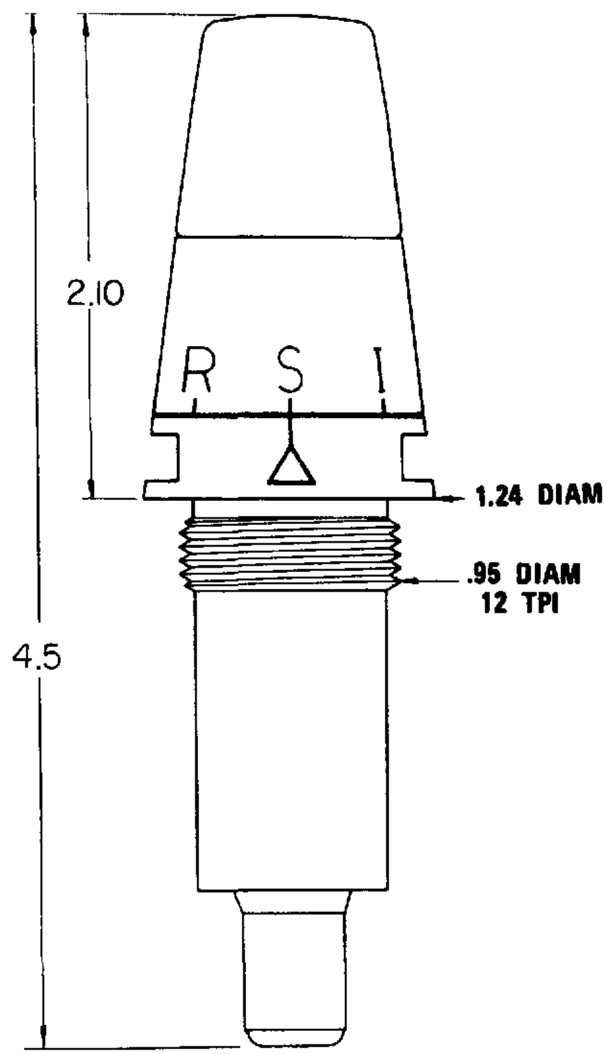

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Figure 2-54. Fuze, PD, Model A, contour view (U).

Fuze, PD, Model A
FOM No. 1390-18-1-18

(U) Description

The Model A PD fuze (fig 2-54) was developed by the Tavaro Company of Switzerland for use with 81-mm and 120-mm mortar ammunition. It is a setback, delayed-arming fuze designed for either instantaneous or delay functioning upon impact. The Model A design has been tested to assure absolute safety against double loading and premature explosions to a distance of 50 meters from the weapon.

(U) Unique Features

- Runaway escapement mechanism controlling the arming of the fuze.
- Unique primer carrier housing two primers and a delay charge.
- Dualized firing pins for instantaneous or delay action.
- Pivotable-type slider housing out-of-line detonator.

(U) Characteristics

Fuze assembly:

Body material	Steel
Weight	?
Markings	R, S, I
Length	4.50 in (114.3 mm)
Thread diam	0.95 in (24.1 mm)

Booster:

Body material	Steel
Body length	?
Explosive	?
Explosive weight	?

(U) **Characteristics (Continued)**

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	50 m (min)
Arming time	0.71 s (est)
Delay time	0.12 s

(U) **Design Details**

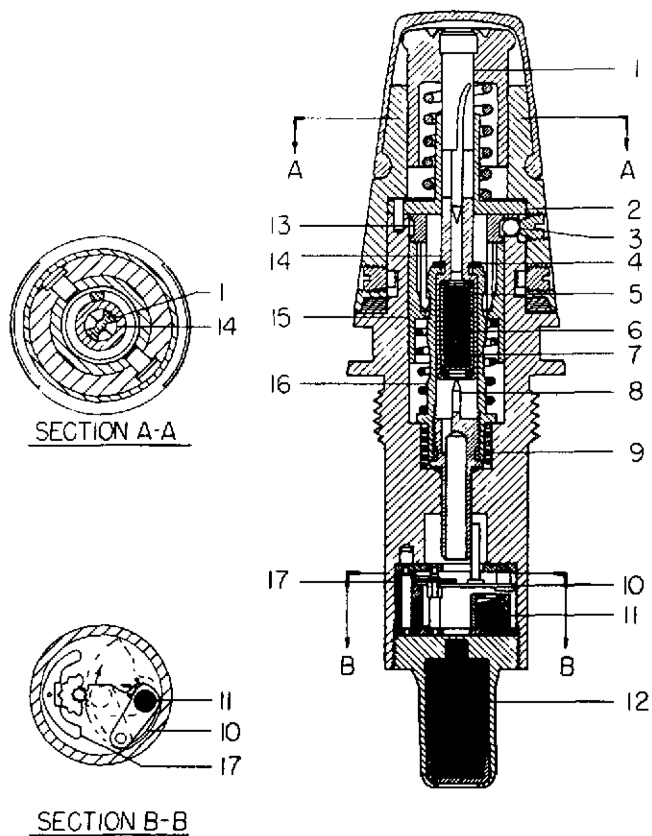

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Figure 2-55. Fuze, PD, Model A (U).

*Out-of-line detonator, ball detent.

Fuze, PD, Model A
FOM No. 1390-18-1-18

(U) Design Details (Continued)

The Model A fuze (fig 2-55) is made mostly of brass and of steel components which are protected against corrosion by a galvanized surface treatment.

The upper rotatable fuze body (section A-A) houses the firing-pin assembly consisting of a striker head, a keyed plunger-type firing pin (1), and a coiled spring. The keyed firing pin (1) is positioned into a guide bush or plate (2), which is pinned to the lower fuze body. The guide bush or plate (2) also provides a seat for the firing pin assembly's coiled spring. The rotatable upper fuze body is then sealed at its forward end by a closing cap which is crimped 360° into an exterior groove.

The lower fuze body houses the primer-delay carrier (14), the lower firing pin (8) with its extension, the detent system, and the delayed-arming mechanism (section B-B).

The primer-delay carrier is positioned in a housing (16). The carrier (14) encases the upper primer (5), the pyrotechnic element (6), and the lower primer (7).

The detent system comprises the locking ball (3), safety ring (13) with prong-like clips, shear ring (4), safety bush or setback sleeve (15), and a setback spring. The coiled spring (9) is then positioned in a compressed state.

Located beneath the lower firing pin (8) is a central flash tube that detents the delayed arming mechanism (section B-B). This mechanism consists of an escapement and pivotable slider (10) housing the out-of-line detonator (11). The escapement consists of a pallet (17), escape wheel, and gear meshed to a spring-driven tooth sector of the pivotable slider.

The lower fuze body, which is transversally cut at its forward end, is secured to the rotatable upper fuze body by set screws. The lower fuze body is threaded internally to facilitate assembly of the booster (12) and is threaded externally for screwing into the high explosive mortar projectile.

(U) Functioning (fig 2-55)

Safety position. The detent ball (3) locks the safety ring (13) which keeps the fuze in the unarmed position.

(U) Functioning (Continued)

Firing position. The fuze may be set for either instantaneous functioning "I" or delayed functioning "R" by rotating the upper fuze body portion to the desired setting.

Upon firing, setback force moves the safety ring (13) and setback sleeve (15) rearward, compressing its spring. The clips of the safety ring (13) then lock onto the lower notch of the primer-delay carrier housing (16). As soon as setback dissipates, the compressed spring (9) expands, moving the setback sleeve (15) and carrier (14) forward to a position where the shear ring (4) is in contact with the plate (2) and the upper primer (5) is in firing position relative to the keyed firing pin (1).

Simultaneously, the forward movement of the housing (16) moves the lower firing pin (8) with its central tube forward, undetenting the pivotable slider (10). The spring-driven tooth sector of the slider controlled by the pallet (17) of the escapement moves the detonator (11) into the armed position. The detonator (11) is then locked onto the booster (12) by a spring washer.

When the shoulder of the keyed firing pin (1) is rotated to the "I" setting, the shoulder is in position to drive the carrier (14) and lower primer (7) against the lower firing pin (8), resulting in initiation of the detonator (11) and booster (12). When the shoulder of the keyed firing pin (1) is rotated to the delay or "R" setting, the shoulder is free to bypass the carrier (14). Upon impact, the firing pin (1) stabs the upper primer (5), initiating the delay element (6), lower primer (7), and in turn the detonator (11) and booster (12).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars
120-mm HE projectiles	120-mm mortars

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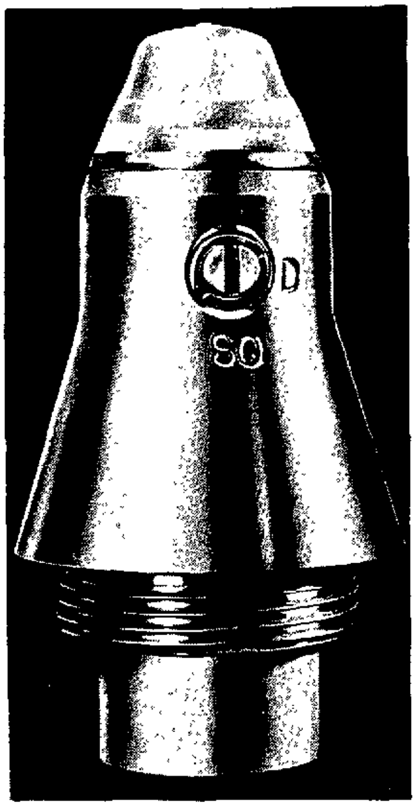
Fuze, PD, Model RKVDIR 0265
FOM No. 1390-18-1-35



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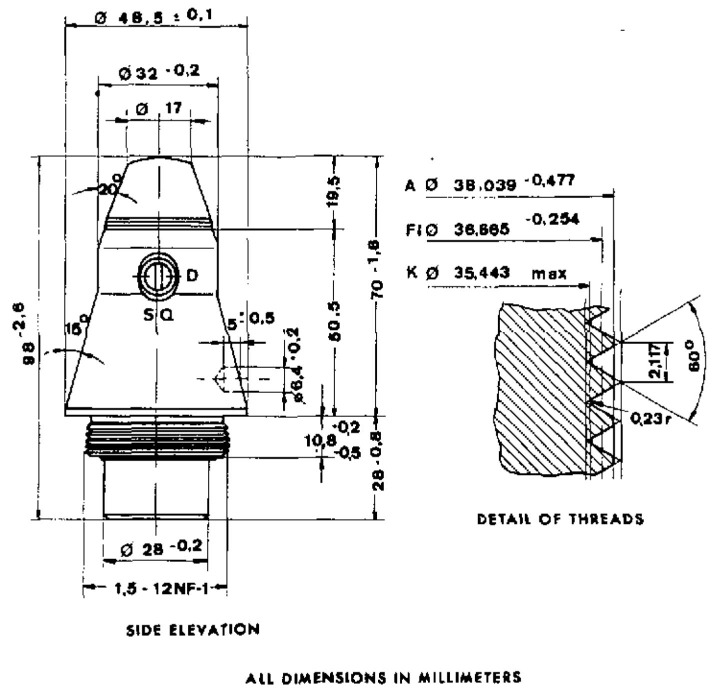

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Figure 2-56. Fuze, PD, Model RKVDIR 0265, full and contour views (U).

(U) Description

The RKVDIR 0265 (fig 2-56) is a setback, delayed-arming fuze designed for either SQ or delay action upon impact. It was developed by Oerlikon of Zurich, Switzerland, for use with non-rotating mortar projectiles. The dimensions shown in figure 2-56 are for installation on 81-mm teardrop-type mortar projectiles.

(U) Unique Features

This fuze contains two firing pins: one for SQ action, the other for delay. The two primer-detonators used are held in an out-of-line position by a spring-loaded slider controlled by an escapement via a pinion-rack arrangement as well as a detent system provided by a setback sleeve, spring, detent balls, and locking bolt.

Fuze, PD, Model RKVDIR 0265
FOM No. 1390-18-1-35

(U) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Weight	585 g (1.29 lb)
Markings	RKVDIR 0265

Booster:

Body material	Aluminum
Body length	16.5 mm approx (0.65 in)
Explosive	Tetryl
Explosive weight	4 g (61.6 gr)

Relay (columnar charge):

Explosive	Tetryl
Explosive weight	0.06 g (0.92 gr)
Length	33 mm approx (1.30 in)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Slider-escapement, locking bolt & detent balls
Arming time	0.80 s
Delay time	0.50 s
Arming distance	25 m

Sensitivity:

SQ action	Functions on 4-mm cardboard target
Delayed action	Less than SQ action

(U) **Design Details** (fig 2-57 and 2-58)

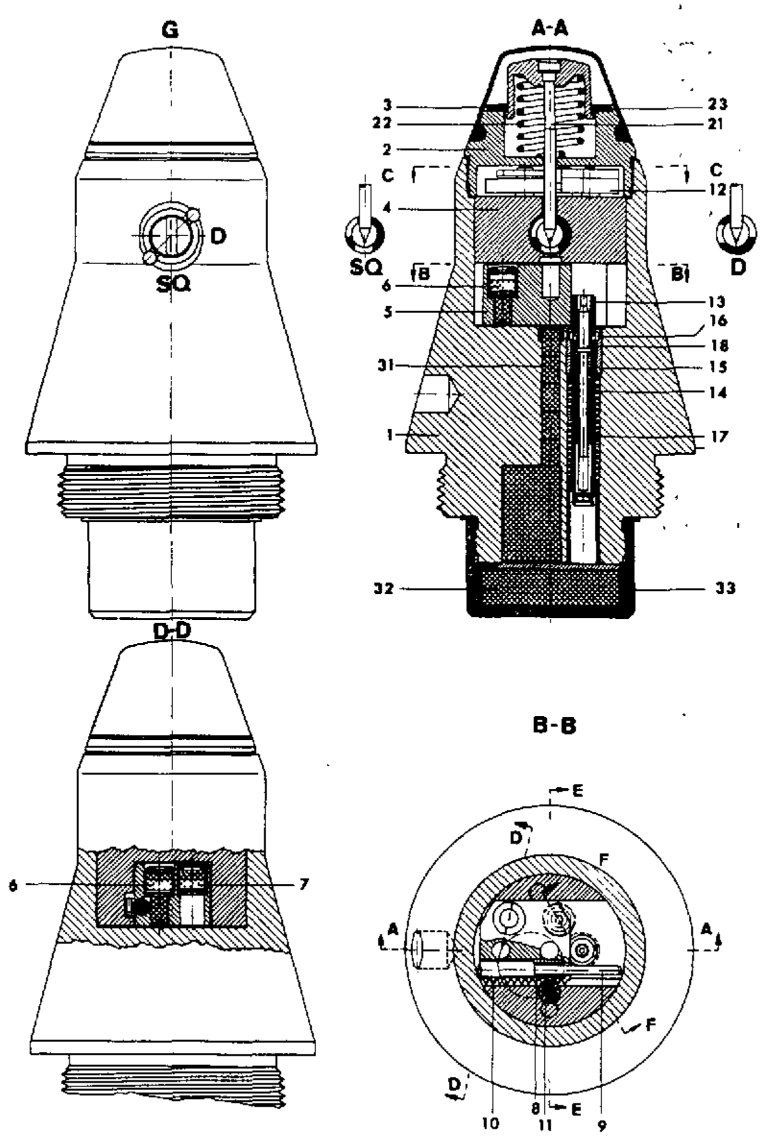

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Figure 2-57. Fuze, PD, Model RKVDIR 0265, detailed sections A-A, B-B, D-D, and G (U).

Fuze, PD, Model RKVDIR 0265
FOM No. 1390-18-1-35

(U) Design Details (Continued)

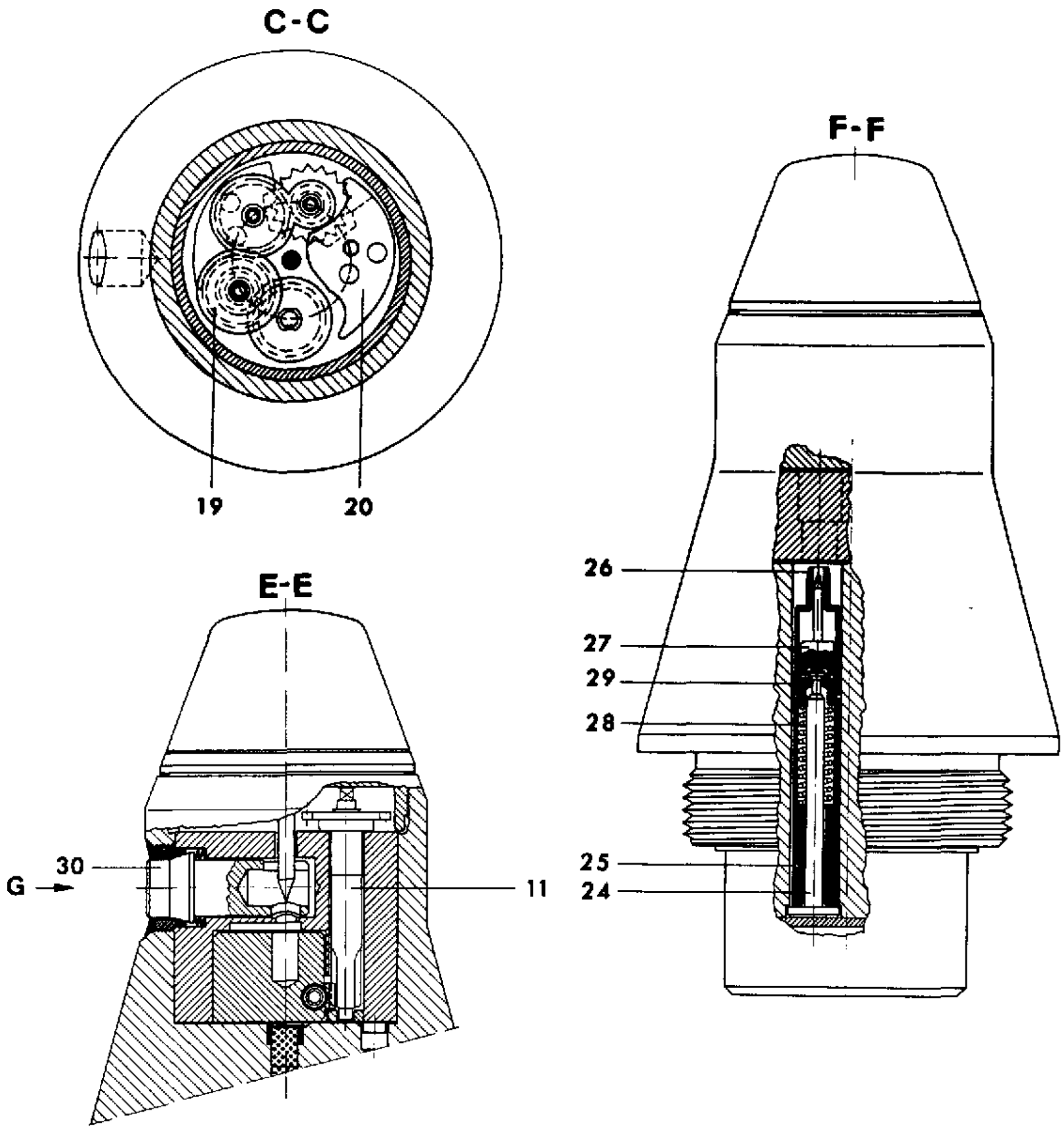

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Figure 2-58. Fuze, PD, Model RKVDIR 0265, detailed sections C-C, E-E, and F-F (U).

(U) **Design Details (Continued)**

The fuze body (1) is tightly sealed at its nose by the fuze head (2) with plastic windshield (3). The nose section of fuze body contains the slider housing (4), which is secured by the fuze head.

The slider (5) (section A-A) can move transversely to the fuze axis in the slider housing. It contains the primer-detonator (6) with a pellet for SQ ignition and another primer-detonator (7) for delayed ignition. Movement to the armed position is (section B-B) by means of the slider spring (8) on a guide pin (9). The rack (10) on the slider meshes with the pinion (11) of the escapement (12).

The inner and outer detent system (section A-A), which is positioned by the bushing (15), locks the slider in the unarmed position until firing. The outer detent consists of the setback sleeve (13) located in a hole in the fuze body. The setback sleeve is held forward, in the safe position, by its spring (14). In this position, it is locked by the detent balls (16). The detent balls ae held outwards by the locking bolt (18) and forward by a spring (17), which are part of the inner detent system.

The escapement (section C-C) consists of a gear train (19) linked to the balance wheel (20). The escapement is mounted on the bearing body and engages the rack of the slider through the pinion (11), section E-E. The escapement (12), section A-A, delays the movement of the slider to the armed position; this delay gives the required trajectory safety.

The SQ mechanism includes the SQ firing pin (21) built into the nose of the fuze. It is held against its stop (23) by the pressure of its spring (22). The delay system (section F-F) is built into the rear of the fuze. It consists mainly of the fixed holding pin (24), the guide bush (25), the sleeve (26), the delay firing pin (27), the spring (28), and two detent balls (29), forming the inner detent system. Because of the compression of the spring, the firing pin is pushed forward. Both detent balls are thereby pushed outwards by the inclined face on the front of the holding pin, thus locking the sleeve in position. The SQ and delay mechanisms are mechanically independent of each other.

The setting key (30), section E-E, can be turned 90° in a sealed bearing. Its inner end is so designed that it offers a passage to the SQ firing pin while it is set to "SQ" (superquick) (section G). If the setting key is set on "D" (delay), the passage is blocked.

Fuze, PD, Model RKVDIR 0265
FOM No. 1390-18-1-35

(U) Design Details (Continued)

Tetryl is used in the fuze in the form of compressed pellets (section A-A). A columnar charge (31) of 0.85 grain (0.055 gram) is located underneath the SQ primer-detonator in the slider. The 62-grain (4.0-gram) charge of the booster (32) forms the lower end of the explosive train. It is contained in the screwed-on cap (33) that also seals the rear end of the fuze.

The total explosive content (without the primer-detonators) of the fuze amounts to 105.3 grains (6.825 grams).

(U) Functioning

This fuze's functioning is similar to fuze, PD, Model 21RKZ-2 (FOM No. 1390-18-1-36).

(U) Packaging

The completely assembled fuze is packaged in a two-piece cardboard tube placed in a two-piece plastic container. The plastic container is then sealed with tape, as illustrated in figure 2-59.

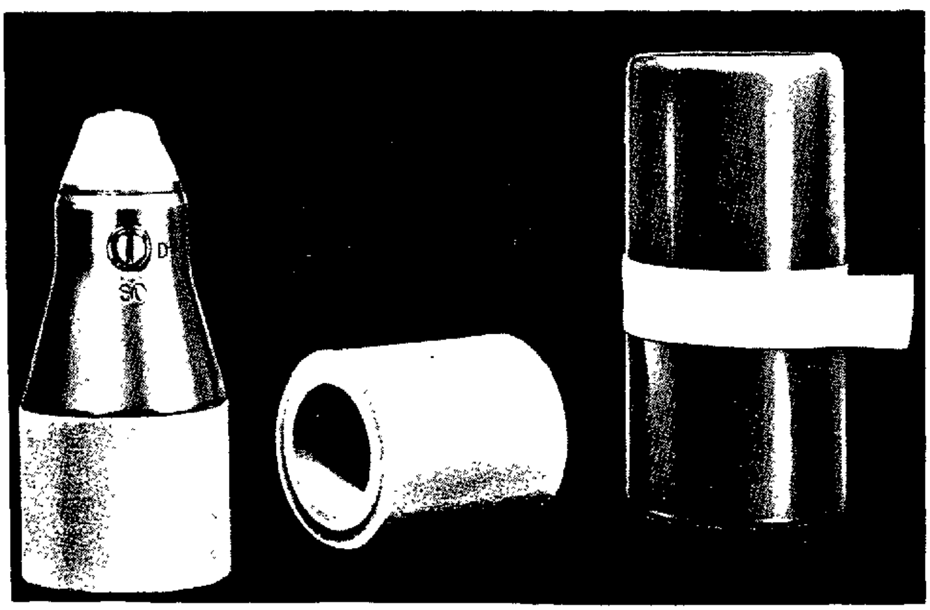

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Figure 2-59. Fuze, PD, Model RKVDIR 0265, packaging container (U).

Fuze, PD, Model RKVDIR 0265
FOM No. 1390-18-1-35

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars

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Fuze, PD, Model 21 RKZ-2
FOM No. 1390-18-1-36

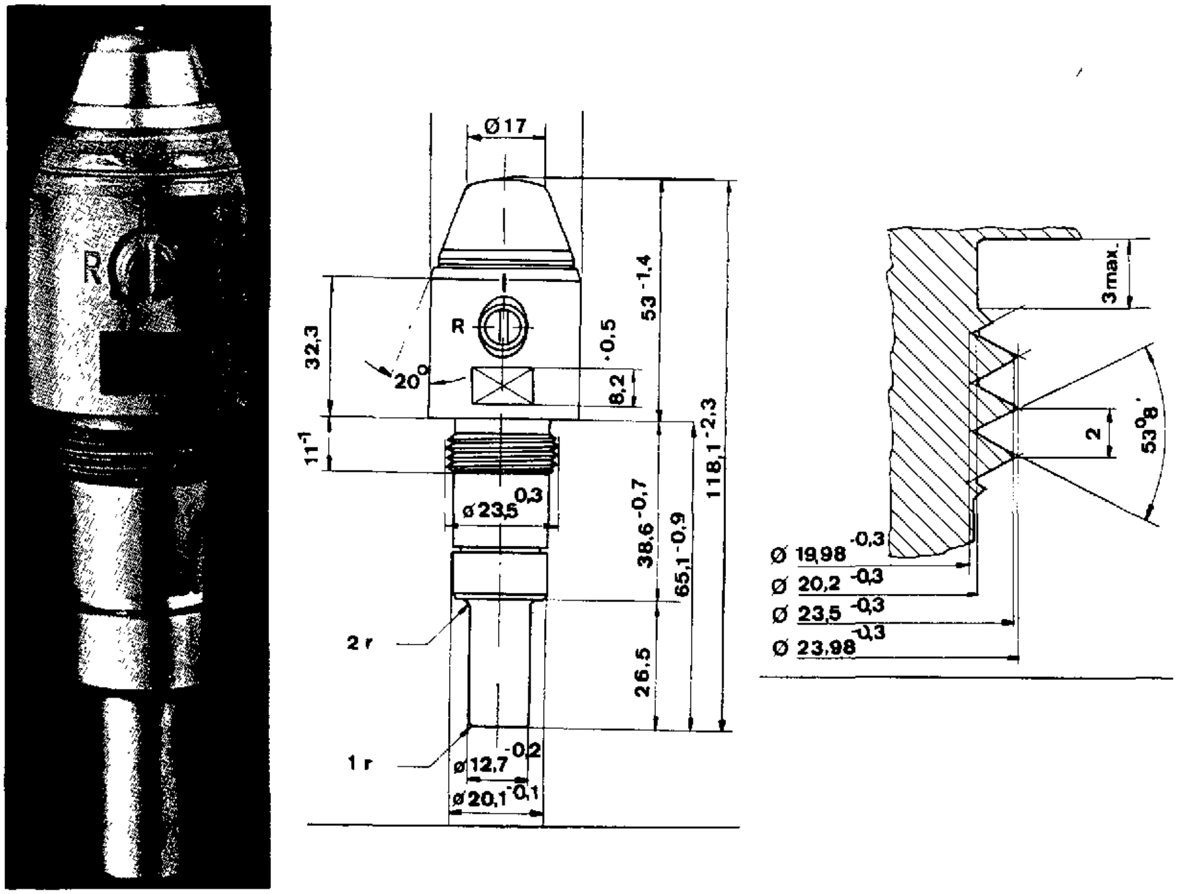

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Figure 2-60. Fuze, PD, Model 21 RKZ-2, full and contour views (U).

(U) Description

The 21 RKZ-2 PD fuze (fig 2-60) is a setback, delayed-arming type designed for either SQ or delay action upon impact. It was developed by Oerlikon of Zurich, Switzerland, for use with non-rotating mortar projectiles. The dimensions shown in figure 2-60 are for installation on 81-mm teardrop-type mortar projectiles. This fuze can be assembled on projectiles provided with NATO threads.

Fuze, PD, Model 21 RKZ-2
FOM No. 1390-18-1-36

(U) Unique Features

This fuze contains two firing pins: one for SQ action, the other for delay. The two primer-detonators are held in an out-of-line position by a spring-loaded slider controlled by an escapement mechanism via a pinion-rack arrangement, as well as a detent systerr provided by a setback sleeve, spring, detent balls, and locking bolt.

(U) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Weight	305 g (0.67 lb)
Markings	21 RKZ-2

Booster:

Body material	Aluminum
Body length	32 mm approx (1.26 in)
Explosive	Tetryl
Explosive weight	?

Relay (columnar charge):

Explosive	Tetryl
Explosive weight	0.055 g (0.85 gr)
Length	39 mm approx (1.54 in)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Slider-escapement, locking bolt, & detent balls
Arming time	0.8 s
Arming distance	25 m
Delay time	0.05 s

Sensitivity:

SQ action	Functions on 4-mm cardboard target
Delayed action	Less than SQ action

(U) **Design Details** (fig 2-61)

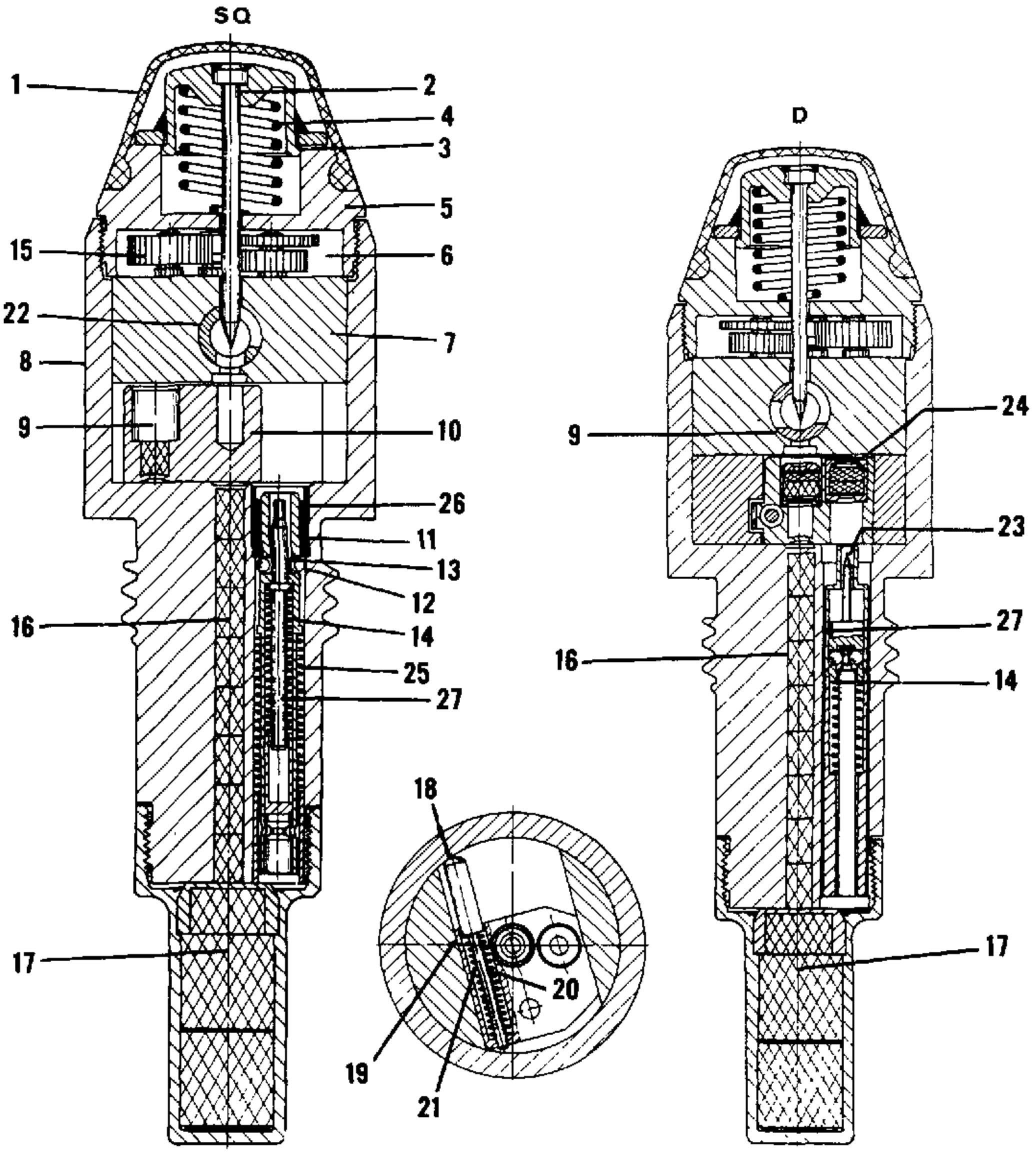

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Figure 2-61. Fuze, PD, Model 21 RKZ-2, section view (U).

Fuze, PD, Model 21 RKZ-2
FOM No. 1390-18-1-36

(U) Design Details (Continued)

The fuze body (8) is tightly sealed at its forward end by the fuze head (5) with plastic windshield (1). The fuze body contains the slider housing (7) which is secured by the fuze head (5).

The slider (10) contains the SQ primer-detonator (9), which is initiated by the SQ firing pin (2), and the delay (D) primer-detonator (24), which is initiated by the delay firing pin (23). Movement to the armed position is by means of the slider spring (20) on the guide pin (21). The rack (19) of the slider meshes with the pinion (18) of the escapement mechanism (6).

The inner and outer detent system locks the slider in the unarmed position until firing. The outer detent system consists primarily of the setback sleeve (11), setback spring (25), and bushing. Parts of the inner detent system include the guide bush, spring, delay firing pin, detent balls (12), locking bolt (13), and holding pin (14). The setback sleeve is held in a safe position by the setback spring. In this position it is locked by the detent balls. The detent balls are held outward by the locking bolt, which is held forward by its spring (14).

The escapement (6) consists of a gear train (15) linked to a balance wheel. The escapement mechanism is mounted on a bearing body that engages the rack of the slider through the pinion. The escapement controls the movement of the slider to the armed position, thereby providing adequate trajectory safety.

The SQ mechanism includes the SQ firing pin (2) built into the nose of the fuze. The SQ firing pin is held against its stop (3) by the pressure of its spring (4). The delay mechanism is built into the rear of the fuze. It includes mainly parts of the inner detent system, which consists of the locking bolt (13), holding pin (14), guide bush (26), guide sleeve, firing pin (23), spring (14), and two detent balls (12).

The delay firing pin (23) is held forward by the compression of the locking-bolt spring (14). Both detent balls are pushed outwards by the inclined face on the front of the holding pin (27), thereby holding the guide sleeve in position.

The setting key (22) can be turned 90° in a sealed bearing. Its inner end is designed to provide an opening for the SQ firing pin when the key is set for "SQ." If the key is set on "D," this opening is blocked.

(U) Design Details (Continued)

Tetryl is used in the fuze in the form of compressed pellets. A columnar charge (16) in line with the firing pin (2) acts as a relay for amplifying the detonation of the booster (17).

(U) Functioning

Upon firing, setback forces causes the locking bolt (13) to move rearward, releasing the detent balls (12). Both springs (14, 25) are fully compressed.

If the key is set for "SQ," then the SQ firing pin (2) moves rearward and enters the blind hole in the slider (10), holding the slider in the unarmed position. If the key is set for "D," the SQ firing pin is blocked from entering the hole of the slider.

When the acceleration ceases, the compressed springs (14, 25) expand, pushing the sleeve (11) and locking bolt (13) forward. The locking bolt moves forward first, pushing the detent balls outward. The sleeve then advances until the detent balls are pushed out against the rim of a pressed-in bushing. The SQ firing pin (2) simultaneously moves back to its original position by the expansion of its spring (4), while the force of spring (20) starts to move the slider to the armed position by driving the escapement mechanism (6) which controls the rate of arming.

The fuze is armed when either the SQ (9) or delay (24) primer-detonators, depending on the setting, are aligned with their respective firing pins (2 or 23).

The slider (10) is kept in the armed position by the slider spring (20) and escapement mechanism (6).

If SQ setting is used, upon impact with the target the SQ firing pin (2) stabs primer-detonator (9), detonating the tetryl column (16) and in turn detonating the booster (17). Figure 2-62 depicts SQ functioning upon impact.

Fuze, PD, Model 21 RKZ-2
FOM No. 1390-18-1-36

(U) Functioning (Continued)

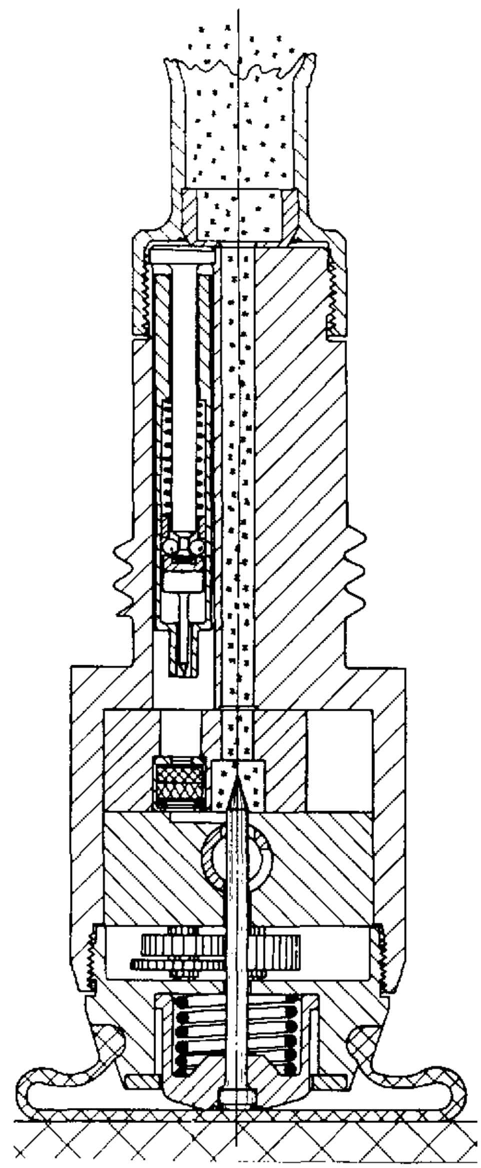

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Figure 2-62. Fuze, PD, Model 21 RKZ-2, SQ functioning (U).

(U) Functioning (Continued)

If the delay setting is used, the SQ firing pin is blocked. Upon impact, the deceleration of the projectile causes the sleeve to move forward due to inertia while the firing pin (23), which is retained by the locking bolt, remains locked. Compression of the spring by the firing pin is now increased. After retardation has reached zero, the spring expands and pushes the sleeve back, allowing the detent balls to move outwards and to release the firing pin which is driven by its spring into the delay primer-detonator. The flash passes through a slot in the slider to the SQ primer-detonator, detonating the columnar charge of tetryl and resulting in detonation of the booster. Figure 2-63 illustrates delay functioning upon impact.

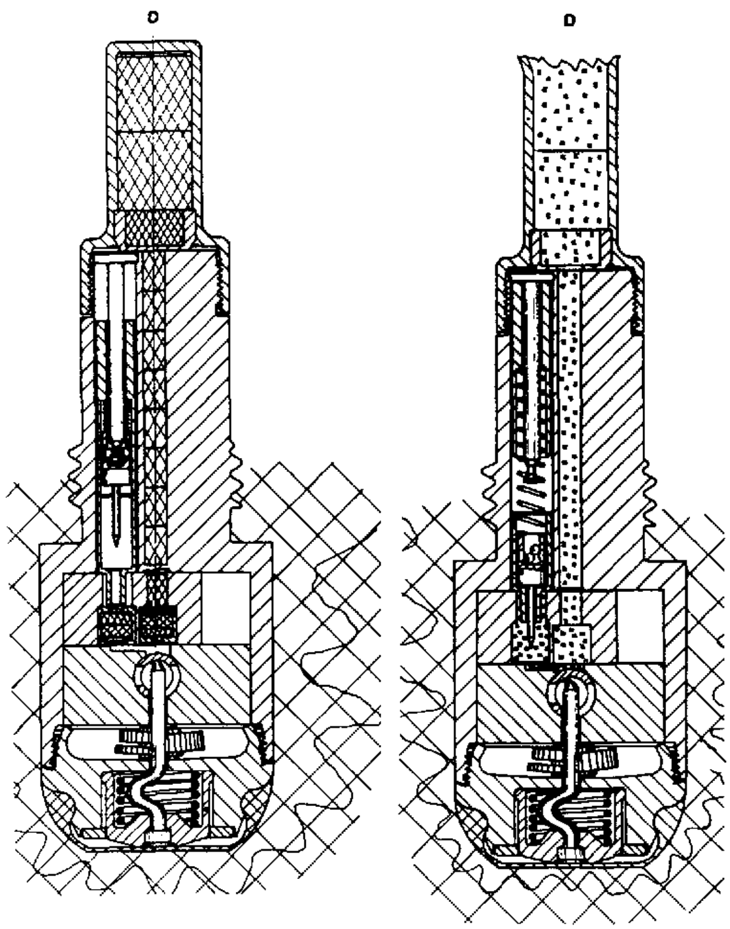

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Figure 2-63. Fuze, PD, Model 21 RKZ-2, delay functioning (U).

Fuze, PD, Model 21 RKZ-2
FOM No. 1390-18-1-36

(U) Packaging

The 21 RKZ-2 fuze is inclosed in a cardboard tube which is packed in a hermetically sealed tin can (fig 2-64).

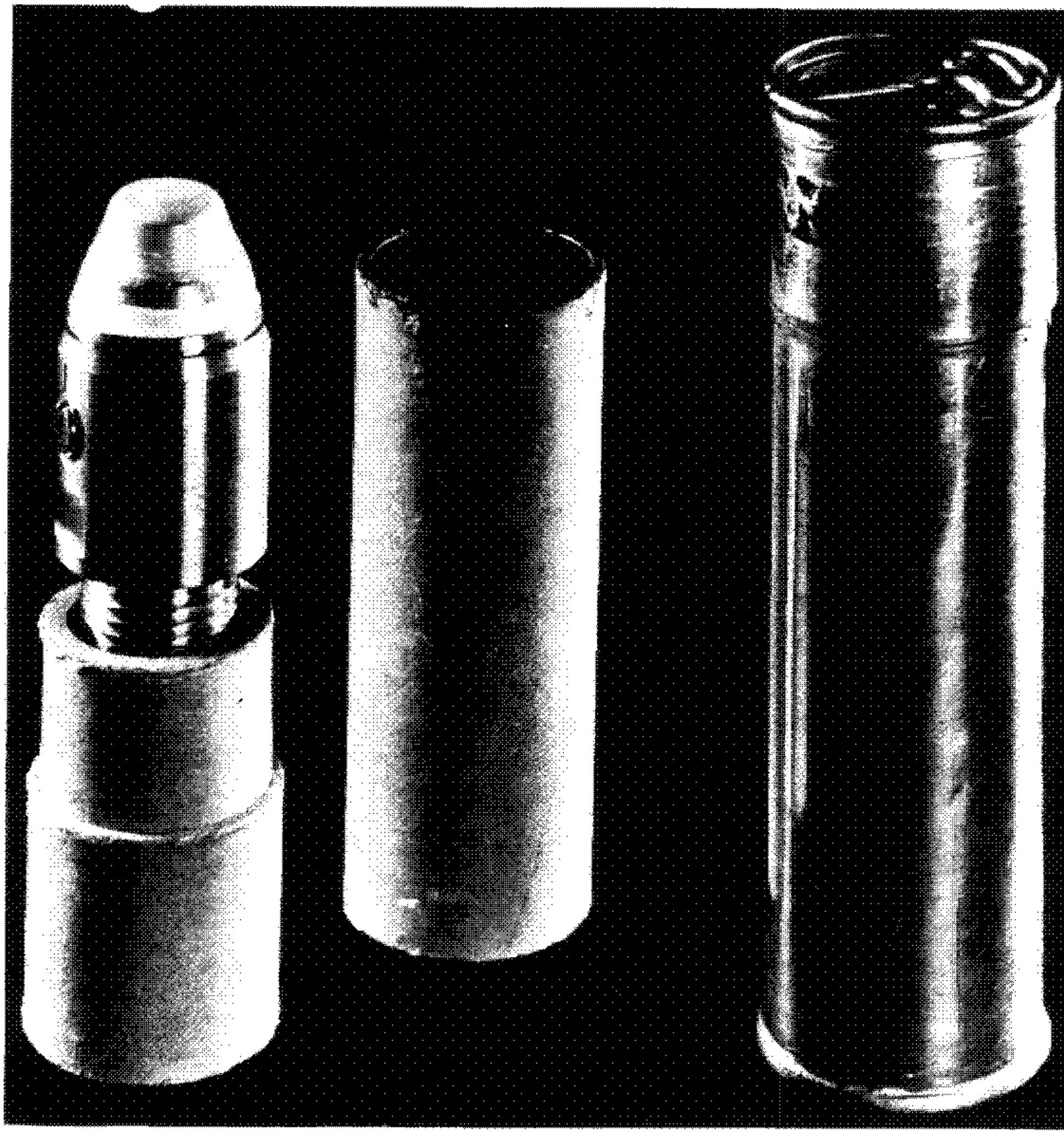

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Figure 2-64. Fuze, PD, Model 21 RKZ-2, packaging container (U).

(U) Special Tests

The 21 RKZ-2 fuze has been successfully tested for double-loading safety, detonator safety, and short-impact safety (i.e., trajectory safety). In addition, drop, jolt, cold, hot, and waterproof tests have been conducted, meeting US Military Standards.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars

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Fuze, PD, Model RKVDIR 0262/7B
FOM No. 1390-18-1-39

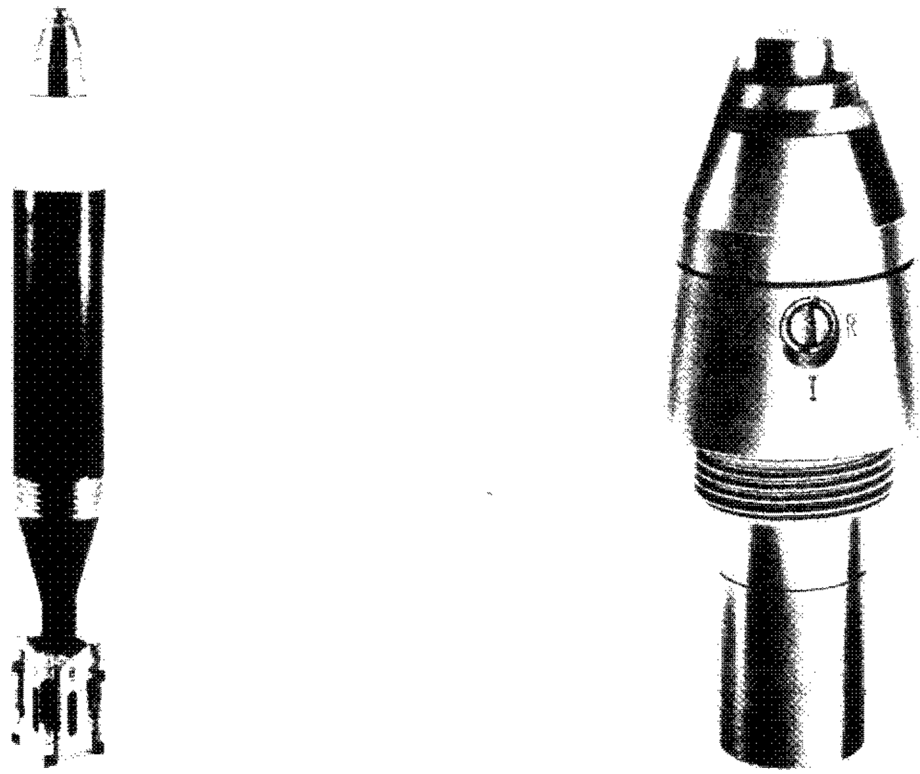

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Figure 2-65. Fuze, PD, Model RKVDIR 0262/7B with 81-mm projectile (U).

(U) Description

The RKVDIR 0262/7B (fig 2-65) is a setback-armed PD fuze designed for either delay and SQ action. Except for no escapement mechanism to control the rate of arming, the RKVDIR 0262/7B is similar in design and functioning to that of the Oerlikon RKVDIR 0265 and 21 RKZ-2 PD fuzes (FOM Nos. 1390-18-1-35 and 1390-18-1-36). This fuze is designed for 81-mm and 120-mm non-rotating mortar projectiles.

(U) Unique Features

- Spring-loaded slider with out-of-line SQ and delay primer-detonators.

Fuze, PD, Model RKVDIR 0262/7B
FOM No. 1390-18-1-39

(U) Unique Features (Continued)

- Inner and outer detent system.

- Two separate firing pins for SQ and delay action.

(U) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Weight	670 g (1.48 lb)
Markings	RKVDIR 0262/7B
Total length	130 mm (5.12 in)
Explosive weight	15 g (0.033 lb)

Booster:

Body material	Aluminum
Body length	?
Explosive	Tetryl
Explosive weight	?

Relay (columnar charge):

Explosive type	Tetryl
Explosive wieight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Locking bolt, two detent balls and slider
Arming time	1.2 s
Arming distance	50 m ?
Delay time	0.05 s

(U) Functioning

Except for having no escapement mechanism to control rate of arming, functioning is similar to that of the RKVDIR 0265 and 21 RKZ-2 PD fuzes.

(U) Remarks

Upon request, Oerlikon will provide this fuze with the trajectory safety (i.e., short-impact safety) by incorporation of the escapement mechanism via a pinion-rack arrangement to the spring-loaded slider containing the SQ and delay primer-detonators.

This fuze has been tested successfully for double-loading safety in both 81-mm and 120-mm mortars. The RKVDIR 0262/7B is specially designed for impact on very hard ground at the highest charge used with the 120-mm mortar. The reliability of the design reportedly has been proved through thorough testing and meets US Military Standards.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortar
120-mm HE projectiles	120-mm mortar

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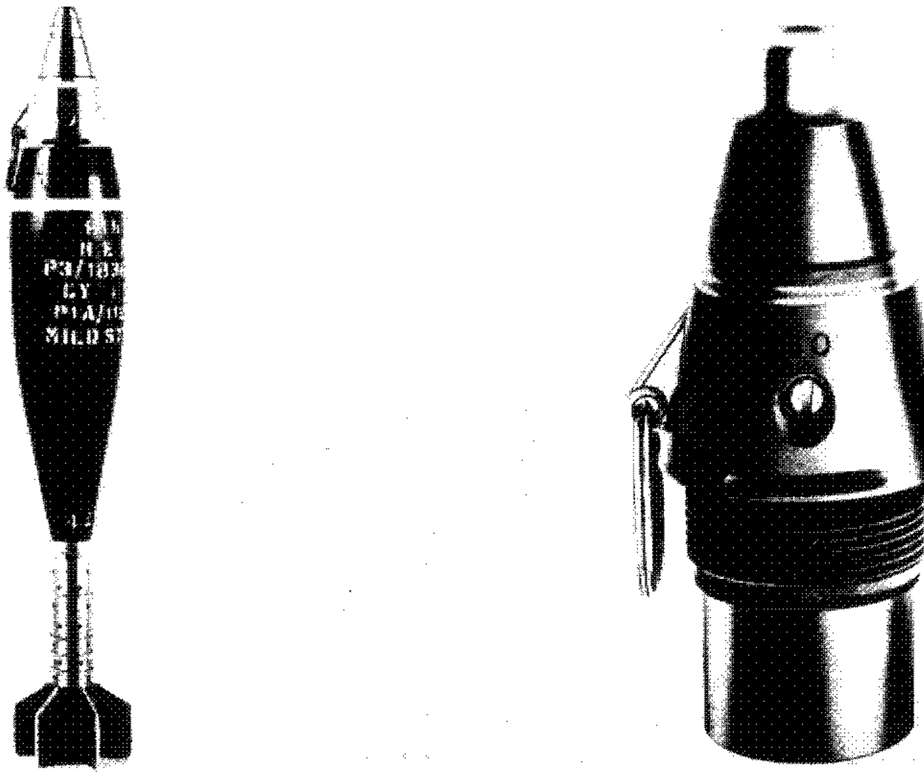

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Figure 2-66. Fuze, PD, Model RKVDIR 0264 with 81-mm projectile (U).

(U) Description

The Oerlikon RKVDIR 0264 PD fuze (fig 2-66) is a setback, delayed-arming type similar to the RKVDIR 0265. This fuze has been introduced in the United Kingdom under the designation L35A1. It is somewhat longer and has a larger booster with more explosives in order to accommodate the heavier and longer modern streamlined 81-mm mortar projectiles.

(U) Unique Features

- Delayed arming controlled via escapement mechanism.

Fuze, PD, Model RKVDIR 0264
FOM No. 1390-18-1-40

(U) Unique Features (Continued)

- Detonator safety via out-of-line explosives.
- Bore safety via inner and outer detent system.

(U) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Total weight	575 g (1.27 lb)
Markings	RKVDIR 0264
Total length	150 mm (5.91 in)
Visible length	86 mm (3.39 in)
Max diam	61 mm (2.40 in)
Explosive type	Tetryl
Explosive weight	34 g (0.075 lb)

Functional data:

Arming	Setback
Firing method	Impact
Safety devices	Slider-escapement, locking bolt, and detent balls, safety pin
Arming distance	25 m
Arming time	0.9 s
Delay time	0.05 s

(U) Functioning

This fuze is similar in functioning to that of the British L35A1 PD fuze (FOM No. 1390-35-1-17) and the Oerlikon RKVDIR 0265 and 21 RKZ-2 PD fuzes.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm mortar projectiles	81-mm mortar

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Fuze, PD, Model RKVDIR MZX-325
FOM No. 1390-18-1-41

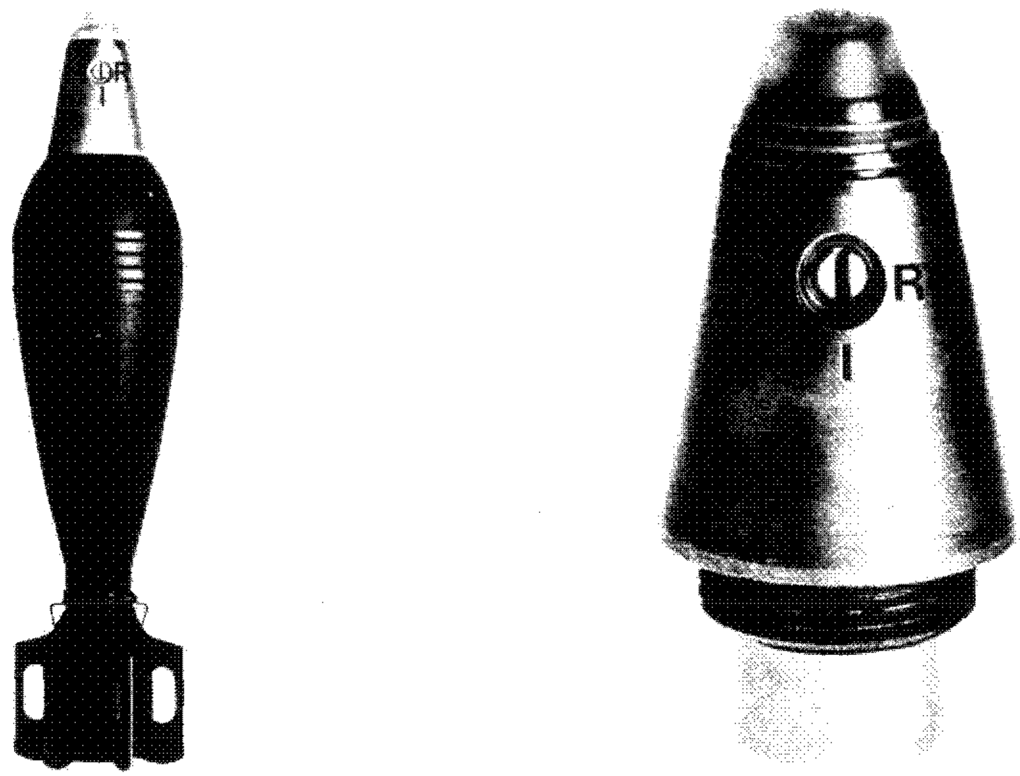

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Figure 2-67. Fuze, PD, Model RKVDIR MZX-325 with 81-mm projectile (U).

(U) Description

The RKVDIR MZX-325 PD fuze (fig 2-67) was developed by Oerlikon for 81-mm and 120-mm non-rotating mortar projectiles. It is a setback, delayed-arming type similar in design and functioning to the RKVDIR 0265 PD fuze. Exposed length of fuze is 67.5 mm with a body diameter of 46.5 mm.

(U) Unique Features

- Delayed arming controlled via escapement mechanism.

Fuze, PD, Model RKVDIR MZX-325
FOM No. 1390-18-1-41

- Detonator safety via out-of-line explosives.
- Bore safety via inner and outer detent system.

(U) **Characteristics**

Fuze assembly:	
Head material	Aluminum
Body material	Cadmium-plated steel
Total weight	596 g (1.31 lb)
Markings	RKVDIR MZX 325
Total explosive weight	13 g (0.29 lb)
Total length	113 mm (4.45 in)
Booster:	
Body material	Aluminum
Body length	?
Explosive	Tetryl
Explosive weight	?
Relay (columnar charge):	
Explosive type	Tetryl pellets
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	Slider-escapement, locking bolt, detent balls
Arming distance	25 m
Arming time	0.9 s
Delay time	0.05 s

(U) **Functioning**

This fuze is similar in functioning to Oerlikon PD fuzes, Models RKVDIR 0265 and 21 RKZ-2. It is easily changed from instantaneous action to delayed action.

(U) **Remarks**

Thorough testing has proven this fuze's double-loading safety and reliability of design. The fuze is very sensitive on instantaneous action upon impact in snow, water, etc., due to the fuze's protruding firing pin and plastic windshield. The delay system allows application for ricochet firing.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortars
120-mm HE projectiles	120-mm mortars

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Fuze, PD, Model RKVDIR 0265/21
FOM No. 1390-18-1-42

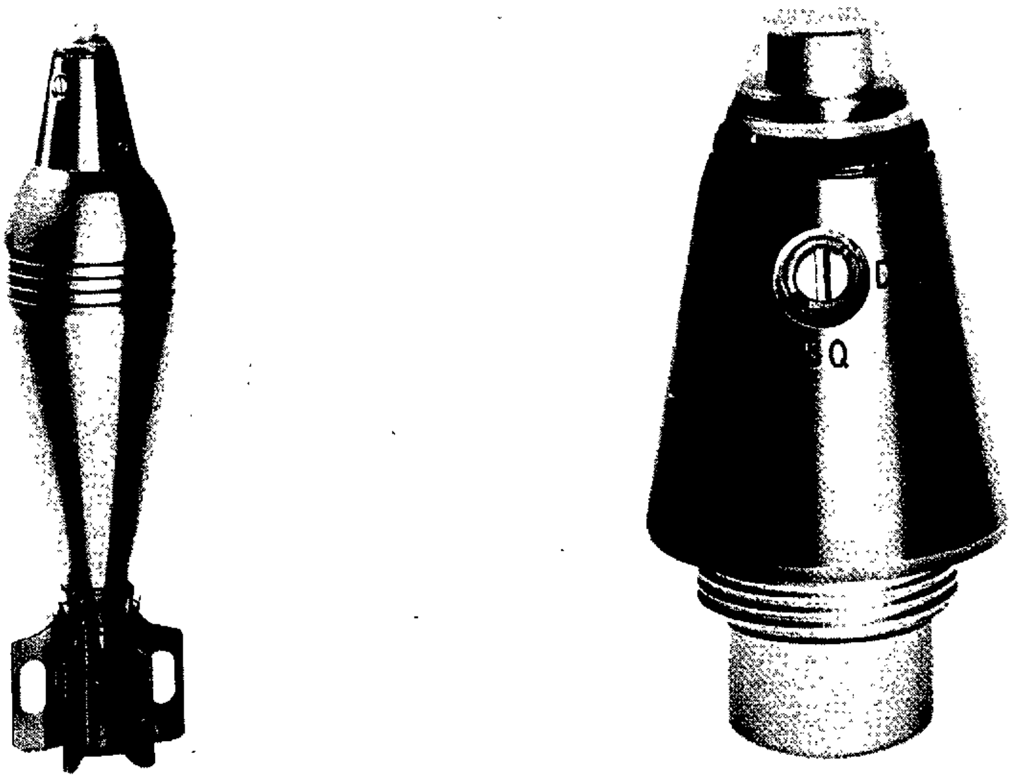

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Figure 2-68. Fuze, PD, Model RKVDIR 0265/21 with 81-mm projectile (U).

(U) Description

The RKVDIR 0265/21 PD fuze (fig 2-68) is a setback-armed type designed for either SQ and delay action. Except for lack of an escapement-pinion-rack arrangement, the fuze is similar in design and functioning to that of the Oerlikon RKVDIR 0265. It is intended for use on both 81-mm and 120-mm mortar projectiles.

(U) Unique Features

- Spring-loader slider with out-of-line explosives.
- Detent system with locking bolt and two detent balls.

Fuze, PD, Model RKVDIR 0265/21
FOM No. 1390-18-1-42

(U) **Characteristics**

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Weight	595 g (1.31 lb)
Markings	RKVDIR 0265/21

Booster:

Body material	Aluminum
Body length	?
Explosive	Tetryl
Explosive weight	?

Relay (columnar charge):

Explosive type	Tetryl pellets

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Slider, locking bolt and 2 detent balls
Arming distance	25 m (approx)
Arming time	0.8 s
Delay time	0.05 s

(U) **Functioning**

Except for escapement mechanism, this fuze is similar in functioning to that of the RKZ-2 and RKVDIR 0265 PD fuzes developed by Oerlikon.

(U) **Remarks**

Upon request, Oerlikon will provide this fuze with the trajectory safety (i.e., short-impact safety) by incorporation of the escapement mechanism via a pinion-rack arrangement to the spring-loaded slider containing the SQ and delay primer-detonators.

(U) **Remarks (Continued)**

This fuze has been successfully tested for double-loading safety in both the 81-mm and 120-mm mortars. This fuze is also designed for impact on very hard ground at the highest charge used with the 120-mm mortar. The reliability of the design reportedly has been proved through thorough testing and meets US Military Standards.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm HE projectiles	81-mm mortar
120-mm HE projectiles	120-mm mortar

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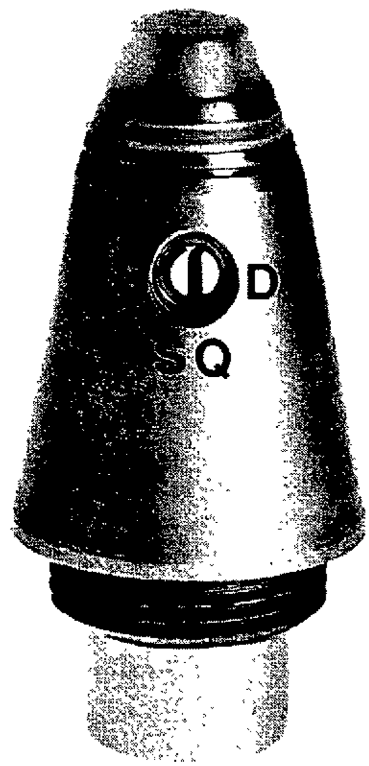

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Figure 2-69. Fuze, PD, Model RKVDIR MZX-328 with 81-mm projectile (U).

(U) Description

The Oerlikon RKVDIR MZX-328 fuze (fig 2-69) is a setback, delayed-arming type similar in design and functioning to that of the RKVDIR 0265. It is intended for use on both 81-mm and 120-mm mortar projectiles.

(U) Unique Features

- Delayed arming controlled via escapement mechanism.
- Detonator safety via out-of-line explosives.
- Bore safety via inner and outer detent system.

Fuze, PD, Model RKVDIR MZX-328
FOM No. 1390-18-1-43

(U) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Total weight	605 g (1.33 lb)
Markings	RKVDIR MZX-328
Total length	99.5 mm (3.92 in)
Visible length	71.5 mm (2.81 in)
Maximum diam	61 mm (2.40 in)
Explosive weight	6.5 g (100 gr)
Explosive type	Tetryl

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Slider-escapement, locking bolt and detent balls
Arming distance	25 m (approx)
Arming time	0.90 s
Delay time	0.05 s

(U) Functioning

The functioning of this fuze is similar to the RKVDIR 0265 PD fuze.

(U) Remarks

This fuze has been successfully tested for double-loading safety in both 81-mm and 120-mm mortars.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortar
120-mm HE projectiles	120-mm mortar

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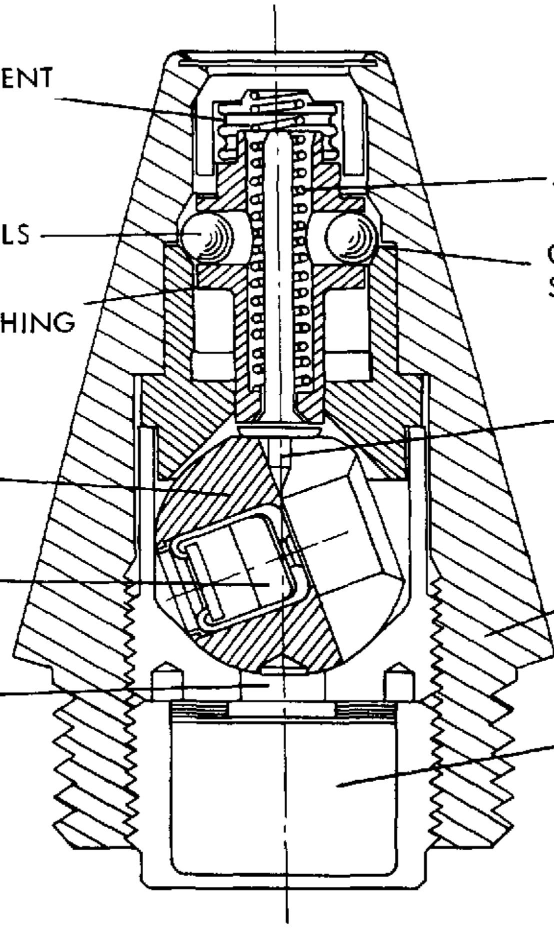

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Figure 2-70. Fuze, PDSD, Type KZD-0250, section view (U).

(U) **Description**

The KZD-0250 (fig 2-70) is a conventional PD fuze with a mechanical self-destruct feature activated by projectile spin decay. The out-of-line detonator is mounted in a ball rotor. The fuze is used with the 30x113-mm B HE-I cartridge, Type MSB-K, which is designed for air-to-air use in DEFA, Type 552, aircraft guns. The KZD-0250 fuze was developed prior to 1962.

Fuze, PDSD, Oerlikon, Type KZD-0250
FOM No. 1390-18-1-44

(U) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	31 g (0.068 lb)
Markings	?

Booster:

Body material	
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Out-of-line detonator (rotor)
Arming distance	3 m (est)
Arming time	?
Self-destruct time	5-13 s (est)
Delay time	N/A

(U) **Design Details**

The fuze consists of an aluminum body that contains a self-destruct mechanism, a firing pin, a ball rotor carrying an out-of-line detonator, and a booster. In storage and shipment, the fuze is kept safe by the out-of-line position of the detonator in the rotor. Rotor position is maintained by pressure from the self-destruct spring and shock element, acting through the firing-pin bushing.

(U) **Functioning**

Upon firing, the shock element is crushed by setback. When setback ceases, centrifugal force causes the arming balls to move outward and forward against the conical surface of the self-destruct housing. This action moves the firing-pin bushing forward, further compressing and restraining the self-destruct spring, and releasing pressure on the rotor. Centrifugal force causes the unbalanced rotor, now free, to rotate until the detonator is aligned with the firing

(U) Functioning (Continued)

pin. Upon impact, the firing pin is driven into the detonator, which initiates detonation of the booster. If impact does not occur, projectile spin will decay and centrifugal force decrease until the compressed self-destruct spring overcomes the spin force on the arming balls and drives the firing pin into the detonator.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
30-mm HEI (mine) cartridge, Type MSB/K (30x113-mm B)	30-mm aircraft gun, DEFA, Type 552

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Fuze, PDSD, Hispano-Suiza, Model AM-2-BM
FOM No. 1390-18-1-47

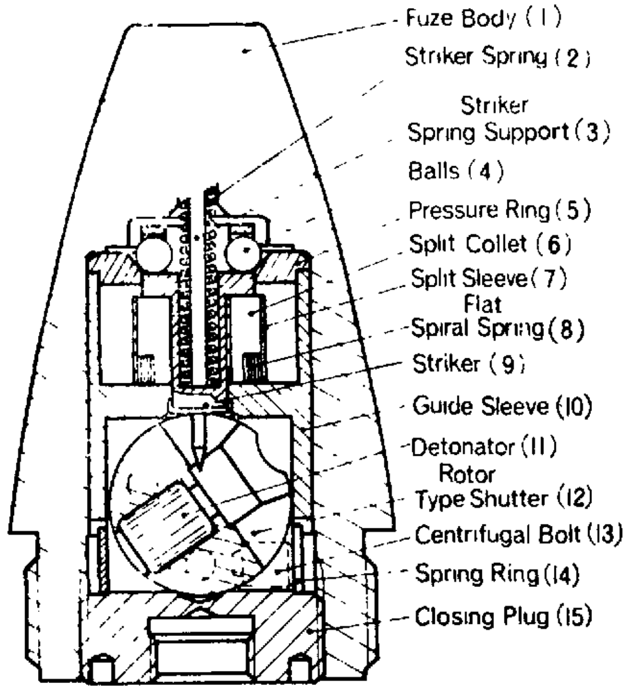

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Figure 2-71. Fuze, PDSD, Model AM-2-BM, section view (U).

(U) Description

This (fig 2-71) is a PDSD fuze with an out-of-line detonator and delayed arming, designed for air-to-air projectiles fired from 30x113-mm B ADEN aircraft guns.

(U) Characteristics

Fuze assembly:

Body material	?
Weight	36-40 g (0.079 to 0.088 lb)
Markings	AM-2 B.M.

Fuze, PDSD, Hispano-Suiza, Model AM-2-BM
FOM No. 1390-18-1-47

(U) **Characteristics (Continued)**

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Arming coil; out-of-line detonator
Arming distance	13 m
Arming time	?
Self-destruct time	6-12 s

(U) **Functioning**

During storage and shipment, the detonator (11) is held out of line with the striker (9) and firing pin by a centrifugal bolt (13) that fits in a recess in the rotor and is retained by a spring ring (14). The firing pin is also restrained from moving rearward by a split collet (6) whose locking segments are retained by an arming coil or spiral spring (8) that is itself retained by a split sleeve (7).

Upon firing, setback forces hold all fuze components in the unarmed position. When the projectile leaves the muzzle, setback ceases and centrifugal force causes the spring ring (14) to open and the centrifugal bolt (13) to move outward, freeing the rotor. Centrifugal force acting on the unbalanced rotor causes it to erect, so that the detonator is aligned with the firing pin and the booster. This occurs at a point approximately 0.9 meter from the gun muzzle. The fuze remains unarmed at this point because the striker is still restrained by the arming delay feature.

At the moment of firing, setback forces increase the pressure exerted by the striker spring (2), acting through the striker, on the split collet and the arming coil, thus retaining them in position. Centrifugal force causes the split sleeve surrounding the split collet to open so that it lies against the inner wall of the recess. As acceleration ceases and setback pressure is reduced, centrifugal force causes the five arming balls (4) to move radially

(U) **Functioning (Continued)**

outward against the conical interior face of the pressure ring (5). This raises the striker body, further compressing the striker spring. As the striker body is lifted, pressure on the split collet and arming coil is removed. Centrifugal force causes the arming coil to unwind, permitting the segments of the split collet to move radially outward, so that they clear the striker. At this point the projectile has traveled about 13 meters from the gun muzzle; the fuze is fully armed, with the detonator in line with the firing pin, and the striker held in its forward position against pressure of the compressed striker spring by centrifugal force acting on the five arming balls. Upon striking a target, impact is transmitted through the striker body, overcoming the centrifugal force acting on the five arming balls and forcing them inwards. The striker spring then thrusts the firing pin into the detonator to initiate fuze functioning with increasing range, the centrifugal force acting on the arming balls decreases as spin decays, which reduces the impact required to overcome this force; the increased sensitivity of the fuze compensates for the reduced striking velocity at longer ranges. If the projectile fails to strike a target, spin continues to decay to a level at which pressure of the striker spring overcomes the centrifugal force acting on the arming balls. At this point, which falls between 6 and 12 seconds of flight, the striker spring drives the striker and firing pin into the detonator, initiating self-destruction of the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
HEI cartridge, Model UIA	30x113-mm B ADEN aircraft gun

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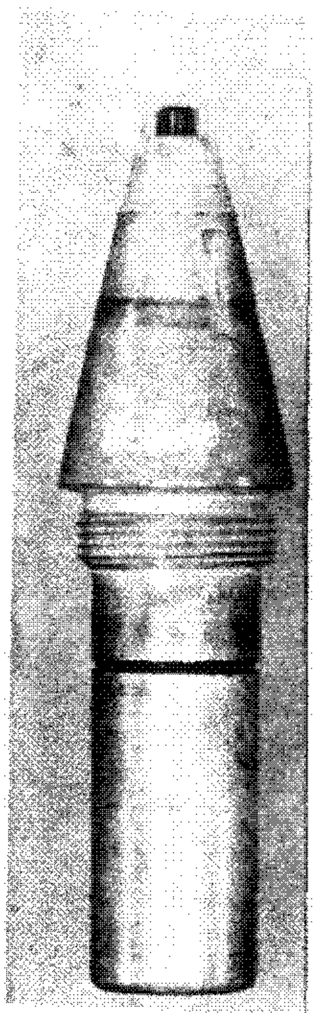

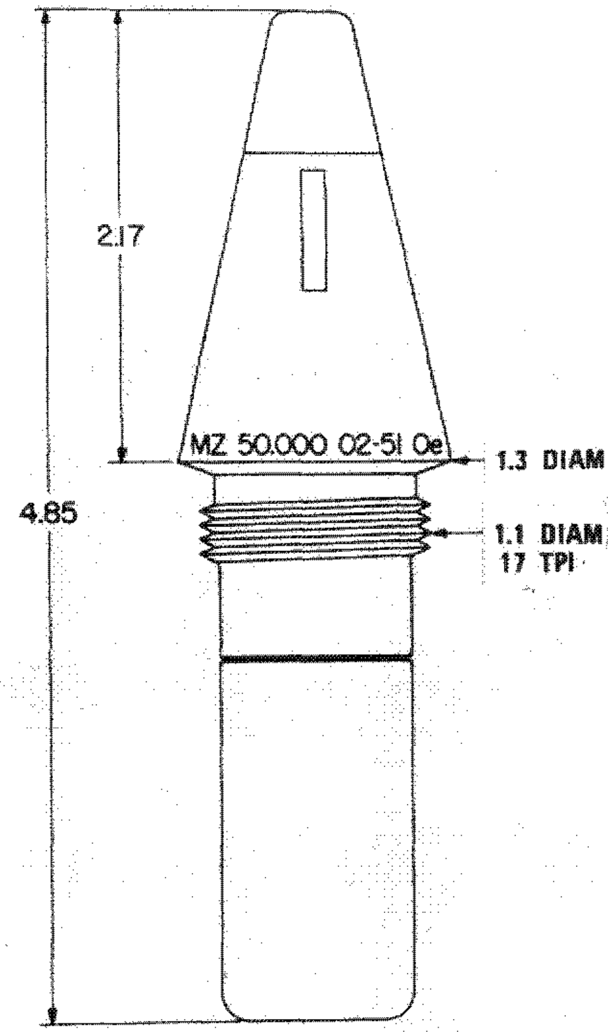

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Figure 2-72. Fuze, PD, Model KVD, full and contour views (U).

(U) Description

The KVD PD fuze (fig 2-72) manufactured by Oerlikon Co. of Switzerland was developed for use with 80-mm high-explosive aircraft rockets. It is a setback, delayed-arming fuze designed for instantaneous action upon impact.

Fuze, PD, Model KVD
FOM No. 1390-18-2-1

(U) Unique Features

- Escapement mechanism controlling the arming time of the fuze.
- Slider housing primer-detonator in out-of-line position detented by setback pin.

(U) Characteristics

Fuze assembly:

Body material	Cadmium-plated brass
Weight	0.67 lb (304 g)
Markings	MZ. 50.00
Length	4.85 in (123.2 mm)
Max diam	1.30 in (33 mm)
Maj thread diam	1.1 in (28 mm)

Booster:

Body material	Steel
Body length	1.75 in (44.45 mm)
Explosive	PETN
Explosive weight	13.62 g (0.030 lb)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Setback pin, setback spring, and out-of-line slider
Arming distance	?
Arming time	?

(U) Design Details

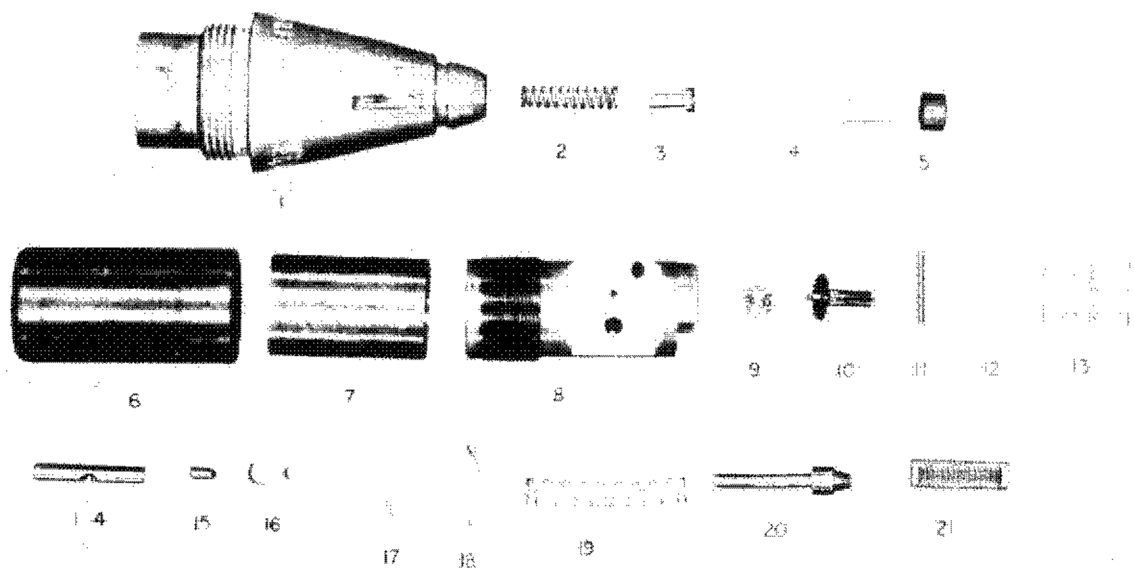

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Figure 2-73. Fuze, PD, Model KVD, exploded view (U).

The fuze (fig 2-73) consists primarily of a cadmium-plated brass fuze body (1) bored out at the nose end and base to facilitate assembly of the firing pin components, escapement and slider mechanism components, detent components, and booster assemblage.

The firing pin components include an aluminum firing pin with a solid cylindrical head (4), a steel support and guide (3), and a steel coil spring (2). The assembly is held in place by 45° chamfered-steel holder (5) crimped 360° at the nose end of the fuze. A polyethylene cap is then crimped to the groove of the fuze's ogive, providing a watertight seal.

The escapement-mechanism components for controlling or delaying the arming of the fuze [i.e., the movement of the rack (21)] includes a brass escape wheel and spur gear (9), a steel pinion-brass gear assembly (10), a steel gear spindle (11), a brass pallet (12), and a brass bearing plate (13) which fits into the transversally cut-out portion of the safety and arming body (8). The retainer sleeve (7) is then slipped over the assembled escapement mechanism. The detent components include the setback pin (20) and the setback spring (19) that fits into an axially drilled hole in the S&A body (8). The rack (21) is also placed in an axially drilled hole in the body (8) and meshes with the pinion gear assembly (10).

Fuze, PD, Model KVD
FOM No. 1390-18-2-1

(U) Design Details (Continued)

The slider (16) and its springs (17 and 18) are positioned in a cut-out portion at the forward end of the S&A body (8). The slider (16) is pinned to the S&A body (8) by the retainer pin (14) which fits into an axially drilled hole and the safety pin (15) which fits into a transversally drilled hole.

The central flash hole of the S&A body (8) is sealed by a front and rear brass closing cup.

The steel booster cup (6), threaded internally and housing two booster pellets, is screwed onto the external threads of the S&A body (8), completing the assemblage.

The fuze body (1) is threaded externally for assembly into the warhead of an 80-mm HE rocket.

(U) **Functioning** (fig 2-74)

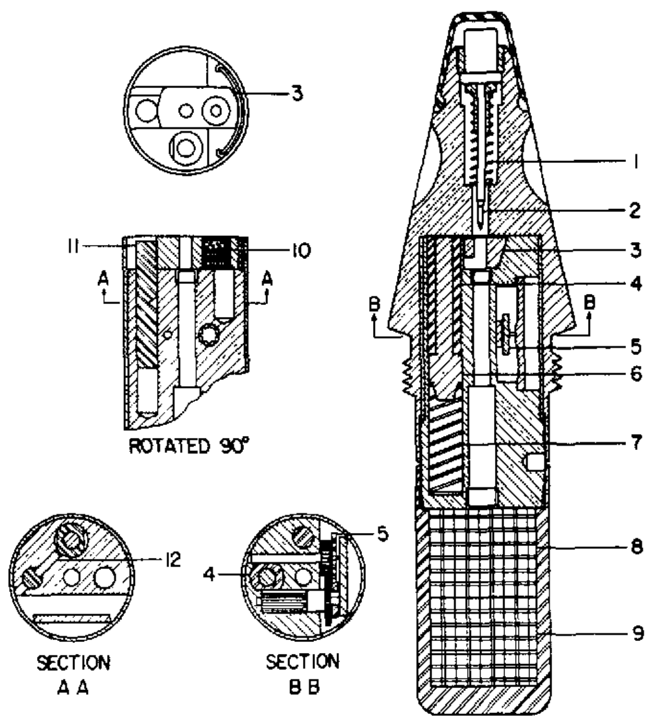

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Figure 2-74. Fuze, PD, Model KVD, section view (U).

(U) Functioning (Continued)

When the carrier rocket is fired, the setback pin (6) and the rack (4) start to move rearward. The setback pin has its travel hindered only by the spring (7) which it compresses quickly. The rearward movement of the rack is delayed by the fuze clockwork mechanism (5) through the pinion gear. When the rack top has moved below the transversely drilled hole in which the safety pin (12) is assembled, the safety pin may be cammed into the cavity above the rack and setback pin. This transfer is accomplished by the continued acceleration forces acting on the safety pin through the tapered surface of its seat in the slider retaining pin (11). When the slider retaining pin moves below the bottom surface of the slider assembly slot, the slider assembly (3) is freed and then pushed across its slot by the slider spring. This movement aligns the primer-detonator (10) between the firing pin (2) and the flash hole to the booster pellets (8 and 9). This, however, does not happen until the acceleration forces, which had also moved the firing-pin point rearward into the hole in the slider, are decreased sufficiently to allow the firing-pin spring (1) to return the firing pin to its forward position out of the slider.

On impact, the polyethylene nose cap is crushed and the firing pin is driven rearward into the primer-detonator.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
80-mm HE rocket	80-mm aircraft rocket launcher

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Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

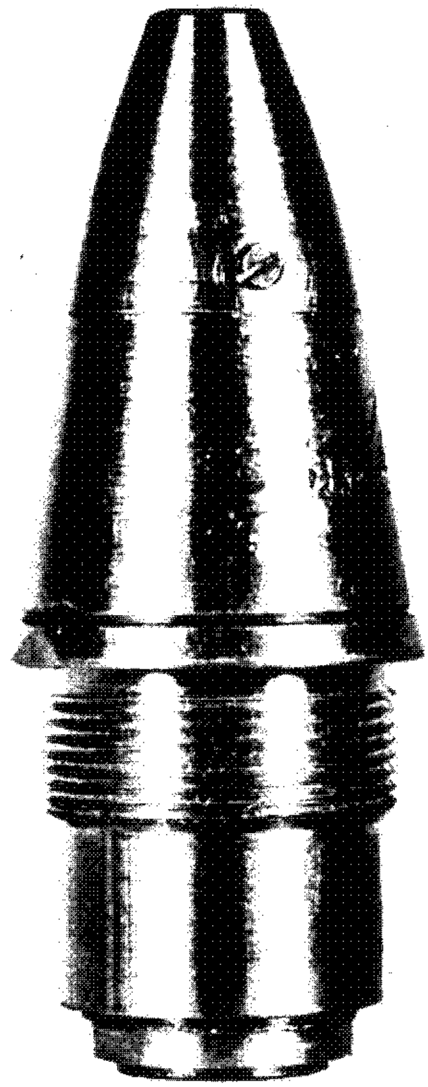

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Figure 2-75. Fuze, PDSD, Model FZ-104, full view (U).

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

(U) **Description**

FZ-104 (fig 2-75) is the basic designation for a family of very reliable PDSD fuzes designed by Bofors for use with the Bofors 40-mm antiaircraft gun, Model L/70. Model FZ-104 is a product-improved Model FZ-103 fuze. Variants of the FZ-104 are used in the Bofors 40-mm L/60 and 57-mm L/60 antiaircraft guns. The FZ-104 and its variants are in use by quite a number of nations throughout the world. Manufacturers in a number of countries, including West Germany and Spain, produce the FZ-104 or its variants under Bofors license. Models FZ-104 and FZ-104 M12 have been NATO standard fuzes constantly since 1960.

Fuze FZ-104 is an effective, rugged, reliable, inexpensive PDSD fuze of relatively simple design. A pyrotechnic element initiated by setback upon firing provides a reliable self-destroying action. Both setback and spin are required to arm the fuze. Delayed arming is ensured by a pyrotechnic delay element which locks the striker into a niche in the side of the out-of-line detonator rotor until approximately 0.06 seconds after firing. Several versions (or variants) of the basic FZ-104 provide different post-impact delay times and the presence or absence of an additional friction detonator to provide a graze action. All five versions of the FZ-104 mentioned here employ a Bofors rain safety device.

The status of the basic FZ-104 fuze is unknown. FZ-104 may be a generalized designation including fuzes FZ-104 M1 and FZ-104 M2, or it could be synonymous with FZ-104 M1. The basic FZ-104 fuze may be out of use, replaced by its variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22.

The variants differ from each other as follows:

- FZ-104 M1 incorporates a 0.3- to 0.4-ms post-impact delay, but does not have the extra friction detonator for graze action.
- FZ-104 M2 incorporates a 0.1- to 0.2-ms post-impact delay, but does not have the extra friction detonator for graze action. Possibly, this is a "superquick" fuze.

(U) Description (Continued)

- FZ-104 M12 incorporates a 0.3- to 0.4-ms post-impact delay, and also incorporates a special friction detonator for graze action.

- FZ-104 M22 incorporates a 0.1- to 0.2-ms post-impact delay, and also incorporates a special friction detonator for graze action. Possibly, this is a "superquick" fuze.

Extensive US test results are available concerning Bofors fuze FZ-305 M12, a fuze employing most of the same internal components as the FZ-104 M12, but fired from the L/60 40-mm antiaircraft gun instead of the L/70 40-mm antiaircraft gun.

(U) Unique Features

Fuze FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, FZ-104 M22 employ a pyrotechnic element to ensure delayed arming. All of these fuzes incorporate an efficient rain safety device designed by Bofors. Models FZ-104, FZ-104 M1, and FZ-104 M12 employ a 0.3- to 0.4-ms post-impact delay (labyrinth and pyrotechnic element) to provide enhanced lethality against thin-skinned targets. Models FZ-104 M12 and FZ-104 M22 incorporate a special friction detonator to give enhanced graze effectiveness. All models have a reliable pyrotechnic self-destruct feature and excellent high obliquity functioning.

(U) Characteristics

Fuzes FZ-104, FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22 are exactly the same, except for the detonator rotor components and the presence or absence of a special friction detonator. A detailed analysis of all explosive elements is available in Picatinny Arsenal Technical Report 4581, November 1973.

Arming method . . . . Setback and spin

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- **1390-19-1-2 (FZ-104)**
- **1390-19-1-2-1 (FZ-104 M1)**
- **1390-19-1-2-2 (FZ-104 M2)**
- **1390-19-1-2-3 (FZ-104 M12)**
- **1390-19-1-2-4 (FZ-104 M22)**

(U) Characteristics (Continued)

Firing method:	
FZ-104	Impact or pyrotechnic self-destruct
FZ-104 M1	Impact or pyrotechnic self-destruct
FZ-104 M2	Impact or pyrotechnic self-destruct
FZ-104 M12	Impact, graze, or pyrotechnic self-destruct
FZ-104 M22	Impact, graze, or pyrotechnic self-destruct
Safety devices	Out-of-line detonator
Arming distance	60 m (minimum)
Arming time	0.06 s (approx)
Self-destruct time	6.5 to 10.5 s
Delay time:	
FZ-104	0.3 to 0.4 ms
FZ-104 M1	0.3 to 0.4 ms
FZ-104 M2	0.1 to 0.2 ms (possibly SQ)
FZ-104 M12	0.3 to 0.4 ms
FZ-104 M22	0.1 to 0.2 ms (possibly SQ)
Fuze assembly:	
Body material	Aluminum
Weight	55 g (0.121 lb)
Length overall	69.8 mm (2.75 in)
Exposed length	41.4 mm (1.63 in)
Maximum diam	25.4 mm (1.00 in)

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

(U) **Characteristics (Continued)**

Booster:

Body material	Aluminum
Body length	18.3 mm (0.72 in)
Filler material	RDX
Filler weight	0.30 g (4.62 gr)

(FOUO) **Manufacturers**

Bofors is known to produce these fuzes. A West German manufacturer (no firm information as to manufacturer) is known to produce the FZ-104 M2, redesignated AZZ DM 91, a West German standard fuze. A Spanish manufacturer, Sociedad Anonima de Placencia de las Armas, located in Andoain, Spain, is known to produce the FZ-104 M12 and a variant model, FZ-305 M12 (for the L/60 Bofors 40-mm antiaircraft gun). The United Kingdom is known to use the FZ-104 M12 (UK designated L41A1) and may also produce the fuze under Bofors license.

Some design features of the FZ-104 and its variants are covered by US patents 3,135,206 ("Fuzes for Projectiles," 2 June 1964) and 3,119,336 ("Fuze for Explosive Projectile," June 1964), both of which are assigned to Bofors.

(FOUO) **Manufacturing Data**

(FOUO) The FZ-104 M12 is known to be manufactured by Bofors facilities in Sweden at the rate of 40,000 per month (1972 figures) using a semiautomated assembly-line process. Total worldwide production of the FZ-104 and its variants is unknown and is difficult to estimate due to wide licensing, many variants, and the designation changes which appear when these fuzes are adopted by a foreign government for its own use.

(U) Cost of the FZ-305 M12 was estimated at $3.07 each in November 1973, with a reduction to approximately $2.25 each possible if produced in large quantity with a cost

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

(U) Manufacturing Data (Continued)

reduction program in effect. It can be reasonably assumed that costs of producing the FZ-104 or its variants would be nearly equal to those of the FZ-305 M12, because the FZ-104 M12 and FZ-305 M12 are identical internally except for slight differences in the rain safety device.

(U) US tests established that poor sealant application practices used by Sociedad Anonima de Placencia de las Armas of Spain resulted in a reliability of only 93% as opposed to a reliability of better than 99.9% for Bofors-manufactured fuzes.

(U) **Functioning** (fig 2-76 and 2-77)

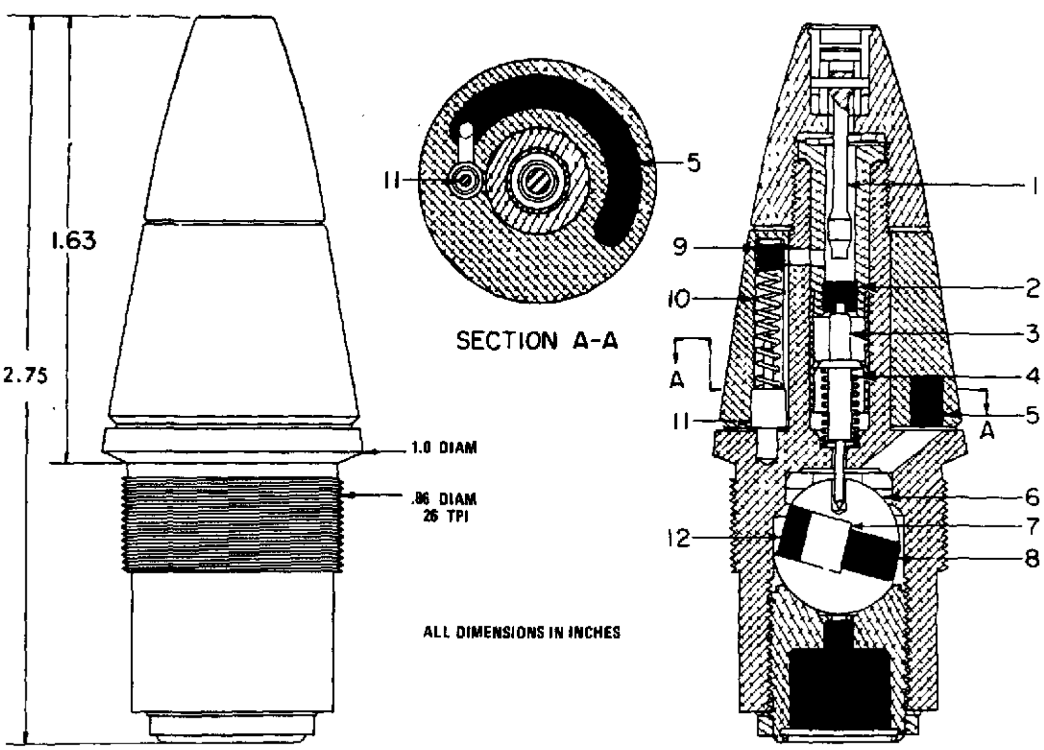

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Figure 2-76. Fuze, PDSD, Model FZ-104, contour and section views (U).

(U) Functioning (Continued)

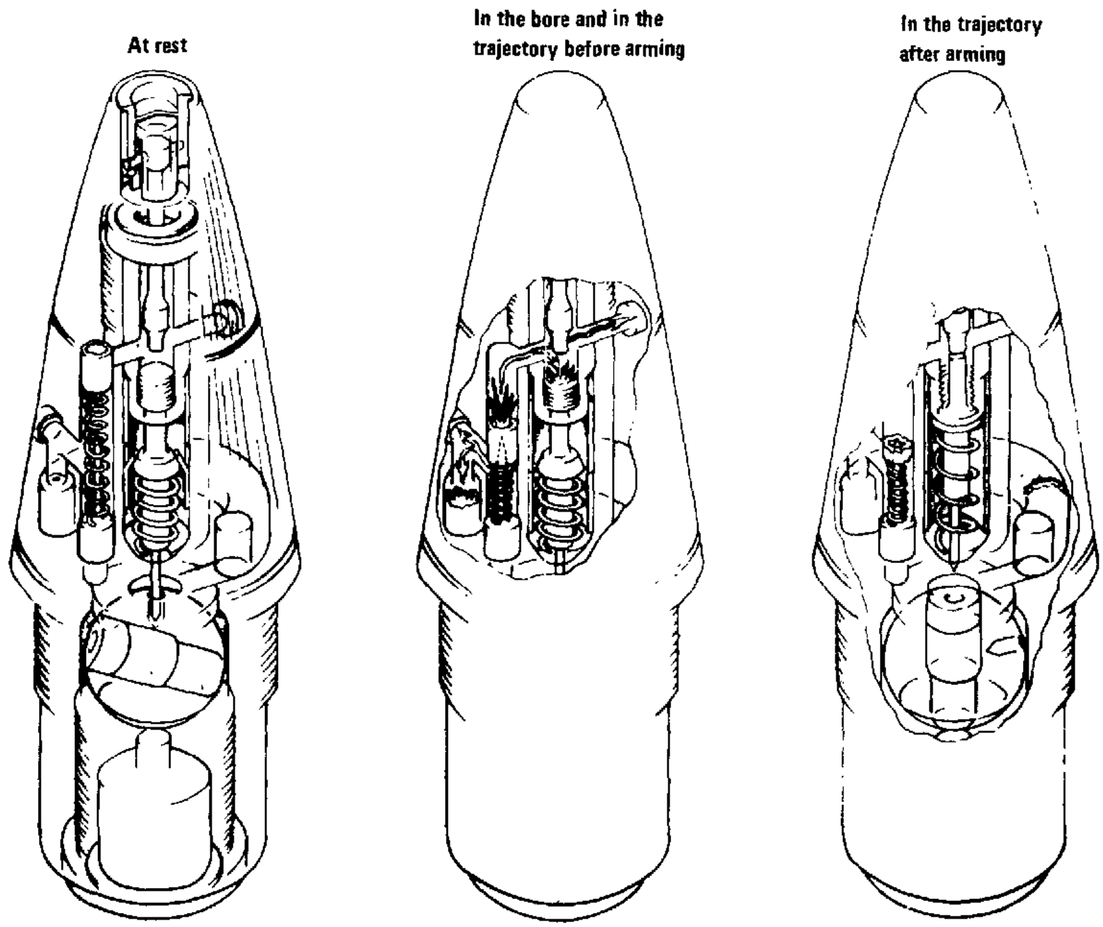

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Figure 2-77. Fuze, PDSD, Model FZ-104, cutaways of fuze depicting safe, unarmed, and armed conditions (U).

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

(U) Functioning (Continued)

Upon firing of the projectile, (fig 2-76) setback forces the setback initiating primer (9) to the rear against the spring (10). The setback initiating primer is ignited on impact with the setback firing pin (11). This action takes place in the gun barrel. The setback initiating primer, in turn, simultaneously ignites the self-destroying powder train (5) and the delay pellet (2) surrounding the impact firing pin (3). When the delay pellet is consumed, the spring (4) pushes the impact firing pin upward, unlocking the ball rotor (6). Centrifugal force moves the rotor, aligning the detonator (12) with the impact firing pin.

Upon impact, the firing pin extension (1) drives the impact firing pin into the detonator. Post-impact delay is provided by the labyrinth and pyrotechnic delay unit (7) between the detonator (12) and the relay (8).

If impact does not occur within the designated time interval, the self-destruction powder train (5) burns through and activates the detonator, which, after a delay, initiates the tetryl lead which, in turn, initiates the RDX booster. Figure 2-77 illustrates the fuze components in safe, unarmed, and armed positions.

In the FZ-104 M12 and FZ-104 M22 variants of the FZ-104, an alternative detonating action may occur in graze impacts. In these variants, there is an additional friction detonator built into the plane of the self-destruction powder train but extending also into the next lower portion of the fuze. This additional friction detonator is adjacent to and just clockwise from the detonator end of the self-destruction train. The fuze design is such that, at extreme impact angles (approximately 70° to 80°), the nose portion of the fuze will break off at the especially weakened joint straddled by the special friction detonator. The friction detonator, a mixture of 50 mg undextrinated lead azide and 15 mg RDX in an aluminum cup, detonates due to friction, ignites the normal detonator within the ball rotor, and detonation of the projectile occurs as previously described.

The post-impact delay elements described above may be altered or eliminated in the FZ-104 M2 and FZ-104 M22 variants.

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- **1390-19-1-2 (FZ-104)**
- **1390-19-1-2-1 (FZ-104 M1)**
- **1390-19-1-2-2 (FZ-104 M2)**
- **1390-19-1-2-3 (FZ-104 M12)**
- **1390-19-1-2-4 (FZ-104 M22)**

(U) Safety Features

The FZ-104, FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22 all have the same safety features. A ball rotor contains the detonator, and is held out of line by the firing pin engaged in a niche in the side of the rotor until firing. The firing pin is held in engagement with the rotor by a delay pellet and a deformable flange.

Transportation safety, handling safety, and delayed arming are ensured by the safety devices and arming sequence previously described. A rain safety device allows safe firing in heavy tropical rain.

These fuzes are known to be safe under practically any conditions. The FZ-104 and FZ-104 M12 have maintained a NATO "Symbol of Interchangeability" for 15 years. This means that these fuzes have not caused an accident within that time span. Extensive tests by US experts concluded that these fuzes should be generally safe, although they did not meet the requirements of some MIL Standards.

(FOUO). **Status**

(U) Fuzes FZ-104 and FZ-104 M12 carry the NATO "Symbol of Interchangeability" and thus would be considered favorably for adoption by many NATO nations. It is probable that both of these fuzes are considered standard in the armed forces of Belgium, Denmark, Norway, and possibly others.

(U) Sweden almost certainly uses at least one fuze from among the FZ-104 group.

(FOUO) Model FZ 104 M2 was standard in the West German armed forces as Model AZZ DM 91 at least as late as 1969. It is probably still standard, although Diehl may be developing a fuze to compete with it.

(U) Model FZ-104 M12 is standard for use in the United Kingdom as Model L41A1.

Fuze, PDSD, Model FZ-104 and variants FZ-104 M1, FZ-104 M2, FZ-104 M12, and FZ-104 M22

FOM Nos.
- 1390-19-1-2 (FZ-104)
- 1390-19-1-2-1 (FZ-104 M1)
- 1390-19-1-2-2 (FZ-104 M2)
- 1390-19-1-2-3 (FZ-104 M12)
- 1390-19-1-2-4 (FZ-104 M22)

(FOUO) Applications (Ammunition and Weapons)

Ammunition	Weapons
40-mm HE-T cartridge, Model SSL/K (Switzerland); 40-mm HE cartridge, Model SS/K (Switzerland); 40-mm HE-T cartridge, Model ?, (Bofors, Sweden); 40x365-mm HEI-T cartridge, Model SB-LS-Z (West Germany)	40-mm antiaircraft gun, Model L/70 (Bofors)

(FOUO) **Interchangeability**

The Bofors FZ family of PDSD fuzes for antiaircraft guns use a great many parts in common. An idea of the degree of commonality of parts between any two fuzes in this family can be obtained by study of the chart "Evolution of Bofors PDSD Fuzes," appendix II of this manual. It should be noted that the fuzes in this family are also produced by at least two and probably more non-Swedish manufacturers under Bofors license, and may carry Bofors or foreign designations. Aside from intra-family fuze parts interchangeability, the Bofors PDSD fuzes use unique sets of components. Packaging for the FZ-104 and all its variants is apparently interchangeable.

(U) **Packaging**

The FZ-104 and all its variants apparently use the same packaging.

Seven fuzes are packed in each sealed cylindrical fuze can. Protective styrofoam spacers hold the fuzes fixed within the can in a hexagonal pattern with one fuze in the center. A key is attached to the lid of each can to ensure easy access to the fuzes. Fourteen cans are packed in each wooden shipping box, for a total of 98 fuzes per box.

(U) **Packaging (Continued)**

Alternatively, the fuzes may be shipped attached to the rounds with which they are to be fired, as is US practice for 40-mm ammunition.

(U) **Test Data**

Extensive US test data for the FZ-104 M12 and FZ-305 M12 fuzes are available in Picatinny Arsenal Technical Report 4581, "Military Potential Test of Fuze, 40-mm, Antiaircraft, Point Detonating Self-Destroying FZ-305 M12 (Bofors)," by Lloyd D. Post, November 1973.

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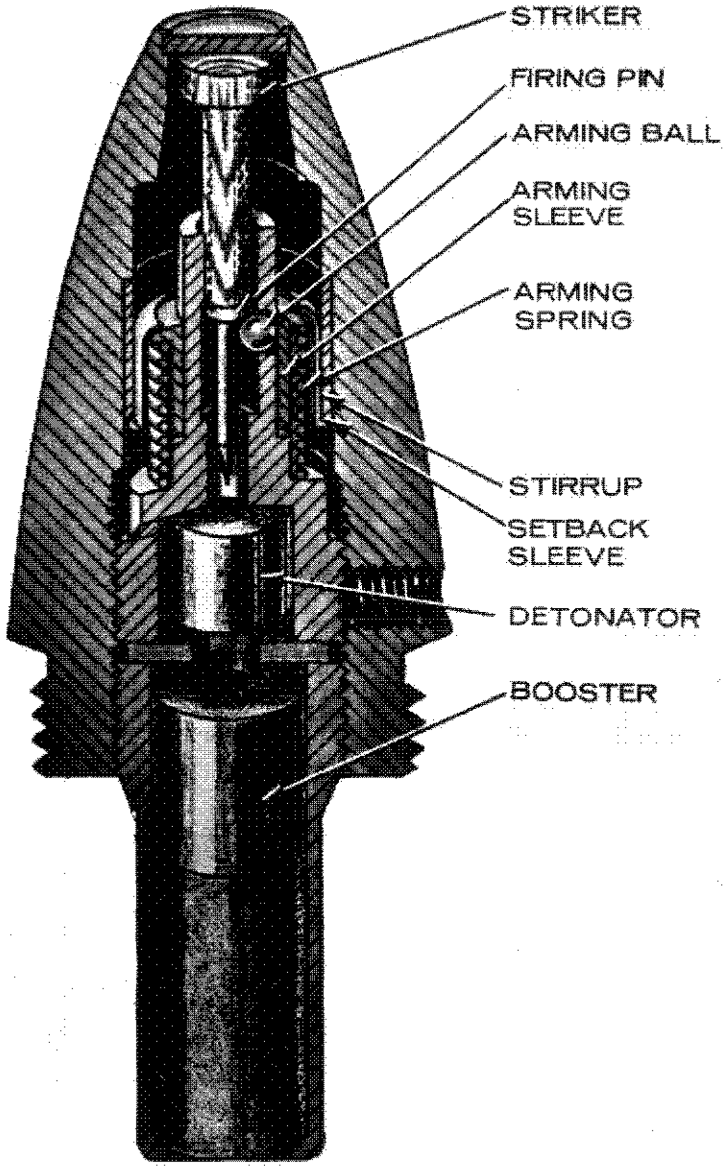

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Figure 2-78. Fuze, PD, Model ?, section view (U).

Fuze, PD, Model ?
FOM No. 1390-19-1-9

(U) Description

This simple direct-acting PD fuze (fig 2-78) is armed by setback, deceleration, and projectile spin by means of a setback sleeve and arming balls. The in-line detonator has no other safety features. The fuze is not detonator-safe and has only a minimal muzzle-safety distance. Its design falls far short of meeting current state-of-the-art safety and arming requirements.

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	19 g (0.042 lb)
Markings	?

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback, deceleration; spin
Firing method	Impact
Safety devices	Arming balls
Arming distance	est 10-20 cm
Arming time	?
Self-destruct time	?
Delay time	?
Frequency (for VT fuze only)	?

(U) **Functioning**

During storage and shipment, the firing pin is restrained from rearward movement and contact with the detonator by three steel arming balls. These balls are surrounded by, and restrained from movement by, a tubular arming sleeve. The arming sleeve is acted upon the compressed arming spring, but is prevented from moving forward by the bent leading edge of the stirrup, which in turn is held in position by the tubular setback sleeve that surrounds these components.

(U) **Functioning (Continued)**

Upon firing, setback forces cause the setback sleeve to move to the rear, carrying with it the stirrup. This movement straightens the bent leading edge of the stirrup, releasing the arming sleeve. Setback forces continue, however, to hold the arming sleeve in position against the pressure of the arming spring; the arming balls are restrained from movement, and the fuze remains unarmed as long as acceleration continues.

When the projectile exits the gun muzzle and acceleration ceases, the arming spring forces the arming sleeve forward. Centrifugal force acts on the arming balls, causing them to move radially outward into the space previously occupied by the arming sleeve. The firing pin is now free to move to the rear; creep (deceleration) forces, however, keep it in its forward position. The fuze is now armed.

Upon impact with a target, the striker drives the firing pin into the detonator, initiating fuze functioning. The fuze does not have a self-destruct feature.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
20-mm (20x110-mm) HEI cartridge, Model M-52	20-mm automatic gun, Model L-70

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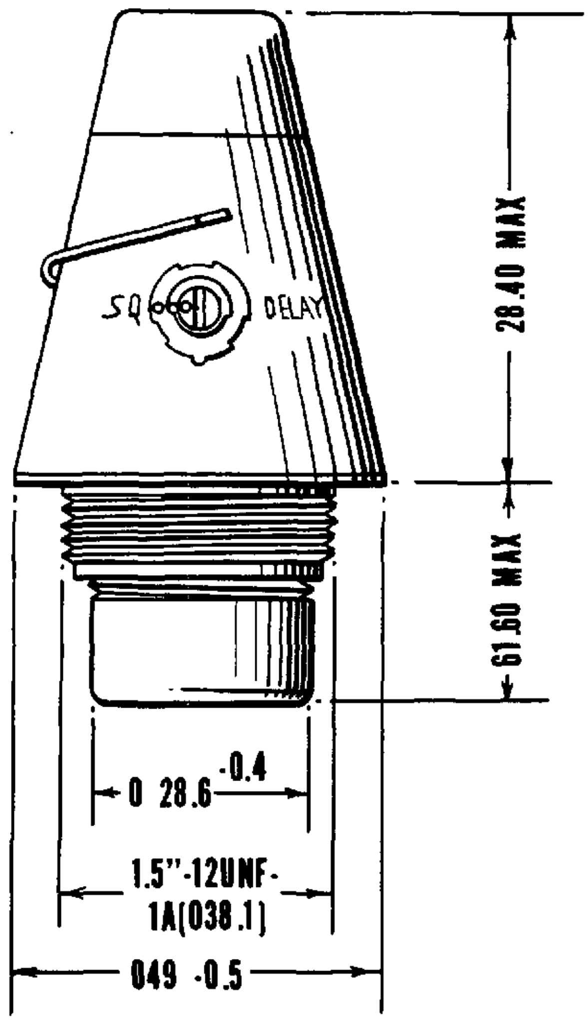

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Figure 2-79. Fuze, PD, Model FB-267, contour view (U).

(U) Description

The FB-267 PD fuze (fig 2-79) is a setback, delayed-arming type designed for SQ or delay functioning upon impact. It was developed by Fratelli-Borletti of Milan, Italy, for use

Fuze, PD, Model FB-267
FOM No. 1390-23-1-4

(U) Description (Continued)

on fin-stabilized mortar projectiles. The fuze is designed to be bore and muzzle safe. A pull wire locking all arming components assures safe shipping, handling, and parachute delivery. The fuze is watertight and is considered reliable in temperatures from -40° to +140°F.

(U) **Unique Features**

- Escapement mechanism for delay arming.
- Out-of-line detonator housed in a slider.

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	245 g (0.54 lb)
Markings	?

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devides	Safety pin, setback pin, out-of-line detonator
Arming distance	50 m
Arming time	1.2 s
Delay time	0.05 s

Sensitivity tests:*

Superquick	Functions on 4-mm paperboard** Functions 2 to 10 m behind 25-mm wood target

*Targets located at 200 m from weapon.
**Mullen bursting strength is 39 to 45 kg/cm^2 @ 18°C @ 65±2% relative humidity.

(U) Design Details

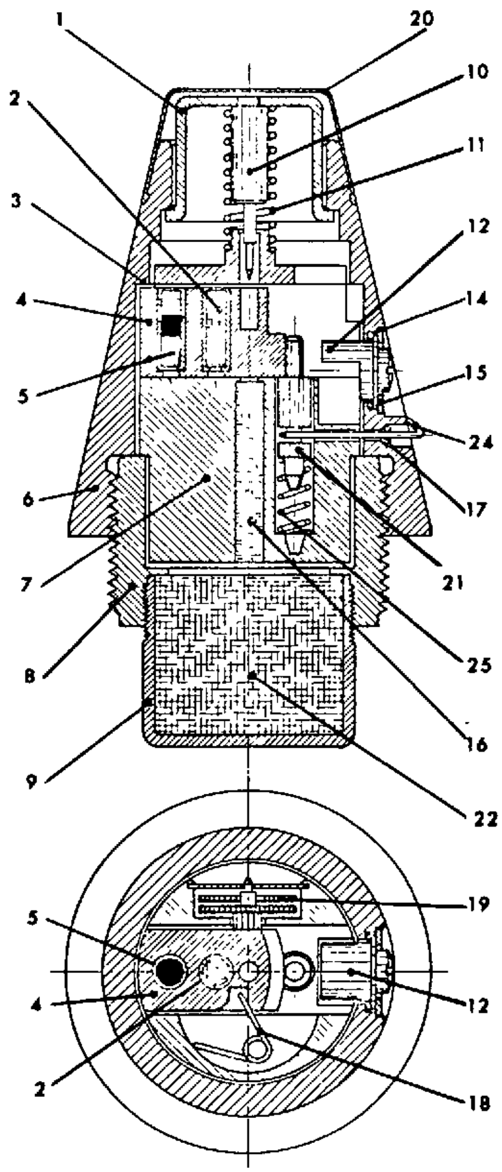

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Figure 2-80. Fuze, PD, Model FB-267, section view, unarmed position (U).

Fuze, PD, Model FB-267
FOM No. 1390-23-1-4

(U) Design Details (Continued)

The fuze (fig 2-80) consists primarily of the upper body (6), lower body (8), and booster assemblage (9). The upper body (6) is bored out to facilitate the firing-pin assembly, slider, delay-arming escapement mechanism, inertial plunger, setback pin, and fuze selector.

The firing-pin assembly consists of the striker cup (1), the firing pin (10), and its spring (11). It is sealed by a plastic cap (20) for protection against water.

The escapement mechanism (19) consists of a gear-pinion arrangement linked to the rack and spring (18) of the slider (4), containing the SQ detonator (2) and delay detonator (5). The slider is locked in the unarmed position by the setback pin (21) and its spring (25). The inertial plunger (7) is locked in safe position by a pull-out wire (24) to assure positive safety during handling, shipping, and parachuting.

The fuze selector (12) is sealed by an "O" ring (14) and retaining ring (15). The lower body adapter (8) is threaded internally and externally. The upper body (6) is sealed by a gasket prior to the lower body (8) being screwed on. The inertial plunger (7) has a central tube filled with a lead charge (16) of tetryl.

The booster cup (9) with its tetryl booster (22) is screwed into the lower fuze body (8), completing the assemblage.

(U) **Functioning**

Upon firing (fig 2-80), setback forces moves the pin (21) rearward, compressing its spring (25) and locking itself in place. This releases the slider, which moves slowly by the action of the spring (18), which is delayed by the escapement mechanism (19) via a pinion-rack arrangement.

Depending on the setting of the selector (12) to "SQ" or delay functioning, either detonator (2 or 5) will align with the firing pin, as depicted in figure 2-81. Upon impact, the firing pin stabs the detonator and in turn initiates the tetryl lead charge, booster, and high explosive filler of the projectile.

(U) Functioning (Continued)

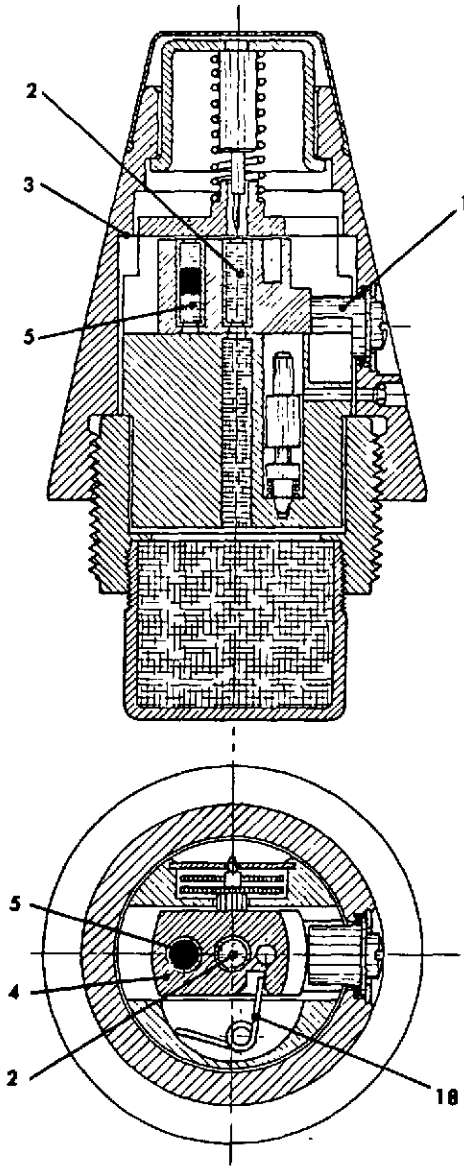

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Figure 2-81. Fuze, PD, Model FB-267, section view, armed position (U).

Fuze, PD, Model FB-267
FOM No. 1390-23-1-4

(U) Modifications

The slider reportedly has been redesigned. No specifics are available at this time.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
60-mm HE projectiles	60-mm mortars
81-mm HE projectiles 43A1	81-mm mortars
120-mm HE projectiles	120-mm mortars

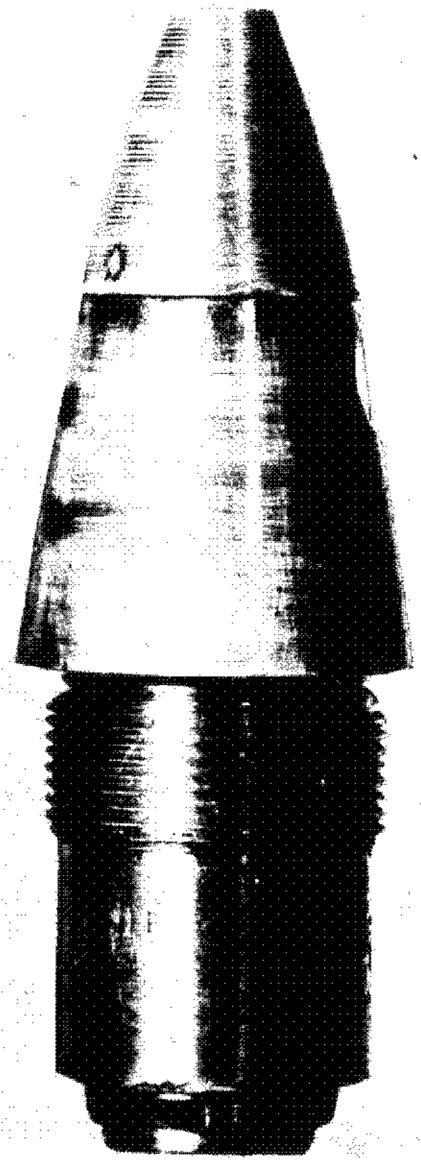

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Figure 2-82. Fuze, PDSD, Model M4A7, full view (U).

Fuze, PDSD, Model M4A7
FOM No. 1390-23-1-5

(U) **Description**

This fuze (fig 2-82), manufactured by Bombrini Parodi-Delfino (BPD), Rome, was designed for use with the Bofors 40-mm antiaircraft gun L/70. It was standard in the Italian Army at least as late as 1969. The internal components of the M4A7 are identical to those used in the M6. Except for a delay element in the detonator of the M5, the M4A7 and M5 are identical.

M4A7 is an SQ functioning fuze with a pyrotechnic self-destruct element burning 6.5 to 10 seconds from the moment of setback. This fuze should be effective against a light target. It should function well over a wide range of temperature and humidity conditions. A minimum number of moving parts are used.

The fuze mechanism is simple, easy to manufacture, safe to handle and transport, and sensitive. Liberal manufacturing tolerances can be used, while moisture and dust can be readily sealed out. Tooling costs for this design are minimal with equally modest production costs.

This fuze was first mass produced in 1958 and is still being produced in quantity.

(U) **Unique Features**

This fuze uses mass (in the form of balls) instead of a spring to displace the striker assembly which holds the out-of-line detonator rotor in the safe position. An inexpensive pyrotechnic element is used to delay arming. Two detents also hold the detonator rotor in the safe position until spin releases them. This fuze is rain safe.

(U) **Characteristics**

Fuze assembly:

Body material	Aluminum (?)
Weight	68 g (0.15 lb)
Markings	?

Booster:

Body material	?
Body length	4.6 mm (0.18 in)
Explosive	?
Explosive weight	?

(U) Characteristics (Continued)

Physical data (from exploitation):

Overall length	72.6 mm (2.86 in)
Visible length	41.7 mm (1.64 in)
Max diam	28.4 mm (1.12 in)

Thread data:

Max diam	21.8 mm (0.86 in)
Pitch	Metric, probably 1 mm

Functional data:

Arming method	Spin, pyrotechnical delay
Firing method	Impact or pyrotechnic (self-destruct)
Safety devices	Out-of-line detonator (rotor) and detent on striker and rotor
Arming distance	Approx 120-150 m
Arming time	Approx 0.13-0.17 s
Self-destruct time	6.5-10 s
Delay time	None (SQ)

Fuze, PDSD, Model M4A7
FOM No. 1390-23-1-5

(U) Functioning (fig 2-83)

1. Closure
2. Nose cap
3. Pin
4. Primer body
5. Primer firing pin
6. Striker assembly
7. Upper fuze body
8. Striker firing pin
9. Detonator
10. Washer
11. Rotor
12. Rotor housing
13. Lower fuze body
14. Booster pellet
15. Booster cup
16. Closing disk
17. Primer
18. Delay element
19. Delay and detent housing
20. Striker detent
21. Seal
22. Self-destruct delay
23. Washer
24. Detent balls
25. Firing-pin recess
26. Spring
27. Booster lead

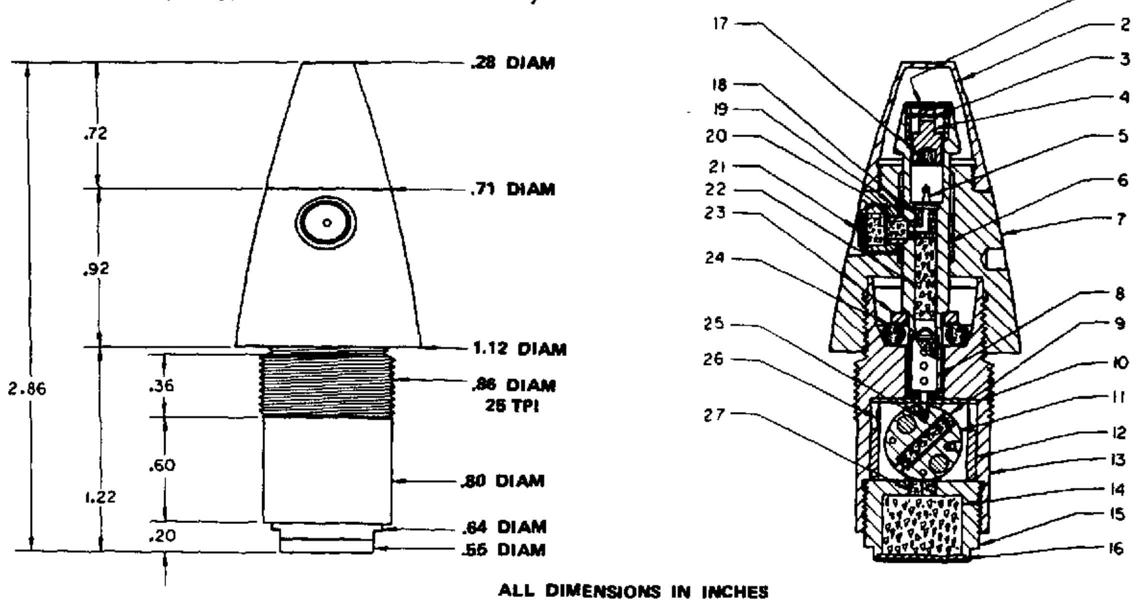

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Figure 2-83. Fuze, PDSD, Model M4A7, contour and section views (U).

When the projectile is fired, setback acting on the primer body (4) causes the pin (3) to bend, allowing the primer body to move to the rear and the primer (17) to be driven against the firing pin (5). The primer initiates the delay element (18) and this, in turn, initiates the self-destruct element (22). As the delay element burns, spin causes the detent (20) to move into the space created by the burning delay. When the detent has withdrawn from engagement with the striker assembly (6), the steel balls (24), acted upon by spin, move outward along the contour of the cavity forcing the washer (23) and striker assembly (6) to

(U) **Functioning (Continued)**

move forward. This action causes the closure (1) of the striker assembly (6) to move against the inner surface of the nose cap (2). The striker firing pin (8) is withdrawn from the firing-pin recess (25).

Two rotor detents extend from the rotor housing (12) into recesses in the rotor, one on each side of the rotor. The detents are held in place by a flat spring (26) formed into a circle. Spin, acting on these detents, deflects the spring (26), and when the detents and firing pin (8) have withdrawn from the rotor recesses, two rotor weights cause the rotor detonator (9) to swing into line with the firing pin (8). The fuze is now armed and will function upon impact with a target. Upon impact, the nose cap (2) is crushed, driving the striker assembly toward the rear, causing the firing pin to impinge on the detonator (9). This action initiates the lead charge (27) which, in turn, initiates the booster (14). The booster detonation initiates the high explosive within the projectile. If the projectile has not yet impacted when the self-destruct delay (22) burns out, the self-destruct element, initiated by the delay element (18) at firing, initiates a detonator within the striker firing pin. This detonator flashes through holes in the firing-pin wall, initiating the rotor detonator and causing the projectile high explosive to detonate as previously described.

(U) **Safety Features**

The striker assembly is initially positioned with the firing pin in engagement with the rotor, holding the detonator out of line. The striker is held in position by a detent and chemical (pyrotechnic) delay.

The rotor is locked in position with the detonator out of line by two rotor detents held in place by a circular leaf spring.

The fuze cannot arm until the projectile has traveled some distance down range because the chemical delay holds the striker detent in position until it has burned out sufficiently to provide space for the detent to retreat radially. The steel balls then displace the striker assembly forward, and finally the rotor must swing into line with the firing pin to complete the arming cycle.

Fuze, PDSD, Model M4A7
FOM No. 1390-23-1-5

(U) Interchangeability

All internal components used in this fuze are interchangeable with those used in the M6 fuze. Except for the use of detonators with different chemical compositions, the M4A7 and M5 fuzes are identical and interchangeable.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
40-mm HE cartridge, Model M1; 40-mm HEI cartridge, Model M1; 40-mm HE-T cartridge, Model M2; 40-mm HEI-T cartridge, Model M2	40-mm antiaircraft gun, Model L/70 (Bofors)

(U) **Packaging**

Normally, the fuzes are shipped attached to the rounds with which they are to be fired.

Whenever the fuzes are shipped separated from the ammunition, a special BPD shipping box is provided. The same shipping box is used for the M4A7 fuze as is described for shipping the M6 and M5 fuzes. For details of this box, see FOM No. 1390-23-1-6 on the M6 fuze.

(U) **Test Data**

No test data for this fuze are presently held by the US intelligence community; however, because the internal components used are identical with those of the M6, it is likely that the performance of the M4A7 will be similar to that of the M6, for which test data are available. Some performance differences should be expected, however, because the M4A7 is fired from a weapon (the L/70 gun) with a higher muzzle velocity and different ballistics from that in which the M6 is fired (the L/60 gun). For a summary of test data on the M6, see the M6 article elsewhere in this handbook.

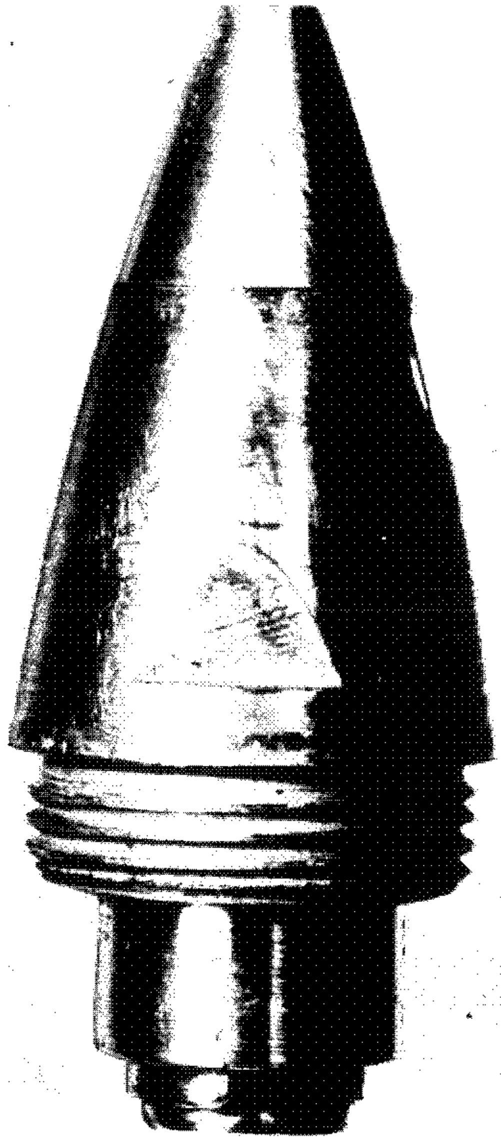

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Figure 2-84. Fuze, PDSD, Model M6, contour and section views (U).

Fuze, PDSD, Model M6
FOM No. 1390-23-1-6

(U) Description

This fuze (fig 2-84), manufactured by Bombrini Parodi-Delfino (BPD) of Rome, was designed for use with the Bofors 40-mm antiaircraft gun L/60. The internal components of the M6 are identical to those of fuze M4A7, and also, except for the chemical composition of the detonator, to those of fuze M5. Fuzes M4A7 and M5, both for use with the Bofors L/70 40-mm antiaircraft gun, use a different body due to being mated with different ammunition.

M6 is an SQ functioning fuze with a pyrotechnic self-destruct mechanism burning 6.5 to 10 seconds from the moment of setback. This fuze should be effective against a light target. It should function well under a wide range of temperature and humidity conditions. A minimum number of moving parts are used.

The fuze mechanism is simple, easy to manufacture, safe to handle and transport, and sensitive. Liberal manufacturing tolerances can be used, while moisture and dust can be readily sealed out. Tooling costs for this design are minimal with equally modest production costs.

In US tests, this fuze functioned reasonably well, although it was considerably less reliable than the Bofors FZ-305 M12 fuze. Detailed test data are available in Picatinny Arsenal Technical Report 4257, August 1971, summarized below.

(U) **Unique Features**

This fuze uses mass (in the form of balls) instead of a spring to displace the striker assembly which holds the out-of-line detonator rotor in the safe position. An inexpensive pyrotechnic element is used to delay arming. Two detents also hold the detonator rotor in the safe position until spin releases them. This fuze is rain safe.

(U) **Characteristics**

Fuze assembly:

Body material	Aluminum (?)
Weight	134 g (0.30 lb)
Markings	?

(U) Characteristics (Continued)

Booster:

Body material	?
Body length	4.6 mm (est) (0.18 in)
Explosive	?
Explosive weight	?

Physical data (from exploitation):

Overall length	72.9 mm (2.87 in)
Visible length	48.0 mm (1.89 in)
Max diam	32.5 mm (1.28 in)

Thread data:

Max diam	30.0 mm (1.18 in)
Pitch	Metric, probably 2 mm

(Model M6/D has thread 1.18-14 NS-2A)

Functional data:

Arming method	Spin, pyrotechnic delay
Firing method	Impact or pyrotechnic (self-destruct)
Safety devices	Out-of-line detonator (rotor) and detents on rotor and striker
Arming distance	Approx 120-150 m
Arming time	Approx 0.13-0.17 s (est)
Self-destruct time	6.5-10 s
Delay time	None (SQ)

Fuze, PDSD, Model M6
FOM No. 1390-23-1-6

(U) Functioning (fig 2-85)

1. Closure
2. Nose cap
3. Pin
4. Primer body
5. Primer firing pin
6. Striker assembly
7. Upper fuze body
8. Striker firing pin
9. Detonator
10. Washer
11. Rotor
12. Rotor housing
13. Lower fuze body
14. Booster pellet
15. Booster cup
16. Closing disk
17. Primer
18. Delay element
19. Delay and detent housing
20. Striker detent
21. Seal
22. Self-destruct delay
23. Washer
24. Detent balls
25. Firing-pin recess
26. Spring
27. Booster lead

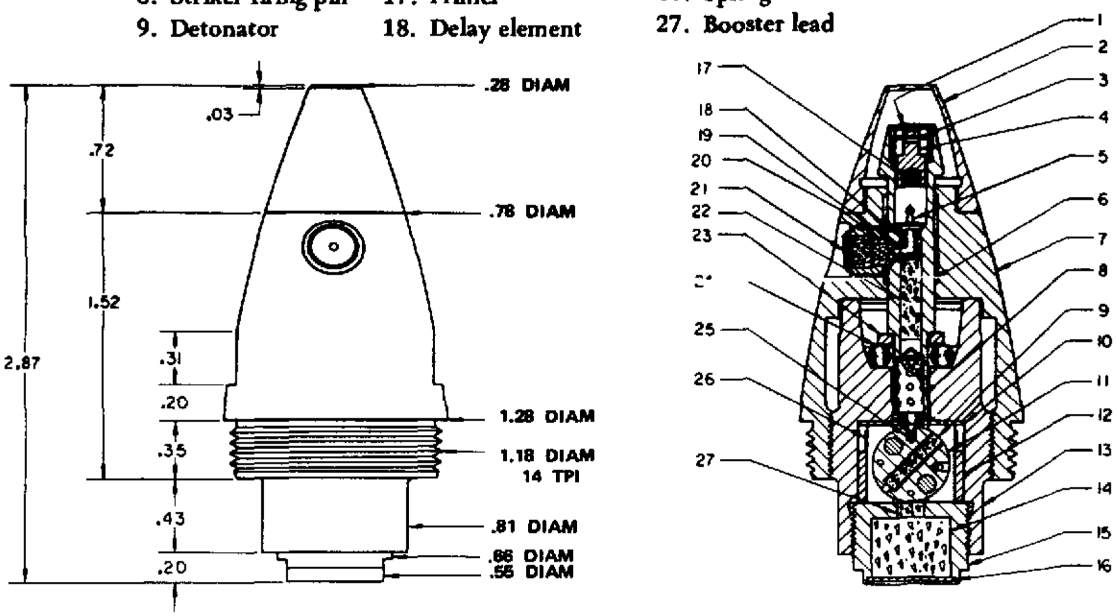

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Figure 2-85. Fuze, PDSD, Model M6, contour and section views (U).

When the projectile is fired, setback acting on the primer body (4) causes the pin (3) to bend, allowing the primer body to move to the rear and the primer (17) to be driven against the firing pin (5). The primer initiates the self-destruct element (22). As the delay element burns, spin causes the detent (20) to move into the space created by the burning delay. When the detent has withdrawn from engagement with the striker assembly (6), the steel

(U) **Functioning (Continued)**

balls (24), acted upon by spin, move outward along the contour of the cavity forcing the washer (23) and striker assembly (6) to move forward. This action causes the closure (1) of the striker assembly (6) to move against the inner surface of the nose cap (2). The striker firing pin (8) is withdrawn from the firing-pin recess (25).

Two rotor detents extend from the rotor housing (12) into recesses in the rotor, one on each side of the rotor. The detents are held in place by a flat spring (26) formed into a circle. Spin, acting on these detents, deflects the spring (26), and when the detents and firing pin (8) have withdrawn from the rotor recesses, two rotor weights cause the rotor detonator (9) to swing into line with the firing pin (8). The fuze is now armed and will function upon impact with a target. Upon impact, the nose cap (2) is crushed, driving the striker assembly toward the rear causing the firing pin to impinge on the detonator (9). This action initiates the lead charge (27) which, in turn, initiates the booster (14). The booster detonation initiates the high explosive within the projectile. In the event that the projectile fails to impact prior to burn-out of the self-destruct delay (22), the self-destruct element, initiated by the delay element (18) at firing, initiates a detonator within the striker firing pin. This detonator flashes through holes in the firing-pin wall, initiating the rotor detonator and causing the projectile high explosive to detonate as previously described.

(U) **Safety Features**

The striker assembly is initially positioned with the firing pin in engagement with the rotor, holding the detonator out of line. The striker is held in position by a detent and chemical (pyrotechnic) delay.

The rotor is locked in position with the detonator out of line by two rotor detents held in place by a circular leaf spring.

The fuze cannot arm until the projectile has traveled some distance down range because the chemical delay holds the striker detent in position until it has burned out sufficiently to provide space for the detent to retreat radially. The steel balls then displace the striker assembly forward, and finally the rotor must swing into line with the firing pin to complete the arming cycle.

Fuze, PDSD, Model M6
FOM No. 1390-23-1-6

(U) Interchangeability

All internal components used in this fuze are interchangeable with those used in the M4A7 fuze, and also, except for the chemical composition of the detonator mechanism, with the M5 fuze.

(U) Status

This fuze was standard in the Italian Army at least as late as 1960, and standard in the West Germany Army as Model AZZ DM 121.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
40-mm HE cartridge, Model No. 1 40-mm HEI cartridge, Model No. 1 40-mm HE-T cartridge, Model No. 2 40-mm HEI-T cartridge, Model No. 2	40-mm antiaircraft gun, Model L/60 (Bofors)

(U) Packaging

Normally, the fuzes are shipped attached to the rounds with which they are to be fired. Whenever the fuzes are shipped separated from the ammunition, BPD provides a special shipping box (fig 2-86) holding 500 fuzes, weighing 45 kg (packed) and with dimensions 690x395x350 mm. The case is made of fir wood, with a zinc-coated sheeting liner. Four trays are packed in the wood box, 125 fuzes to a tray, with each fuze isolated from its neighbors in every direction by sitting in a hole in the tray. Sheets of 1.5-mm-thick bituminized cardboard are placed between trays of fuzes in order to isolate the noses of lower layer fuzes from the bases of those on the next higher layer. The liner sheeting is tin-soldered at the top edges to ensure an airtight seal. The wooden lid is fixed to the box by 10 screws. Slat-type carrying handles (at different heights to facilitate packing) are attached to each end of the box.

The same packaging is also used for fuze M4A7 and fuze M5.

(U) Packaging (Continued)

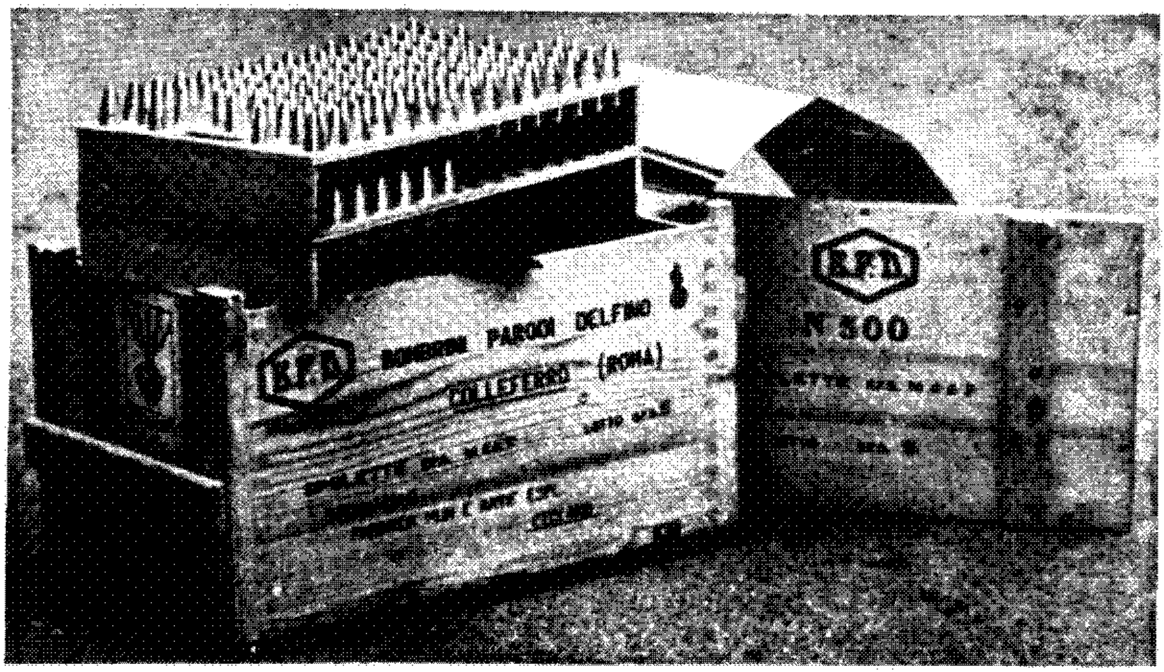

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Figure 2-86. Fuze, PDSD, Model M6, shipping box (U).

(U) Summary of Test Data (from PA Tech Report 4257)

Functioning:

Total function/number tested (excluded non-functions and low orders)	71/92
% Function	77.2
Reliability at 90% confidence level	68.0
Functioned as intended/number tested	68/92
% Function	74.0
Reliability at 90% confidence level	66.0

Delay arming:

Nominal distance (ft)	467
σ (standard deviation) (ft)	24.4

Fuze, PDSD, Model M6
FOM No. 1390-23-1-6

(U) **Summary of Test Data (from PA Tech Report 4257) (Continued)**

Self-destruct:

Nominal time (s)	10.08
σ (standard deviation) (s)	0.27

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Figure 2-87. Fuze, PDSD, Model M5, full view (U).

Fuze, PDSD, Model M5
FOM No. 1390-23-1-9

(U) Description

This fuze (fig 2-87), manufactured by Bombrini Parodi-Delfino (BPD) of Rome, was designed for use with the Bofors 40-mm antiaircraft gun L/70. It is reportedly used by West Germany, but its present status is unknown. The M5 has a delay after impact function built into the detonator composition. Except for this post-impact delay, fuze M5 is identical to fuze M4A7, which is SQ functioning. Fuze M6 uses the same internal components as the M4A7.

M5 is a short-delay functioning fuze with a pyrotechnic self-destruct element burning 6.5 to 10 seconds from the moment of firing. This fuze should be effective against a light target. The delay functioning detonator should enhance ammunition effectiveness against aircraft and unarmored vehicles by allowing some (up to 1 meter) penetration before projectile detonation. M5 should function well over a wide range of temperature and humidity conditions. A minimum number of moving parts are used.

The fuze mechanism is simple, easy to manufacture, safe to handle and transport, and sensitive. Liberal manufacturing tolerances can be used, while moisture and dust can be readily sealed out. Tooling costs for this design are minimal with equally modest production costs.

(U) Unique Features

A pyrotechnic post-impact delay element in the detonator assembly should provide enhanced effectiveness.

Mass (in the form of balls) is used instead of a spring to displace the striker assembly which holds the out-of-line detonator rotor in the safe position. An inexpensive pyrotechnic element is used to delay arming. Two detents also hold the detonator rotor in the safe position until spin releases them. This fuze is rain safe.

(U) Characteristics

Fuze assembly:

Body material	Aluminum (?)
Weight	68 g (0.15 lb)
Markings	?

(U) **Characteristics (Continued)**

Booster:

Body material	?
Body length	4.6 mm (0.18 in)
Explosive	?
Explosive weight	?

Physical data:

Overall length	72.6 mm (2.86 in)
Visible length	41.7 mm (1.64 in)
Max diam	28.4 mm (1.12 in)

Thread data:

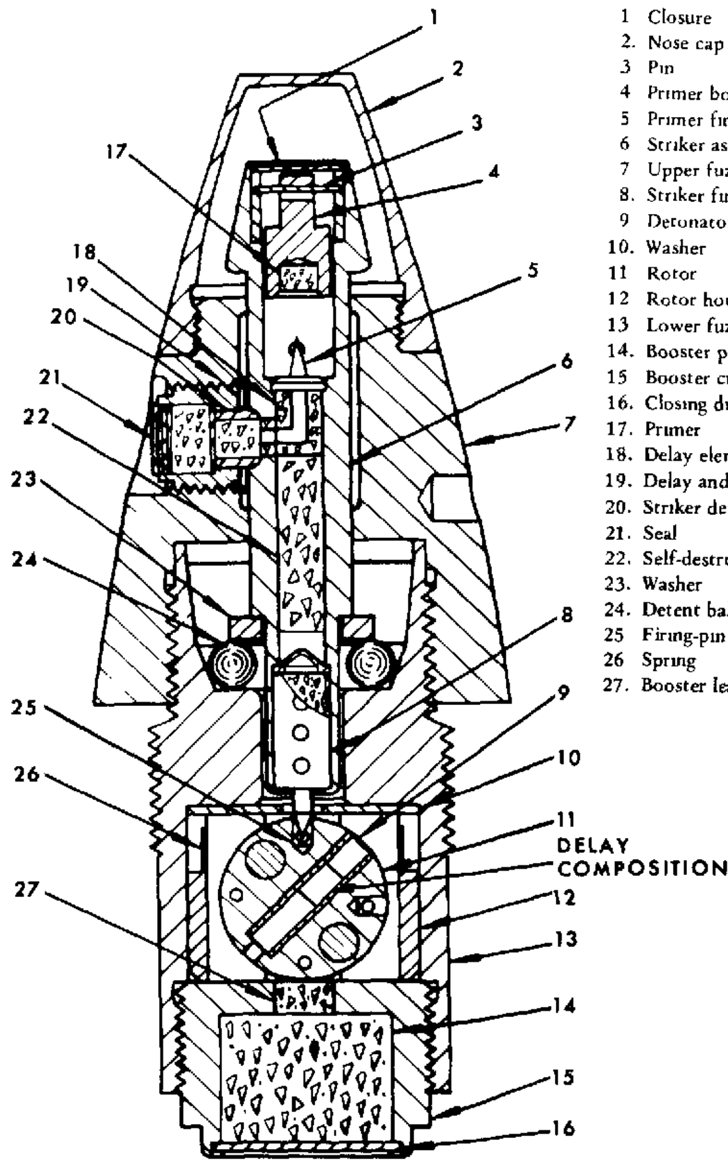
Max diam	21.8 mm (0.86 in)
Pitch	Metric, probably 1 mm

Functional data:

Arming method	Spin, pyrotechnic delay
Firing method	Impact or pyrotechnic (self-destruct)
Safety devices	Out-of-line detonator (rotor) and detent on striker and rotor
Arming distance	120-150 m (est)
Arming time	0.13-0.17 s (est)
Self-destruct time	6.5-10 s
Delay time	Approx 0.0005 s

Fuze, PDSD, Model M5
FOM No. 1390-23-1-9

(U) **Functioning** (fig 2-88)



1 Closure
2. Nose cap
3 Pin
4 Primer body
5 Primer firing pin
6 Striker assembly
7 Upper fuze body
8. Striker firing pin
9 Detonator
10. Washer
11 Rotor
12 Rotor housing
13 Lower fuze body
14. Booster pellet
15 Booster cup
16. Closing disk
17. Primer
18. Delay element
19. Delay and detent housing
20. Striker detent
21. Seal
22. Self-destruct delay
23. Washer
24. Detent balls
25 Firing-pin recess
26 Spring
27. Booster lead

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Figure 2-88. Fuze, PDSD, Model M5, section view (U).

(U) Functioning (Continued)

When the projectile is fired, setback acting on the primer body (4) causes pin (3) to bend, allowing the primer body to move to the rear and the primer (17) to be driven against the firing pin (5). The primer initiates the delay element (18) and this, in turn, initiates the self-destruct element (22). As the delay element burns, spin causes the striker detent (20) to move into the space created by the burning delay. When the detent has withdrawn from engagement with the striker assembly (6), the steel balls (24), acted upon by spin, move outward along the contour of the cavity forcing the washer (23) and striker assembly (6) to move forward. This action causes the closure (1) of the striker assembly (6) to move against the inner surface of the nose cap (2). The striker firing pin (8) is withdrawn from the firing-pin recess (25).

Two rotor detents extend from the rotor housing (12) into recesses in the rotor, one on each side of the rotor. The detents are held in place by a flat spring (26) formed into a circle. Spin, acting on these detents, deflects the spring (26) and when the detents and firing pin (8) have withdrawn from the rotor recesses, two rotor weights cause the rotor detonator (9) to swing into line with the firing pin (8). The fuze is now armed and will function upon impact with a target. Upon impact, the nose cap (2) is crushed, driving the striker assembly toward the rear, causing the firing pin to impinge on the detonator (9). This action initiates the lead charge (27) which, in turn, initiates the booster (14). The booster detonation initiates the high explosive within the projectile. If the projectile has not yet impacted when the self-destruct delay (22) burns out, the self-destruct element initiated by the delay element (18) at firing initiates a detonator within the striker firing pin. This detonator flashes through holes in the firing-pin wall, initiating the rotor detonator and causing the projectile high explosive to detonate as previously described.

(U) Safety Features

The striker assembly is initially positioned with the firing pin in engagement with the rotor, holding the detonator out-of-line. The striker is held in position by a detent and chemical (pyrotechnic) delay.

The rotor is locked in position with the detonator out-of-line by two rotor detents held in place by a circular leaf spring.

Fuze, PDSD, Model M5
FOM No. 1390-23-1-9

(U) **Safety Features (Continued)**

The fuze cannot arm until the projectile has traveled some distance down range because the chemical delay holds the striker detent in position until it has burned out sufficiently to provide space for the detent to retreat radially. The steel balls then displace the striker assembly forward, and finally the rotor must swing into line with the firing pin to complete the arming cycle.

(U) **Interchangeability**

This fuze employs a delay element in the detonator composition. Except for this delay, fuze M5 is identical to fuze M4A7. All M5 internal components except the delayed detonator are also interchangeable with those used in fuze M6.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
40-mm HE cartridge, Model M1; 40-mm HEI cartridge, Model M1; 40-mm HE-T cartridge, Model M2; 40-mm HEI-T cartridge, Model M2	40-mm antiaircraft gun, L/70 (Bofors)

(U) **Packaging**

Normally, the fuzes are shipped attached to the rounds with which they are to be fired. Whenever the fuzes are shipped separated from the ammunition, BPD provides a special shipping box. Identical boxes are used for shipping M4A7, M5, and M6 fuzes, 500 to a box. For a detailed description and photography of this packaging, see the section on fuze M6 in this study.

(U) **Test Data**

No test data for this fuze are presently held by the US intelligence community. Test data for the similar fuze M6 may not be applicable to the M5 because the delay-after-impact element in the M5 could affect performance adversely.

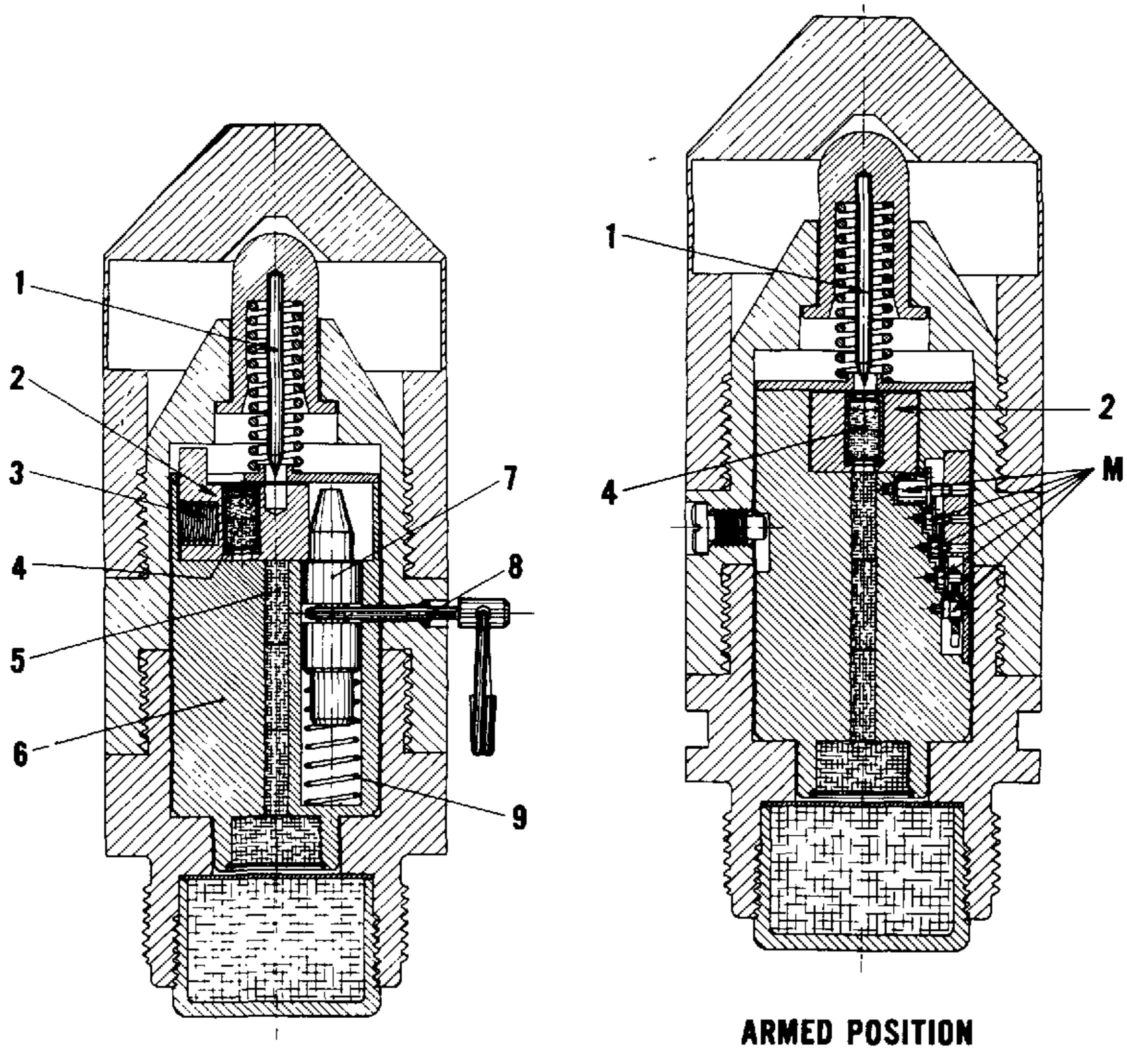

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Figure 2-89. Fuze, PD, Model 225A, section views of unarmed and armed positions (U).

(U) Description

The Model 225A fuze (fig 2-89 and 2-90) is a setback, delayed-arming fuze designed for instantaneous and graze functioning upon impact. It was developed by Fratelli Borletti of Milan, Italy, for use with the XM151 2.75-inch airborne rockets. External shape and dimensions are similar to US fuzes M423 and XM427E1.

Fuze, PD, Model 225A
FOM No. 1390-23-2-2

(U) Unique Features

- "V"-shaped nose cap for graze functioning.
- Escapement to control or delay the arming.
- Slider housing out-of-line detonator.

(U) Characteristics

Fuze assembly:	
Body material	?
Weight	?
Markings	FB 225A
Booster:	
Body material	?
Body length	?
Explosive	?
Explosive weight	?
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	?

*Pull wire, locking pin, and out-of-line detonator.

(U) **Design Details** (figs 2-89 and 2-90)

The FB 225A is a three-piece design consisting of a nose cap, upper body section, and lower body section. The nose cap has an internally truncated "V"-shape cutout to permit the striker assembly (1) and inertial plunger (6) to be cammed when the projectile grazes the ground upon impact.

The striker assembly (1) includes a striker head, setback spring, and firing pin. The spring-loaded slider (3,2) houses an out-of-line detonator (4). The movement of the slider (2) is controlled by the clockwork mechanism (M).

The safety system consists of locking pin (7), locking-pin spring (9), and pull wire (8).

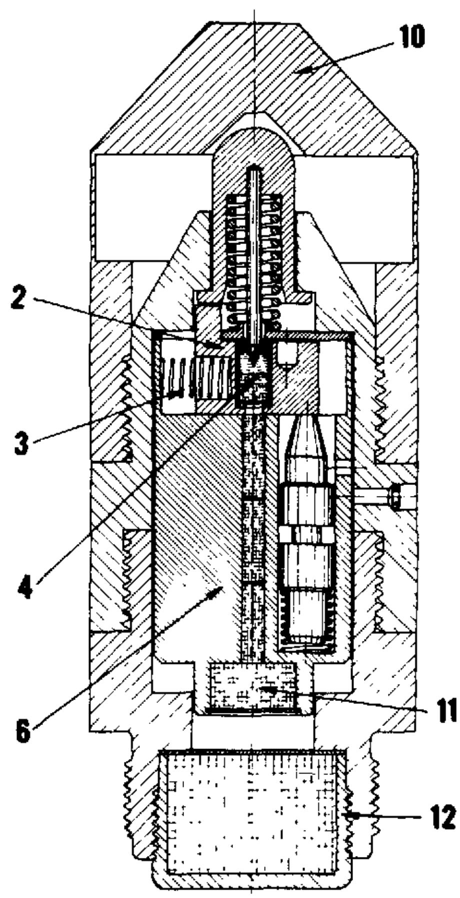
The explosive train includes the detonator (4), a columnar lead charge (5), a relay, and a booster. The booster assembly screws into the base of the lower body section of the fuze.

(U) **Functioning**

Prior to firing, the safety pin (8) is removed (see fig 2-89). Upon firing, acceleration of the rocket causes the locking pin (7) to move rearward, compressing its spring and undetenting the slider (2), which is pushed into the armed position by its spring (3). This movement is delayed by the clockwork (M) (see fig 2-89). When the clockwork runs down, the detonator (4) aligns itself with the striker (1) and the columnar lead charge. The fuze is now armed.

Upon impact (see fig 2-90) with no-graze action, the nose cap (10) drives the striker into the detonator (4), initiating the lead charge (5) and in turn the relay charge (11) and booster (12). In the event the striker does not function the detonator, the inertial plunger (6) simultaneously drives the detonator into the striker. Upon impact with graze action, the nose cap (10) cams the striker (1) and the inertial plunger pushes the detonator (4) into the striker (1), initiating the lead charge (5) and in turn the relay charge (11) and booster (12).

(U) Design Details (Continued)



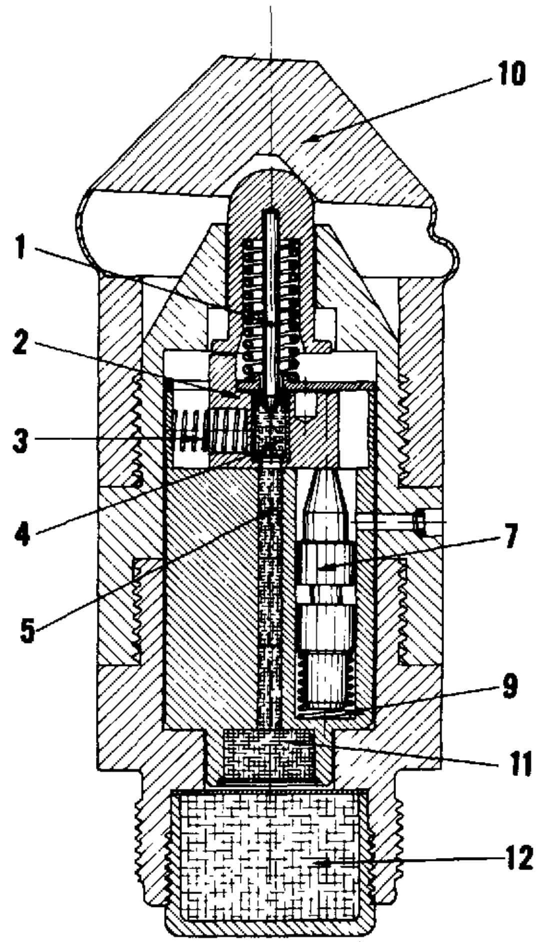


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Figure 2-90. Fuze, PD, Model 225A, impact position, no-graze and graze actions (U).

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
2.75-in HE rockets, Model XM151	2.75-in rocket launchers

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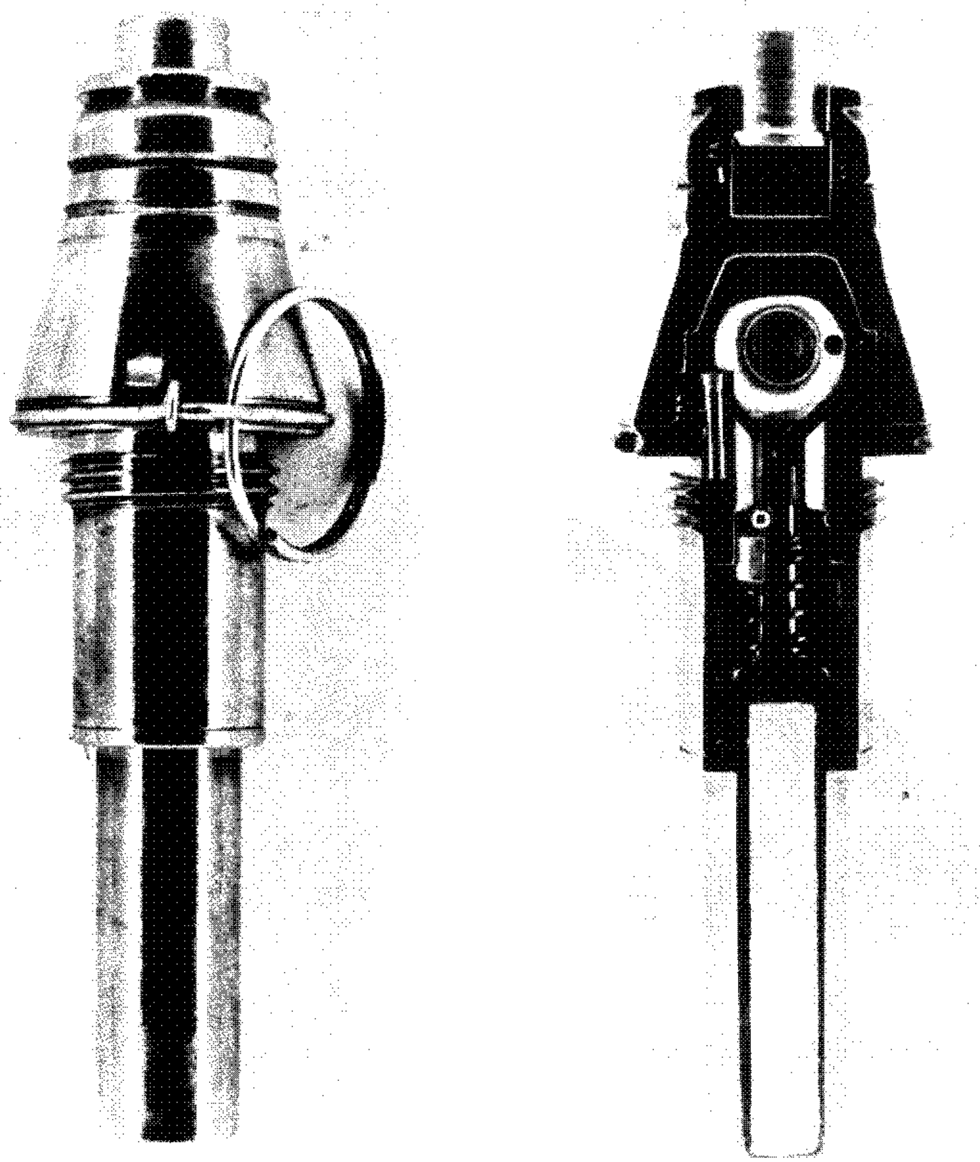

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Figure 2-91. Fuze, PD, Model 53, full and cutaway views (U).

Fuze, PD, Model 53
FOM No. 1390-24-1-2

(U) Description

The Model 53 (fig 2-91) is a setback-armed PD fuze designed for instantaneous action upon impact. It was designed by Esperanza Y CIA, S.A. of Marquina, Spain, for use with mortar projectiles of any caliber.

(U) Unique Features

- Eccentric weight ball rotor containing out-of-line detonator.
- Safety wire locking setback sleeve.
- Two balls detenting the ball rotor.

(U) Characteristics

Fuze assembly:	
Body material	Brass
Weight	225 g? (0.50 lb)
Markings	Model 53
Length	114.5 mm (4.51 in)
Thread diam	22.3 mm (0.88 in)
TPI	13
Booster:	
Body material	Brass
Body length	51 mm (2.01 in)
Explosive	Tetryl ?
Explosive weight	?
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	5 meters
Arming time	?

*Safety wire locking setback sleeve and detent on ball rotor housing out-of-line detonator.

(U) Design Details

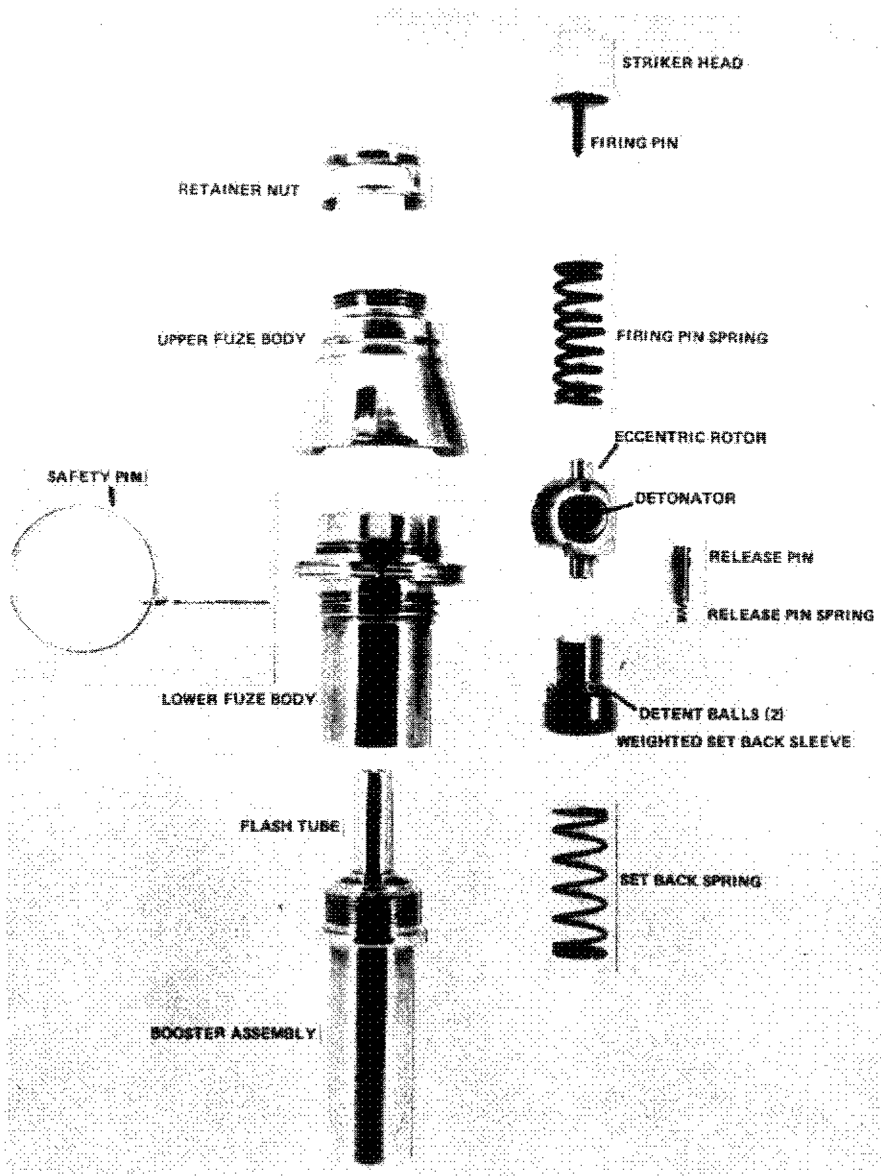

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Figure 2-92. Fuze, PD, Model 53, exploded view (U).

Fuze, PD, Model 53
FOM No. 1390-24-1-2

(U) **Design Details (Continued)**

(U) The fuze (fig 2-92) consists of a striker assembly, upper fuze body, lower fuze body, and booster assemblage. The forward end of the upper fuze body is threaded externally and bored out to facilitate assembly of the striker. The striker consists of an aluminum striker head, steel coil spring and firing pin which is locked in position by a retainer nut forming the striker assembly. The rearward portion of the upper fuze body is hollowed out to house the eccentrically weighted ball rotor containing the out-of-line detonator. In addition, the upper fuze body is threaded internally to receive the lower fuze body.

The lower fuze body is threaded externally for screwing onto the projectile and internally to facilitate assembly of the booster. The lower fuze body houses the weighted setback sleeve, two detent balls, the setback spring and spring-loaded release pin which engages a flat surface of the ball rotor and a brass flash tube for assembly into the booster assembly. A safety pin, inserted through a transverse opening through the lower fuze body and setback sleeve, provides additional safety.

(U) Functioning (fig 2-93)

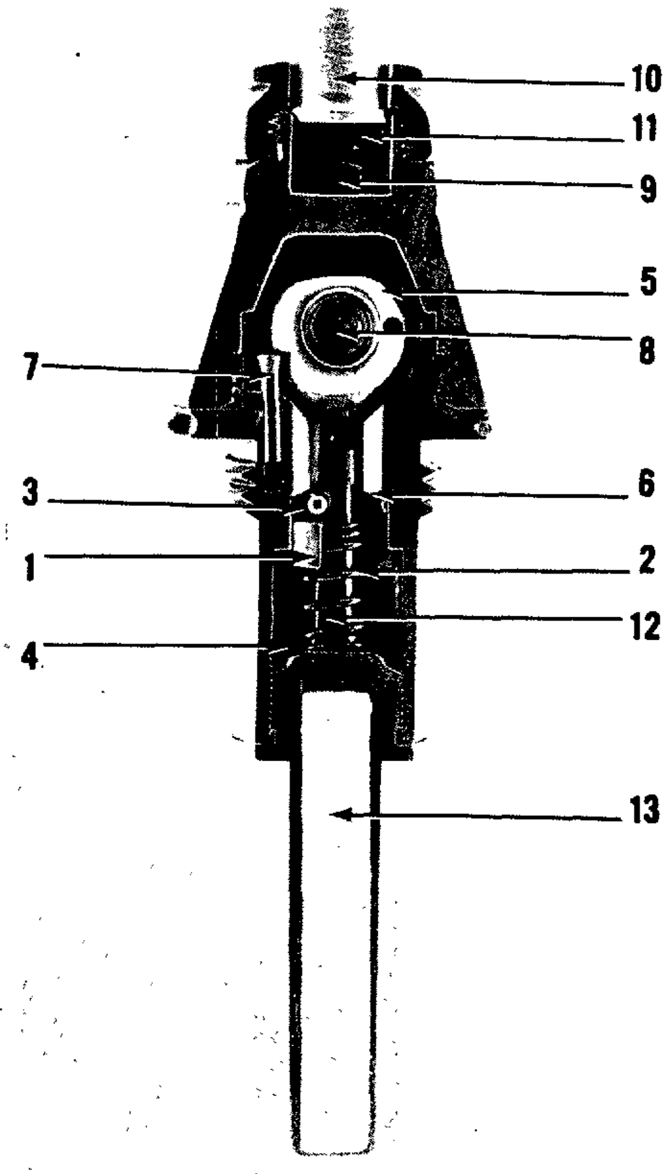

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Figure 2-93. Fuze, PD, Model 53, section view (U).

Fuze, PD, Model 53
FOM No. 1390-24-1-2

(U) Functioning (Continued)

Prior to firing, the safety pin is removed.

Upon firing, setback forces move the weighted setback sleeve (1) rearward, compressing its spring (2); this in turn frees the two detent balls (3) which fall into the cavity (4) of the lower fuze body. The eccentric weighted ball rotor (5) is now free to move.

As setback forces dissipate, the setback sleeve (1) moves forward by expansion of its spring (2) and rests on a shoulder (6) of the lower fuze body.

The eccentrically weighted ball rotor as a result of its mass and the help of a spring-loaded release pin (7) rotates 90°, arming the fuze. The detonator (8) is now in line with the firing pin (9).

Upon impact, the striker head (10) forces the firing pin (9) against its spring (11), stabbing the detonator (8) which in turn flashes through the flash tube (12), initiating the booster (13) and resulting in detonation of the high explosive projectile.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
60-mm projectiles	60-mm mortar
81-mm projectiles	81-mm mortar

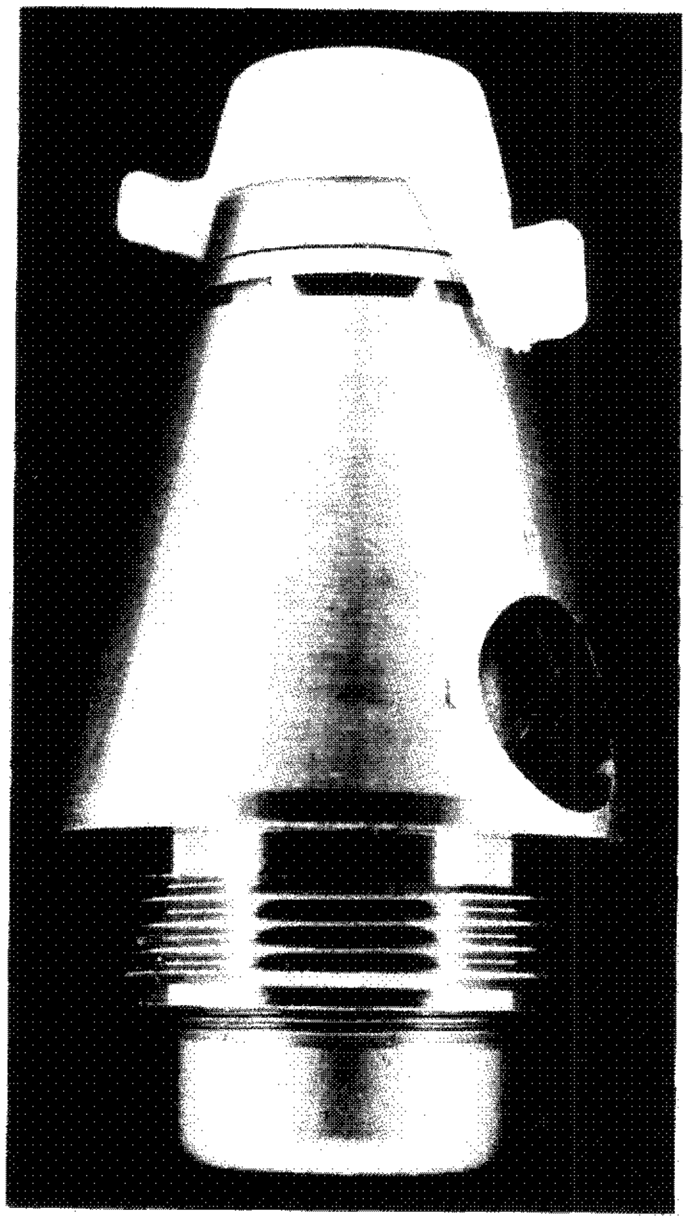

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Figure 2-94. Fuze, PD, Model D, full view (U).

Fuze, PD, Model D
FOM No. 1390-24-1-3

(U) Description

The Model "D" PD fuze (fig 2-94) is a setback-armed type designed for either instantaneous or delay action upon impact. It was developed by Esperanza Y CIA, S.A. of Marquina, Spain, for use with mortar projectiles.

(U) Unique Features

- Employs a visual and touch needle which tells you the fuze is armed.
- Employs a plastic safety cap and steel pin.
- Employs a spring-loaded slider detented by a unique arming mechanism.

(U) Characteristics

Fuze assembly:

Body material	Anodized aluminum
Weight	212 g (0.47 lb)
Max body diam	48.7 mm (1.92 in)
Length (overall)	94.5 mm (3.72 in)
Thread diam	37.5 mm (1.48 in)
TPI	12

Booster:

Body material	Anodized aluminum
Body length	20 mm (0.79 in)
Body diam	27.7 mm (1.09 in)
Explosive	Tetryl ?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Safety cap, safety pin detent on slider
Arming distance	40 m
Arming time	1.2 s
Delay time	?

(U) Design Details

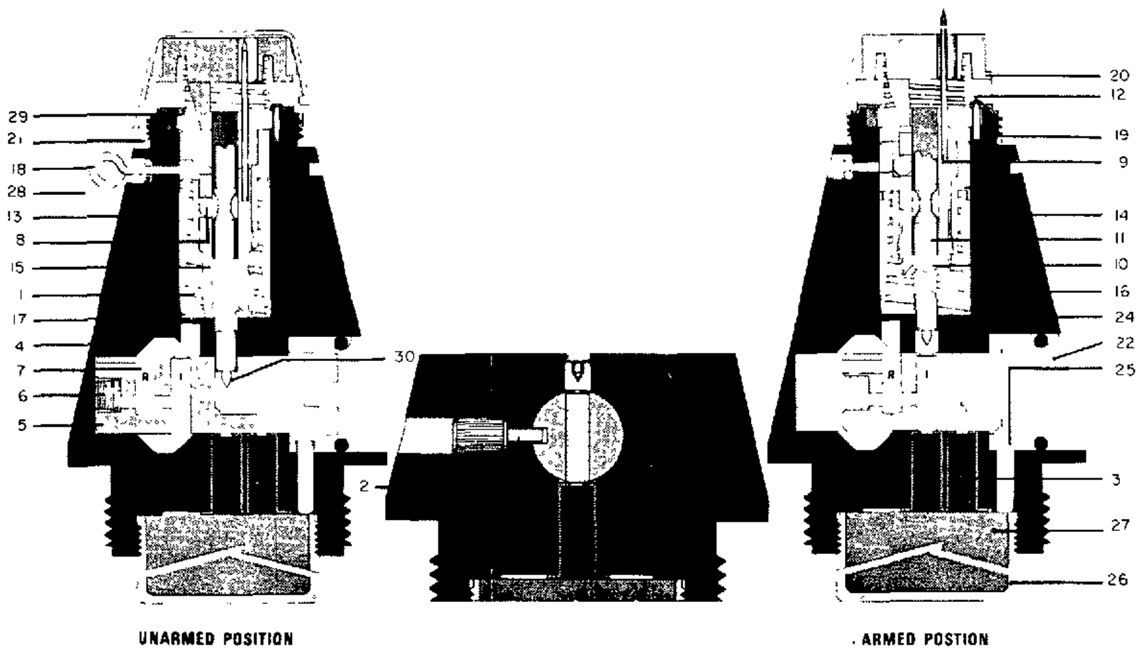

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Figure 2-95. Fuze, PD, Model D, section view (U).

The fuze (fig 2-95) consists of the firing-pin assembly, fuze body, and booster assemblage. The conical-shaped fuze body (17) is threaded internally to facilitate assembly of the booster assembly (26) and externally for securing the firing-pin assembly. The firing-pin assemblage consists of the striker head (20), coil spring (29), and a cylinder (15), housing the piston (11), silicone charge (10), and firing pin (30).

The hollow cylinder (15) and the piston (11) are recessed out to hold the detent ball (8). The hollow cylinder has a hole drilled longitudinally for positioning of a needle (9), which acts as visual and touch-type indicator when the fuze is armed. The striker head (20) is secured by a retainer nut (21), forming the nose portion of the fuze.

(U) Design Details (Continued)

The arming mechanism, housed in the fuze body, consists of the detent ball (8), weighted setback sleeve (14), setback spring (4), piston (11), cylinder (15), silicone charge (10), and firing pin (30), which detents the spring-loaded slider housing the instantaneous detonator and the delay detonator (7).

The slider assembly consists of a spring (6), slider block (5), and guide pin (2). There are two transverse openings in the fuze body (17) 90° apart; one is totally enclosed and is designed to facilitate the slider (6,5), and the other smaller one is provided with a guide pin (2) which abuts onto the slider. The slider (6,5) is sealed by the setting plug (22), with a ring washer to prevent moisture from entering.

The setting plug (22) is provided with a slot on the outside to facilitate fuze setting to either delay or instantaneous action. The end of the pin (2), which is pressure fitted inside the fuze body (17), juts out and fits into an axial groove in the side of the slider (6,5) allowing the slider to be guided properly when forced to move by its spring (6).

On the cylinder (15), a conical sleeve (1) is fitted. This has been cut longitudinally to permit slightly separated and projecting strips, which act as a clip. When the weighted setback sleeve (14) is forced rearward during firing, it latches onto the conical sleeve (1) and on set forward takes the cylinder (15) with it.

A silicone charge (10) is positioned inside the cylinder (15); above it a piston (11) is held in place by a washer (19) and retainer nut (21). The silicone, when compressed by action of the spring (4), is forced out of small holes in the base of the charge. This produces a time lag for trajectory safety before the slider is released for arming the fuze.

(U) Functioning (fig 2-95)

Prior to firing, the safety cap (28) and safety pin (18) are removed. Upon firing, setback forces the weighted setback sleeve (14) rearward, compressing the spring (4) until it is clipped onto the cylinder (15) by means of the strips of the sleeve (1), thereby releasing ball (8).

Upon dissipation of setback forces, the spring (4) expands, moving the cylinder (15) forward. Overcoming the resistance afforded by the silicone charge (10), the silicone is

(U) Functioning (Continued)

forced out through openings in the base of the charge holder. This permits a time delay for trajectory safety.

The cylinder continues to advance, moving the firing pin with it and undetenting the slider (6,5). The slider (6,5), by virtue of its spring (6), moves either the delay detonator (7) or the instantaneous detonator, depending on fuze setting, in line with the firing pin.

Upon impact, the striker head (20) compresses the spring (29), pushing the cylinder (15) rearward and causing the firing pin (30) to stab the detonator which flashes through one of the flash channels (3), depending on the fuze setting, initiating the booster (27) and in turn the main charge of the projectile.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
60- and 81-mm projectiles	60- and 81-mm mortars

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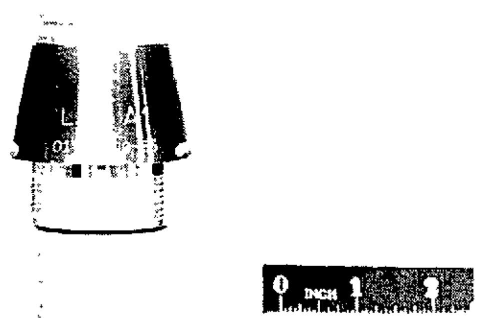
Fuze, PD, Model L35A1
FOM No. 1390-35-1-17



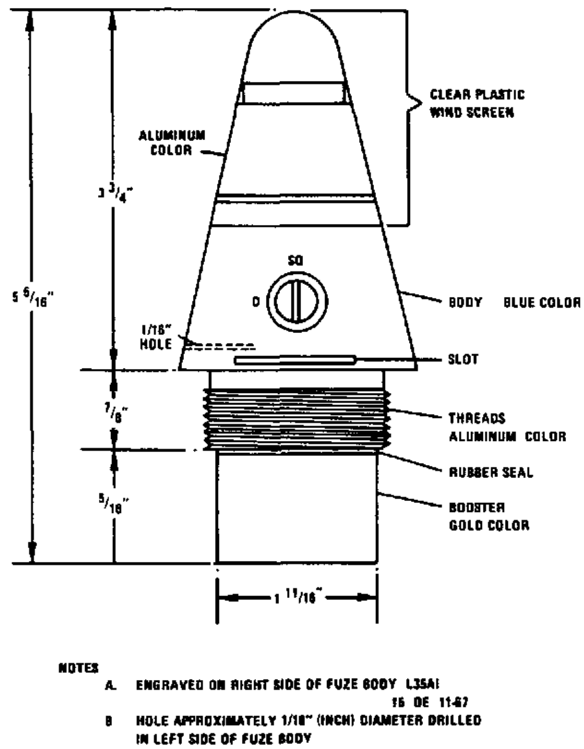


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Figure 2-96. Fuze, PD, Model L35A1, full and contour views (U).

(C) Description

The UK L35A1 PD fuze (fig 2-96) is a setback, delayed-arming type designed for either SQ or delayed action. It is intended for use with the UK L15A1 81-mm high explosive mortar projectile. The L35A1 is a copy of the Oerlikon RKVDIR-0264 PD fuze.

(C) Unique Features

- This fuze features a delayed-arming mechanism similar to that used in US SQ and delay fuzes. The runaway-type escapement, called a clutter escapement by the United Kingdom, provides trajectory safety.

Fuze, PD, Model L35A1
FOM No. 1390-35-1-17

(C) Unique Features (Continued)

- A unique detent system as well as a safety pin provides additional safety.

(C) Characteristics

Fuze assembly:

Head material	Aluminum
Body material	Cadmium-plated steel
Weight	575 g (1.27 lb)
Markings	L35A1
Total length	150 mm (5.91 in)
Visible length	86 mm (3.39 in)
Max diam	61 mm (2.40 in)
Explosive weight	34 g (0.075 lb)
Threat count	12 TP1

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Escapement-slider, locking bolt, detent balls, and safety pin
Arming distance	25 m
Arming time	0.9 s
Delay time	0.05 s

Sensitivity:

SQ action	Functions on 4-mm cardboard target.
Delay action	Less than SQ action

(C) Design Details

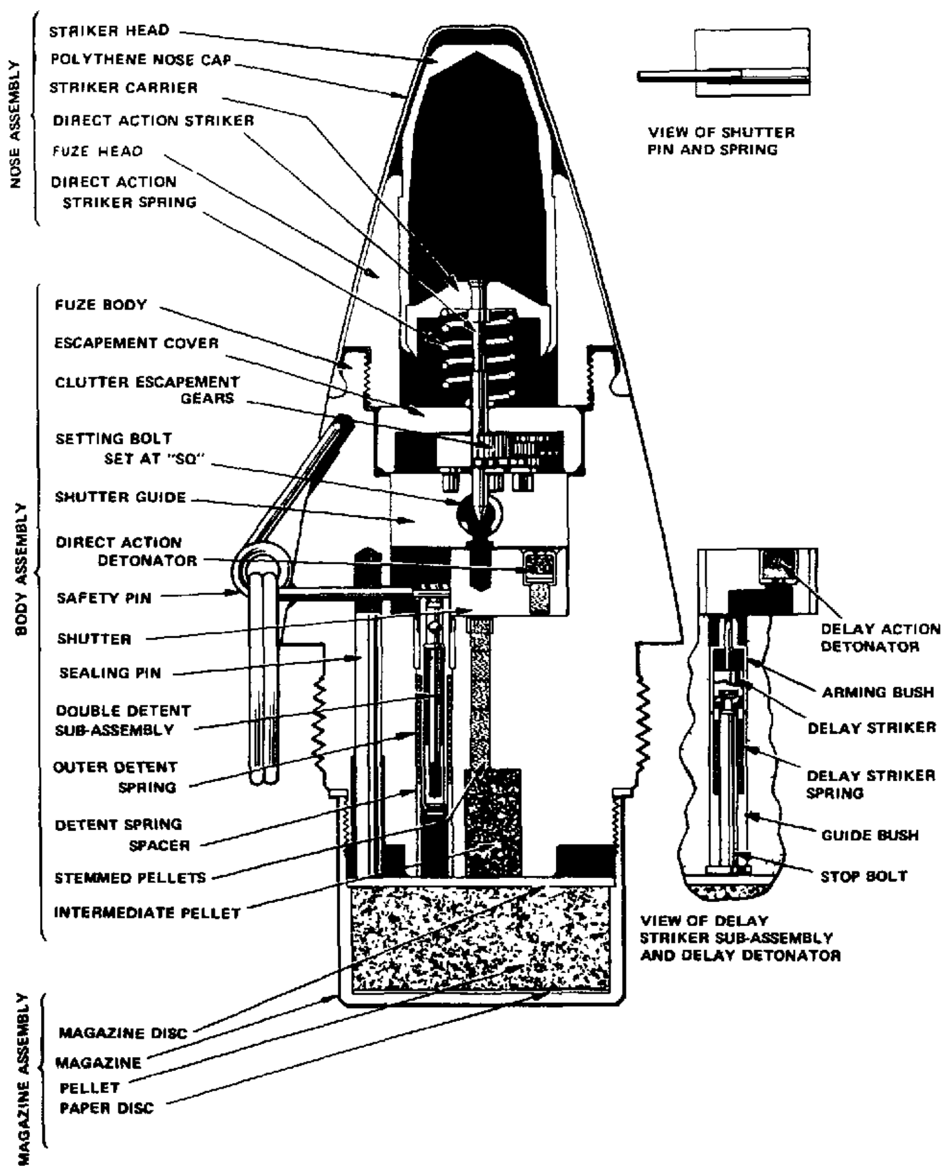

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Figure 2-97. Fuze, PD, Model L35A1, section view (U).

Fuze, PD, Model L35A1
FOM No. 1390-35-1-17

(C) Design Details (Continued)

The L35A1 fuze (fig 2-97) consists of a nose, body, and magazine (i.e., booster) assemblage. The body assembly forms the major portion of the fuze and contains the following:

- Clutter escapement consisting of brass gears on a steel shaft, balance wheel, and its aluminum cover.

- Friction-loaded setting bolt mechanism for controlling the function desired.

- Shutter (i.e., slider) guide assembly consisting of shutter, shutter pin, two primer-detonators, and spring.

- A detent system (i.e., inner and outer detent mechanism) and safety pin.

- Delay striker (i.e., firing pin) mechanism.

- CE stemming (i.e., tetryl relay charge).

The magazine (i.e., booster) assembly consists of a cylindrical aluminum casing, closed at one end and internally screw-threaded at the open end, an explosive pellet of CE (i.e., tetryl), and polythene and paper disks. Assembly of the magazine to the fuze body is effected by the magazine being screwed onto the lower portion of the fuze body to form the base of the fuze.

The nose assembly comprises an aluminum fuze head housing, the direct action striker (i.e., SQ firing pin) assembly. This is also made of aluminum except for the steel striker (i.e., firing pin) spring and a snap-on polythene (i.e., polyethylene) nose cap. The fuze head is externally screw threaded and is assembled by screwing into the forward end of the fuze body to form the leading portion of the fuze.

(C) Safety Arrangements

Before firing (safety pin in position):

- The safety pin locks the outer detent in the safe position.

- The shutter (i.e., slider) carrying the two primer-detonators is locked in a safe position by the double detent mechanism. With the shutter in this position, the accidental firing of a primer-detonator would not cause the fuze to function.

- Accidental depression of the striker head would cause the delay action striker to enter an empty recess in the shutter while the base of the shutter prevents any forward movement of the free elements in the delay striker mechanism.

After firing (safety pin removed):

- The clutter escapement controls the shutter movement and prevents it from reaching the armed position too quickly.

- The delay-action striker is held away from the primer-detonator by its spring until the spring is overcome by the force upon impact.

- In case of a premature deceleration of the fuze caused by striking overhead foliage or camouflage netting, the delay striker mechanism starts functioning; however, because of the shutter movement being controlled by the escapement mechanism, the free element of the delay striker mechanism on moving forward will enter a blind recess in the base of the shutter. This forward movement of the free element prevents further movement of the shutter, resulting in a dud.

(C) Functioning

The fuze is designed to operate with either SQ or delay functions. Before firing, the setting bolt is set to the required function, and the safety pin pulled out. The polythene nose cap remains in place.

(C) Operation of Fuze Set SQ—Safety Pin Removed

On firing, the inner detent immediately starts to setback. The outer detent is prevented from moving to the setback position by the locking balls. The setback movement of the inner detent continues and brings its tapered portion opposite the locking balls so that they have space to move inwards. As the action proceeds, the locking balls eventually clear the detent retaining sleeve, and the outer detent becomes free to setback. Eventually, both detents are in the setback position.

As flight deceleration commences, the inner detent, being of lighter mass, reasserts faster than the outer detent, and its taper pushes the locking balls outwards. When the outer detent starts to reassert, the locking balls butt against the rear shoulder of the detent retaining sleeve. The double detent mechanism is now held in the setback or armed position.

When the double detent mechanism moves to the setback position, it is clear of, and releases, the shutter. The shutter, under constant pressure from the shutter spring, starts to slide to the armed position. The rack on the shutter turns the drive shaft and operates the clutter escapement. The clutter escapement controls the speed of movement of the shutter, the shutter eventually arrives in the armed position, and the SQ detonator is directly in the line of travel of the striker point.

On nose impact, the SQ striker is driven onto the SQ detonator which ignites and initiates the pellet in the shutter. The explosive reaction of the pellet in the shutter is focused through a specially formed septum to give the maximum effect through the stemming closing cup onto the stemming in the fuze body. The stemming detonates the magazine pellet, and the fuze functioning is complete.

If, on impact, the desired SQ action does not operate (e.g., a graze hit on target), the delay function described in the following paragraph is still capable of initiating the explosive train at delay conditions.

(C) Operation of Fuze Set D—Safety Pin Removed

On firing, the double detent and shutter mechanisms operate as described in the previous paragraph.

(4)

(C) Operation of Fuze Set D—Safety Pin Removed (Continued)

On nose impact, the SQ striker is driven onto the setting bolt, either bending or breaking loose, and is prevented from striking the SQ detonator.

The sudden deceleration of the fuze at impact causes all the free components inside to move forwards. Thus the guide bush and the arming bush in the delay striker mechanism slide forward in unison. There is no gap between their adjacent surfaces. At this instant, the delay striker is locked in position by the stop bolt and stop-bolt balls. The stop-bolt balls are retained in the locking position by the guide bush.

When deceleration is almost complete, the guide bush is pushed backwards away from the arming bush by the delay striker spring. The gap now created allows the stop-bolt balls to move outwards consequent to pressure from the delay striker and against the taper on the stop bolt. Immediately the stop bolt balls clear the stop bolt the striker plunges forward under pressure from the delay striker spring and ignites the delay detonator.

The delay detonator causes the SQ detonator to function by the effect of the reaction through the thin walls separating the two detonators. The walls are compositely thin enough to act as a septum. A flash channel from the delay detonator to the SQ detonator is provided in the shutter guide as an additional means of assistance in take-over. The SQ detonator now continues the explosive reaction, and functioning of the explosive train is completed as described in the previous paragraph.

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectile, Model L15A1; 81-mm smoke (WP) projectile, Model L19A3	81-mm mortar, Model L16

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Fuze, PD, Model 944 Mk 1
FOM No. 1390-35-1-32

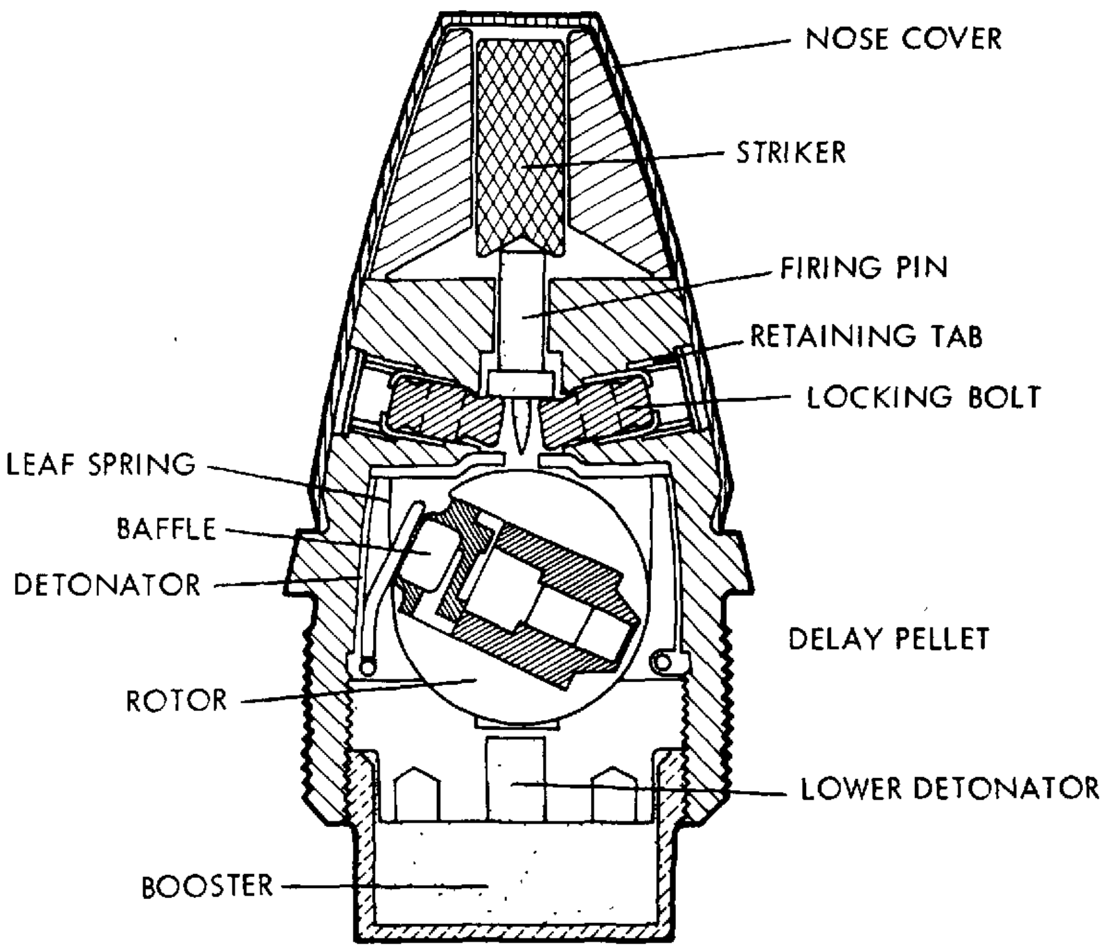

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Figure 2-98. Fuze, PD, Model 944 Mk 1 (U).

(U) **Description**

The No. 944 Mk 1 PD fuze (fig 2-98) is used with the 30x113-mm B Mk5 HE cartridge in the ADEN aircraft gun. Its uncomplicated design utilizes two locking bolts to secure the firing pin and a ball rotor containing an out-of-line detonator and a delay element. The fuze has no self-destruct feature.

Fuze, PD, Model 944 Mk 1
FOM No. 1390-35-1-32

(U) **Characteristics**

A sheet-metal nose cover is crimped to a groove in the fuze body. The steel fuze body contains a firing pin restrained in the unarmed position by two locking bolts, themselves retained in position by sheet-metal tabs. A ball rotor containing a detonator and a delay pellet is held out of line with the firing pin and booster by a leaf spring. A tetryl-filled booster cup closes the base of the fuze.

Fuze assembly:

Body material	Steel
Weight	?
Markings	944 Mk 1

Booster:

Body material	Aluminum alloy
Body length	?
Explosive	Tetryl
Explosive weight	2.1 g (32.3 gr)

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Safety bolts, out-of-line, rotor-mounted detonator
Arming distance	2 to 3 m
Arming time	3 to 4 ms
Self-destruct time	?
Delay distance after impact	230 to 760 mm

(U) **Functioning**

Upon firing, setback force acts on the striker, firing pin, and locking bolts to restrain the bolts from moving radially outward under the influence of centrifugal force. When setback ceases, centrifugal force causes the locking bolts to move outwards, forcing open the retaining tabs. When the bolts are completely withdrawn, the tabs spring into grooves in the locking bolts to prevent the latter from slipping back and impeding the firing pin. At this point the firing pin is free to move, but deceleration (creep) forces keep it in its forward position.

(U) **Functioning (Continued)**

Simultaneously with the above, setback forces acting on the leaf spring hold it against the rotor to keep the latter from moving. Centrifugal force increases until it overcomes the combined force of setback and spring tension, causing the free end of the spring to move outward and thus free the rotor. The spinning rotor now moves until the detonator and delay column are in line with firing pin and booster. The positioning of the rotor takes several milliseconds, which insures that the projectile has moved an estimated 2 to 3 meters from the barrel before the fuze becomes armed.

Upon impact, the fuze nose is crushed, and the firing pin initiates the detonator. The flash from the detonator passes a baffle and ignites a delay pellet. After a brief delay that enables the projectile to penetrate the target, the delay pellet initiates a lead-azide lower detonator that in turn initiates the booster and the high explosive projectile filler.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
HE cartridge, Model Mk 5	30x113-mm aircraft gun, ADEN

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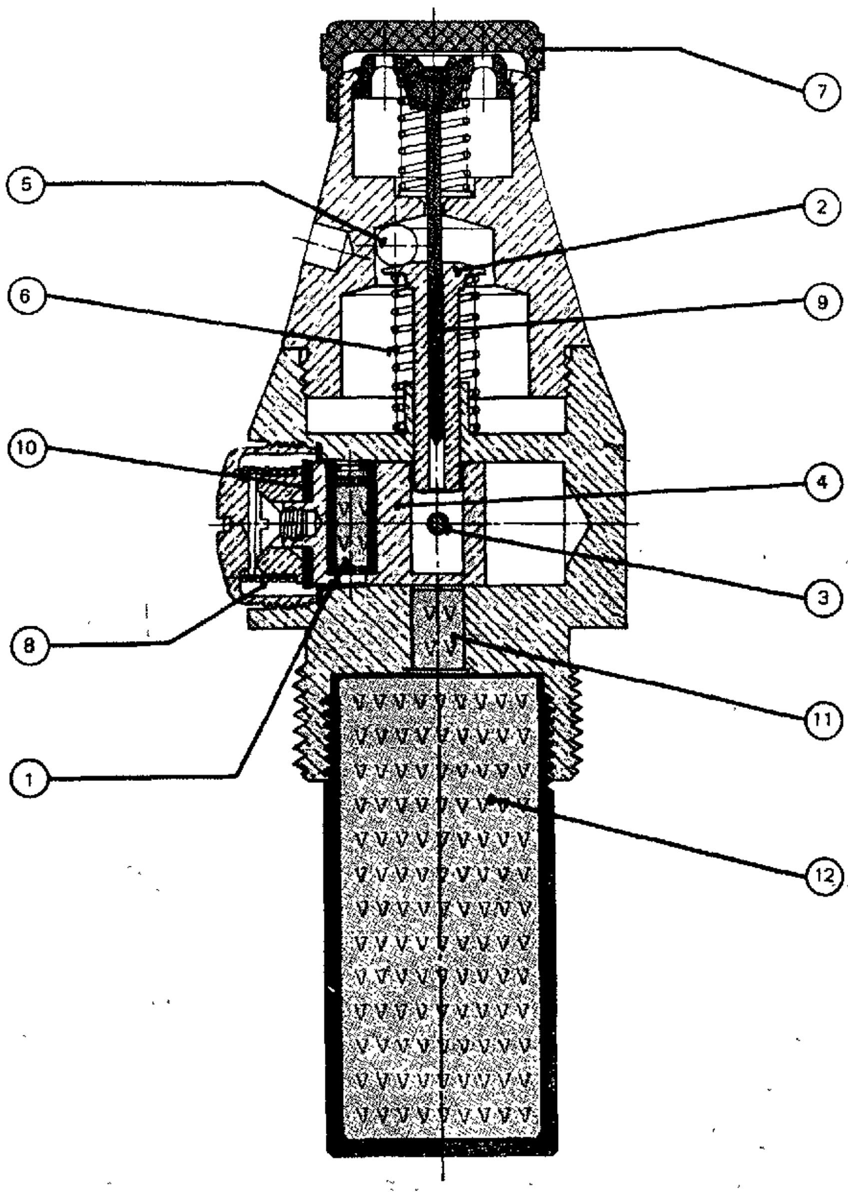

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Figure 2-99. Fuze, PD, Model M2, section view (U).

Fuze, PD, Model M2
FOM No. 1390-37-1-2

(U) **Description**

The M2 fuze (fig 2-99) is a setback-armed PD type developed by Soltam, Ltd., of Haifa, Israel. It is of rugged construction designed to provide rough handling, detonator safety, and trajectory safety. It is intended for use with 60-mm mortar projectiles.

(U) **Unique Features**

The M2 features a spring-loaded slider held in the out-of-line position by a sleeve and detent ball. Other safety features include a safety cap and pin.

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	?
Markings	?

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Safety pin and cap, detent sleeve and ball
Arming distance	?
Arming time	?

(U) **Functioning (fig 2-99)**

The fuze is unable to function as long as the detonator (1) is not aligned with the firing pin (9). The spring-loaded slider (8,4) is detented by the setback sleeve (2) and its spring (6) as well as the check ball (5). The safety pin (3) provides additional safety to assure the slider will not move.

(U) **Functioning (Continued)**

Just before firing, safety pin (3) and cap (7) are removed. Upon firing, setback sleeve (2) compresses spring (6), releasing ball (5) which falls in a cavity in the fuzes's nose portion. As setback forces dissipate, the spring (6) expands, pushing sleeve (2) forward undetenting the spring-loaded slider (8,4) which moves the detonator (1) in line with the firing pin (9). The movement is retarded by a friction disk (10), providing enough time for the projectile to travel a safer distance from the weapon and crew.

Upon impact, the firing pin stabs the detonator, igniting the lead charge (11) and booster (12) and resulting in detonation of the high explosive filler of the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
60-mm HE projectiles	60-mm mortars

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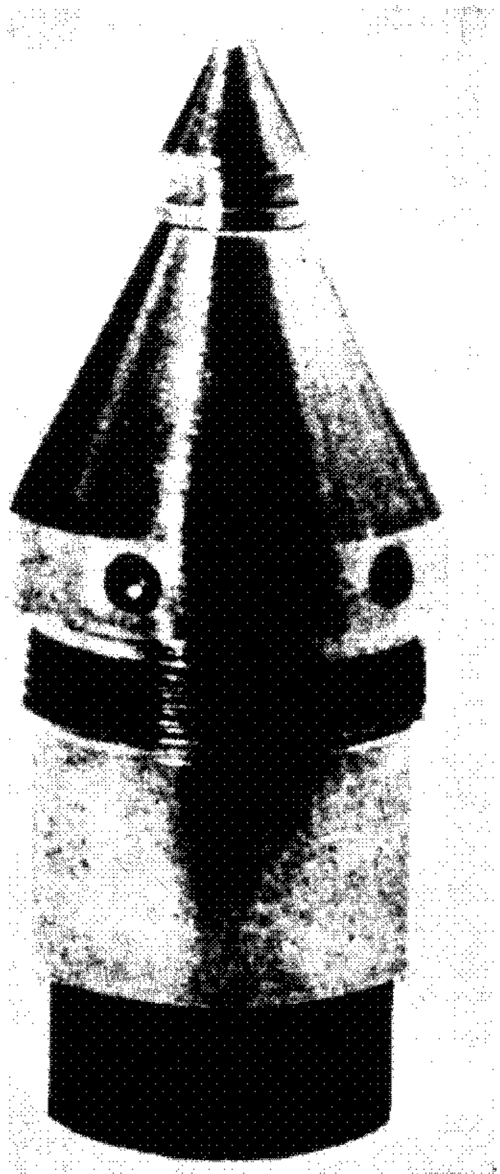

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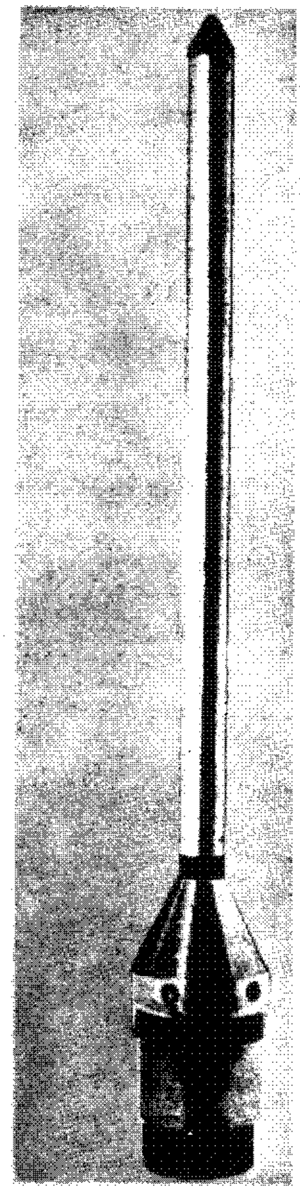

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Figure 2-100. Fuze, PD, Model M150, full view (U).

Fuze, PD, Model M150
FOM No. 1390-37-1-3

(U) Description

The M150 (fig 2-100) is a setback, delayed-arming PD fuze having a multimode functioning capability. The M150 was developed by Rafael of Haifa, Israel, for increasing the effectiveness of their 120-mm mortar projectiles. Multimode functioning is provided by a dual-configuration design. In the above target mode, the fuze functions superquick, whereas in the penetration target mode the fuze penetrates prior to functioning. In addition, the fuze has a self-destruct and grazing capability.

(U) **Unique Features**

- Employs automatic safety wire.
- Employs delay arming of 0.5 to 2 seconds.
- Employs velocity amplifier rod for proximity functioning.
- Employs fuze plug for penetration prior to functioning.
- Employs detonator safety device.

(U) **Characteristics**

Fuze assembly:

Body material	Steel
Weight w/o rod	1.330 kg (2.93 lb)
Weight w/rod	1.450 kg (3.20 lb)
Length w/rod	516 mm (20.3 in)
Length w/o rod	167.5 mm (6.59 in)

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Extension rod:

Length	425.5 mm (16.8 in)
Weight	0.180 kg (0.4 lb)

(U) **Characteristics (Continued)**

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	2 s
Self-destruct time	?
Delay time	?

(U) **Design Details**

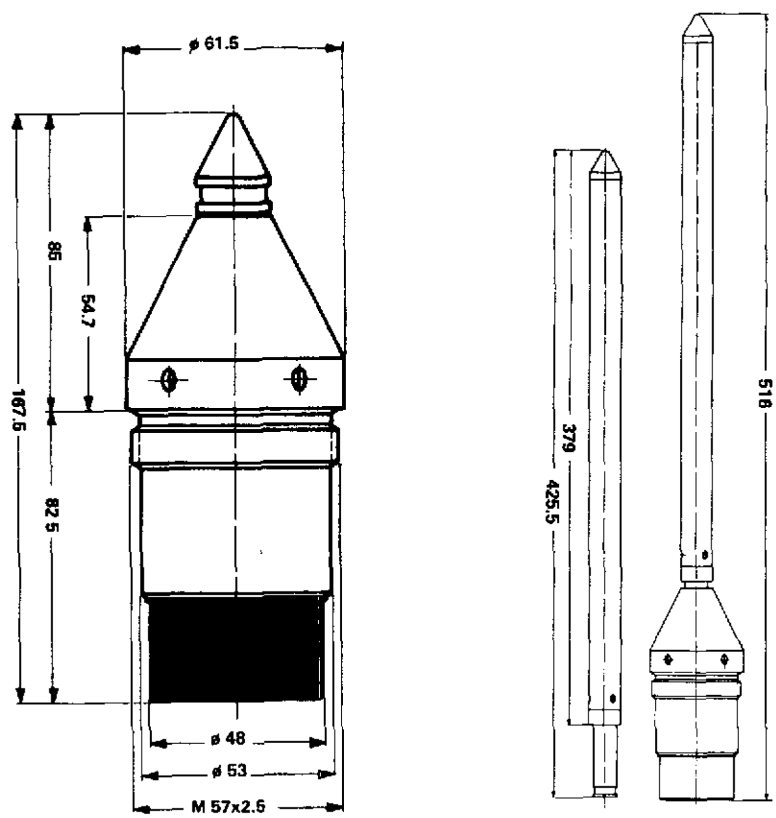

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Figure 2-101. Fuze, PD, Model M150, contour view (U).

*Automatic safety-wire, dual delay arming device, detonator safety device, self-destruct element.

Fuze, PD, Model M150
FOM No. 1390-37-1-3

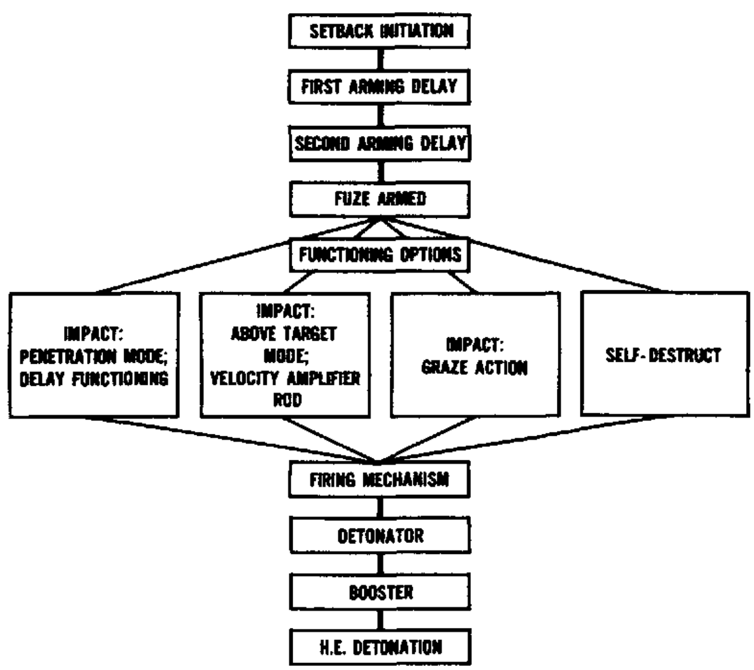
(U) Design Details (Continued)

Design details are not known on the M150. Conversion from the target penetration mode is accomplished by removal of the fuze plug and insertion of the velocity amplifier rod (see fig 2-101). Bore safety is provided by a safety wire called an integrator element by Israel. Muzzle safety is provided by a delay arming mechanism reportedly consisting of a detent system on the detonator (most likely contained in a slider). The detent system reportedly consists of the two tin brakes controlled via a piston-cylinder arrangement. The first brake is released after a 0.5-second delay, and the second brake is released after a 2-second delay.

The dual-configuration design consists of a velocity amplifier rod, fuze plug, thick wall nose fuze portion, fuze body housing, arming mechanism, detonator, self-destruct device, detonator safety device, detonator lead, and booster assembly.

(U) Functioning

The functioning sequence is delineated in the following block diagram:



(UNCLASSIFIED)

Figure 2-102. Fuze, PD, Model M150, block diagram, functioning sequence (U).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
120-mm HE projectiles	120-mm mortar

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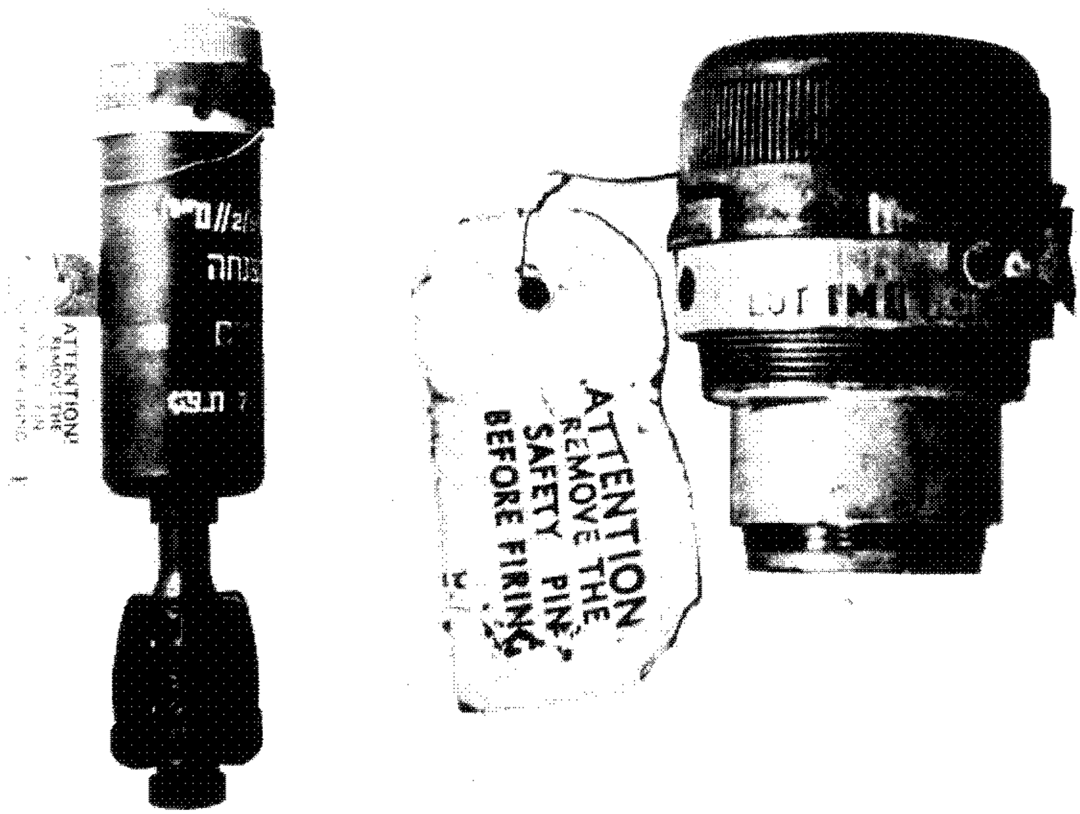
Fuze, PD, Model ?
FOM No. 1390-37-1-5



Neg. 516415 (UNCLASSIFIED)

Figure 2-103. Fuze, PD, Model ?, full view with 52-mm projectile (U).

(C) Description

The Israeli PD fuze (fig 2-103) was produced by Israeli Military Industries (IMI) for use with 52-mm high-explosive mortar projectiles. It is a setback-armed type designed to function upon impact. Safety features include a safety cap and pin which allows the ammunition to be air-droppable.

(C) Unique Features

The IMI fuze employs a spring-loaded, pivotable-type rotor keeping detonator in the out-of-line position for bore safety.

Fuze, PD, Model ?
FOM No. 1390-37-1-5

(C) Characteristics

Fuze assembly:	
Body material	Zinc alloy
Weight	416 g (0.92 lb)
Markings	LOT IMI 1-1/68
Body length	1.99 in (50.5 mm)
Max diam	2.08 in (52.8 mm)
Thread diam	1.76 in (44.7 mm)
TPI	20 (LH)
Booster:	
Body material	Zinc alloy
Length	0.38 in (9.7 mm)
Thread diam	1.30 in (33.0 mm)
TPI	24
Explosive weight	6.7 g (0.015 lb)
Explosive type	?
Detonator:	
Type	STAB
Length	0.18 in (4.6 mm)
Diam	0.30 in (7.6 mm)
Weight	0.96 g (14.8 gr)
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	Safety cap and pin, out-of-line detonator
Arming distance	?
Arming time	?

(C) **Design Details** (fig 2-104)

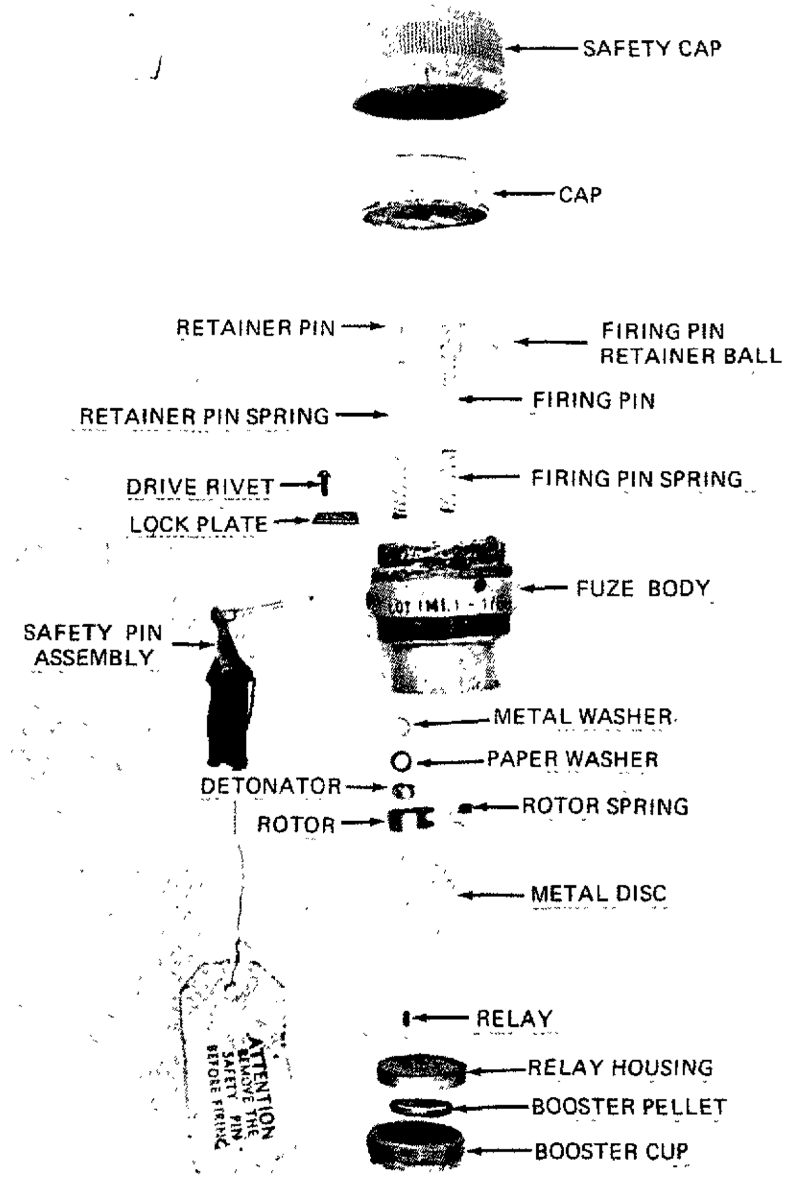


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Figure 2-104. Fuze, PD, Model ?, exploded view (U).

Fuze, PD, Model ?
FOM No. 1390-37-1-5

(C) **Design Details (Continued)**

The firing-pin spring and firing pin are positioned in the center hole of the fuze body, with the cutout portion of the firing pin in position to receive the firing-pin retainer ball. The ball is then dropped into an adjoining hole, permitting the ball to roll into the firing-pin cutout. With the ball in position, the retainer-pin spring and retainer pin are placed into the fuze body. The lock plate is then turned on the drive rivet, securing the retainer pin within the fuze body. The cap is then crimped to the fuze body to prevent contaminants from entering. Prior to crimping, the shoulder of the fuze body is waterproofed with a red sealant. The safety cap is next screwed onto the fuze body and the safety pin inserted to prevent premature movement of the firing pin.

The detonator with paper and steel washers is placed in the rotor. The rotor spring is then positioned outside the rotor so that upon insertion into base opening of the fuze body, the rotor is under spring-tension against the firing pin. A metal disk and delay housing with relay are next positioned into the fuze body. The booster cup with booster pellet is then screwed into the fuze body, completing the assembly of the fuze.

(C) **Functioning** (fig 2-105)

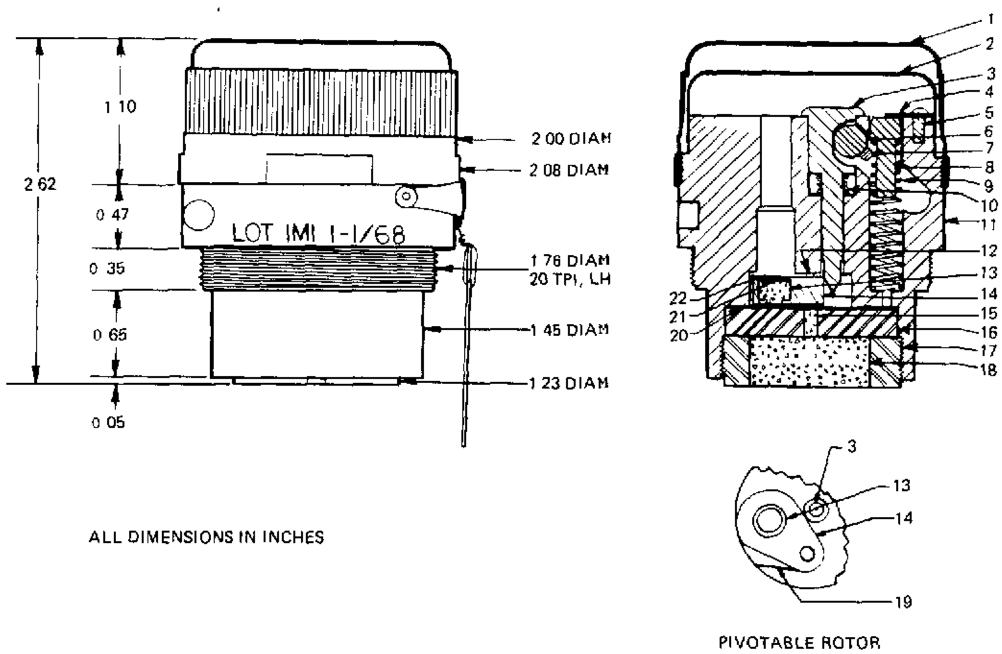

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Figure 2-105. Fuze, PD, Model ?, contour and section views (U).

(C) **Functioning (Continued)**

Prior to firing, the safety pin (7) and safety cap (1) are removed. Upon firing, setback forces compress the firing-pin spring (10) and the retainer spring (9), forcing the firing pin (3) and the retainer pin (8) rearward and releasing the retainer ball (6) which falls into a void of another channel.

As setback forces dissipate, the firing-pin spring and retainer spring expand, moving the firing pin (3) and retainer pin (8) forward. The retainer pin now blocks the opening where the retainer ball went, undetenting the firing pin which had moved forward simultaneously and releasing the spring-loaded rotor (14) which now pivots on its pin (12), aligning the detonator with the firing pin (3). The fuze is now armed.

Upon impact with the target, the cap (2) is crushed, causing the firing pin (3) to stab the detonator (13), which initiates the relay (15), which in turn initiates the booster pellet (18) and results in detonation of the high explosive charge in the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
52-mm HE projectiles; 52-mm smoke (WP) projectiles	52-mm mortar

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Fuze, PDSD, Type ?
FOM No. 1390-37-1-9

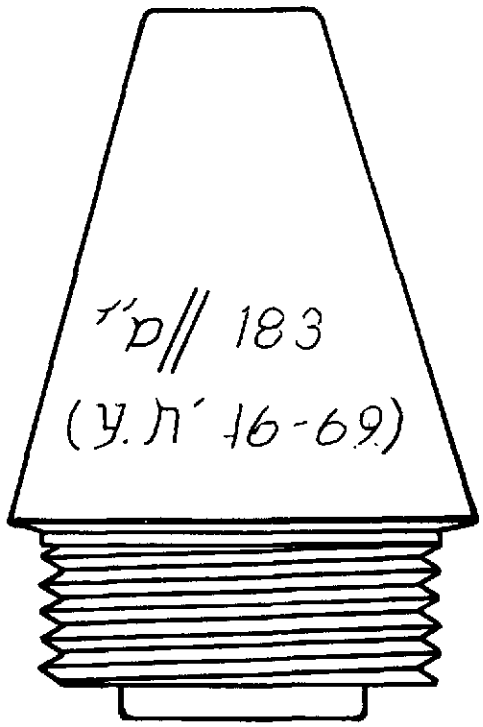

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Figure 2-106. Fuze, PDSD, Type ?, full view (U).

(U) Description

This is a conventional PD fuze (fig 2-106) with a mechanical self-destruct feature activated by projectile spin decay. The out-of-line detonator is mounted in a ball rotor. The fuze is used with the 30x113-mm B HE-I cartridge, Type 6532, which is designed for air-to-air use in DEFA, Type 552, aircraft guns. The fuze is a copy of the Oerlikon PDSD fuze, Type KZD-0250, which was developed prior to 1962. The fuze body bears stenciled markings of the type shown. The upper line indicates manufacture in Israel, while the lower line shows lot and year data.

Fuze, PDSD, Type ?
FOM No. 1390-37-1-9

(U) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	32.4 g (0.071 lb)
Markings	See fig 2-106

Booster:

Body material	(Cup) aluminum
Body length	7.6-mm (0.30 in)
Explosive	?
Explosive weight	1.4 g (21.6 gr)

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Out-of-line detonator in ball rotor
Arming distance	3 m (est)
Arming time	?
Self-destruct time	5-13 s (est)
Delay time	?

The fuze consists of an aluminum body that contains a self-destruct mechanism, a firing pin, a ball rotor carrying an out-of-line detonator, and a booster. In storage and shipment, the fuze is kept safe by the out-of-line position of the detonator in the rotor. Rotor position is maintained by pressure from the self-destruct spring and shock element, acting through the firing-pin bushing.

(U) Functioning

Upon firing, the shock element is crushed by setback. When setback ceases, centrifugal force causes the arming balls to move outward and forward against the conical surface of the self-destruct housing. This action moves the firing-pin bushing forward, further compressing and restraining the self-destruct spring and releasing pressure on the rotor. Centrifugal force causes the unbalanced rotor, now free, to rotate until the detonator is aligned with the firing pin. Upon impact, the firing pin is driven into the detonator, which initiates detonation of the booster. If impact does not occur, projectile spin will decay and centrifugal force decrease until the compressed self-destruct spring overcomes the spin force on the arming balls and drives the firing pin into the detonator.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
30x113-mm B HEI projectile, Type 6532	30-mm aircraft gun, DEFA, Type 552

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Fuze, PD, Model V18I.R.
FOM No. 1390-37-2-2

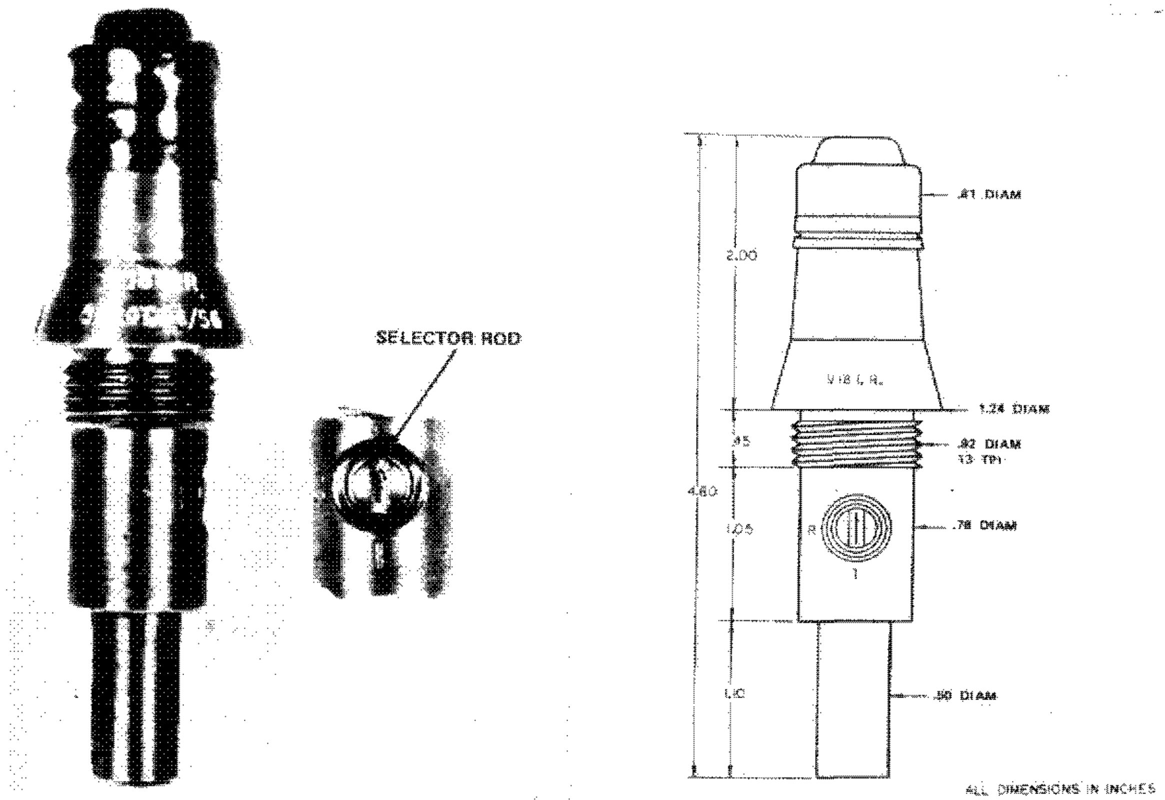

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Figure 2-107. Fuze, PD, Model V18I.R., full and contour views (U).

(C) Description

The V18I.R. PD fuze (fig 2-107) is a setback-armed type designed for either instantaneous or delay action functioning upon impact. It was produced by Israeli Military Industries for use with Israeli shoulder-fired 82-mm high explosive rockets. It is similar in design to the French V-18-I except that the French fuze does not contain a delay-functioning feature. This fuze is not considered bore safe.

Fuze, PD, Model V18I.R.
FOM No. 1390-37-2-2

(C) **Characteristics**

Fuze assembly:

Body material	Brass
Weight	220 g (0.49 lb)
Markings	V18I.R.
Thread diam	23 mm (0.91 in)
TPI	13
Length overall	117 mm (4.61 in)
Max diam	3.15 mm (0.12 in)

Detonator cup:

Material	Copper
Length	23 mm (0.91 in)
Diam	10.8 mm (0.43 in)
Weight	2.2 g (34.0 gr)

Booster cup:

Material	Copper
Length	14 mm (0.55 in)
Diam	10.8 mm (0.43 in)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Detent balls (3)
Arming distance	*
Arming time	?
Delay time	?

[1] Varies, depending upon angle of fall.

(C) Design Details

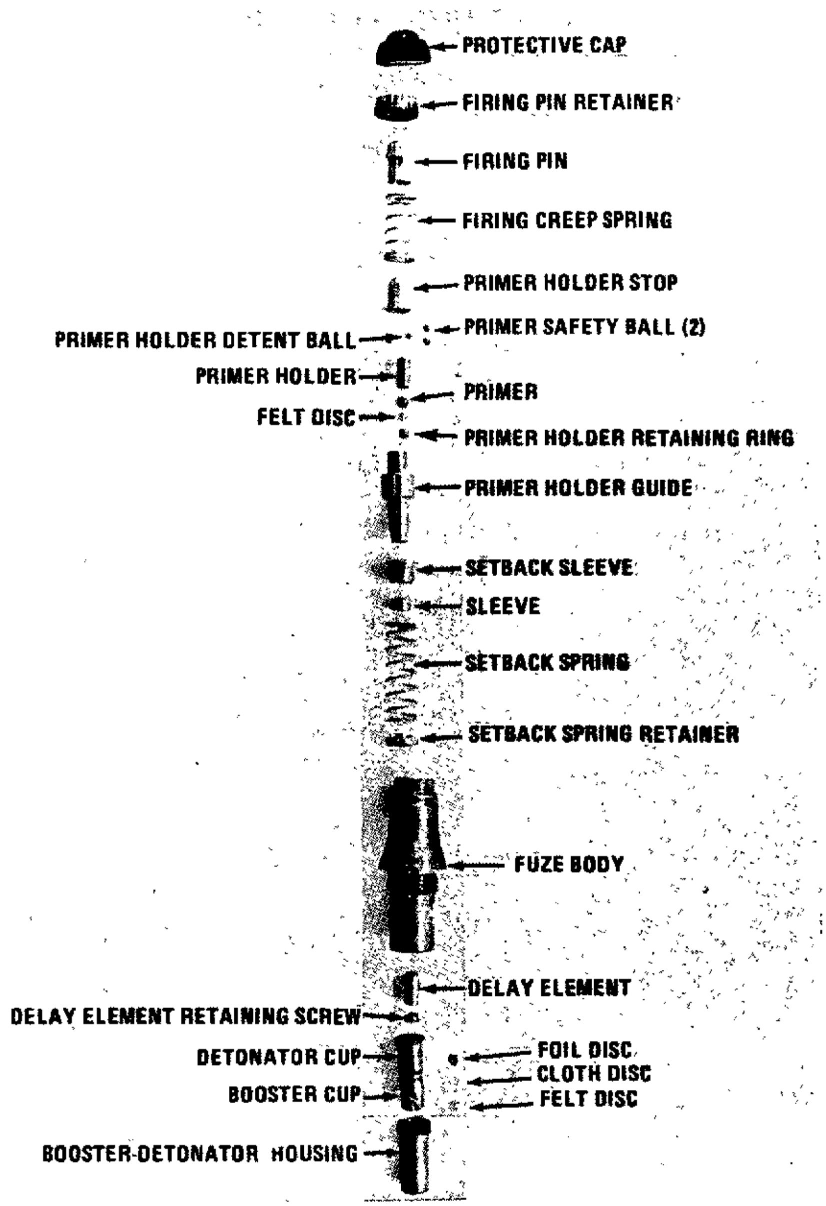

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Figure 2-108. Fuze, PD, Model V18I.R., exploded view (U).

Fuze, PD, Model V18I.R.
FOM No. 1390-37-2-2

(C) Design Details (Continued)

The fuze consists of a one-piece brass fuze body and a detonator-booster housing. The brass fuze body, which is sealed at the nose by a protective cap and at the rearward end by the detonator-booster housing, includes the components illustrated in figure 2-108.

(C) Functioning (fig 2-109)

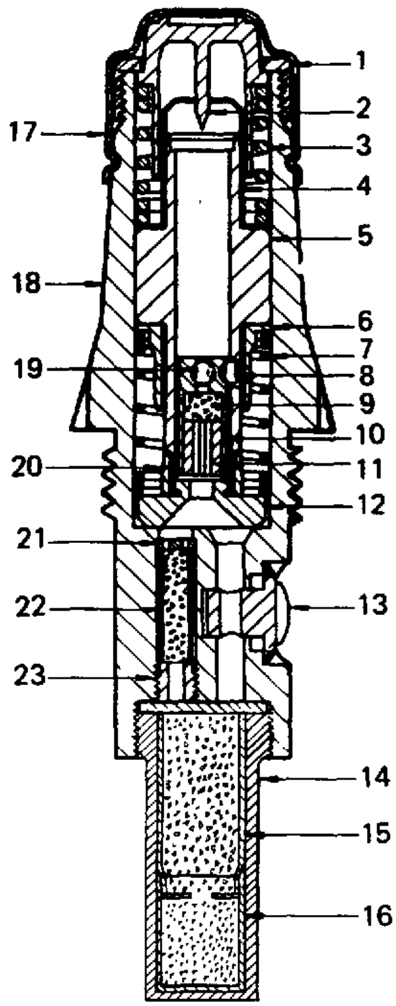

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Figure 2-109. Fuze, PD, Model V18I.R., section view (U).

(C) **Functioning (Continued)**

Prior to firing, the fuze selector rod (13) is set with the indicator arrow to I or R, depending on whether instantaneous or delay action is desired.

Upon firing, setback forces moves the setback sleeve (6) rearward, compressing its spring (7) until it is locked in the tapered retainer (20). The primer holder detent ball (8) is released. During deceleration, the setback sleeve remains locked to the tapered retainer. As the angle of fall of the projectile increases, the primer-holder (10) moves forward while the detent ball (8) falls into the void area of the primer-holder guide (5). Travel of the primer holder (10) is stopped by the primer-holder stop (4).

Simultaneously the two primer safety balls (19) are pushed into a recess in the front end of the primer holder guide (5) by the tip of the firing pin (2). The fuze is now armed.

Upon impact, the two primer safety balls (19) lock the primer holder (10) in the forward position so that the firing pin (2), moving rearward against its spring (3), can produce a full blow on the primer (9).

If set on instantaneous, the primer flash initiates the detonator (15) and booster (16) located in the detonator-booster housing (14). At low angles of fall, the primer holder (10) is carried forward upon impact by inertia forces and impales on the firing pin, thereby initiating the primer (9) and in turn the detonator and booster.

If a delay action is used, the direct passage from the primer to the detonator is closed and upon impact the primer flash would initiate the delay element (22) which, upon completion of burning, would ignite the detonator, setting off the booster.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
82-mm HE rocket	82-mm rocket launcher

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Fuze, PD, Model M.K.E. 101
FOM No. 1390-39-1-1

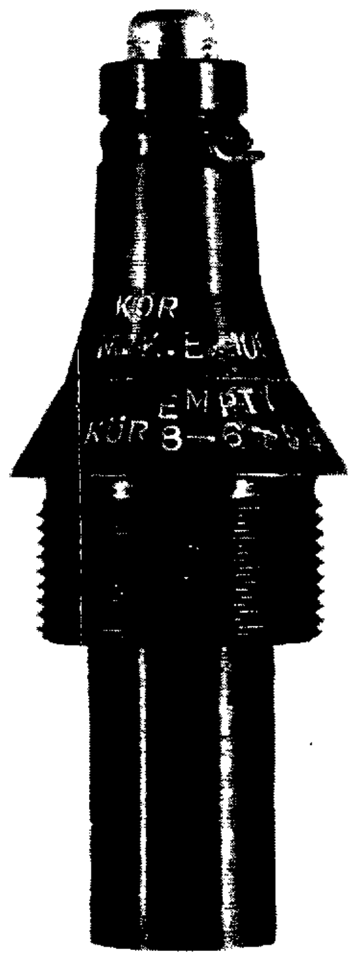

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Figure 2-110. Fuze, PD, M.K.E. 101, full view (U).

(U) **Description**

The Turkish M.K.E. 101 PD fuze (fig 2-110) is a setback-armed type designed for SQ or delay functioning upon impact. It is similar in functioning to the French V-18-IR fuze (FOM No. 1390-17-1-2). The fuze is not considered detonator safe by US standards. The fuze is assembled in an adapter having a 2-inch thread size to meet NATO standards.

Fuze, PD, Model M.K.E. 101
FOM No. 1390-39-1-1

(U) Characteristics

Fuze assembly:

Body material	Brass
Weight w/o explosive	1.60 lb (725.7 g)
Markings	M.K.E. 101
Length	5.05 in (128.3 mm)
Max diam	31.5 mm (1.24 in)
Maj thread diam	23.4 mm (0.92 in)
TPI	16
Thread pitch	1.5 mm (0.06 in)

Booster:

Body material	Brass
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback*
Firing method	Impact
Safety devices	**
Arming distance	17 m
Arming time	0.7 s (est)
Delay time	0.08 s

*Arming based upon calculated setback of 60 g's.
**Safety wire and detent balls.

(U) **Design Details** (fig 2-111)

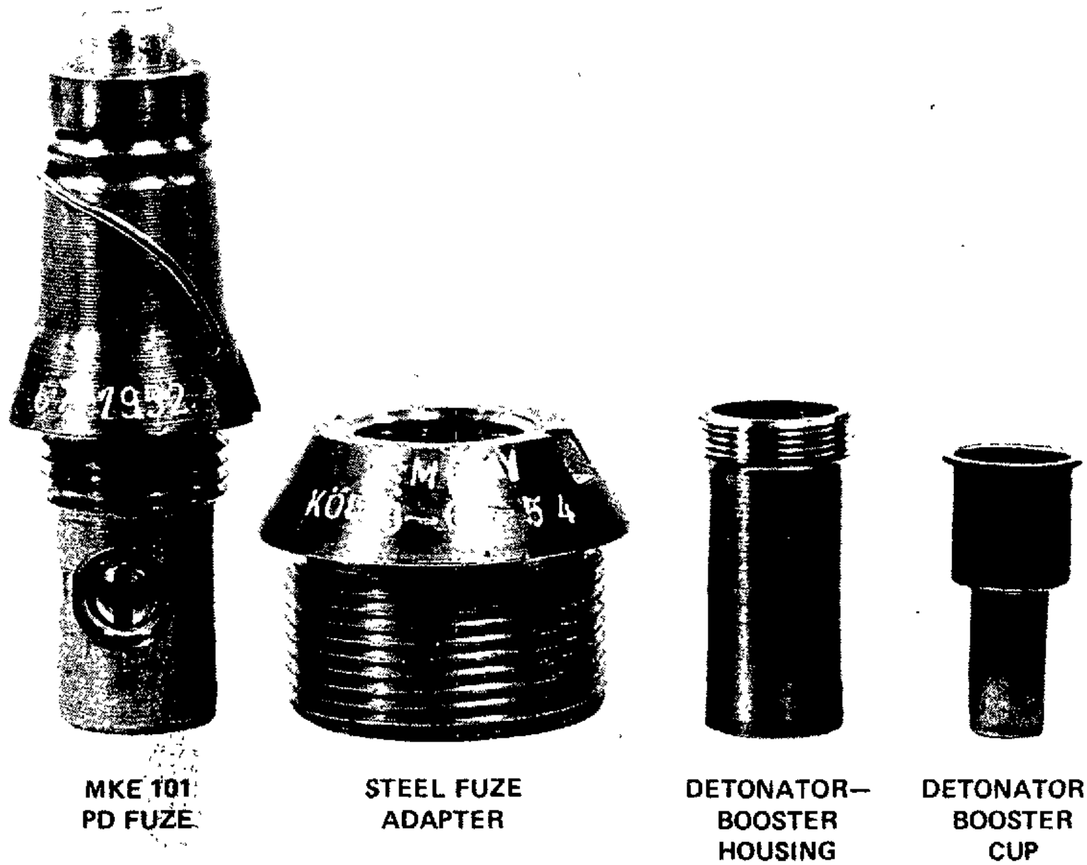

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Figure 2-111. Fuze, PD, Model M.K.E. 101, exploded view (U).

The M.K.E. 101 fuze consists of a brass PD fuze, a steel fuze adapter, and a detonator-booster assembly.

The PD fuze is a bored-out brass body designed to house the plunger-type firing-pin assembly, an inertial assembly, a primer housing, the detent system, a selector screw with flash channels for either delay or SQ action, and a delay-charge assembly. The fuze body is sealed at the forward end by a striker head retaining nut and is threaded internally at the rear to facilitate assembly of the detonator-booster.

Fuze, PD, Model M.K.E. 101
FOM No. 1390-39-1-1

(U) **Design Details (Continued)**

The fuze is also threaded externally for screwing into a steel fuze adapter to facilitate assembly to projectiles having 2-inch thread diameters.

(U) **Functioning** (fig 2-112)

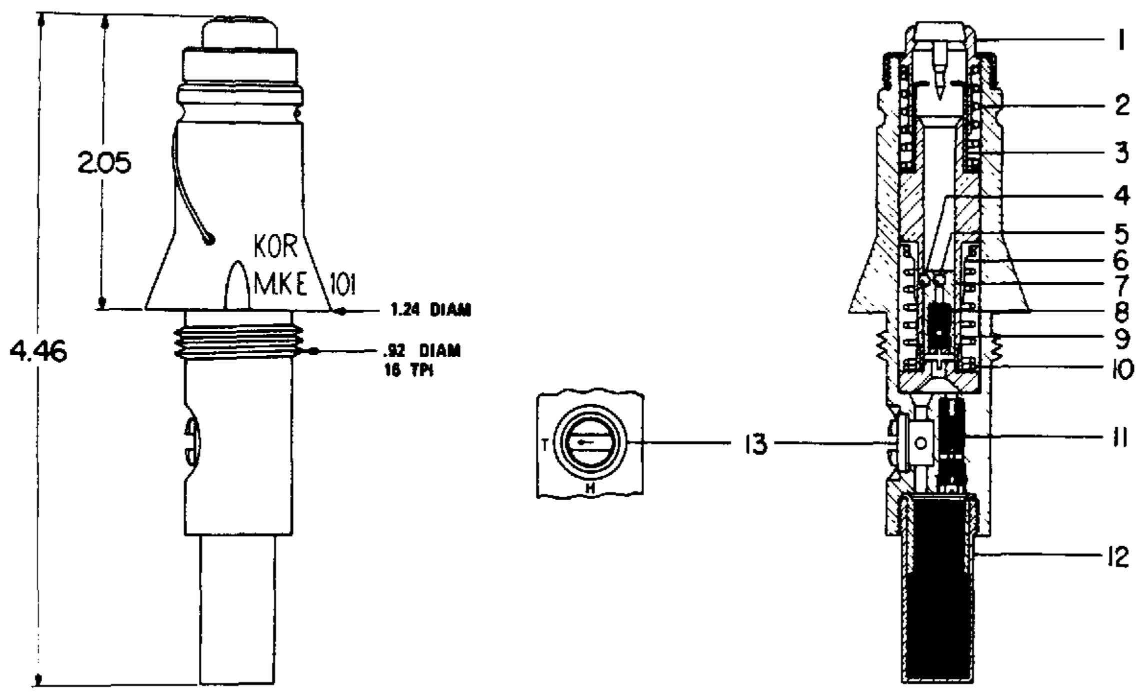

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Figure 2-112. Fuze, PD, Model M.K.E. 101, contour and section views (U).

Prior to firing, the type of action desired must be selected before assembling into the projectile. The arrow stamped at the bottom of the slot in the selector (13) is set at "H" for SQ action, "T" for delayed action. The safety wire must also be removed before firing.

(U) Functioning (Continued)

Upon firing, setback forces cause the safety collar or setback sleeve (6) to move rearward against the setback spring (10). The setback sleeve becomes wedged on the tapered surface at the rear end of the inertial-element assembly (9). The primer locking ball (4) is thus released so that it can move outward and free the primer-holder assembly (7). In flight, the primer-holder assembly can then move forward under the influence of creep forces until its forward end contacts the firing-pin spring guide (3). Movement of the inertial element is restrained by firing-pin spring (2).

At impact, the firing pin and striker assembly (1) is pushed rearward against its spring, while the inertial-element assembly moves forward. The unrestrained primer-holder assembly moves forward relatively more rapidly than the inertial element and its associated components. As the firing pin enters the primer body cavity, the two primer detent balls (5) are pushed outward to protrude into the cavity between the forward lip of the inertial element, the firing-pin spring guide, and the firing pin. This locks the primer assembly to the forward moving inertial element. The momentum of the entire inertial assembly, rather than just that of the primer assembly, impales the primer (8) on the firing-pin point to initiate the primer.

When the selector is set for delay action, the primer flash ignites the charge in the delay-holder assembly (11). This, in turn, sets off the detonator booster (12).

On an SQ setting, the primer flash passes through the open flash hole to initiate the detonator-booster directly. If for some reason the detonator-booster is not set off in this manner, it may still be initiated through the delay element which is also ignited by the same primer flash.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
81-mm HE projectiles	81-mm mortar

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Section III.

POINT INITIATING, BASE DETONATING FUZES

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Section III.

POINT INITIATING, BASE DETÓNATING FUZES

GENERAL

(U) Point initiating, base detonating (PIBD) fuzes have been designed or are under development for high-explosive antitank (HEAT) munitions fired from tank guns, grenade launchers, recoilless antitank weapons, aircraft rocket launchers, small arms (20 through 30 mm), and for antitank guided missiles (ATGMs). This type of fuze functions on mechanical or piezoelectric principles by contact with the target, and with initiation at the nose end and detonation at the base of the projectile or warhead. This type of fuze normally requires a very complex design, especially in an ATGM which normally incorporates redundancy in design.

(U) Most of the fuze developments included in this handbook have been designed for quicker reaction time through the use of the piezoelectric principles; however, some of the older spitback-type fuzes have been included. Most fuzes require setback or centrifugal force environmental stimulus for arming. Delay arming is accomplished by a pyrotechnic and/or mechanical timer. In some cases, electrical impulses generated at launch for rockets or ATGMs are used to initiate the arming process with dual electric igniters for greater reliability. With the exception of the spitback fuze types, the fuze designs presented in this handbook reflect the current state-of-the-art and in some cases include unique features. The fuzes described in this section are designed for either high- or low-"g" accelerations and for fin- or spin-stabilized projectiles or warheads.

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*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

Fuze, PIBD, 30 mm, Model ? (Rheinmetall)
FOM No. 1390-16-1-44

(U) Description

This is a PIBD fuze for the 30x170-mm flat-cone shaped-charge projectile developed by Rheinmetall, GmbH, Diesseldorf, Germany. The fuze incorporates a piezoelectric element that transmits current to an electric detonator in the projectile base.

(U) Characteristics

Fuze assembly:	
Body material	?
Weight	?
Markings	?
Booster:	
Body material	?
Body length	?
Explosive	?
Explosive weight	?
Functional data:	
Arming method	Spin
Firing method	Impact, setback
Safety devices	Out-of-line detonator
Arming distance	?
Arming time	?
Self-destruct time	?
Delay time	?

(U) **Design Details**

The fuze is composed of a piezocrystal impact element in the projectile nose, placed at an optimum standoff distance from the flat-cone shaped charge in the projectile body. The current created by the piezocrystal upon impact with a target travels along an insulated electrical conductor to a BD element in the projectile base. The base fuze contains an out-of-line electric detonator in a ball rotor, and S&A mechanisms to insure safety in handling and bore safety.

Fuze, PIBD, 30 mm, Model ? (Rheinmetall)
FOM No. 1390-16-1-44

(U) Design Details (Continued)

Details of this fuze and projectile are proprietary information of Rheinmetall, GmbH, and the General Electric Company of Burlington, VT, the US licensee.

(U) Functioning

Arming is accomplished by a combination of setback and spin acting on the base elements of the fuze. The fuze is armed when the rotor is aligned with the projectile axis after it has cleared the gun muzzle. Upon impact, current generated from the piezocrystal initiates the electric detonator, resulting in detonation of the projectile's shaped charge.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
30x170-mm HEAT projectile	30-mm AA gun

Fuze, PIBD, for Cobra ATGM
FOM No. 1390-16-8-1

(C) Description

The German Cobra ATGM has a PIBD fuze. The fuze impact bolt is supported by a plate held in place by a plastic hood. When the fuze hits a hard target with sufficient forward velocity, the impact bolt is driven rearward, piercing the support plate and penetrating the fuze capsule. If the impact bolt is slowly pressed into the fuze housing, it will not penetrate the support plate, but will push it rearward along with the fuze capsule carrier and related mechanism. When the pressure on the impact bolt is released, a compressed spring will move the fuze capsule carrier and impact bolt back into their initial positions. If the slow-moving force on the impact bolt increases to the point where the fuze body is actually deformed, the support plate will break in a designated place, and the fuze capsule carrier will fall inside the warhead casing, making the warhead inoperative. The base fuze mechanism or safety element, which contains an out-of-line detonator, is inserted into the base of the warhead. For this mechanism to commence arming, it must receive at least 8 g's acceleration for a period of approximately 0.5 second. Normal arming is accomplished approximately 3 seconds from missile launch.

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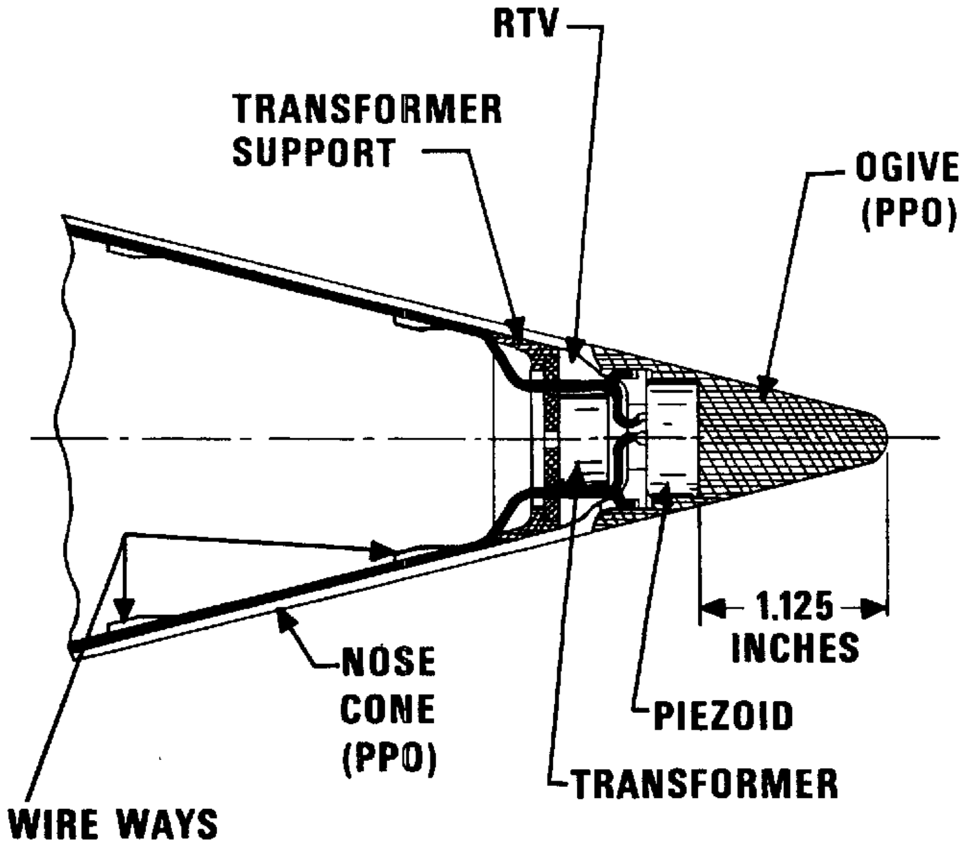

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Figure 3-1. Fuze, PIBD, Model F-1, PI element (U).

(C) **Description**

The F-1 PIBD fuze uses a piezogenerator (fig 3-1) as the PI element for generating voltage to initiate a bridge wire-type detonator housed in the base fuze. The base fuze departs from conventional practices by the utilization of rocket motor pressure as an environmental stimulus coupled with acceleration of the rocket. The omission of a timing mechanism and the sequential operation of the base fuze components assure adequate time prior to the arming of the fuze.

Fuze, PIBD, Model F-1
FOM No. 1390-17-2-5

(C) Unique Features

- Piezoid with impedance matching transformer.
- Slider with bridge-wire detonator shorted out.
- Pressure piston, shear wire, and bore rider safety pin detenting slider.

(C) Characteristics

Point initiating element:	
Piezoid:	
Type	High impedance
Material	Lead zirconate-titanate
Diameter	0.708 in (18 mm)
Length	0.327 in (8.4 mm)
Capacitance	~750-950 pF
Dielectric constant:	
K3	1900
D33	2.7×10^{-9} coulomb/lbf
Transformer:	
Type	Impedance matching
Primary winding	100 turns
Secondary winding	25 turns
Voltage reduction	4 to 1
Impedance reduction	10 to 1
Primary resistance	2.5 ohms
Secondary resistance	0.2 ohms
Primary inductance	20 mH
Secondary inductance	1.2 mH
Base fuze:	
Weight	50 g (0.11 lb)
Volume	1.78 in^3 (29.2 cm^3)

(C) **Characteristics (Continued)**

Detonator:

Model	ADFP
Type	Bridge wire, low impedance
Resistance	19.5 ±3.5 ohms
Explosive	Lead azide 100 mg (15.4 g)
Components	PETN 165 mg (25.5 g)

Functional data:

Arming method	Gas pressure and acceleration forces
Firing method	Rocket motor gases
Safety devices	Piston shear wire and bore rider safety pin
Arming distance	4.6 m
Arming time	?
Self-destruct time	?
Delay time	?

(C) **Design Details**

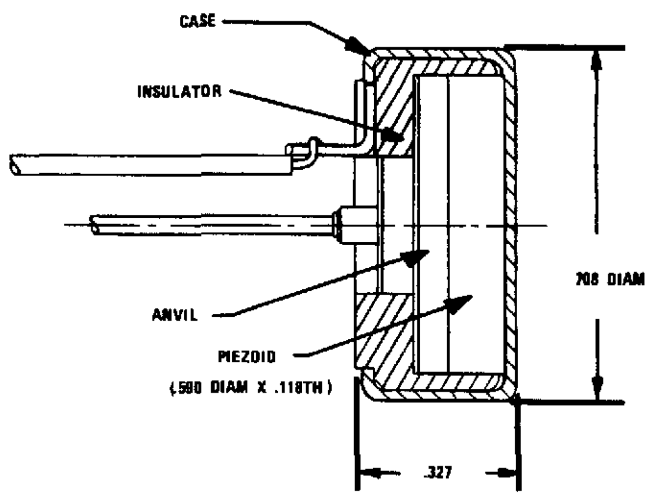

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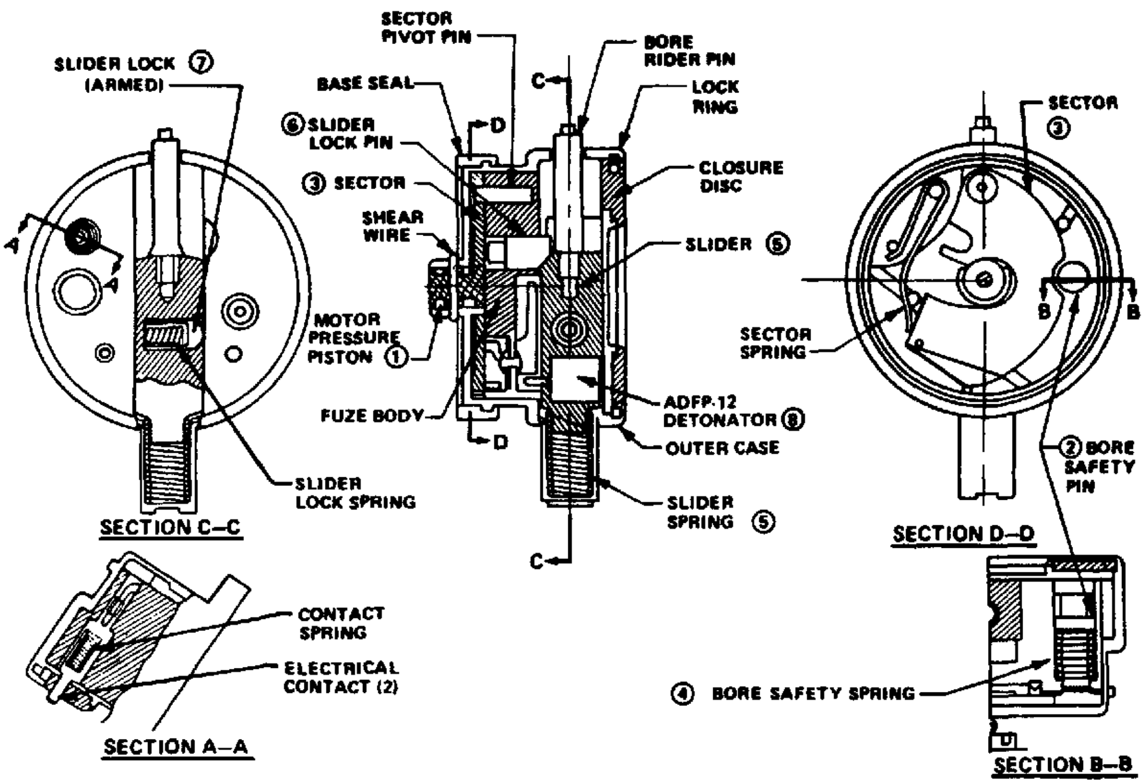
Figure 3-2. Fuze, PIBD, Model F-1, section view of piezoid (U).

Fuze, PIBD, Model F-1
FOM No. 1390-17-2-5

(C) Design Details (Continued)

The piezogenerator (fig 3-1) consists of a piezoid package and an impedance matching transformer. The piezoid (fig 3-2) is mounted in the nose cone. The transformer support is glued to the nose cone, and the piezoid and transformer leads are soldered together. The ogive of the warhead is glued to the nose cone. The cavity around the transformer is filled with room temperature vulcanizing rubber (RTV), and the resistance wires are glued in the wireways of the warhead. The assembled nose cone is made of polyphenylene oxide (PPO) plastic. The impedance matching transformer consists of two iron cores with a primary winding of 100 turns and a secondary winding of 25 turns. The piezoid package is located 1.125 in (28.6 mm) behind the nose of the warhead (see fig 3-1).



(CONFIDENTIAL)

Figure 3-3. Fuze, PIBD, Model F-1, BD element (U).

(C) Design Details (Continued)

The Base fuze (fig 3-3) is a compact design weighing 50 grams and occupying 1.78 in^3 (29.2 cm^3) of volume requiring approximately 0.920 in (23.4 mm) of warhead section length. The base fuze components are as follows:

(1) The *outer case* is machined from aluminum bar stock and anodized. The extension to house the slider spring is bonded to the body after anodizing. This extension also holds the fuze fixed with respect to the motor when the warhead is being assembled.

(2) The *pressure piston* is machined from aluminum and anodized. It is mated to the case prior to drilling the shear wire hole. The seal between the pressure piston and the case is made by an O-ring of synthetic material.

(3) The *sector* has a complex shape requiring at least two different setups to produce. It is made from aluminum. The weight is consistent from fuze to fuze.

(4) The *body and slider* are machined from MAKROLON, a polycarbonate plastic (LEXAN is also a polycarbonate). LEXAN, and probably MAKROLON, can be injection-molded; therefore, the reason for the extensive machining is unclear. The dimensional tolerances do not appear prohibitive.

(5) The *slider lock pin, bore safety pin, and slider lock* are made from nickel-plated steel.

(6) The *bore rider pin* is made from red anodized aluminum. The *bore rider extension* (not shown) is molded from plastic.

(7) The *closure disk* is a composite of steel and MAKROLON.

(8) The *detonator contacts* engage both side and bottom of detonator pins. The contacts are made from tempered beryllium copper hot-dipped in solder.

(9) The *base seal* is made of synthetic elastomer providing a secondary seal of the warhead and fuze from rocket motor gases. The prime seal is an O-ring mounted in the forward motor bulkhead. It also provides a cushioning effect for the fuze after the warhead is mounted.

Fuze, PIBD, Model F-1
FOM No. 1390-17-2-5

(C) Functioning (fig 3-3)

Upon firing, the propellant gas impinges on the piston (1); simultaneously the round accelerates and the bore safety pin (2) sets back, blocking the sector (3); then the propellant pressure becomes sufficient to shear the pressure piston shear wire, releasing the sector (3). At the tube exit, the bore rider extension is ejected by the spinning motion and a light spring. After burnout, the bore safety pin is moved forward by its spring (4), then the sector (3) is allowed to complete its travel. The slider (5) begins to move in line, forcing the slider lock pin (6) into a slot in the sector (3). At the completion of travel (14 mm or 0.550 in), the slider (5) is locked by the slider lock (7). The detonator (8) is now connected to the piezogenerator through the slide contacts. The functioning sequence of the fuze is shown in block diagram, figure 3-4.

BLOCK DIAGRAM OF FUZE SEQUENCE (U)

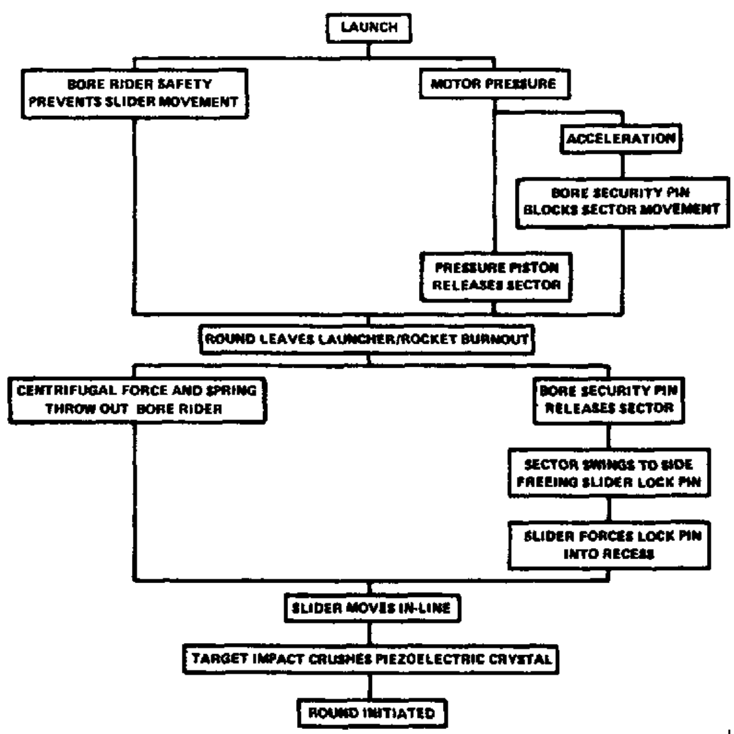


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Figure 3-4. Fuze, PIBD, Model F-1, diagram of functioning sequence (U).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
89-mm HEAT rocket LRAC, Model F-1	89-mm rocket launcher, Model F-1

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Fuze, PIBD, for HOT ATGM
FOM No. 1390-17-8-2

(C-NFD) **Description**

The HOT* ATGM has a PIBD fuze. The electrical fuze is initiated by crushing the outer shell of the warhead until it makes contact with the inner liner. The fuze will initiate at angles of incidence up to 80°.

The S&A operation is accomplished by a series of devices designed to prevent premature detonation. The activation of these devices is dependent upon:

- The missile leaving the launch tube (a locking device held in position by the walls of the launch tube releases when the missile leaves the tube and allows a spring to drive the arming device into position).
- Launch acceleration (launch acceleration locks a device into position which permits alignment of the explosive train).
- Guidance wire (when the guidance wire has unwound approximately 30 to 50 meters, it pulls a shorting pin).
- Thermal battery (initiation of the onboard thermal battery is necessary to close an arming switch).
- Time delay (a simple time delay is also incorporated into the arming sequence).

*HOT (Haut Subsonique Optiquement teleguide tire' dun tube).

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Fuze, PIBD, for Milan ATGM
FOM No. 1390-17-8-3

(U) **Description**

The French Milan ATGM has a PIBD fuze. The pyrotechnic fuze used to detonate the main charge also functions as the front bulkhead of the motor. A primer pellet gate piston assures safety of the fuze while the missile is in the tube. When the missile leaves the launch tube, a spring-loaded pin moves and unlocks the piston. Gas pressure from the propulsion motor then displaces the piston and thereby arms the fuze.

The electrical circuit which ignites the detonator squib in the fuze is shorted until the missile is a safe distance from the gunner. A shorting contact, in parallel with the squib bridge wire, is broken after 20 meters of guidance (factory adjustable) wire has been unreeled.

Detonation occurs as the warhead ogive is deformed at impact, making electrical contact between the inner and the outer shells. The fuze weighs 300 grams and will initiate at impact angles of up to 80°.

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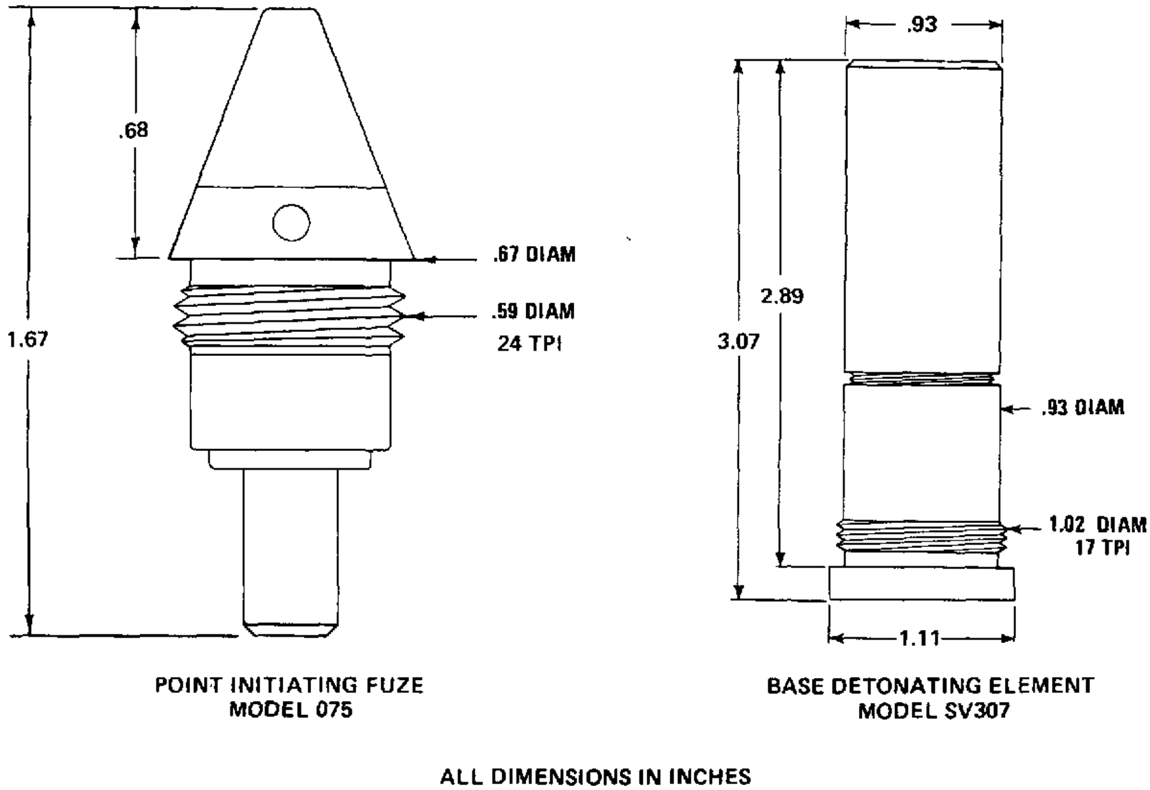

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Figure 3-5. Fuze, PIBD, Model ?, contour views of PI and BD elements (U).

(U) Description

The Swiss PIBD fuzing system (fig 3-5) designed by Oerlikon for 80-mm aircraft HEAT rockets consists of a PI fuze, Model 075, and a BD element, Model SV307. It is a setback, delay-arming type that functions upon impact with the target.

(U) Unique Features

It employs an escapement via a pinion-gear-rack arrangement with a spring-loaded slider providing a mechanical block of the spitback flash from the PI fuze. The delayed arming is controlled via the escapement.

Fuze, PIBD, Model ?
FOM No. 1390-18-2-2

(U) Characteristics

PI fuze:

Body material	Tin-coated brass
Weight	0.05 lb (22.7 g)
Overall length	1.67 in (42.42 mm)
Major body diam	0.67 in (17 mm)
Thread diam	0.59 in (15 mm)
TPI	24
Pitch	1 mm (0.04 in)

BD element:

Body material	Aluminum
Weight	0.33 lb (149.8 g)
Overall length	3.07 in (77.98 mm)
Major body diam	0.93 in (23.62 mm)
Thread diam	1.02 in (25.9 mm)
TPI	16
Pitch	1.5 mm (0.06 in)

Functional Data:

Arming method	Setback
Firing method	Impact
Safety devices	*, **
Arming distance	?
Arming time	?

*PI fuze has a setback sleeve, setback spring, and shear ring that acts as a safety against initiation of flashback primer.
**Base element has spring-loaded slider providing a mechanical block of the flash path to the detonator. The slider's movement is delayed by an escapement mechanism.

(U) Design Details

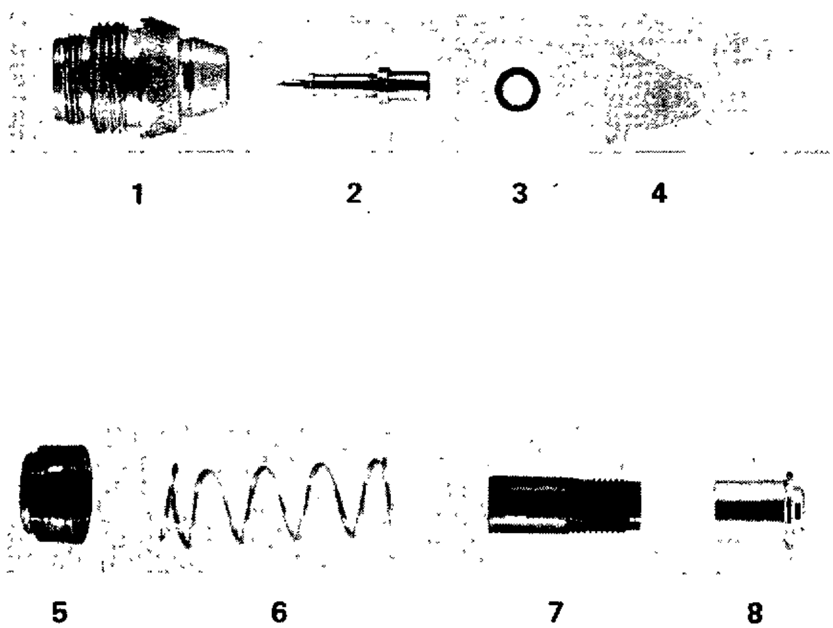

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Figure 3-6. Fuze, PI, Model 075, exploded view (U).

PI fuze, Model 075. The PI fuze (fig 3-6) consists of a tin-coated brass fuze body (1), a steel plunger-type firing pin (2), steel ring (3), polyethylene nose cap (4), brass spring and shear safety support (5), steel setback spring (6), primer assembly (7), and aluminum primer carrier with steel shear ring (8).

Fuze, PIBD, Model ?
FOM No. 1390-18-2-2

(U) Design Details (Continued)

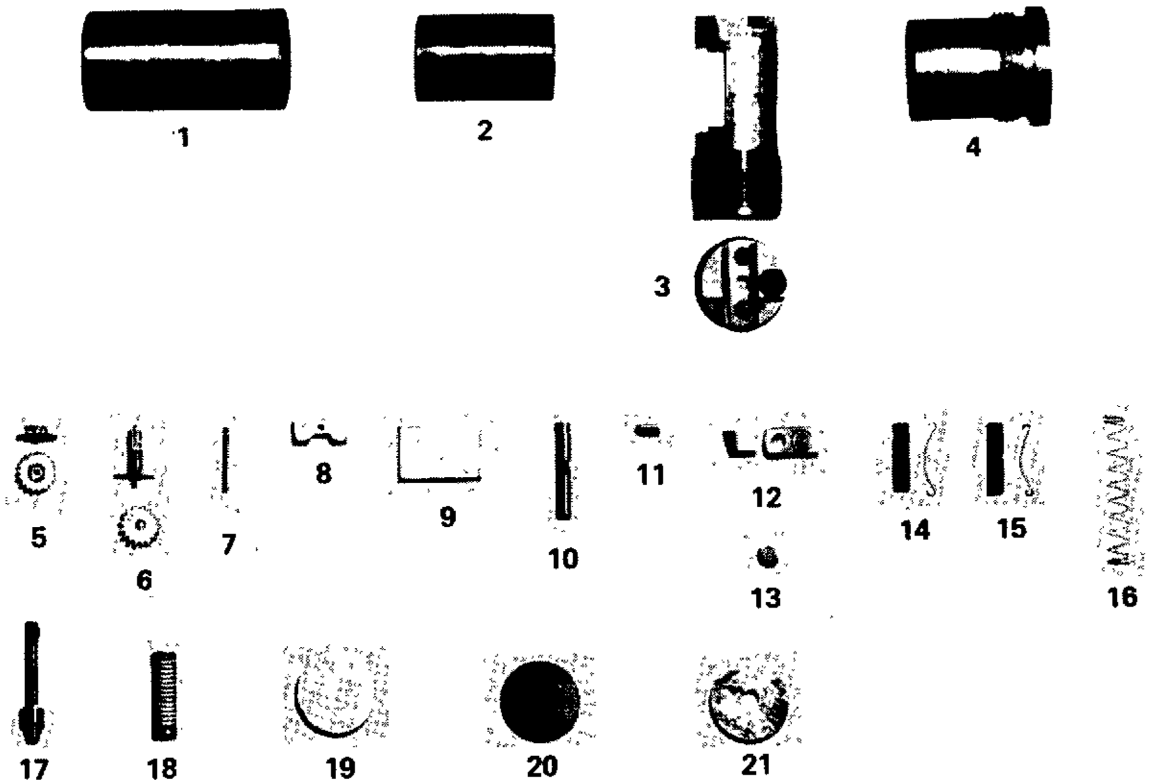

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Figure 3-7. Fuze, BD, Model SV307, exploded view (U).

BD element, Model SV307. The BD element (fig 3-7) consists of the delay assembly housing (1), retainer sleeve (2), fuze body (3), booster housing (4), gear assembly (5), pinion-gear assembly (6), gear spindle (7), pallet (8), bearing plate (9), slider retaining pin (10), safety pin (11), slider assembly (12), slider block (13), inner slider spring (14), outer slider spring (15), setback spring (16), setback pin (17), rack (18), booster disk (19), booster cushion (20), and booster washer (21).

(U) Functioning

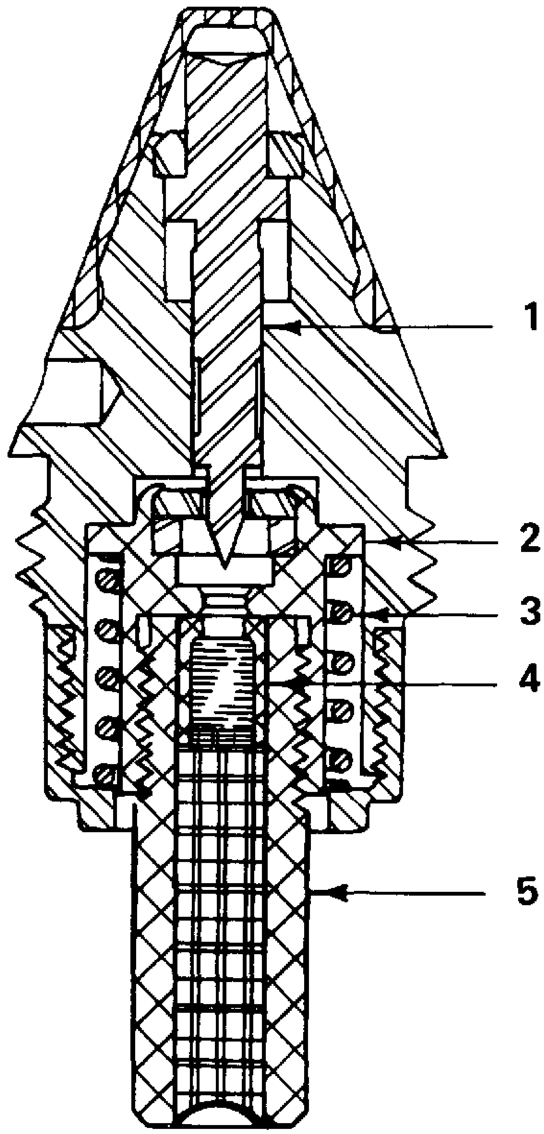

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Figure 3-8. Fuze, PI, Model 075, section view (U).

Fuze, PIBD, Model ?
FOM No. 1390-18-2-2

(U) **Functioning (Continued)**

Point initiating fuze, Model 075 (fig 3-8). On acceleration, both the striker pin (1) and primer-carrier assembly (5) move rearward. If impact occurs before the acceleration load on the spring (3) falls below the approximate 4.5-lb (2 kg) load required to keep it fully compressed, the primer carrier moves forward against the striker-pin flange. Impact forces of approximately 700 lb (317.5 kg) shear the plate (i.e., top washer of the primer-carrier assembly) and permit the striker point to enter and set off the primer (4). If impact occurs after the acceleration load on the spring (3) falls below the approximate 4.5-lb load referred to above, the spring will have returned the striker pin and primer-carrier assembly to their normal position. In this case the striker pin will be forced rearward into the primer after shearing the plate. It should be noted that the primer spitback charge bottom is concave shaped to obtain better initiation.

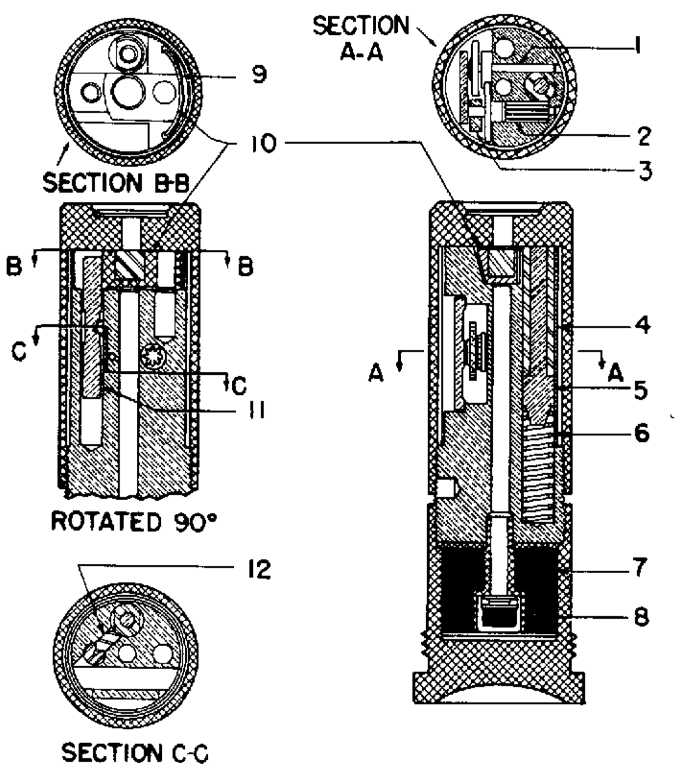

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Figure 3-9. Fuze, BD, Model SV307, section view of BD element (U).

(U) **Functioning (Continued)**

Base detonating element, Model SV307 (fig 3-9). When the carrier rocket is fired, the setback pin (5) and the rack (4) start to move rearward. The setback pin's travel is hindered only by the spring (6), which it compresses relatively quickly. On the other hand, the rearward movement of the rack is delayed by the fuze clockwork mechanism (3) through the pinion gear (2). When the rack top has moved below the transversely drilled hole in which the safety pin (12) is assembled, the safety pin is cammed into the cavity above the rack and setback pin. This transfer is accomplished with the aid of the continued acceleration forces acting on the safety pin through the tapered surface of its seat in the slider retaining pin (11). When the slider retaining pin moves below the bottom surface of the slider assembly slot, the slider assembly (10) is freed and is then pushed along its slot by the slider-spring assembly (9). This movement aligns the slider hole with the flash hole of the base detonating element. A clear path is then open between the point impact fuze primer carrier charges and the detonator assembly (8) at the bottom of the base element.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
80-mm HEAT rocket	80-mm rocket pods mounted on aircraft

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Fuze, PIBD, for Bantam ATGM
FOM No. 1390-19-8-1

(U) **Description**

The Swedish Bantam ATGM has a PIBD fuze. The fuze is armed when a microswitch, mounted on one spool of control wire, is closed after 230 meters of wire have been dispensed. The fuze is initiated when an electrical connection is made between two ogival, thin metal shells that make up the nose of the missile. The two shells are ordinarily separated by a small space until the missile strikes an object, deforming the outer shell so that it contacts the inner shell.

The double-sheathing nose design ensures that fuzing at angles of impact up to 90° is achieved.

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Fuze, PIBD, Model ?
FOM No. 1390-21-2-2

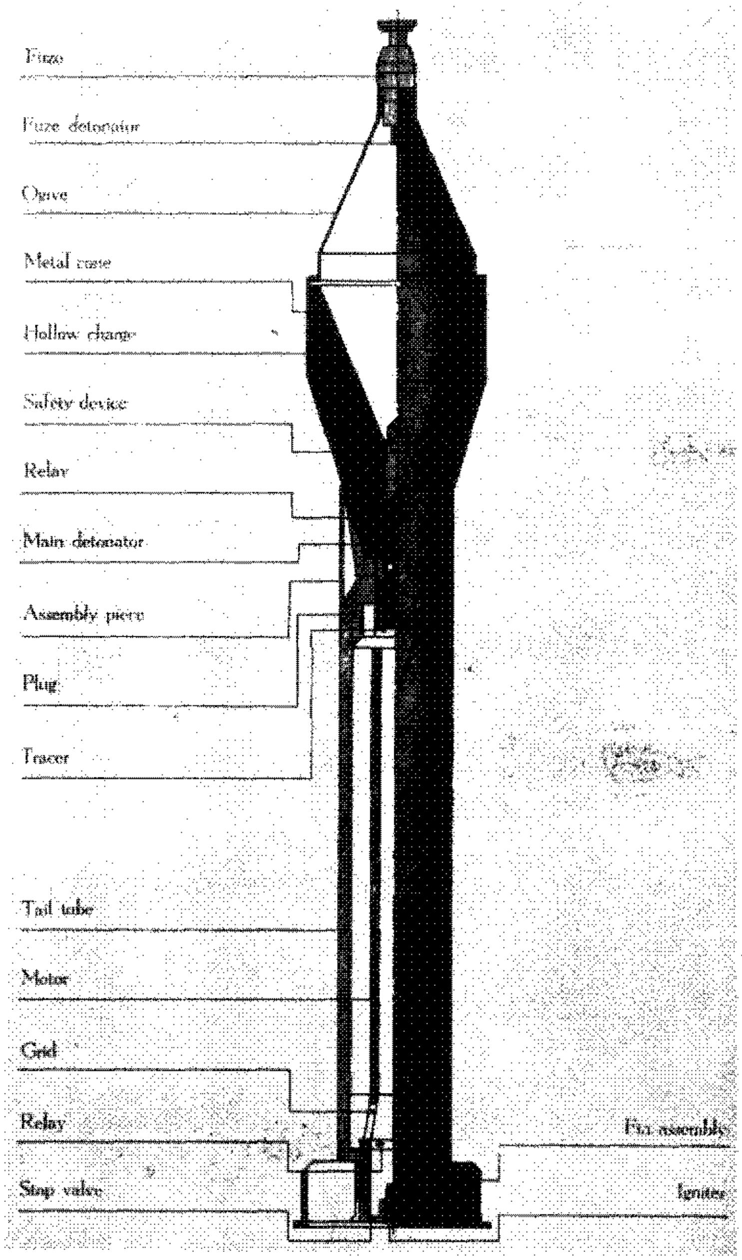

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Figure 3-10. 75-mm HEAT grenade with PIBD fuze (U).

Fuze, PIBD, Model ?
FOM No. 1390-21-2-2

(U) **Description**

The Belgium PIBD fuze is a spitback type designed for use with the super-blindicide 75-mm HEAT rocket, Energa (fig 3-10). It consists of a setback-armed, PI fuze with a graze-sensitivity feature and a BD element with a safety device providing a mechanical block on the main detonator.

(U) **Functioning**

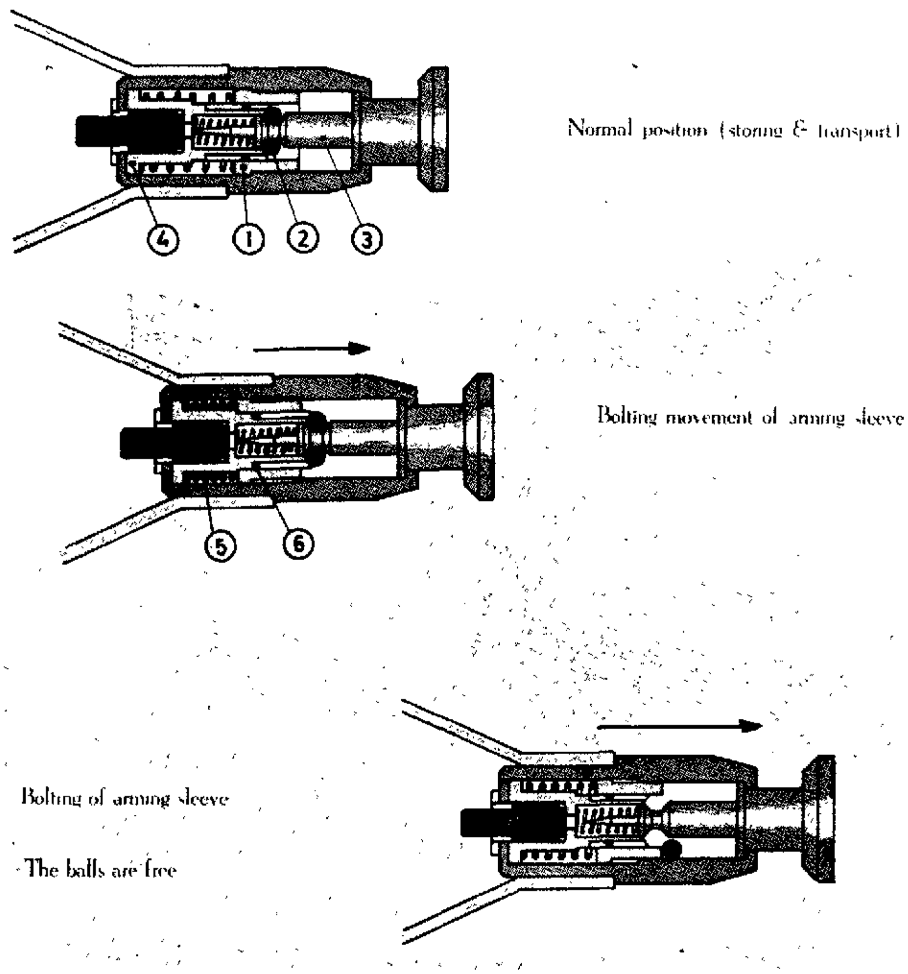

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Figure 3-11. Fuze, PI, arming sequence (U).

(U) Functioning (Continued)

The arming of the PI fuze (fig 3-11) is as follows: Upon setback, the setback sleeve (1) moves rearward, compressing its spring and thereby releasing the detent balls (2). This movement releases the striker (3) and detonator housing.

The PI fuze portion is now armed and ready to function.

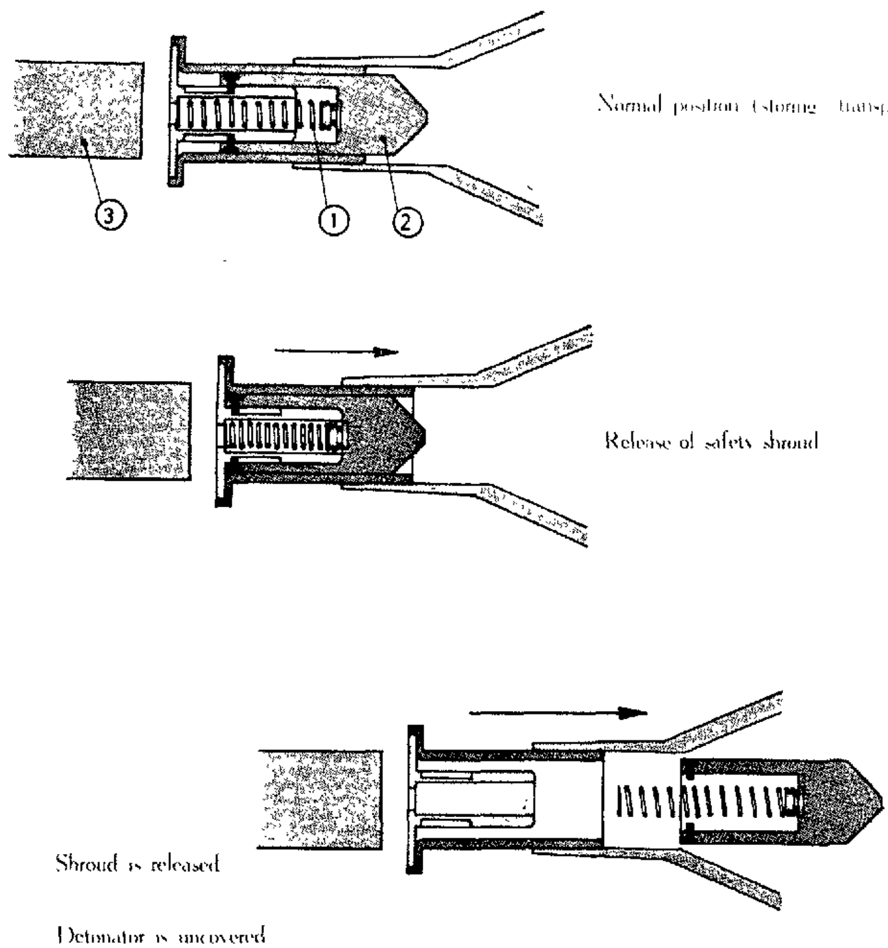

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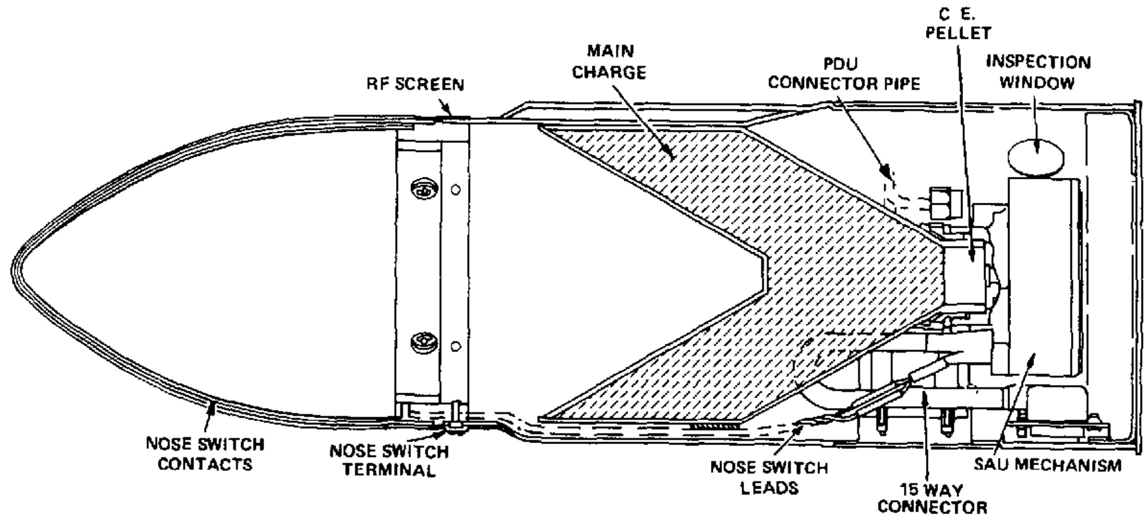
Figure 3-12. Fuze, PIBD, arming of safety device (U).

Fuze, PIBD, Model ?
FOM No. 1390-21-2-2

(U) **Functioning (Continued)**

The arming of the safety device (fig 3-12) is as follows: When setback ceases, the safety cap (2) under pressure from spring (1) as a result of setback is thrown forward toward the front, freeing the passageway to the main detonator (3).

Upon impact, the striker stabs the detonator which spits back to the main detonator at the base of the warhead. This, in turn, initiates the relay or booster charge, resulting in detonation of the shaped charge.



WARHEAD, GM, K14A1

(CONFIDENTIAL)

Figure 3-13. Fuze, PIBD, for Swingfire, section view of warhead (U).

(C) **Description**

The Swingfire warhead GMK14A1 (fig 3-13) has a PIBD fuze developed in England by Graviner, Ltd. It includes a nose switch, a safety and arming unit (SAU), and a pressure delay unit (PDU).

(C) **Characteristics**

Fuze assembly:

Body material	Aluminum
Weight of SAU	43 g (0.095 lb)
Markings of SAU	GM, K31A1
Markings of PDU	GW, K1A1

Fuze, PIBD, for Swingfire ATGM
FOM No. 1390-35-8-1

(C) Characteristics (Continued)

Booster:

Explosive	CE
Explosive weight	18 g (0.040 lb)

Functional data:

Arming method	Propellant actuated
Firing method	Impact
Safety device	PDU and mechanical detent
Arming time	3 s
Arming distance	80 m

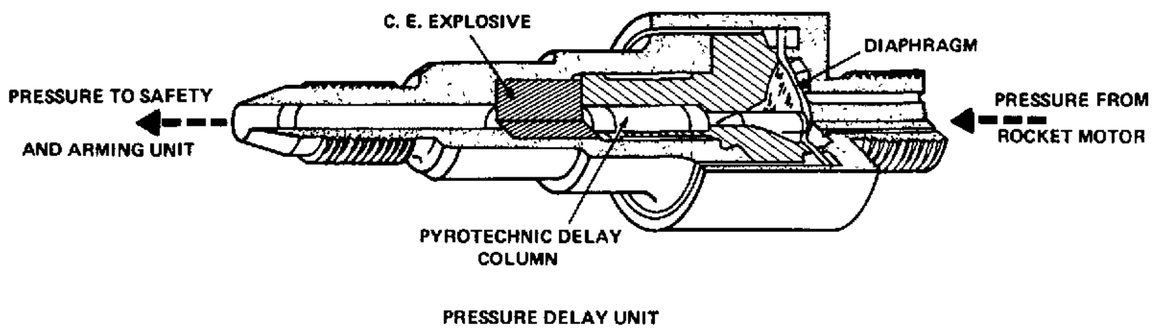


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Figure 3-14. Fuze, PIBD, for Swingfire, PDU (U).

Fuze, PIBD, for Swingfire ATGM
FOM No. 1390-35-8-1

1. FLYING LEAD TO WARHEAD NOSE SWITCH
2. 15-WAY FLYING LEAD SAU-AFTBODY
3. 15-POLE PLUG
4. WINDOW
5. REVERSIBLE DIAPHRAGM HOUSING
6. FIRING CAPACITOR
7. BLEED RESISTORS
8. CHARGE RESISTORS
9. CHARGING SWITCH AND SHORTING LINK
10. SHUTTER MECH HOUSING
11. CHARGING SWITCH OPERATING ARM
12. EXPLOSIVE MOTOR
13. SCREENED IGNITER

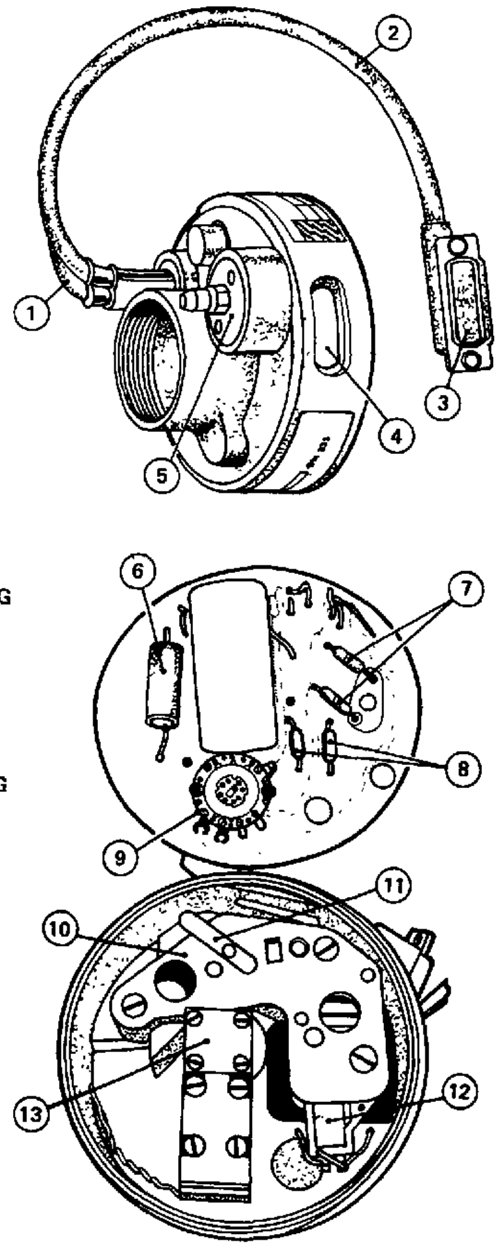

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Figure 3-15. Fuze, PIBD, for Swingfire, SAU (U).

Fuze, PIBD, for Swingfire ATGM
FOM No. 1390-35-8-1

(C) Design Details

The PDU (fig 3-14) consists basically of a diaphragm, striker, pyrotechnic delay column, and CE charge. It is operated by pressure from within the rocket motor.

The SAU (fig 3-15) is a complete assembly screwed to the rear of the main charge casing. The unit consists of a body casting containing a rotatable shutter which carries a detonator, a screened igniter, a CE pellet, an explosive motor, actuator arm and spring, and a pressure-operated lock post. The unit is connected electrically to the missile by a 15-way connector plugged into the leads running under the strake. The unit has a two-way switch lead and a circuit board mounted in the rear of the assembly. The circuit board comprises a capacitor, resistors, and a rotary charging switch. The unit is connected to the PDU by a pipe.

The nose switch consists of:

- The nose cone which is an ogival aluminum alloy RF screen.
- Inner and outer ogival copper liners which are insulated from each other and from switch contacts. Electrical connections from the inner and outer switch contacts are by means of a twisted pair of leads connected to a flying lead from the SAU.

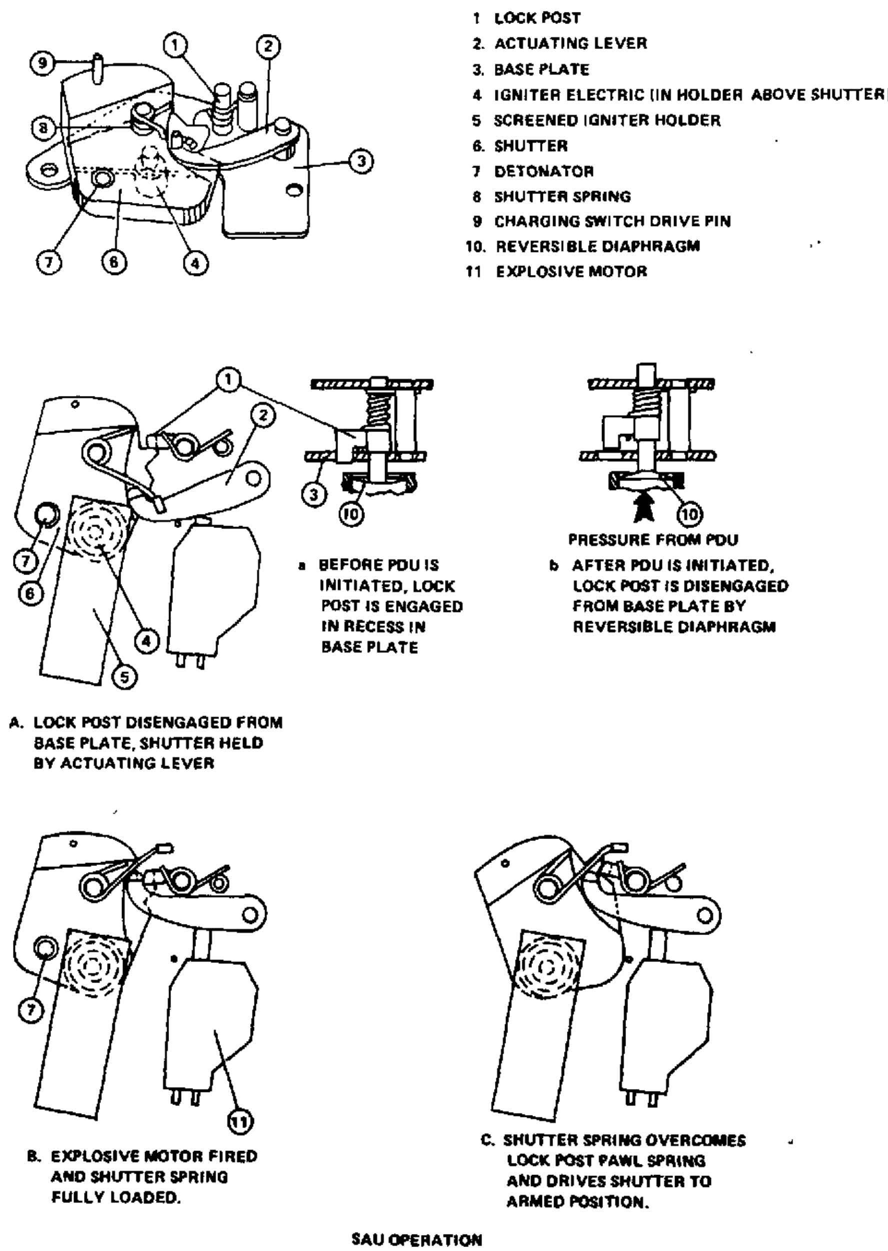

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Figure 3-16. Fuze, PIBD, for Swingfire, SAU operation (U).

Fuze, PIBD, for Swingfire ATGM
FOM No. 1390-35-8-1

(C) Functioning

PDU. When pressure in the propulsion motor has built up to 800 lb/in^2, the diaphragm in the PDU reverses and initiates the delay column. Gas pressure reaches the PDU through the air space between the hypalon inhibitor and rocket motor casing. After a delay of 2 seconds, the CE charge is initiated and the resultant gas pressure is piped to the SAU to disengage the shutter lock post.

SAU (fig 3-16). The first restraint, the shutter lock post, holds the shutter in the SAFE position. It is disengaged from the shutter by the reversal of a diaphragm actuated by pressure from the pressure delay until approximately 2 seconds after launch, corresponding to about 50 meters of missile flight.

The second restraint, applied by the actuator arm, is removed by the explosive motor. The actuator arm is pivoted in the body casting and is the means by which additional torque is applied to the actuating spring to rotate the shutter. The actuator arm is moved by a piston in the explosive motor.

The explosive motor, mounted on the base of the body, is fired by the breaking of a loop after the first 80 meters (±10 meters) of wire has been dispensed. On firing, the piston of the explosive motor operates the actuator arm, which increases torque on the shutter driving spring and drives the shutter to the armed position.

The shutter is pivoted in the body casting and is actuated by a torsion spring anchored between the shutter and the actuator arm. In the SAFE condition, the shutter is positioned between the igniter and the CE pellet and held by the lock post. The igniter is thus screened from the CE pellet and the main charge. In the ARMED condition, the detonator in the shutter is positioned between the igniter and the CE pellet to complete the explosive train to the main charge.

Should the explosive motor fire before the lock post has been raised (due to more than a 2-second delay in the PDU or a free-running wire), the SAU will still arm after both restraints have been removed. Rotation of the shutter moves the plastic link to close the charging switch on the breadboard. This allows current to flow from the thermal battery to charge up the firing capacitor. Simultaneously the shutter movement breaks a shorting link across the igniter by opening a switch.

(C) Functioning (Continued)

Nose switch. On impact, the nose of the warhead is crushed, and the inner and outer copper liners of the nose switch make contact and complete the igniter firing circuit; current then flows from the firing capacitor to fire the igniter. This fires the detonator which in turn fires the stemming and main charges. The copper cone in contact with the main charge creates a shaped-charge effect forming a high-speed jet. Should the nose switch not function for any reason, at the end of flight the bleed resistors will discharge the firing capacitor once the flow of current from the thermal battery ceases. The warhead will then be safe.

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Fuze, PIBD, for Vigilant ATGM
FOM No. 1390-35-8-2

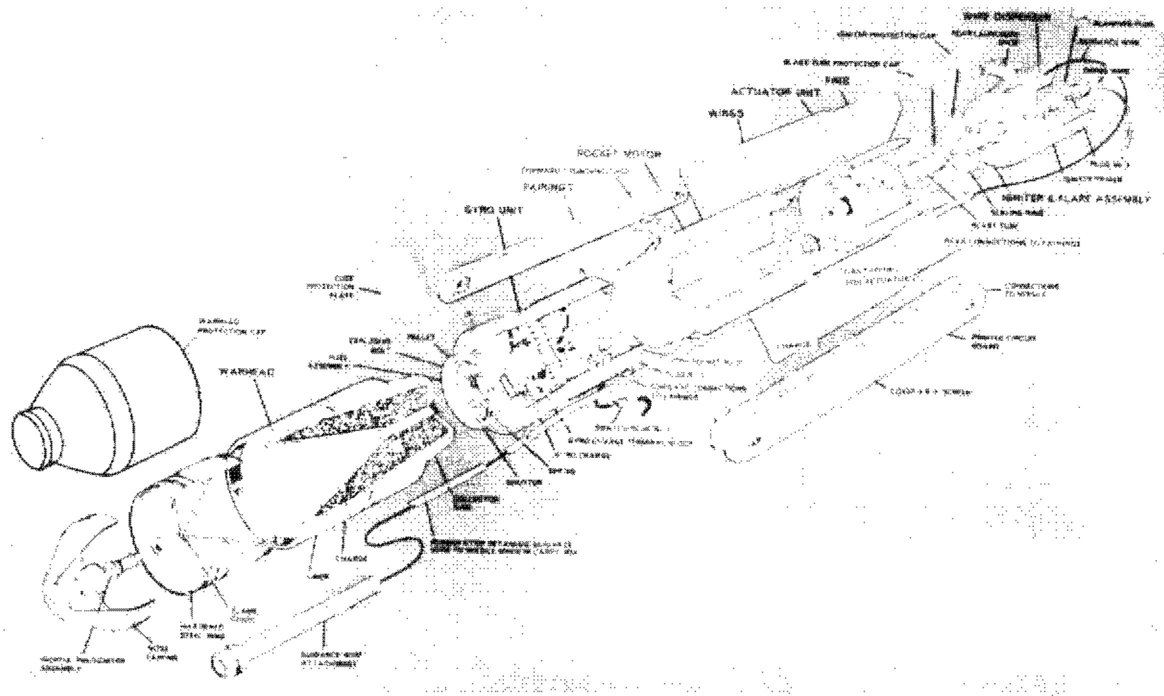

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Figure 3-17. Fuze, PIBD, for Vigilant ATGM (U).

(C) Description

(U) The Vigilant fuze (fig 3-17) has a nose contact that will operate at angles of incidence up to 70°. Arming is accomplished by the simultaneous application of electric power from the missile alternator.

(C) The fuze is designed to meet British Ordnance Board Safety requirements. The nose probe contact retracts for storage. It is manually extended and automatically locked out when setting up for firing. Two-stage arming is employed: the combination of an inertial-operated, distance-measuring mechanism and a "g"-sensitive shutter detent that prevents arming until the missile has sustained at least a 3-g acceleration for 1.5 seconds and has flown 110 meters (2.5 seconds). An escapement mechanism controls the speed of rotation of the shutter.

Fuze, PIBD, for Vigilant ATGM
FOM No. 1390-35-8-2

(C) **Description (Continued)**

(C) The turbo-alternator charges up a capacitor. When the nose probe crushes on impact, the capacitor is discharged through a detonator. This explodes the warhead through a boost pellet assembly. At normal impact angles a crush switch on the nose closes, causing the warhead to detonate. If the impact occurs at angles greater than 45° so that the crush switch is not closed, an inertial-operated switch initiates detonation.

Section IV.

BASE DETONATING FUZES

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Section IV.

BASE DETONATING FUZES

GENERAL

(U) Base detonating (BD) fuzes have been designed or are under development for armor-piercing, high-explosive incendiary (APHEI) projectiles, high-explosive antitank (HEAT) projectiles, and high-explosive plastic (HEP) projectiles. These fuzes usually function on mechanical or electrical principles, by contact with the target and with detonation at the base end of the projectile or warhead. This type of fuzing is less complex than the PIBD fuze, and offers a direct solution to fuzing problems associated with the initiation of shaped-charge or HEP projectiles used in a direct fire role.

(U) The fuzes described in this section are designed for either high- or low-"g" accelerations and for fin- or spin-stabilized projectiles or warheads.

(U) Some of the fuze developments included in this handbook incorporate a graze-sensitive or self-destruct feature and have been designed to function either instantaneously or with a delay upon impact with the target.

(U) Most BD fuzes require either a setback or centrifugal force environmental stimulus for arming; some of the fuzes, especially for ATGMs, have delayed arming, usually accomplished by a pyrotechnic delay or mechanical timer.

(U) With the exception of some older obsolescent types, the fuze designs presented in this handbook reflect the current state-of-the-art and, in some cases, have unique features.

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INDEX

*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

Fuze, BD, Model BDZ DM 711
FOM No. 1390-16-1-30

(FOUO) Description

According to an official West German source, fuze BDZ DM 711 is a German-produced copy of US fuze, BD, M91A1. This fuze was standard in the West German Armed Forces at least as late as 1969. See pertinent US publications (e.g., TM 9-1300-203) for technical details of this fuze.

(FOUO) Applications (Ammunition and Weapons)

Ammunition	Weapons
90x607-mm cartridge, Model ?	90-mm guns
105x617-mm HEP-T cartridge, Model ?	105-mm guns or howitzers

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Fuze, BD, Model BDZ DM 731
FOM No. 1390-16-1-31

(FOUO) **Description**

Fuze BDZ DM 731 is a West German-produced copy of UK fuze L29A2 or L29A3. This fuze was standard in the West German Armed Forces at least as late as 1969. See FOM No. 1390-35-1-3 (fuze L29A2) and FOM 1390-35-1-28 (fuze L29A1), for functioning data and technical details.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
105x617 HESH (HEP) cartridge, Model ? (probably UK designed and/or produced)	105-mm guns

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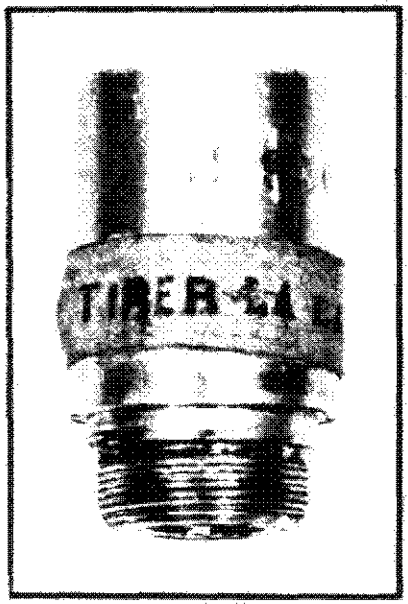

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Figure 4-1. Fuze, BD, Model (STRIM), full view (U).

(U) Description

The French BD fuze (fig 4-1) was developed by Societe Technique de Recherches Industrielles de Mechaniques (STRIM) of Paris. The fuze is a setback-armed type employing a ribbon spring that unwinds after setback, arming the fuze. It is not considered bore safe by US standards.

(U) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	0.11 kg (0.24 lb)
Diam	34 mm (1.34 in)
Length	69 mm (2.72 in)

Fuze, BD, Model (STRIM)
FOM No. 1390-17-2-4

(U) Characteristics (Continued)

Detonator:

Explosive	*
Weight	0.916 g (14.1 gr)

Booster pellet:

Explosive	RDX/wax**
Weight	9.24 g (0.020 lb)
Diam	22 mm (0.866 in)
Height	23 mm (0.910 in)

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	Safety pin; arming spring
Arming distance	4 m
Arming time	?

*Lead azide, tetryl, potassium chlorate, antimony sulfate, and mercury fulminate.
**Pressed to fit a hemispherical cavity of the main shaped charge having a radius of 9.3 mm (0.37 in)

(U) Design Details (fig 4-2)

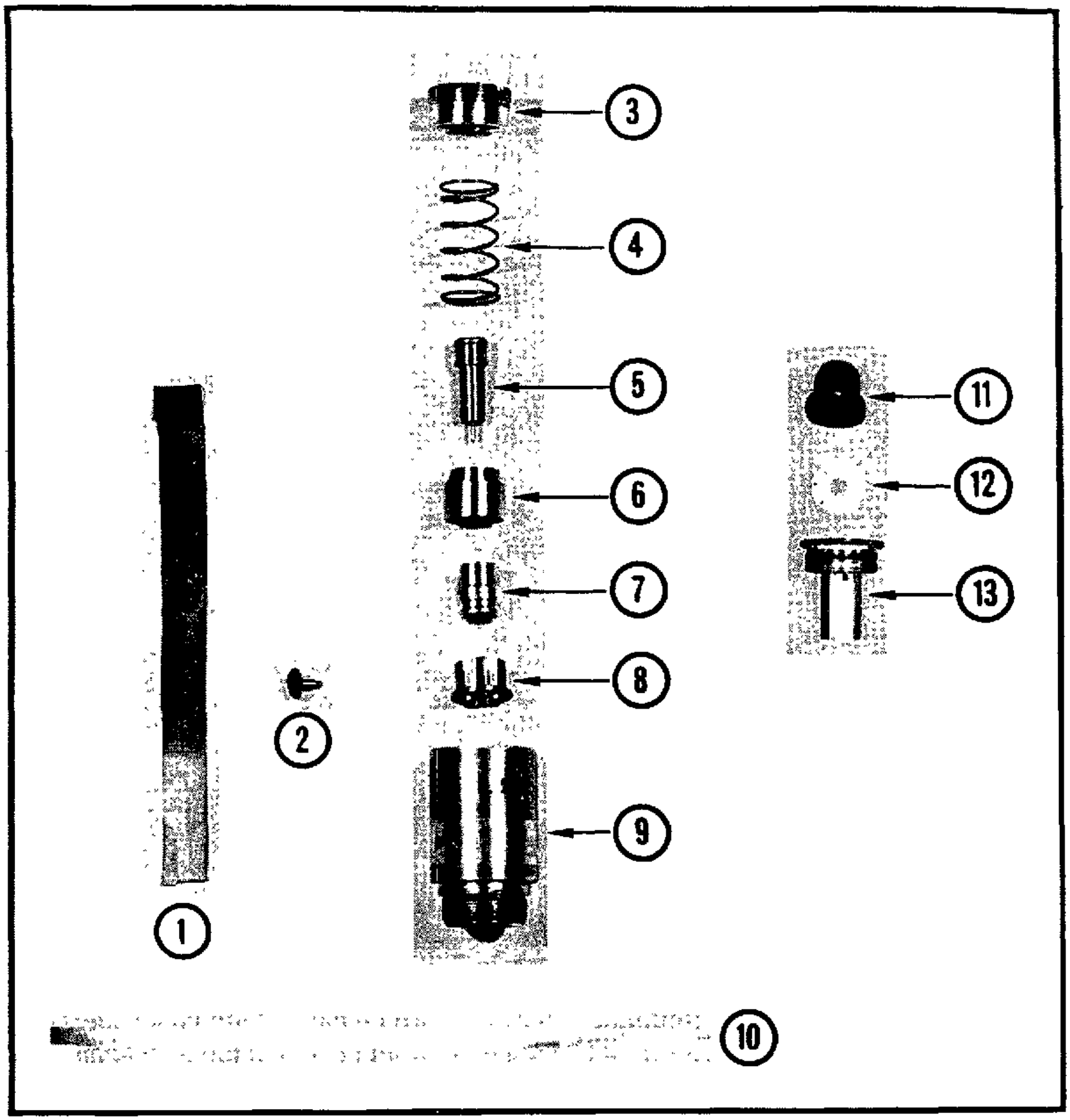

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Figure 4-2. Fuze, BD, Model (STRIM), exploded view (U).

Fuze, BD, Model (STRIM)
FOM No. 1390-17-2-4

(U) **Design Details (Continued)**

The bored-out aluminum fuze body (9) is threaded internally at the forward end to receive the detonator assembly (11, 12, and 13) and externally for assembly into the base of the warhead. The rear of the fuze body (9) is sealed by an aluminum closure cover (3).

The arming mechanism consists of a brass setback sleeve (6), steel setback spring (4), and a ribbon-type steel spring (10). The ribbon-type spring is wound up and positioned inside a housing (7) and locked in place by the brass ring-shaped retainer (8) with finger-like prongs.

The firing-pin assembly (5) consists of a steel pin and brass holder, whereas the detonator assembly includes the detonator holder (13), a felt cushion (12), and the hemispherical-shaped detonator (11).

The setback sleeve (6) is secured in place by a brass safety pin (2) inserted through an opening drilled into the side of the fuze body. The brass safety pin is held in place by an adhesive tape (1) taped around the fuze body.

(U) **Functioning**

Prior to firing, the adhesive tape (1) and safety pin (2) are removed.

On firing, the setback sleeve (6) moves rearward, compressing its spring (4). The ring-shaped retainer (8) also moves rearward, expanding its finger-like prongs over the raised portion of the ribbon spring housing (7).

When setback forces dissipate, expansion of the spring (4) pushes the sleeve (6) forward as well as the retainer (8), allowing the ribbon-type spring (10) to unwind and eliminating the obstruction that blocked the firing pin (5) from stabbing the detonator (11).

Upon impact, inertia forces the firing pin to stab the detonator, which in turn sets off the booster pellet and shaped charge of the warhead.

(U) Modifications

Modifications have been made to this fuze. A set screw replaced staking of the firing pin. Removal of the safety pin is accomplished by a pull-ring instead of unwinding friction tape. The firing pin was made longer and the setback spring stronger.

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
73-mm HEAT warhead, Model 1950	73-mm rocket launcher, Model 1950

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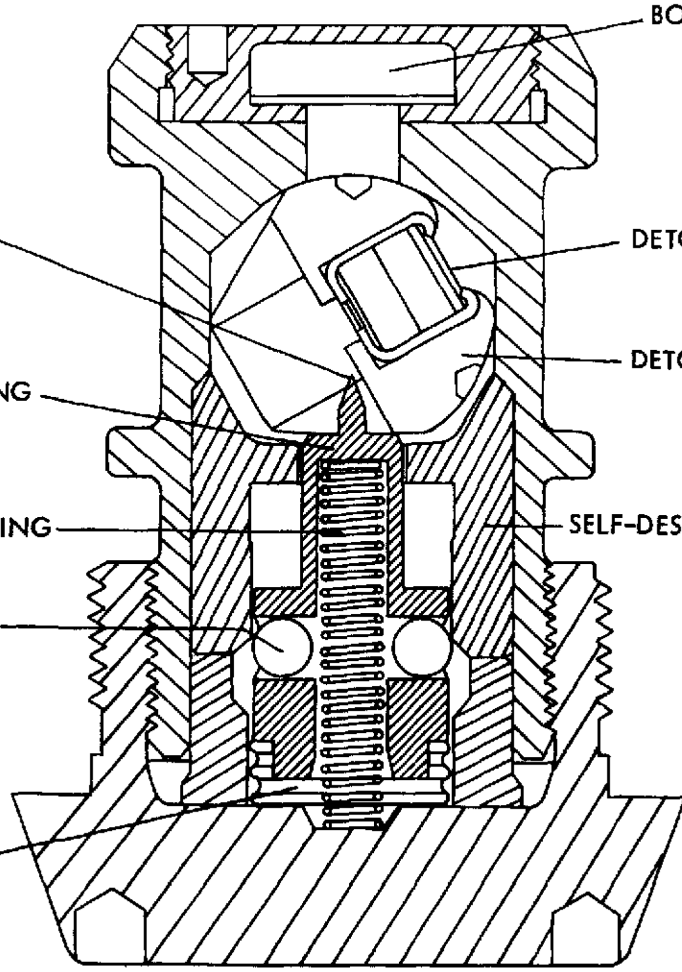

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Figure 4-3. Fuze, BDSD, Model BZD-0236, section view (U).

(U) **Description**

The Oerlikon, Type BZD-0236, fuze (fig 4-3) is a conventional BDSD fuze with a mechanical self-destruct feature and an out-of-line detonator. It is designed for 30x113-mm B APHEI, Type PSBH/B, cartridges for DEFA 500-series aircraft guns.

Fuze, BDSD, Oerlikon, Type BZD-0236
FOM No. 1390-18-1-45

(U) **Characteristics**

Fuze assembly:

Body material	Aluminum
Weight	3.4 g
Markings	None

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Out-of-line detonator in ball rotor.
Arming distance	?
Arming time	?
Self-destruct time	?
Delay time	?

(U) **Design Details**

The fuze consists of an aluminum fuze body containing a self-destruct mechanism, firing pin, ball rotor with an out-of-line detonator, and booster. In storage and shipment, the fuze is kept safe by the out-of-line position of the detonator in the rotor. Rotor position is maintained by pressure from the self-destruct spring and the shock element, acting through the firing-pin bushing.

(U) **Functioning**

Upon firing, setback forces cause the firing pin bushing to move to the rear, crushing the shock element and further compressing the self-destruct spring. At this point, centrifugal force causes the arming balls to move outward and rearward against the conical interior surface of the self-destruct housing. This action moves the firing-pin bushing further rearward and restrains the self-destruct spring, releasing pressure on the rotor. Centrifugal

(U) **Functioning (Continued)**

force causes the unbalanced rotor, now free, to rotate until the detonator is aligned with the firing pin. Upon impact, inertia added to the pressure of the compressed self-destruct spring overcomes centrifugal force, acting on the arming balls. These balls are forced inward into their recess in the firing-pin bushing, and the firing pin is driven into the detonator, thus initiating detonation of the booster. If impact does not occur, projectile spin will decay and centrifugal force decrease until the compressed self-destruct spring overcomes the spin force on the arming balls and drives the firing pin into the detonator.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
30x113-mm B APHEI, Type PSBH/B	30-mm aircraft gun, DEFA, Type 552

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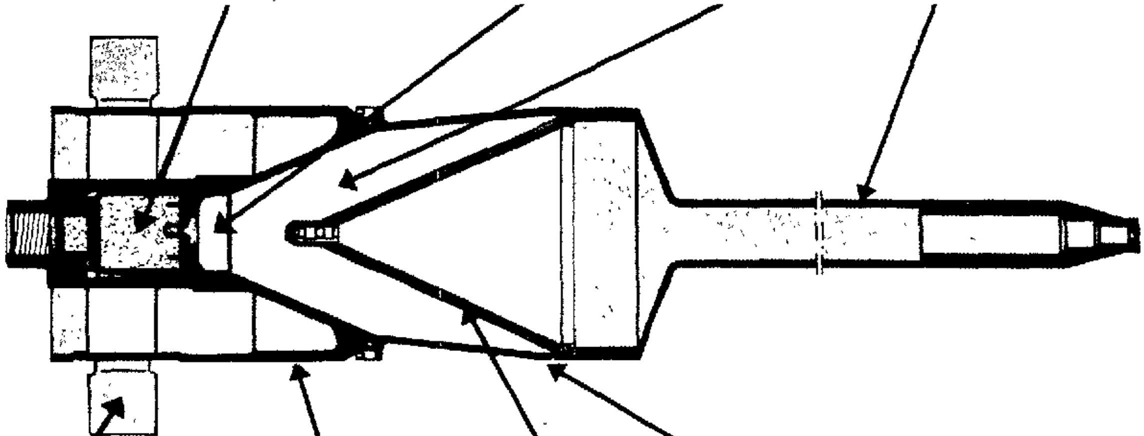

74-MM HEAT PROJECTILE (MINIMAN)

BD, FUZE, (PIEZOELECTRIC TYPE)

(CONFIDENTIAL)

Figure 4-4. Fuze, BD, Model (MINIMAN), full view (U).

Fuze, BD, Model (MINIMAN)
FOM No. 1390-19-1-7

(C) Description

The Swedish BD fuze (fig 4-4) is a setback-, delayed-arming type that functions on the piezoelectric principle upon impact with the target. It was developed by Forsvarets Fabriksverk of Eskilstuna, Sweden, for use with the 74-mm HEAT projectile fired from the 74-mm antitank launcher (MINIMAN). The manufacturer claims functioning up through 70° obliquity.

(C) Unique Features

- A piezoid mounted in the base that is excited by the shock wave travelling through the distance tube and shell body upon impact.
- The use of a diode to provide brush discrimination.
- A ball-race metering system for controlling the spring-driven rotor housing the electric detonator.
- Detent system on spring-driven rotor.

(C) Characteristics

Fuze assembly:
Body material .... ?
Weight .... ?
Markings .... ?

Booster:
Body material .... ?
Body length .... ?
Explosive .... ?
Explosive weight .... ?

(C) **Characteristics (Continued)**

Functional data:

Arming method	Setback
Firing method	Impact
Safety devices	
Arming distance	?
Arming time	?
Delay time	?

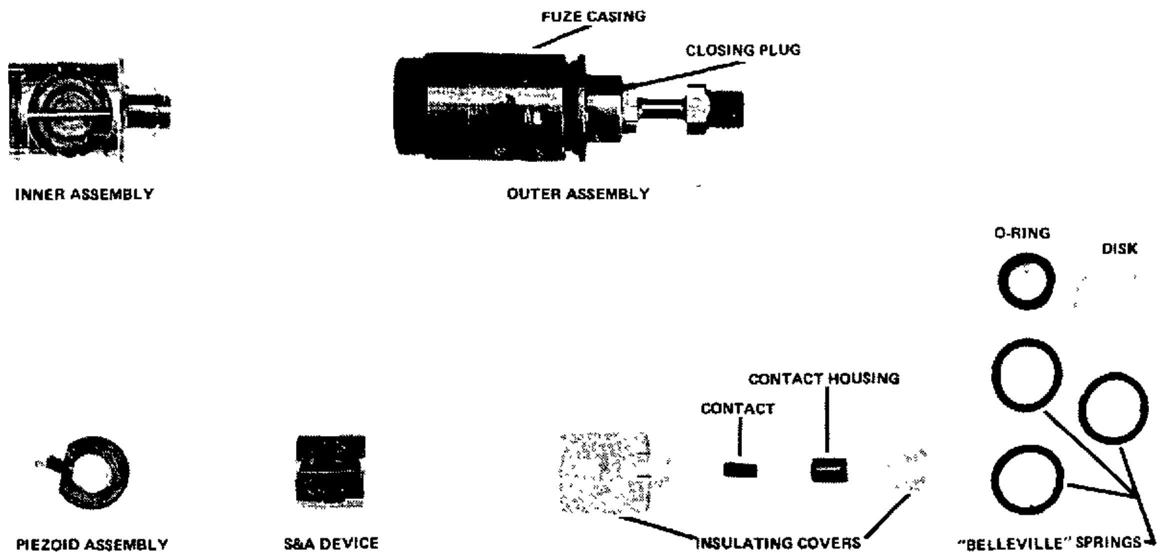

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Figure 4-5. Fuze, BD, Model (MINIMAN), exploded view (U).

(C) **Design Details**

General. The MINIMAN piezoelectric, BD fuze (fig 4-5) is a compact design. It consists primarily of a piezoid assembly, S&A device, and contact housing. The inner assembly is then covered with a transparent, plastic, insulating material and inserted into the fuze outer assembly. A plastic disk is placed around the contact housing as well as an "O"-ring and three belleville springs. The closing plug is then screwed into the casing of the outer assembly until metal-to-metal contact occurs between the casing and plug. The fuze is threaded at both ends. The forward end is screwed into the base of the projectile.

Fuze, BD, Model (MINIMAN)
FOM No. 1390-19-1-7

(C) Design Details (Continued)

S&A device (Fig 4-6)

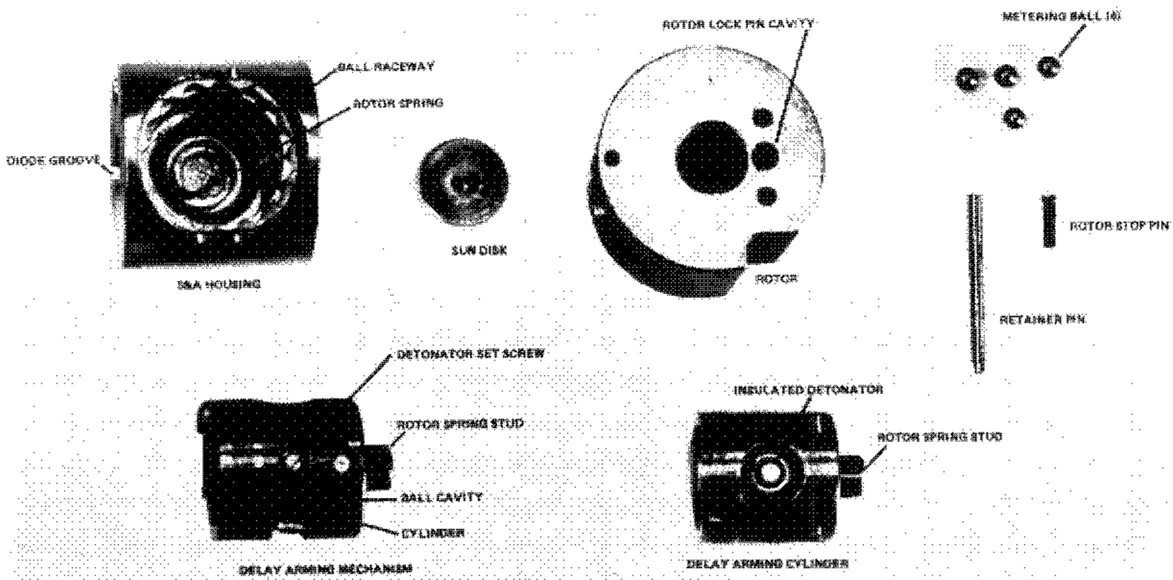

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Figure 4-6. Fuze, BD, Model (MINIMAN), disassembled S&A device (U).

The S&A device consists of a cylindrical, slotted S&A housing bored out and machined to facilitate a flat rotor spring, ball raceway, sun disk and delayed-arming cylinder housing the rotor and a slotted rotor spring stud.

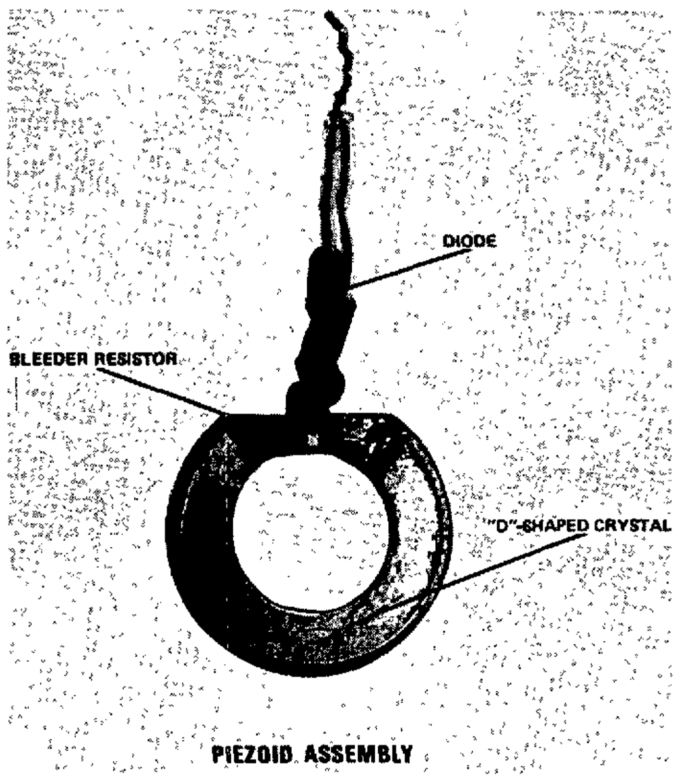
The delayed-arming cylinder also has holes drilled to accommodate four balls for metering the motion of the spring-driven rotor, which houses an insulated electric detonator. The center set screw locks the detonator contained in the rotor.

In addition, there are two detent balls detenting the rotor lock pin. These balls are held in place by two spring-loaded pins in adjacent holes. These pins release the detent balls on setback. The long retainer pin shown above retains the rotor and delayed-arming cylinder in the S&A housing.

(C) Design Details (Continued)

The S&A housing is grooved to provide space for the diode of the piezoid assembly. The detonator is of the grounded-case design with an insulated center contact.

Piezoid assembly.



(CONFIDENTIAL)
Figure 4-7. Fuze, BD, Model (MINIMAN), piezoid assembly (U).

The piezoid assembly (fig 4-7) consists of a bleeder-type resistor, "D"-shaped piezoid or crystal, and diode. The crystal is made of lead-zirconate-titanate material placed between two metallic collectors. The piezoid is a high-impedance type excited by the shock travel generated upon impact with the target. The diode permits brush discrimination and precludes functioning when the projectile brushes leaves or twigs during flight.

Fuze, BD, Model (MINIMAN)
FOM No. 1390-19-1-7

(U) Functioning

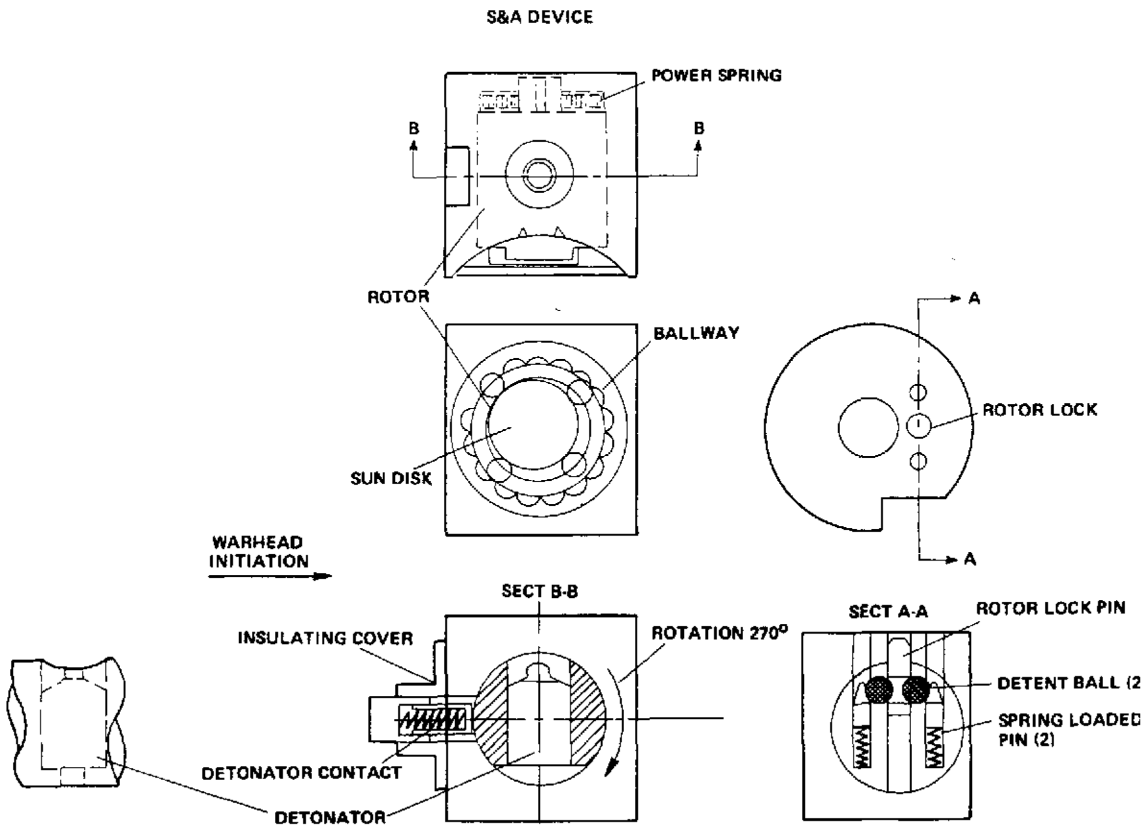


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Figure 4-8. Fuze, BD, Model (MINIMAN), section view of S&A device (U).

The S&A device (fig 4-8) arms by setback during acceleration at launch. Upon setback, the spring-loaded pins move rearward, releasing the two balls, undenting and releasing the rotor lock pin. The rotor which houses the detonator is now driven to electrical alignment by the rotor spring. The rotor motion is metered or controlled via the ball raceway mechanism. The rotor moves 270°, pressing through the aligned position with the detonator upside down. The contact pin can only enter the rotor and contact the detonator button when it comes to rest at the rotor stop pin. The contact pin also serves to lock the rotor once armed.

(U) **Functioning (Continued)**

Upon impact with the target, the shock wave travels through the distance tube and projectile body to the piezoid. The piezoid is then excited and produces the necessary voltage to fire the electric detonator and, in turn, detonate the booster and the shaped charge of the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
74-mm HEAT projectile	74-mm RCLS antitank weapon (MINIMAN)

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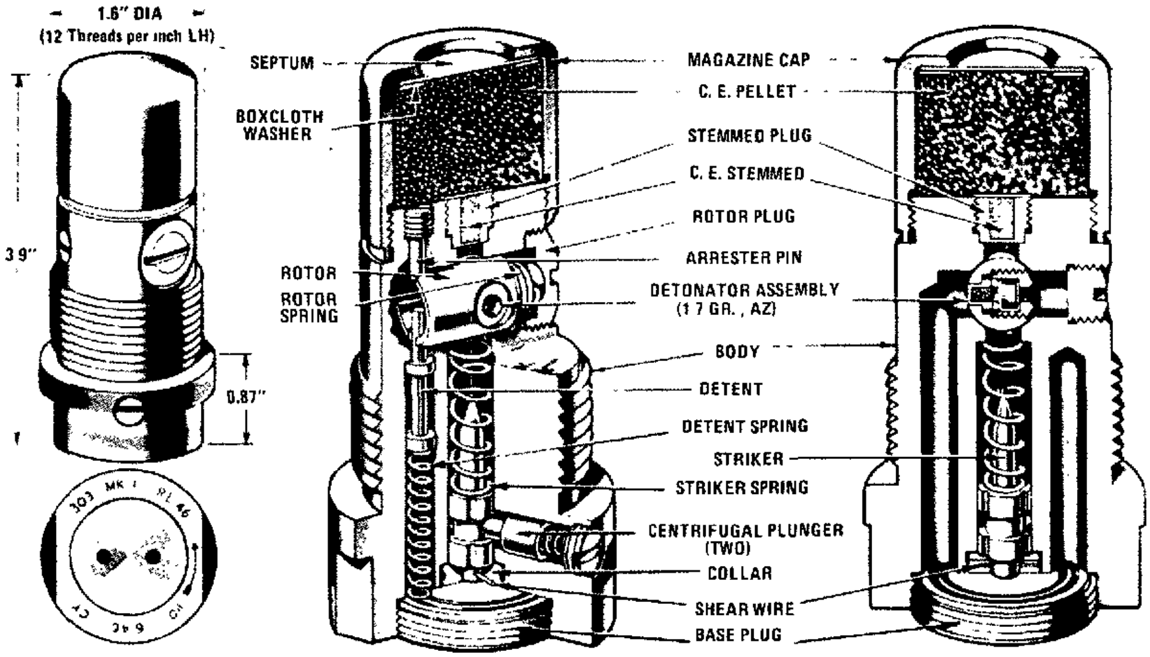

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Figure 4-9. Fuze, BD, Model No. 303 Mk 1, contour and cutaway views (U).

(C) Description

The No. 303 Mk 1 BD fuze (fig 4-9) is a setback- and centrifugally-armed type which functions upon impact. It was developed by the United Kingdom for use with 165-mm HESH ammunition fired from the L9A1 gun mounted on the armored reconnaissance vehicle (AVRE). This fuze is bore safe by US standards.

(C) Unique Features

- Setback pin detenting torqued spring-loaded rotor housing an out-of-line detonator.

Fuze, BD, Model No. 303 Mk 1
FOM No. 1390-35-1-1

(C) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	?
Markings	303 MK R.L.46
Length	99 mm (3.901 in)
Thread diam	40.6 mm (1.60 in)
TPI	12 (LH)

Booster:

Body material	?
Body length	25.4 mm (1.00 in)
Explosive	Tetryl
Explosive weight	28.3 g (0.062 lb)

Functional data:

Arming method	Setback & centrifugal force
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	?

(C) **Design Details**

General. The No. 303 Mk 1 BD fuze (fig 4-9) consists principally of a body, magazine, stemmed plug, rotor plug, rotor assembly, arrester pin, detent and detent spring, striker and striker spring, centrifugal plunger, collar, shear wire, and base plug.

Body. The body is made of aluminum. Externally it is formed with an enlarged portion at the base, above which it is screw-threaded to 1.6-in (41-mm) diameter (12 TPI, left hand) to suit the fuze hole in the base of the shell. Above the threaded portion, it is of slightly reduced diameter and formed plain; at the top, it is further reduced in diameter, an undercut being made above which it is screw-threaded to accept a cap that forms the

*Arrester and setback pins detent a torqued rotor that houses a line detonator, two centrifugal plungers detenting firing pin and shear wire.

(C) Design Details (Continued)

magazine. Two flats are formed on the sides of the enlarged portion to facilitate assembly or removal from the shell.

From the base, a hole is bored in the center of the body to house the striker and striker spring, while off center three holes are bored: one to house the detent and detent spring, the other two to lighten the body and also act as vents to relieve pressure should the detonator be fired prematurely. A hole is also drilled in the center of the top and screw-threaded to take the arrester pin. Below the stemmed plug, a larger hole is drilled through the side of the body to house the rotor assembly which, after insertion, is retained in position and sealed by screwing home the rotor plug. This horizontal hole also connects with one of the vent holes bored from the base of the body. Another hole is bored through the side of the enlarged portion of the body at the base to accept the two centrifugal plungers which are retained in position by screwed plugs. Two blue bands are painted around the base portion of the fuze.

Magazine (i.e., booster). The magazine consists of a cup-shaped flat-bottom cap, threaded internally at the mouth to screw on to the top of the fuze body. A hole is also formed in the top, being closed by a brass septum, beneath which is inserted a box-cloth washer. A CE pellet weighing approximately 1 oz (28.35 grams) is assembled in the magazine.

Stemmed plug. The plug is of metal, screw-threaded externally, with a hole drilled through the center leaving a thin diaphragm of metal at the base. This recess is filled with CE stemmed in (i.e., tetryl filled) and retained in position by a paper disk shellaced to the top surface of the plug. The plug is screwed into the hole formed in the center of the top of the body.

Rotor plug. This is made of metal, screw-threaded externally, with a screwdriver slot cut across the base. Internally, it is recessed to fit over the end of the rotor assembly. It is assembled in the side of the body behind the rotor assembly.

Arrester pin. This is made of metal, formed with a cylindrical shank and an enlarged screw-threaded head. It screws into the hole formed off center in the top of the body, the shank or stem emerging through the bottom of the hole acts as a stop or arrester when the detent sets back and the rotor assembly revolves under the influence of the rotor spring.

Fuze, BD, Model No. 303 Mk 1
FOM No. 1390-35-1-1

(C) Design Details (Continued)

Rotor assembly. The rotor assembly consists of a cylindrical housing, with a rotor, rotor spring, detonator plug and 1.7-g (0.11-gram) "A" (copper alloy shell) detonator, distance piece, and lead-azide CE (i.e., tetryl) sleeve. A hole bored in the side of the rotor accommodates the lead-azide sleeve, above which is inserted the distance piece and detonator housed in the detonator plug. One end of the rotor is closed and formed with a spigot or boss, over which is assembled a cylindrical-coiled rotor spring. Slots are cut in the sides of the open end of the rotor: the end of the detent engages in the smaller slot; the other, which is wider, acts as a stop when it comes into contact with the stem of the arrester pin when the rotor revolves.

Detent (setback pin). The detent is made of steel and consists of a rod with a cylindrical flanged head, a collar being formed about the center of the rod to act as a guide. Inserted from the base of the body, it seats on the detent spring. The stem of the detent engages in a slot in the rotor assembly and retains it in the unarmed position until the shell is fired.

Detent spring (setback spring). This is a cylindrical-coiled steel wire spring which is positioned behind the detent.

Striker (firing pin). The striker is made of steel, in the form of a rod with a needle point at the front. At the lower portion of the rod, two collars are formed which act as centering bands, the portion between the collars forming a recess into which the centrifugal plungers engage. A small spigot is formed at the rear of the striker, and a small hole to accept a copper shear wire is drilled through it.

Striker spring. The striker spring is a cylindrical-coiled steel-wire spring which is assembled over the stem of the striker, the top coil resting below an undercut formed in the top of the channel of the body.

Centrifugal plungers. The plungers consist of a short stem with an enlarged cylindrical head. A recess formed in the top of the head makes a seating for the coiled spring. The plungers are inserted through the side of the body, the holes being closed by screwed plugs. The stems of the plungers engage in the recess between the two collars formed on the striker and prevent the striker from moving forward until the plungers are withdrawn by centrifugal force.

(C) **Design Details (Continued)**

Collar. The collar is inserted over the spigot formed at the rear of the striker and secured by the shear wire, which is inserted in holes drilled through the collar and spigot. In flight, the shear wire in the collar prevents the striker from moving forward after the plunger is disengaged by centrifugal force.

Base plug. The base plug is a solid screw-threaded disk. Two grooves are formed on its inner face, connecting the two vents drilled in the body. Two holes, diametrically opposite, are formed on the outer surface of the base for the assembly tool.

(C) **Functioning**

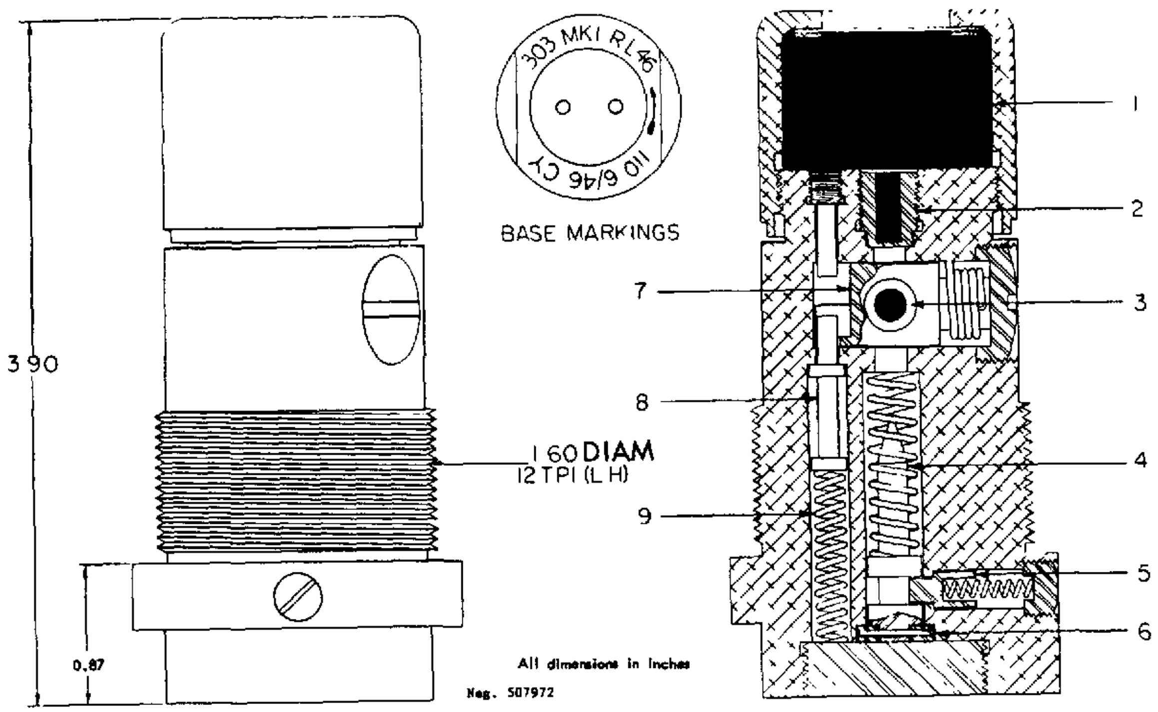

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Figure 4-10. Fuze, BD, Model No. 303 Mk 1, section view (U).

Fuze, BD, Model No. 303 Mk 1
FOM No. 1390-35-1-1

(C) Functioning (Continued)

The No. 303 Mk 1 BD fuze (fig 4-10) requires both centrifugal and setback forces to arm. Upon firing the projectile, setback forces the detent (8) to the rear, compressing its spring (9). This motion of the detent releases the rotor (7). When setback ceases, the rotor rotates a quarter of a turn, bringing the detonator (3) into line. At the same time, centrifugal forces move the two spin detents (5) out, releasing the firing pin (4). The fuze is now fully armed; however, the detonator and the firing pin are kept separated by the shear wire (6) and the firing-pin spring.

On impact, the shear wire is broken and the firing pin moves forward, compressing the spring and piercing the detonator. In turn, the detonator initiates the tetryl lead (2) and the booster (1).

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
165-mm HESH projectile, Model LI, Mk1	165-mm AVRE with Model L9A1 gun

(C) Remarks

Although this fuze was declared obsolete in 1962, it has good design features that warrant incorporation into this handbook.

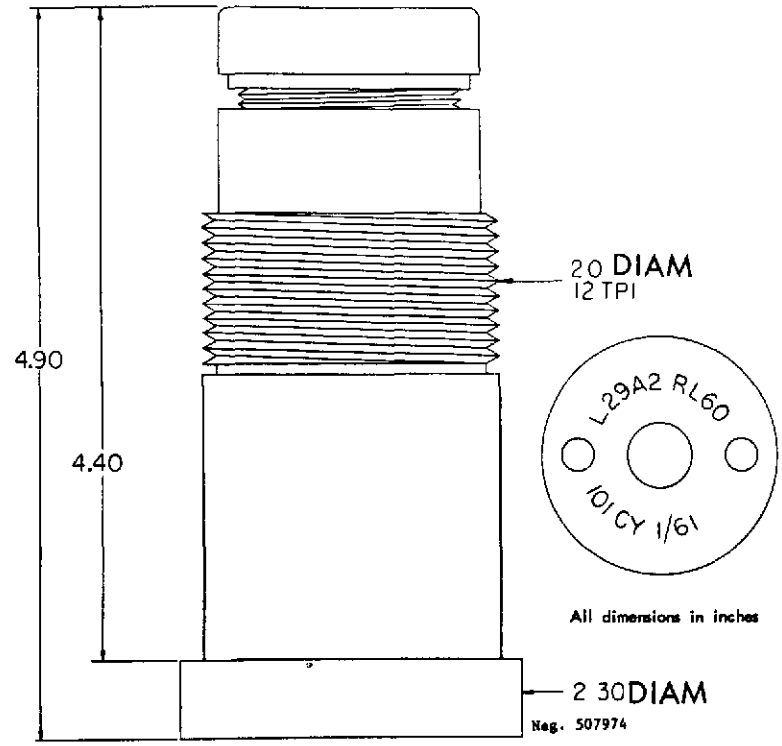

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Figure 4-11. Fuze, BD, Model L29A2, contour view (U).

(U) General

The L29A2 (fig 4-11) is a delayed-arming, graze-sensitive, BD fuze designed to function on impact with the target. Except for minor modifications to the delayed-arming shutter and detonator, the L29A2 is similar in design and functioning to the UK L29A1 design (see FOM No. 1390-35-1-28).

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Fuze, BD, Model L24A2
FOM No. 1390-35-1-7

(C) General

The L24A2 is a delayed-arming, graze-sensitive, BD fuze similar in design and functioning to that of the L24A1 (see FOM No. 1390-35-1-27) except for the delayed-arming shutter and detonator.

(C) Application (Ammunition and Weapons)

Ammunition	Weapons
165-mm HESH projectile, Model L33A1	165-mm AVRE guns, Model L9A1

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Fuze, BD, Model L19A4
FOM No. 1390-35-1-4

(C) General

The L19A4 fuze is standard for use with 76-mm, 25-pounder, 105-mm, and 120-mm HESH projectiles. It is similar in design and functioning to the earlier L19A1 (see FOM No. 1390-35-1-26), L18A2, and L19A3 models. It is a delayed-arming, graze-sensitive, BD fuze. The only differences between the L19 series fuzes are the minor changes in the delayed-arming shutter and the detonator.

(C) Application (Ammunition and Weapons)

Ammunition	Weapons
76-mm, 25-pounder, 105-mm, and 120-mm HESH projectiles	76-mm gun, Model 15A1, on Saladin or Scorpion armored cars; 25-pounder gun/howitzer, Mk 2; 105-mm tank gun, Model L7A1; 120-mm RCLS BAT gun; 120-mm tank gun, Model L1

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Fuze, BD, Model L10 Mk 1
FOM No. 1390-35-1-24

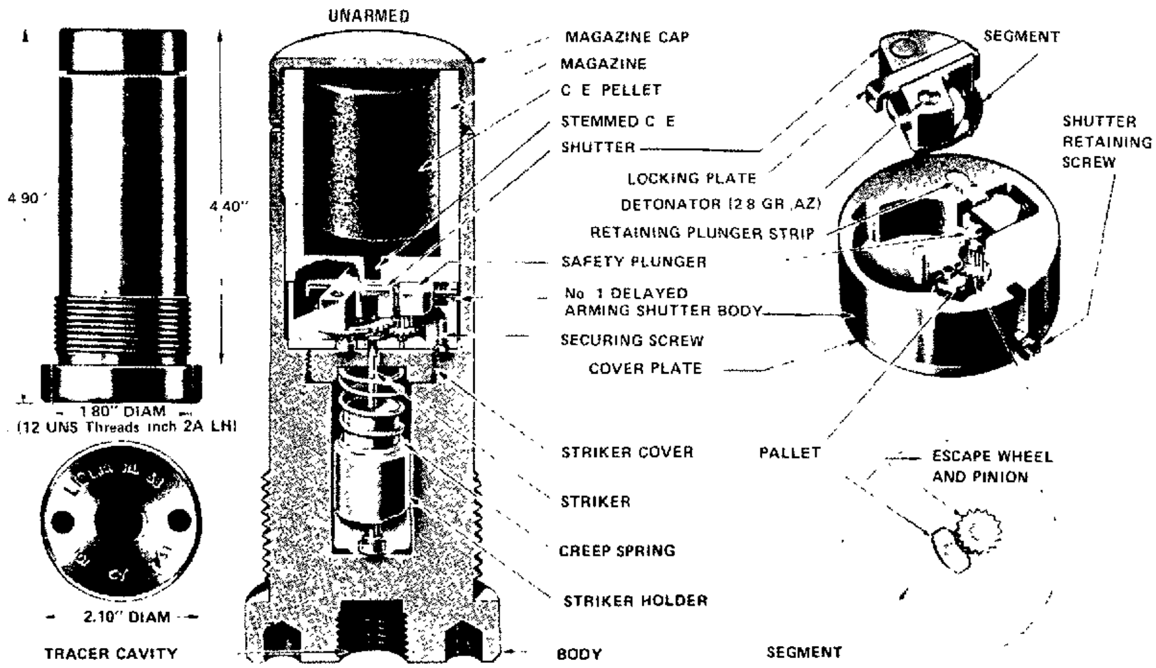

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Figure 4-12. Fuze, BD, Model L10 Mk 1, contour and section views (U).

(C) Description

The L10 Mk 1 (fig 4-12) is a delayed-arming, graze-sensitive, BD fuze designed for use with HESH projectiles fired from the UK 25-pounder gun. It is considered bore safe by US standards. The fuze arms within 0.06 second, with the projectile spinning at 5900 r/min.

(C) Unique Features

- Shutter housing out-of-line detonator.
- Escapement controlling movement of shutter.
- Spring-loaded safety plunger engaging locking plate detenting shutter.

Fuze, BD, Model L10 Mk 1
FOM No. 1390-35-1-24

(C) **Characteristics**

Fuze assembly:	
Body material	Anodized aluminum alloy
Weight	?
Markings	L10 Mk 1
Max length	4.90 in (124.46 mm)
Thread diam	1.80 in (45.72 mm)
TPI	12
Booster:	
Body material	Anodized aluminum alloy
Body length	?
Explosive	Tetryl
Explosive weight	?
Functional data:	
Arming method	Setback & centrifugal force
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	0.06 s

(C) **Design Details**

General. The L10 Mk 1 fuze (fig 4-12) incorporates a delayed-arming shutter. It consists principally of a body, magazine and cap, striker assembly and cover, creep spring, and delayed-arming shutter No. 1 containing a 0.18 gram (2.8 gr) "AZ" detonator.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape with a wide flange formed at the base, above which it is externally threaded to 1.8-inch (45.72-mm) diameter (12 UNS TPI-2A, left hand) to suit the fuze hole of the shell for approximately a quarter of its length; the remainder of the body is left plain. A hole is drilled in the center of the base and threaded to accept a tracer adapter (120-mm [4.72-in] shell only). Two holes, diametrically opposite, are also formed in the base to enable the fuze

*Safety plunger, locking plate, and out-of-line detonator.

(C) Design Details (Continued)

to be inserted or removed from the shell. The base of the body and flange is coated with varnish RD 1177 after lot and filler data have been stamped on the base. Internally, the body is bored to three diameters, the smaller at the base to accommodate the striker assembly, the second shorter but slightly larger in diameter and threaded to take the striker cover, while the third and largest is threaded at the mouth. This recess accommodates the delayed-arming shutter above which the magazine is screwed home.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy. The magazine is cup-shaped and threaded externally for about two-thirds of its length; the remaining portion is left plain. Two key slots are formed on its outer rim to facilitate assembly. Internally, a small recess is drilled in the bottom, leaving a thin diaphragm of metal between the recess and the outer surface of the base of the magazine. This small recess in the bottom of the magazine is filled with tetryl, while a prepressed pellet of tetryl is inserted in the larger recess. The threads of the magazine are coated with composition RD 1285 or 1285 A, and it is then screwed into the open end of the fuze body, the base of the magazine resting above the delayed-arming shutter. The outer end of the magazine protrudes outside the body of the fuze and is closed by a magazine cap.

Magazine cap. The magazine cap is made of anodized aluminum alloy. The cap is cup-shaped, the inner rim being threaded to engage over the mouth of the magazine.

Striker assembly. The striker assembly consists of a holder, needle striker, and plug.

- **Striker holder.** The weighted, cylindrical striker holder is made of steel electroplated with zinc. It is formed in two diameters with a small recess formed in the base and a hole bored through the center to house the needle striker.

- **Needle striker (firing pin).** Made of steel electroplated with zinc, the needle striker is formed with a stem with a sharp point and a flanged head.

- **Plug.** The plug is a flat disk of brass formed with a hole through the center.

Fuze, BD, Model L10 Mk 1
FOM No. 1390-35-1-24

(C) Design Details (Continued)

The stem of the needle striker protrudes through the hole bored in the striker holder. The needle striker is retained in the holder by the brass plug, which is assembled behind its flanged head and secured by spinning over a lip formed on the base of the holder. After turning over the lip, the needle striker must be free to move sideways in the hole in the striker holder. The striker assembly is inserted into the fuze body together with the creep spring and is retained in position by screwing home the striker cover.

Striker cover. Made of anodized aluminum alloy, the striker cover is in the form of a disk, the outer rim of which is threaded. The underside is recessed to make a seating for the top of the creep spring. A small hole is also drilled in the center through which the point of the striker emerges when the striker holder sets forward on impact or graze.

Creep spring. The creep spring is made of steel, tinned and electroplated with zinc. The cylindrical coiled spring has four effective coils of 0.040-inch (10.15-mm) diameter, with one coil at each end close coiled and ground square with the axis of the spring. It is assembled around the top portion of the striker holder and prevents the holder from creeping forward while the shell is in flight. It is retained in position by the striker cover.

Delayed-arming shutter No. 1. The assembly comprises four main components, an aluminum-alloy circular-shaped body, the escapement, a steel electroplated with zinc safety plunger with spring, and an anodized aluminum alloy rotary type shutter containing a 2.8-g (0.18-gram) "AZ" lugless (tinned copper-alloy cup) detonator. The shutter is held in the unarmed position by means of a spring-loaded safety plunger which engages in a locking plate. The safety plunger is retained in a recess formed in one side of the shutter body by a plunger retaining strip. On spin, the safety plunger, overcoming its spring, disengages from the recess in the end of the locking plate by the influence of centrifugal force, and the lead-weighted, biased shutter rotates until the detonator in it is in a central position over the striker nose. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the plunger in its recess in the shutter body and prevents it from moving into the shutter housing when the plunger spring reasserts itself, thus obviating the possibility that the shutter and delayed-arming mechanism will be fouled by the plunger. The locking plate, which fits into a slot made across the face of the shutter, moves out and when the shutter reaches the fully armed position engages in a recess made in the outer side of the shutter body, thus locking the shutter in the armed position. The delay is obtained by means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape

(C) Design Details (Continued)

wheel is fitted with a pinion which is in mesh with a segment on the side of the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary movement of the shutter. The approximate time of arming is 0.06 second from the time the shutter commences to open, which occurs when the shell is spinning at 5900 r/min. A coverplate, made of aluminum alloy is assembled on the base of the shutter body and is retained in position by securing screws. It is prepared to accept the pivot pins of the shutter and escape wheel. The shutter body is fitted in the fuze body below the magazine which, when assembled, holds it in position. It is also secured by a screw inserted through the side of the fuze body. The threads and slotted head of the screw are coated with composition RD 1285 or 1285 A at the time of assembly.

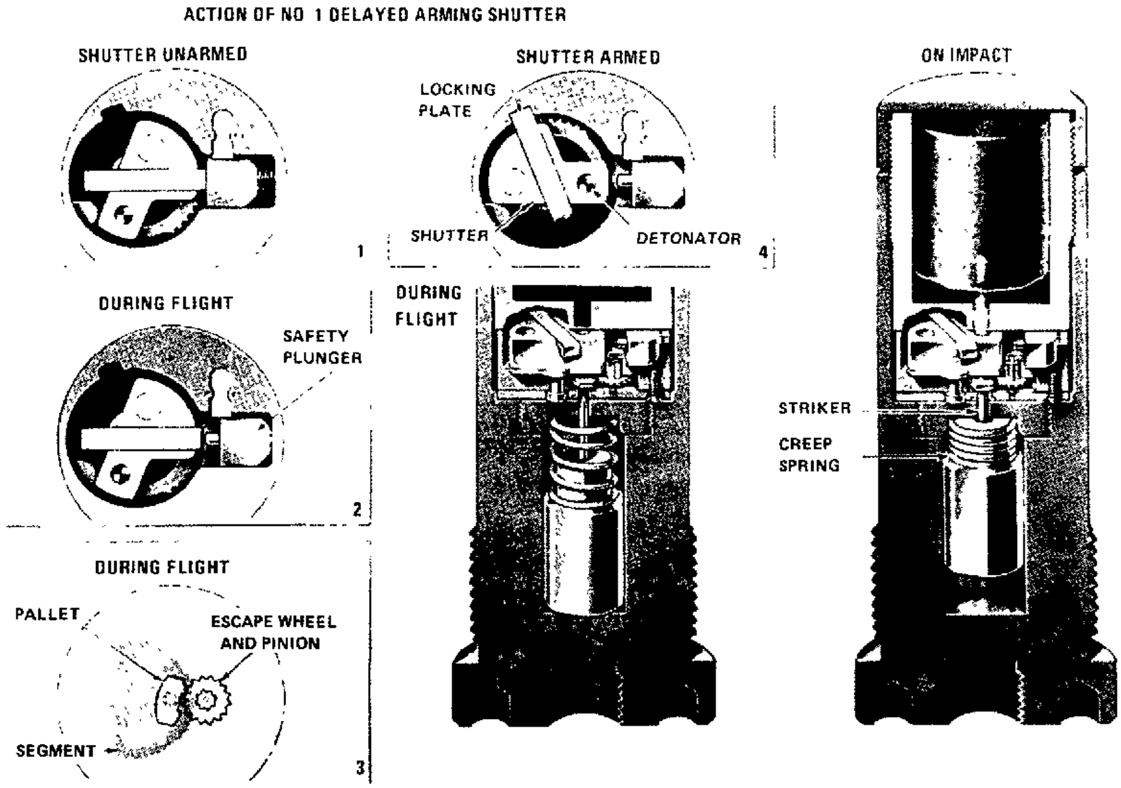
(C) Safety

Safety is provided as follows:

- The shutter is retained in the unarmed position by the spring-loaded safety plunger, which engages in a shutter locking plate.
- When the shutter is in the unarmed position, its detonator is screened off from the striker and from the tetryl-filled channel leading to the tetryl pellet in the magazine.
- The shutter is designed to provide a slight delay before it reaches the armed position. The appropriate time of operation is 0.06 second at 5900 r/min.
- The creep spring prevents the striker holder and striker from moving forward during flight.

Fuze, BD, Model L10 Mk 1
FOM No. 1390-35-1-24

(C) Functioning



(CONFIDENTIAL)
Figure 4-13. Fuze, BD, Model L10 Mk 1, functioning views (U).

On firing, the shutter and striker-needle holder set back and are retained in the unarmed position by friction.

During flight, the safety plunger overcomes its spring and moves outward to release the shutter. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the latter and prevents it from leaving its recess in the shutter housing when the plunger spring reasserts itself, thus obviating the possibility that the shutter and delayed-arming mechanism will be fouled by the plunger. The shutter begins to rotate until its detonator reaches a central position directly in alignment with the striker needle and the stemmed CE (tetryl) leading to the CE pellet in the magazine. The delay is obtained by

(C) **Functioning (Continued)**

means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape wheel is fitted with a pinion which is in mesh with a segment on the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary movement of the shutter. When the shutter reaches the fully armed position, it is locked by the locking plate, which moves outwards along its slot in the top face of the shutter to engage in a recess in the shutter housing.

On impact or graze, the momentum of the striker holder overcomes the creep spring and carries the striker forward for the point to pierce the detonator. The resultant detonating wave is transmitted through the stemmed CE (tetryl) in the magazine channel, to the CE pellet in the magazine and thence on to detonate the bursting charge in the shell.

(C) **Application (Ammunition and Weapons)**

Ammunition	Weapons
HESH projectiles	QF 25-pounder gun

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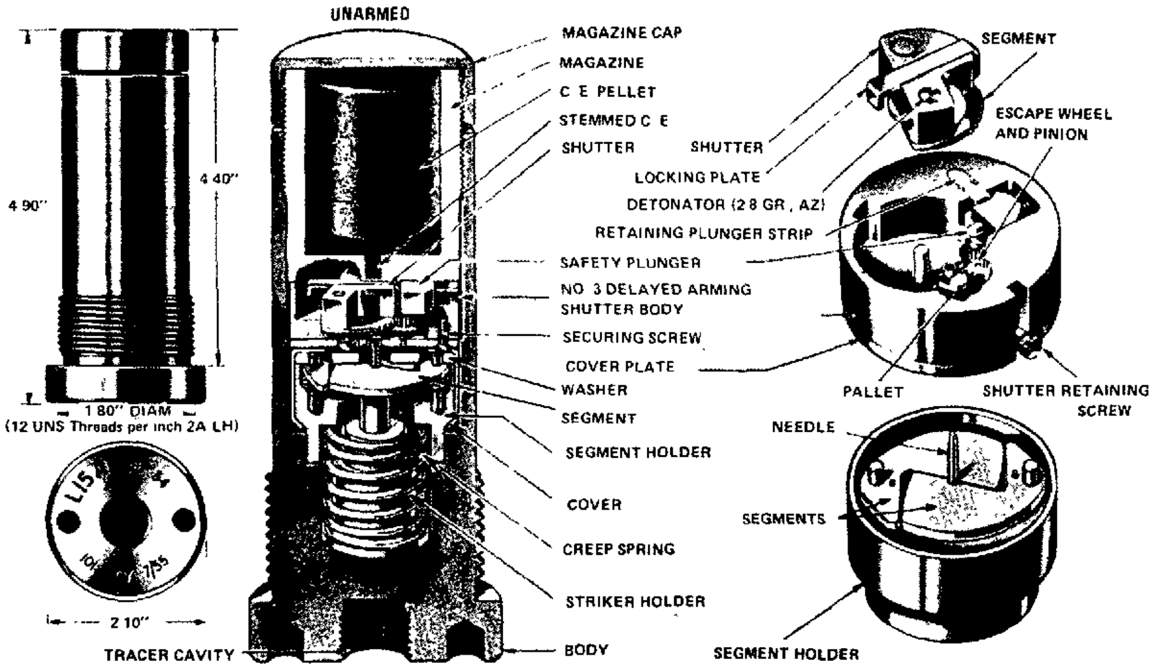


Neg. 552502 (CONFIDENTIAL)

Figure 4-14. Fuze, BD, Model L15A2, contour and section views (U).

(C) Description

The L15A2 (fig 4-14) is a delayed-arming, graze-sensitive, BD fuze designed to function upon impact with the target. It is intended for use with HESH ammunition fired from the 120-mm tank gun, L1. The L15A2 is both bore and muzzle safe.

(C) Unique Features

- Shutter housing out-of-line detonator.
- Escapement controlling movement of shutter.
- Spring-loaded safety plunger detenting shutter.

Fuze, BD, Model L15A2
FOM No. 1390-35-1-25

(C) Characteristics

Fuze assembly:	
Body material	Anodized aluminum alloy
Weight	?
Markings	L15A1
Length	4.90 in (124.46 mm)
TPI	12
Booster:	
Body material	Anodized aluminum alloy
Body length	?
Explosive	Tetryl
Explosive weight	?
Functional data:	
Arming method	Setback & centrifugal force
Firing method	Impact
Safety devices	Spring-loaded safety plunger & safety locking plate
Arming distance	?
Arming time	0.02 to 0.06 s

(C) **Design Details**

General. The L15A2 BD fuze (fig 4-14) consists principally of a body, striker assembly, creep spring, striker locking-segment assembly, delayed-arming shutter No. 3 containing a 2.8-gr (0.18-gram) "AZ" detonator, magazine and cap.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape with a wide flange formed at the base, above which it is externally threaded to 1.80-inch (45.72-mm) diameter (12 UNS TPI 2A, left hand) for approximately a quarter of its length to screw into the base of the shell. Above the threaded portion, the remainder of the body is left plain. A hole is drilled in the center of the base and threaded to accept a tracer-adapter (120-mm L1 TK shell only). Two holes, diametrically opposite, are also formed in the base to enable the fuze to be inserted or removed from the shell. Internally, the body is bored

(C) Design Details (Continued)

from the top in four diameters: the smaller at the base to accommodate the striker assembly and creep spring; the second and third, which are slightly larger in diameter, accommodate the striker locking segment assembly; while the fourth and largest is threaded at the mouth. This larger recess accommodates the delayed-arming shutter assembly, above which the magazine is assembled. The base and the flange of the body are coated with varnish after the markings have been stamped on.

Striker assembly. This consists of a brass, electrotinned, cylindrical body with a flange at the base, above which it is formed on three decreasing diameters, a recess being formed in the top of the smallest diameter to accept the base portion of the electroplated tin- or zinc-coated steel needle (firing pin), the stem of which, on assembly in the fuze, protrudes through the center of the two striker locking segments. The needle, the base of which is flanged, is retained in the recess in the top of the striker body by a tin-coated brass washer, which is secured by spinning over the lip of the recess. The needle is free to move sideways in the recess. The striker assembly is inserted into the cavity in the base of the fuze body together with the creep spring, which is assembled around the larger diameter of the striker body, the bottom coil resting on the flange. The creep spring is retained under initial compression by the top coil, seating in a recess and bearing against the base of the striker locking-segment holder.

Creep spring. The creep spring is a cylindrical-coiled, tinned, steel-wire spring with four effective coils of 0.056-inch (1.42-mm) diameter wire, one coil at each end being close coiled and ground square with the axis of the spring. It is assembled around the larger diameter of the striker body and prevents the assembled striker from creeping forward when the shell is in flight and the locking segments open under the influence of centrifugal force.

Striker-locking segment assembly. This is assembled in the fuze body, the lower portion fitting over the top of the striker. It is retained in position by a screw inserted through the side of the fuze body, the shank of which bears on the striker locking segment cover. The striker-locking segment assembly comprises a holder, two electrotin-plated steel pins, two springs, two segments, a washer, and a cover.

(C) Design Details (Continued)

Holder. The holder is made of anodized aluminum alloy and is cylindrical in shape. Externally, it is formed on two diameters, the larger being at the top. The bottom portion of the larger diameter is chamfered to blend with the smaller. The bottom of the smaller diameter is also chamfered. Internally from the base it is bored out in two diameters, while a recess is formed in the top face to house the two locking segments, leaving a platform of metal between the top and bottom. A hole, the lower edge of which is chamfered, is drilled through the center of the platform to permit the stem of the striker to pass through. In the base of the recess in the top of the holder, near the periphery, two holes, diametrically opposite, are drilled to accept the steel pins, over which are assembled the coiled springs and the segments. When assembled, the tops of the two pins protrude above the top surface of the holder.

Segments. The segments are made of aluminum alloy and are perfectly flat, irregular, arc-shaped fitments. One end is in the form of a toe which is machined to act as a working surface when the two segments are assembled in the unarmed or locked position, the other end is wider and acts as a weight which, under the influence of centrifugal force, overcomes the springs and allows the two segments to open outwards. Two holes are drilled near the toe, the larger to fit over the pin on which the segment pivots, the smaller accommodating the turned-up end of the segment spring. In the closed or unarmed position, the top portion of the striker bears against the underside of the closed segments, and thus the striker is prevented from moving forward until the segments are opened by centrifugal force.

Segment springs. These springs are made of 0.022-inch (0.55-mm) diameter tinned-steel wire, with 6.2 close-wound coils, the ends of the wire being bent up at right angles to the coils. These are assembled over the pivot pins and beneath the segments, the lower end of the spring fitting into a small hole drilled in the holder adjacent to the pin, while the upper end of the spring is located in a small hole drilled in the segment.

Washer. Made of aluminum alloy, the washer is in the form of a flat disk with a hole formed in the center, and two slots, diametrically opposite, near the periphery. It is assembled on top of the holder, the protruding ends of the pivot pins being located in the slots, and the pivot of the striker needle protruding through the center hole.

(C) Design Details (Continued)

Cover. The cover is made of aluminum alloy, formed with a large hole in the center. It fits over the top of the holder and retains the washer in position above the segments. It is secured in position by spinning the bottom edge around the external chamfered portion of the holder.

Delayed-arming shutter No. 3. (See sec VIII) This consists of four main components, the body, the escapement, a safety plunger with spring, and a rotary-type shutter containing a 0.18-gram (2.77-gr) "AZ" lugless (tinned copper alloy cup) detonator assembled in a circular-shaped shutter body. The shutter is held in the unarmed position by means of a spring-loaded safety plunger which engages in a locking plate. The safety plunger is retained in a recess in the side of the shutter body by a plunger retaining strip. On spin, the safety plunger overcomes its spring and disengages from the recess in the end of the locking plate under the influence of centrifugal force, and the lead-weighted biased shutter rotates until the detonator is in a central position over the striker hole. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the plunger in its recess in the shutter body.

The locking plate, which fits into a slot made across the face of the shutter, moves out and engages in a recess made in the outer side of the shutter body, thus locking the shutter in the armed position. The delay is obtained by means of a pallet and pinion mechanism positioned beneath the shutter, and this oscillates a segment by means of a 'scape (escape) wheel and pinion which retards the opening of the shutter. The shutter commences to open when the projectile is spinning between 7000 and 8500 r/min. The time of opening is between 0.020 and 0.055 second when the projectile is spinning at 9000 r/min. The delayed-arming shutter assembly is assembled in the fuze body below the magazine. It is located and prevented from revolving by a screw inserted through the side of the fuze body which enters a slot formed in the side of the shutter body. It is further secured by a screw inserted through the side of the fuze body, the stem of which enters a hole drilled in the shutter body. The threads of both screws are coated with cement. The junction of the thread is stabbed after screwing home. The slotted end of the screw is then coated with cement.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy. It is cup-shaped and threaded externally commencing at the mouth for about two-thirds of its length, the remaining portion being slightly reduced in diameter and left plain. Two slots are

Fuze, BD, Model L15A2
FOM No. 1390-35-1-25

(C) Design Details (Continued)

formed in the outer rim to facilitate assembly. Internally, the magazine is bored out to take a prepressed pellet of tetryl and a small recess, filled with loose tetryl stemmed in, is drilled in the center of the bottom, leaving a thin diaphragm of metal between the recess and the outer surface at the base of the magazine. The magazine is screwed into the open end of the fuze body, the base of the magazine resting above the delayed-arming shutter assembly. The outer end of the magazine protrudes above the body of the fuze and is closed by a magazine cap.

Magazine cap. The cap is made of anodized aluminum alloy. It is cup-shaped with an internal thread to screw over the mouth of the magazine; the threads are coated with RD 1285 or 1285 A prior to assembly.

(C) Safety

Safety is provided as follows:

- The rotating delayed-arming shutter is retained in the safe or unarmed position by the spring-loaded safety plunger which engages in the safety locking plate. This provides bore and muzzle safety to cover a specified minimum distance from the gun.

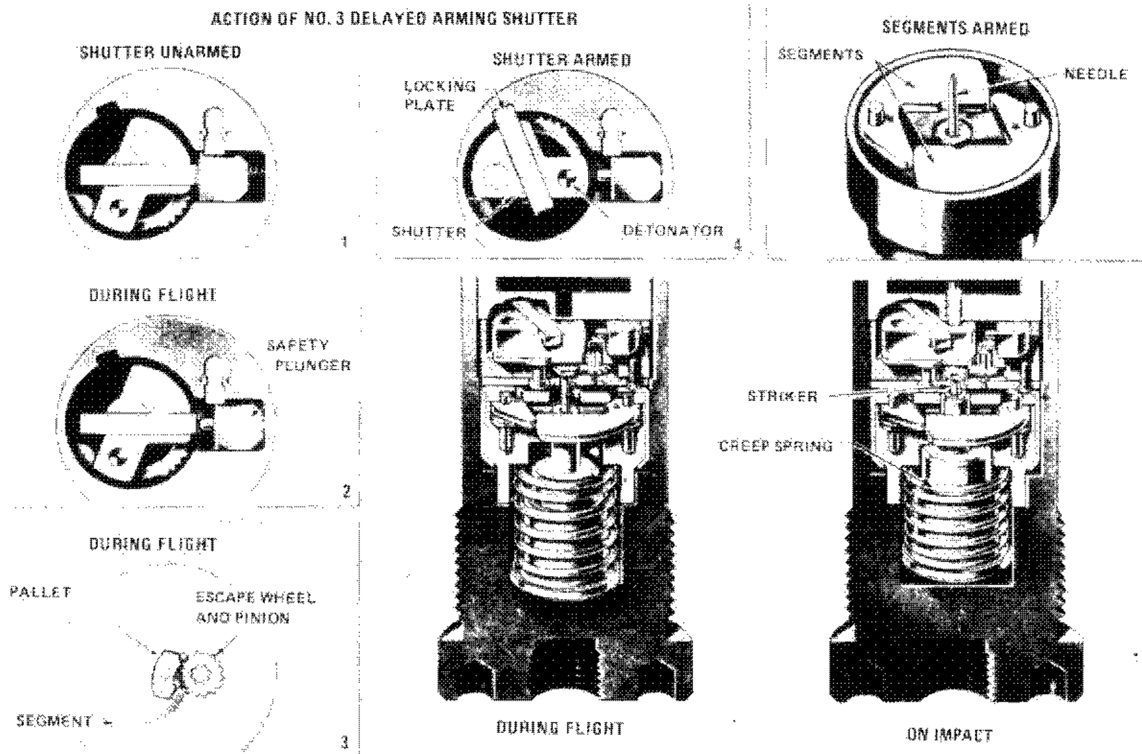
- When the shutter is in the unarmed position, its detonator is screened off from the striker and from the stemmed tetryl channel leading to the tetryl pellet in the body of the magazine.

- The shutter is designed to provide a slight delay before it reaches the armed position. The approximate time of operation is 0.020 to 0.055 second at 9000 r/min.

- The striker locking segments prevent the striker from moving forward before firing and hold the striker in the "SAFE" position in transit, handling, and loading.

- The creep spring prevents the tendency of the striker to move forward during flight, due to deceleration after leaving the muzzle.

(C) Functioning (Fig 4-15)



(CONFIDENTIAL)
Figure 4-15. Fuze, BD, Model L15A2, functioning views (U).

On firing, the shutter, striker locking segments, and striker setback are retained in the unarmed position by friction.

During flight, the segments in the striker-locking assembly move outward against their springs, leaving a clear passage for the striker to move forward. The safety plunger overcomes its spring and moves outwards to release the shutter. The shutter begins to rotate until its detonator reaches a central position directly in alignment with the striker needle and the stemmed tetryl channel leading to the magazine. The delay is obtained by means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape wheel is fitted with a pinion that is in mesh with a segment on the side of the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary

Fuze, BD, Model L15A2
FOM No. 1390-35-1-25

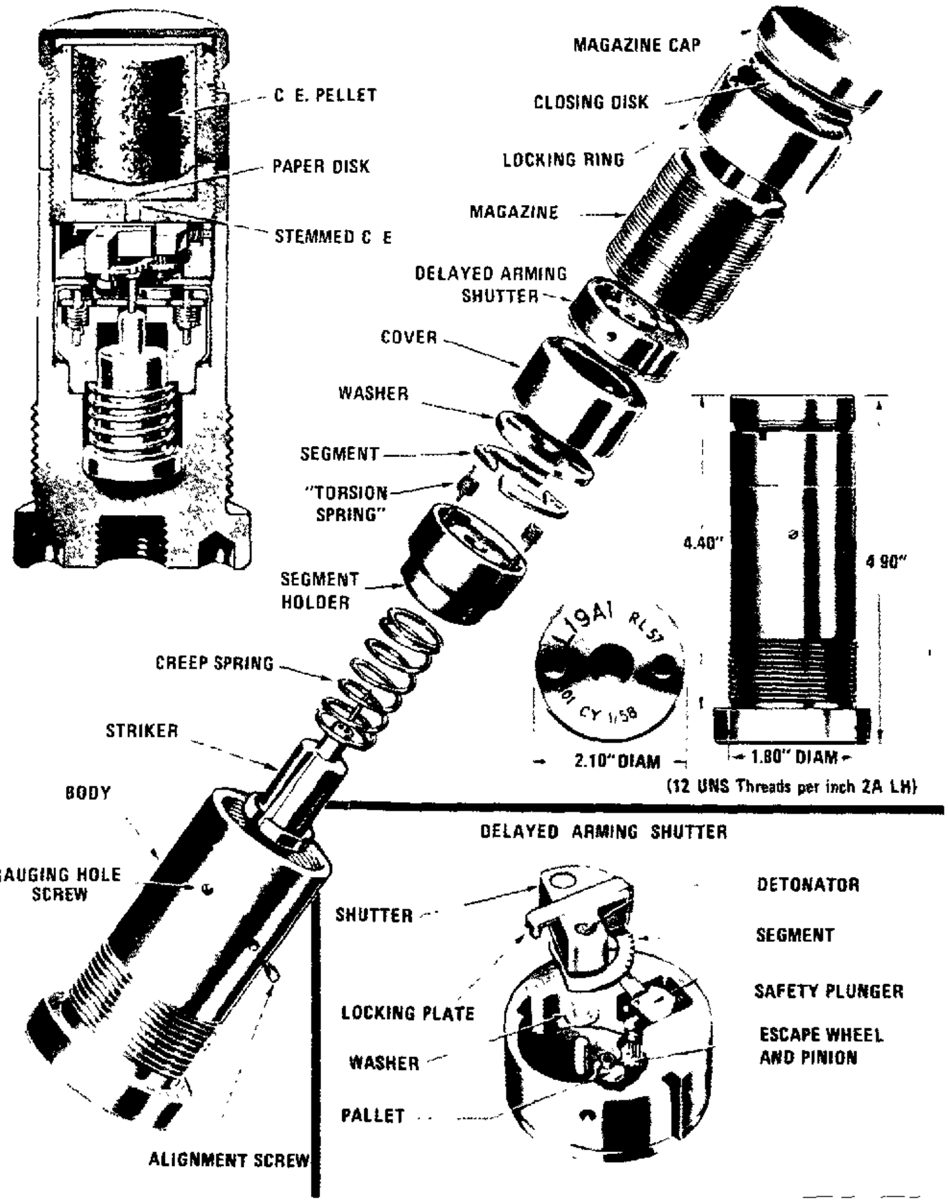
(C) Functioning (Continued)

movement of the shutter. When the shutter reaches the fully armed position, it is locked by the locking plate which moves outwards along its slot in the top face of the shutter to engage in a recess in the shutter housing.

On impact or graze, the momentum of the striker holder overcomes the creep spring and carries the striker needle forward to pierce the detonator. The resultant detonating wave is transmitted through the stemmed tetryl in the magazine channel to the tetryl pellet in the magazine and thence to the bursting charge in the shell.

(C) Application (Ammunition and Weapons)

Ammunition	Weapons
HESH projectiles, Models L2A2 and L2A3	120-mm tank gun, Model L1



Neg. 552503 (CONFIDENTIAL)

Figure 4-16. Fuze, BD, Model L19A1, exploded, section, and contour views (U).

Fuze, BD, Model L19A1
FOM No. 1390-35-1-26

(C) Description

The L19A1 BD fuze (fig 4-16) was designed for use with HESH projectiles. It is a delayed-arming, graze-sensitive type that functions on impact with the target. It is considered bore safe by US standards. The fuze arms in about 0.02 to 0.06 second at 9000 r/min.

(C) Unique Features

- Shutter housing out-of-line detonator.
- Escapement controlling the movement of the shutter.
- Spring-loaded plunger engaging locking plate.

(C) Characteristics

Fuze assembly:

Body material	Anodized aluminum alloy
Weight	481 g (1.06 lb)
Markings	L19A1
Length	4.90 in (124.50 mm)
Max diam	2.10 in (53.55 mm)
Thread diam	1.80 in (45.70 mm)
TPI	12

Booster:

Body material	Anodized aluminum alloy
Body length	45.7 mm
Explosive	Tetryl
Explosive weight	63.8 g (0.14 lb)

(C) Characteristics (Continued)

Functional data:

Arming method	Setback & centrifugal force
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	0.02 to 0.06 s

(C) Design Details

The L19A1 fuze (fig 4-16) incorporates a delayed-arming shutter and a striker-locking assembly. It consists principally of a body, magazine and cap, striker assembly, creep spring, striker locking segment, locking ring, and delayed-arming shutter No. 3 series containing a 2.8-gr (0.18-gram) "AZ" detonator.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape with a wide flange formed at the base, above which it is externally threaded to 1.80-inch (45.7-mm) diameter (12 UNS TPI-2A left hand) gage for approximately a quarter of its length; the remainder of the body is left unthreaded. A hole is drilled in the center of the base and threaded to accept a tracer-adapter. Two key holes, diagonally opposite, are also formed in the base to enable the fuze to be inserted or removed from the shell. Internally, the body is bored from the top in four diameters, the smaller at the base to accommodate the striker and creep spring, the second and third, which are slightly larger in diameter, accommodate the striker-locking segment, while the fourth and largest is screw-threaded at the mouth. This larger recess accommodates the delayed-arming shutter, above which the base portion of the magazine is screwed home. The base and flange of the body are coated with varnish after the marking has been stamped on. Two threaded holes are formed in the body: the lower is for the alignment screw for the delayed-arming shutter, and the upper is for shutter gaging.

Striker. The striker consists of a brass electrotinned, cylindrical body, with a flange at the base. Above the flange it is formed on three decreasing diameters, a recess being formed in the top of the smallest diameter for the electroplated tin- or zinc-coated steel needle (firing pin), the stem of which protrudes through the center of the striker-locking segment.

*Safety plunger, locking plate, and out-of-line detonator.

(C) Design Details (Continued)

The needle, the base of which is flanged, is retained in the recess in the top of the body by a tin-coated brass washer, which is secured by spinning over a lip at the top of the recess. The needle is free to move sideways in its recess.

The striker is inserted into the cavity in the base of the fuze body together with the creep spring, which is assembled around the larger diameter of the striker body, the bottom coil resting on the flange. The creep spring is retained under initial compression by the top coil seating in a recess and bearing against the base of the striker-locking segment assembly.

Creep spring. The creep spring is a cylindrical-coiled, tinned, steel-wire spring, with five effective coils of 0.048-in (12.2-mm) diameter (18 SWG) (16 AWG) wire, one coil at each end being close coiled and ground square with the axis of the spring. It is assembled around the larger diameter of the striker body and prevents the assembled striker from creeping forward when the shell is in flight.

Striker-locking segment assembly. This is assembled in the fuze body, the lower portion fitting over the top of the striker. It is retained in position by the delayed-arming shutter and the magazine. The striker-locking segment assembly comprises a holder, two electrotin-plated steel pins, two springs, two segments, a washer, and a cover.

Segment holder. The cylindrical segment holder is made of aluminum alloy. Externally it is formed in two diameters, the larger being at the top. The bottom portion of the larger diameter is chamfered to blend with the smaller. The bottom of the smaller diameter is also chamfered. Internally, from the base it is bored out in two diameters, while a recess is formed in the top face to house the two locking segments, leaving a platform of metal between the top and bottom. A hole is drilled through the center of the platform to permit the striker to pass through. In the base of this recess, near the periphery, two holes, diametrically opposite, are drilled to accept the steel pivot pins over which are assembled the coiled torsion springs and the segments, this assembly being contained by the washer and cover. When assembled, the tops of the two pins protrude above the top surface of the holder.

Segments. The segments are made of aluminum alloy, and are perfectly flat, irregular, arc-shaped fitments. One end is in the form of a toe, which is machined to act as a working surface when the two segments are assembled in the unarmed or locked position. The other

(C) Design Details (Continued)

end is wider and acts as a weight which, under the influence of centrifugal force, overcomes the springs and allows the two segments to open out. Two holes are drilled near the toe, the larger to fit over the pin on which the segment pivots, the smaller accommodating the turned up end of the segment spring. In the closed or unarmed position, the top portion of the striker bears against the underside of the closed segments; the striker is thereby prevented from moving forward until the segments are opened by centrifugal force, while the needle of the striker assembly protrudes through the hole formed by the two semicircular slots, one in each segment, through the washer and cover and into the pivot tube of the shutter delayed arming.

Segment spring. The segment springs are made of 0.024 (23 SWG) (22 AWG) tinned steel wire, with 5.2 close-wound coils, the ends of the wire are bent up at right angles to the coils. These are assembled over the pivot pins and underneath the segments, the lower end of the spring fitting into a small hole drilled in the holder adjacent to the pin, while the upper end of the spring is located in a small hole drilled in the segment.

Washer. Made of anodized aluminum alloy, the washer is in the form of a flat disk with a hole formed in the center and two slots, diametrically opposite, near the periphery. It is assembled on top of the holder, the protruding ends of the pivot pins being located in the slots and the point of the striker needle protruding through the central hole.

Cover. The cover is made of aluminum alloy, formed with a large hole in the center. It fits over the top of the holder and retains the washer in position above the segments. It is secured in position by spinning or pressing the bottom edge over and around the external chamfer of the larger diameter portion of the segment holder.

Locking ring. The locking ring is made of anodized aluminum alloy. It is cylindrical in shape, formed plain on the outside, and screw-threaded internally. Two slots, diametrically opposed, are cut across the mouth to facilitate assembly. It is screwed onto the upper part of the magazine, locking against the top of the body.

Delayed-arming shutter No. 3 series. (See sec VIII) This consists of four main components, the body, the escapement, a safety plunger with spring, and a shutter containing a 2.8-gr (0.18 gram) "AZ" lugless (tinned copper alloy cup) detonator assembled in a circular-shaped shutter body, over which fits a cover plate. The shutter is held in the

(C) Design Details (Continued)

unarmed position by means of the spring-loaded aluminum-alloy safety plunger which engages in one end of a locking plate. The safety plunger is retained in a recess in the side of the shutter body by a plunger retaining strip. On spin, the safety plunger overcomes its spring and disengages from the recess in the end of the locking plate by centrifugal force. The lead-weighted shutter rotates until the detonator is in a central position over the striker hole. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the plunger in its recess in the shutter body. The locking plate, which fits into a slot made across the face of the shutter, moves out and engages in a recess made in the outer side of the shutter body, thus locking the shutter in the armed position. The delay is obtained by means of a pallet-and-pinion mechanism positioned beneath the shutter that oscillates a segment by means of a 'scape wheel and pinion which retard the opening of the shutter. The shutter commences to open when the shell is spinning between 7000 and 8500 r/min. The time of opening is between 0.020 and 0.055 second when the shell is spinning at 8000 r/min.

The closed (lower) face of the delayed-arming shutter rests on the segment holder. When the magazine is screwed home, it clamps both the delayed-arming shutter and segment holder in position, with the creep spring located between the striker flange and the face of the large recess in the holder. The correct position of the delayed-arming shutter is controlled by the engagement of a screw with the vertical slot in the body. The fuze body and the delayed-arming shutter body are provided with safety inspection holes which are in alignment in the assembled fuze, and through which the "SAFE" position of the shutter is verified at the filling stage. After inspection the hole is closed by a screw. The threads of this screw are coated with cement and the thread is staked after screwing home; the slotted end of the screw is then coated with cement.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy. It is cup-shaped and externally threaded except for an undercut at each end. Two key slots are formed in the outer rim to facilitate assembly. Internally, the magazine is bored out to take a prepressed pellet of CE (tetryl) and a small recess, which is filled with loose CE stemmed in, is drilled in the center at the bottom, leaving a thin diaphragm of metal between the recess and the outer surface at the base of the magazine. The magazine is screwed into the open end of the fuze body, the base of the magazine resting on the delayed-arming shutter. The outer end of the magazine protrudes above the body of the fuze; it is locked into the body by the locking ring and is closed by the magazine cap.

(C) **Design Details (Continued)**

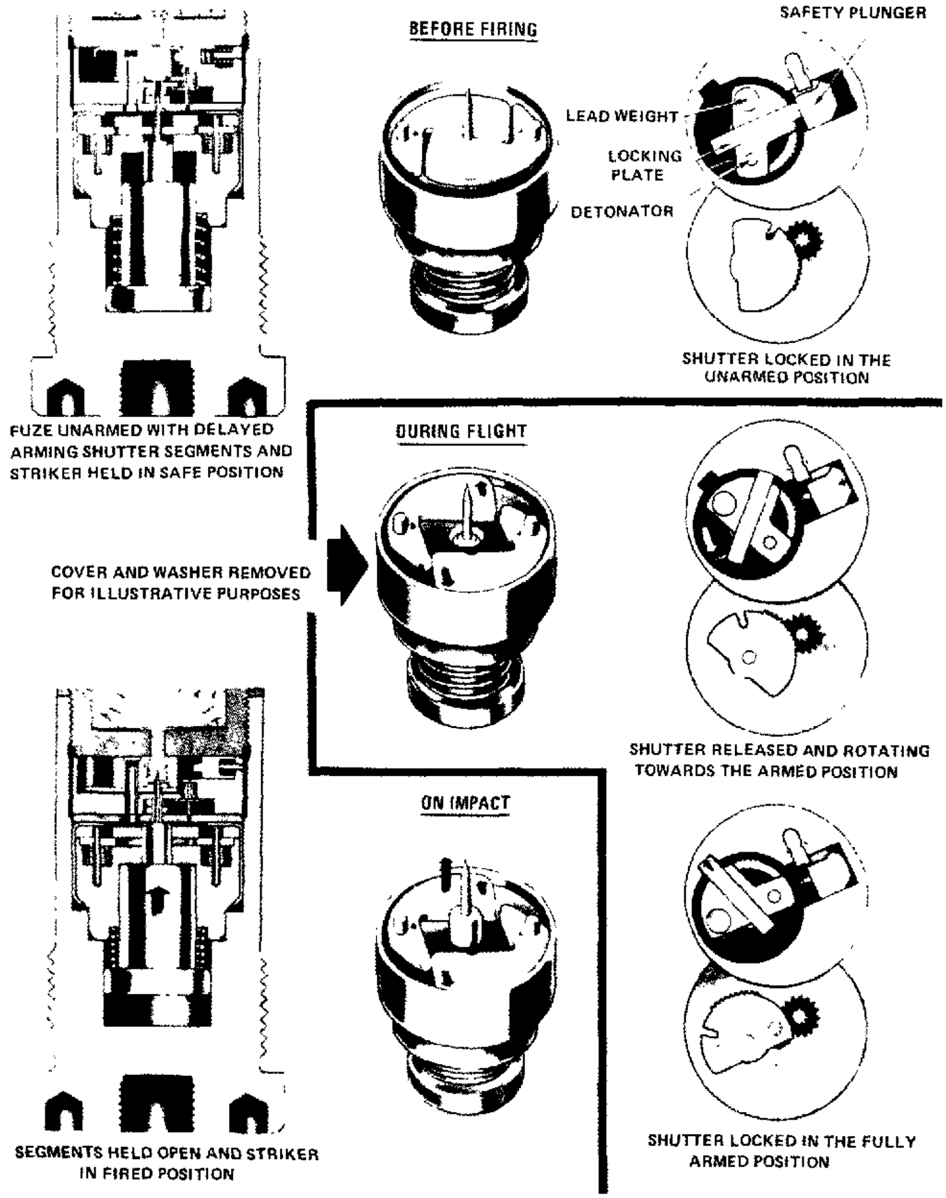
Magazine cap. The magazine cap is made of anodized aluminum alloy. It is cup-shaped with an internal thread to screw over the magazine; the threads are coated with RD 1286 prior to assembly. A box-cloth disk is attached to the inner surface by shellac adhesive. It is then secured by crimping the outer rim in three or more equi-spaced positions.

(C) Safety

Safety is provided as follows:

- The rotating delayed-arming shutter is retained in the safe or unarmed position by the spring-loaded safety plunger, which engages in the safety locking plate. This provides bore and muzzle safety to cover a specified minimum distance from the gun when arming commences.
- When the shutter is in the unarmed position, its detonator is screened off from the striker and from the stemmed CE channel leading to the CE pellet in the body of the magazine.
- The shutter is designed to provide a slight delay before it reaches the armed position; the approximate time of operation is 0.02 to 0.055 second at 9000 r/min.
- The striker locking segments prevent the striker from moving forward before firing and hold the striker in the "SAFE" position in transit, handling and loading.
- The creep spring keeps the striker from moving forward during flight due to deceleration after leaving the muzzle.

(C) Functioning (Fig 4-17)



(CONFIDENTIAL)

Figure 4-17. Fuze, BD, Model L19A1, functioning views (U).

(C) Functioning (Continued)

On firing, the shutter, striker-locking segments, and striker setback are retained in the unarmed position by friction.

During flight, the segments in the striker-locking assembly move outward against their springs, leaving a clear passage for the striker to move forward. The safety plunger overcomes its spring and moves outward to release the shutter. The shutter begins to rotate until its detonator reaches a central position directly in alignment with the striker needle and the stemmed CE (tetryl) channel leading to the magazine. The delay is obtained by means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape wheel is fitted with a pinion which is in mesh with a segment on the side of the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary movement of the shutter. When the shutter reaches the fully armed position, it is locked by the locking plate which moves outward along its slot on the face of the shutter to engage in a recess in the shutter housing.

On impact or graze, the momentum of the striker holder overcomes the creep spring and carries the striker needle forward to pierce the detonator. The resultant detonating wave is transmitted through the stemmed CE pellet in the magazine and thence to the bursting charge in the shell.

(C) Summary of Differences

- **Model A1 fuze (obsolescent).** The Model A1 is fitted with delayed-arming shutter No. 3.

- **Model A2 fuze (obsolescent).** The Model A2 is fitted with delayed-arming shutter No. 3A, which differs from the No. 3 in that it incorporates a redesigned cover plate (QX 75 SA in lieu of QX 573).

- **Model A3 fuze (obsolescent).** The Model A3 is fitted with delayed-arming shutter No. 3B, which is similar to the No. 3A shutter except that it incorporates certain components manufactured from corrosive-resistive stainless steel in lieu of steel.

Fuze, BD, Model L19A1
FOM No. 1390-35-1-26

(C) Summary of Differences (Continued)

- Model A4 fuze. This model is fitted with delayed-arming shutter No. 3C, 3C/1, or 3C/2. All of these shutters differ from the No. 3, 3A, and 3B in that they incorporate a 2.6-gr (0.17-gram) "LZ" detonator in lieu of a 2.8-gr (0.18-gram) "AZ" detonator.

In addition, the shutters differ in the following way:

- No. 3C – same body as No. 3B, i.e., die cast.
- No. 3C/1 – body machined from bar, it also incorporates a shutter gaging hole of increased diameter.
- No. 3C/2 – body die cast but incorporating a shutter gaging hole of increased diameter.

C) Applications (Ammunition and Weapons)

Ammunition	Weapons
105-mm HESH projectiles, Models L35A1 and L37	105-mm tank gun, Models L18A3 and L20A1
120-mm HESH projectiles	120-mm BAT gun and tank gun

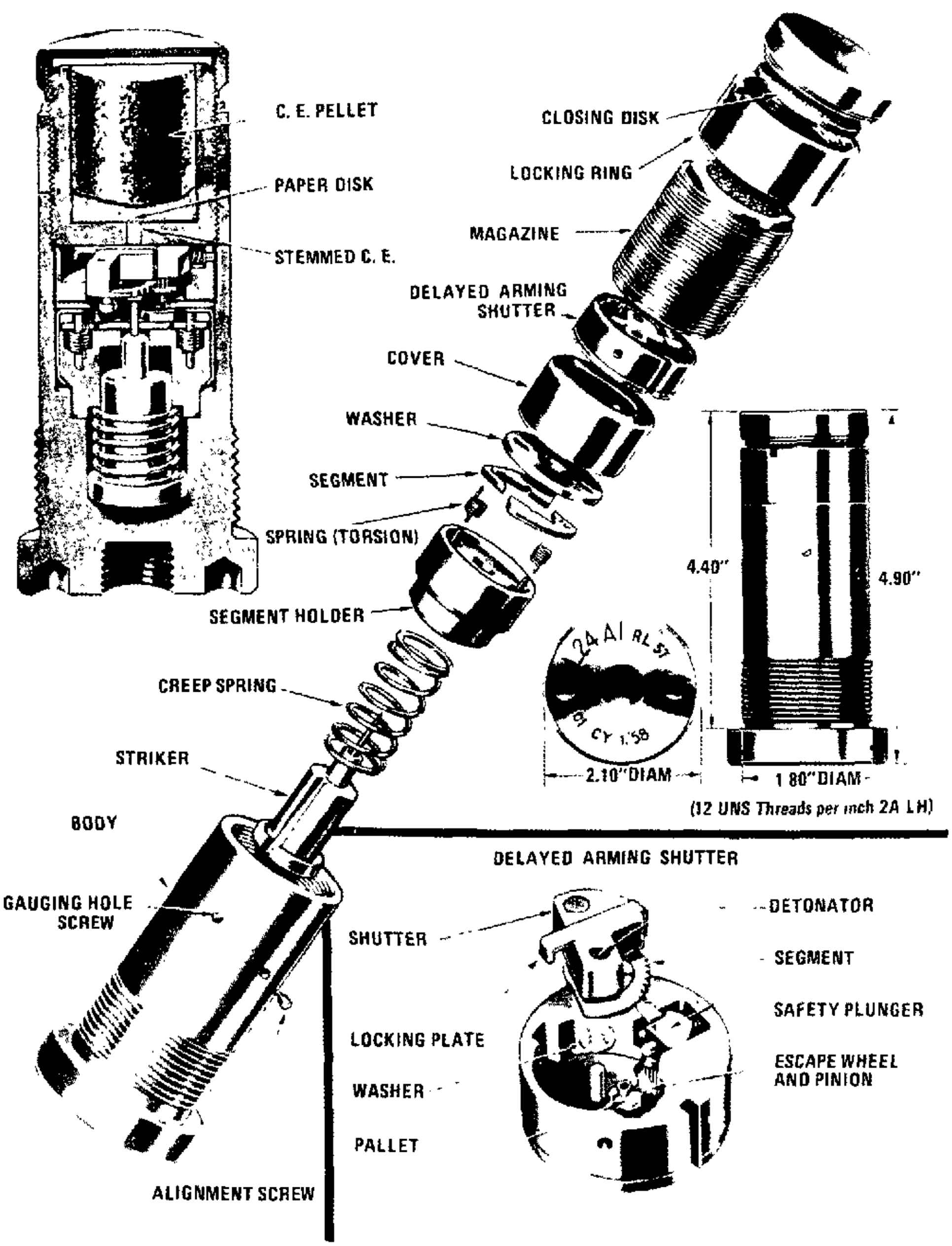


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Figure 4-18. Fuze, BD, Model L24A1, exploded, section, and contour views (U).

Fuze, BD, Model L24A1
FOM No. 1390-35-1-27

(C) Description

The L24A1 (fig 4-18) is a delayed-arming, graze-sensitive, BD fuze designed for the L33A1 165-mm HESH projectile. It is considered bore safe by US standards.

(C) Unique Features

- Shutter housing out-of-line detonator.
- Escapement controlling movement of shutter.
- Spring-loaded safety plunger engaging a safety locking plate.

(C) Characteristics

Fuze assembly:	
Body material	Anodized aluminum alloy
Weight	504 g (1.10 lb)
Markings	L24A1
Length	4.40 in (111.76 mm)
Max diam	2.10 in (53.43 mm)
Thread diam	1.80 in (45.72 mm)
TPI	12
Booster:	
Body material	Anodized aluminum body
Body length	?
Explosive	Tetryl
Explosive weight	70.8 g (0.16 lb)
Functional data:	
Arming method	Setback and centrifugal force
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	0.05 to 0.08 s

*Safety plunger, locking plate, and out-of-line detonator.

(C) **Design Details**

General. The L24A1 fuze (fig 4-18) incorporates a delayed-arming, shutter-locking assembly. It consists principally of a body, magazine and cap, striker assembly, creep spring, striker-locking segment, locking ring, and delayed-arming shutter No. 4 series containing a 0.18-gram (2.80-gr) "AZ" detonator.

Note: The L24 fuze differs from the L19 fuze in only two features:

- Striker-locking segment assembly is fitted with weaker torsion springs than those used in the L19 fuze.
- Delayed-arming shutter No. 4 is designed to arm at a lower rate of spin; a stainless steel safety plunger and a weaker plunger spring than that used in the delayed-arming shutter No. 3 is used.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape with a wide flange formed at the base, above which it is screw-threaded externally to 1.80-inch (45.72-mm) diameter (12 UNS TPI-2A left hand) gage for approximately a quarter of its length; the remainder of the body is left plain. A hole is drilled in the center of the base and screw-threaded to accept a tracer-adapter. Two holes, diagonally opposite, are also formed in the base to enable the fuze to be inserted or removed from the shell. Internally, the body is bored from the top in four diameters, the smaller at the base to accommodate the striker and creep spring, the second and third, which are slightly larger in diameter, accommodate the striker-locking segment, while the fourth and largest is screw-threaded at the mouth. This larger recess accommodates the delayed-arming shutter, above which the base portion of the magazine is screwed home. The base and flange of the body are coated with varnish after the marking has been stamped on. Two screw-threaded holes are formed in the body: the lower is for the delayed-arming shutter-alignment screw, and the upper for shutter gaging.

Striker. The striker consists of a brass electrotinned cylindrical body with a flange at the base, above which it is formed on three decreasing diameters. A recess is formed in the top of the smallest diameter for the electroplated tin- or zinc-coated steel needle, the stem of which protrudes through the center of the striker locking segment. The needle, the base of which is flanged, is retained in the recess in the top of the body by a tin-coated brass washer secured by spinning over a lip at the top of the recess. The needle is free to move sideways in its recess.

Fuze, BD, Model L24A1
FOM No. 1390-35-1-27

(C) **Design Details (Continued)**

The striker is inserted into the cavity in the base of the fuze body together with the creep spring, which is assembled around the larger diameter of the striker body, the bottom coil resting on the flange. The creep spring is retained under initial compression by seating the top coil in a recess and bearing it against the base of the striker-locking segment assembly.

Creep spring. The creep spring is a cylindrical-coiled, tinned, steel-wire spring, with five effective coils of 0.048-inch (1.22-mm) (18 SWG) diameter wire, one coil at each end being close coiled and ground square with the axis of the spring. It is assembled around the larger diameter of the striker body and prevents the assembled striker from creeping forward when the shell is in flight.

Striker-locking segment assembly. This is assembled in the fuze body, the lower portion fitting over the top of the striker. It is retained in position by the delayed-arming shutter and the magazine. The striker-locking segment assembly comprises a holder, two electrotin-plated steel pins, two springs, two segments, a washer, and a cover.

Segment holder. The cylindrical segment holder is made of aluminum alloy. Externally it is formed in two diameters, the larger being at the top. The bottom portion of the larger diameter is chamfered to blend with the smaller. The bottom of the smaller diameter is also chamfered. From the base it is bored out internally in two diameters, while a recess is formed in the top face to house the two locking segments, leaving a platform of metal between the top and bottom. A hole is drilled through the center of the platform to permit the striker to pass through. In the base of this recess near the periphery, two holes, diametrically opposite, are drilled to accept the steel pivot pins, over which are assembled the coiled torsion springs and the segments. This assembly is contained by the washer and cover, and when assembled, the tops of the two pins protrude above the top surface of the holder.

Segments. The segments are made of aluminum alloy, and are perfectly flat, irregularly shaped pieces. One end is in the form of a toe, which is machined to act as a working surface when the two segments are assembled in the unarmed or locked position. The other end is wider and acts as a weight which, under the influence of centrifugal force, overcomes the springs and allows the two segments to open out. Two holes are drilled near the toe, the larger fitting over the pin on which the segment pivots, the smaller accommodating the

(C) Design Details (Continued)

turned-up end of the segment spring. In the closed or unarmed position, the top portion of the striker bears against the underside of the closed segments; the striker is thus prevented from moving forward until the segments are opened by centrifugal force. The needle of the striker assembly protrudes through the hole formed by the two semicircular slots, one in each segment, through the washer, and into the pivot tube of the delayed-arming shutter.

Segment spring. The segment springs are made of 0.18-inch (0.45-mm) (26 SWG) diameter tinned steel wire, with 6.1 close-wound coils, the ends of the wire being bent up at right angles to the coils. The springs are assembled over the pivot pins and underneath the segments. The lower end of the spring fits into a small hole drilled in the holder adjacent to the pin, while the upper end is located in a small hole drilled in the segment.

Washer. The washer is made of anodized aluminum alloy in the form of a flat disk with a hole formed in the center and two slots, diametrically opposite, near the periphery. It is assembled atop the holder, the protruding ends of the pivot pins being located in the slots and the point of the striker needle protruding through the central hole.

Cover. The cover is made of aluminum alloy, formed with a larger hole in the center. It fits over the top of the holder and retains the washer in position above the segments. It is secured in position by spinning or pressing the bottom edge over around the external chamfer of the larger diameter portion of the segment holder.

Locking ring. The locking ring is made of anodized aluminum alloy. It is cylindrical in shape, formed plain on the outside, and internally threaded. Two slots, diametrically opposed, are cut across the mouth to facilitate assembly. It is screwed onto the upper part of the magazine, locking against the top of the body.

Delayed-arming shutter No. 4 series. This consists of four main components: the body, the escapement, a safety plunger with spring, and a shutter containing a 0.18-gram (2.80-gr) "AZ" lugless (tinned copper alloy cup) detonator assembled in a circular-shaped shutter body over which fits a cover plate. The shutter is held in the unarmed position by means of the spring-loaded, stainless-steel, safety plunger, which engages in one end of a locking plate. The safety plunger is retained in a recess in the side of the shutter body by a plunger retaining strip. On spin, the safety plunger overcomes its spring and disengages from the recess in the end of the locking plate by centrifugal force, and the lead-weighted shutter

Fuze, BD, Model L24A1
FOM No. 1390-35-1-27

(C) Design Details (Continued)

rotates until the detonator is in a central position over the striker hole. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the plunger in its recess in the shutter body. The locking plate, fits into a slot made across the face of the shutter, moves out, and engages in a recess made in the outer side of the shutter body, thus locking the shutter in the armed position. The delay is obtained by means of a pallet-and-pinion mechanism positioned beneath the shutter; this oscillates a segment by means of a 'scape wheel and pinion which retard the opening of the shutter. The shutter commences to open when the projectile is spinning between 3700 and 4500 r/min. The time of opening is between 0.045 and 0.075 second when the shell is spinning at 5900 r/min.

The closed (lower) face of the delayed-arming shutter rests on the segment holder. When the magazine is screwed home, it clamps both the delayed-arming shutter and segment holder in position, with the creep spring located between the striker flange and the face of the larger recess in the holder. The correct position of the delayed-arming shutter is controlled by the engagement of a screw with the vertical slot in the body. The fuze body and the delayed-arming shutter body are provided with safety gaging holes aligned in the assembled fuze and through which the "SAFE" position of the shutter is gaged at the filling stage. After gaging, the hole is closed by a screw. The threads of this screw are coated with cement; the thread is stabbed after assembly, and the slotted end of the screw is then coated with cement.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy; it is cup-shaped and externally threaded except for an undercut at each end. Two key slots are formed in the outer rim to facilitate assembly. Internally, the magazine is bored out to take a prepressed pellet of tetryl and a small recess, which is filled with loose tetryl, is drilled in the center at the bottom, leaving a thin diaphragm of metal between the recess and the outer surface at the base of the magazine. The magazine is screwed into the open end of the fuze body, the base of the magazine resting on the delayed-arming shutter. The outer end of the magazine protrudes above the body of the fuze; it is locked into the body by the locking ring and is closed by the magazine cap.

Magazine cap. The magazine cap is made of anodized aluminum alloy. It is cup-shaped with an internal thread to screw over the mouth of the magazine; the threads are coated with RD 1286 prior to assembly. A box-cloth disk is attached to the inner surface by shellac adhesive. It is then secured by the outer rim and crimped at three or more equidistant points.

(C) Safety

Safety is provided as follows:

- The rotating delayed-arming shutter is retained in the safe or unarmed position by the spring-loaded safety plunger, which engages in the safety locking plate. This provides bore and muzzle safety to cover a specified minimum distance from the gun when arming commences.

- When the shutter is in the unarmed position, its detonator is screened off from the striker and from the tetryl-filled channel leading to the CE (tetryl) pellet in the body of the magazine.

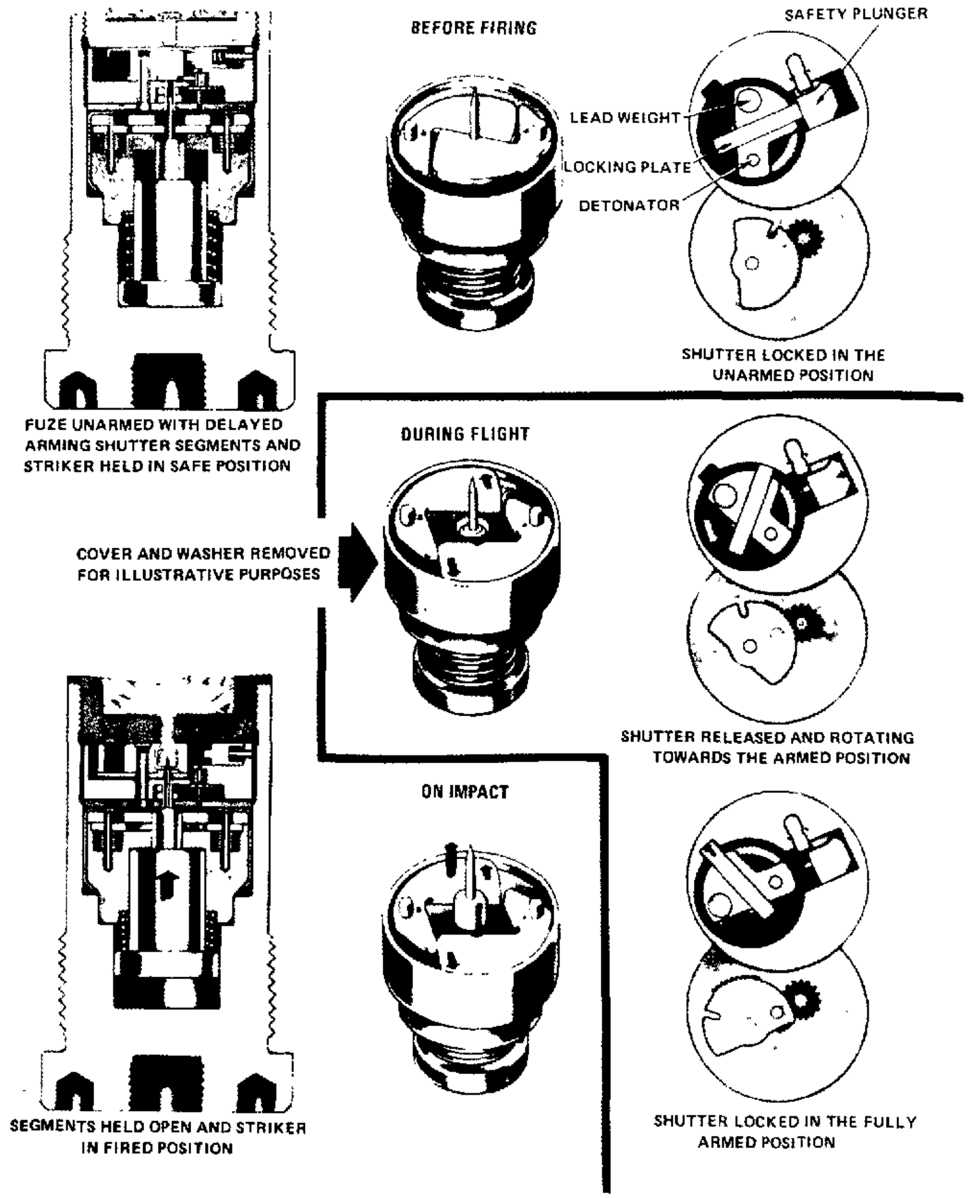
- The shutter is designed to provide a slight delay before it reaches the armed position. The approximate time of operation is 0.045 to 0.075 second at 5900 r/min.

- The striker locking segments prevent the striker from moving forward before firing and hold the striker in the "SAFE" position in transit, handling, and loading.

- The creep spring prevents the tendency of the striker to move forward during flight due to deceleration after leaving the muzzle.

Fuze, BD, Model L24A1
FOM No. 1390-35-1-27

(C) Functioning (Fig 4-19)



(CONFIDENTIAL)
Figure 4-19. Fuze, BD, Model L24A1, functioning views (U).

(C) Functioning (Continued)

On firing, the shutter, striker-locking segments, and striker setback are retained in the unarmed position by friction.

During flight, the segments in the striker-locking assembly move outward against their springs, leaving a clear passage for the striker to move forward. The safety plunger overcomes its spring and moves outward to release the shutter. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the latter and prevents it from leaving its recess in the shutter housing when the plunger spring reasserts itself. The shutter begins to rotate until its detonator reaches a central position directly in alignment with the striker needle and the stemmed CE (tetryl) channel leading to the magazine. The delay is obtained by means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape wheel is fitted with a pinion which is in mesh with a segment on the side of the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary movement of the shutter. When the shutter reaches the fully armed position, it is locked by the locking plate, which moves outward along its slot in the top face of the shutter to engage in a recess in the shutter housing.

On impact or graze, the momentum of the striker holder overcomes the creep spring and carries the striker needle forward to pierce the detonator. The resultant detonating wave is transmitted through the stemmed CE (tetryl) in the magazine channel to the CE pellet in the magazine and thence to the bursting charge in the shell.

(C) Summary of Differences

- **Model A1 fuze (obsolescent).** The Model A1 is fitted with delayed-arming shutter No. 4.

- **Model A2 fuze.** This model is fitted with delayed-arming shutter No. 4A or 4A/1.

Both of these shutters differ from the No. 4 in that they incorporate a 2.6-gr (0.17 gram) "LZ" detonator in lieu of a 2.8-gr (0.18 gram) "AZ" detonator. In addition, the shutters differ in the following way:

Fuze, BD, Model L24A1
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(C) Summary of Differences (Continued)

- No. 4A–die cast body as for No. 4, but with larger diameter shutter-gaging hole.

- No. 4A/1–machined from bar, it also incorporates a larger diameter shutter gaging hole than the No. 4 shutter.

(C) Application (Ammunition and Weapons)

Ammunition	Weapons
HESH projectile, Model L33A1	165-mm gun, AVRE, Model L9A1

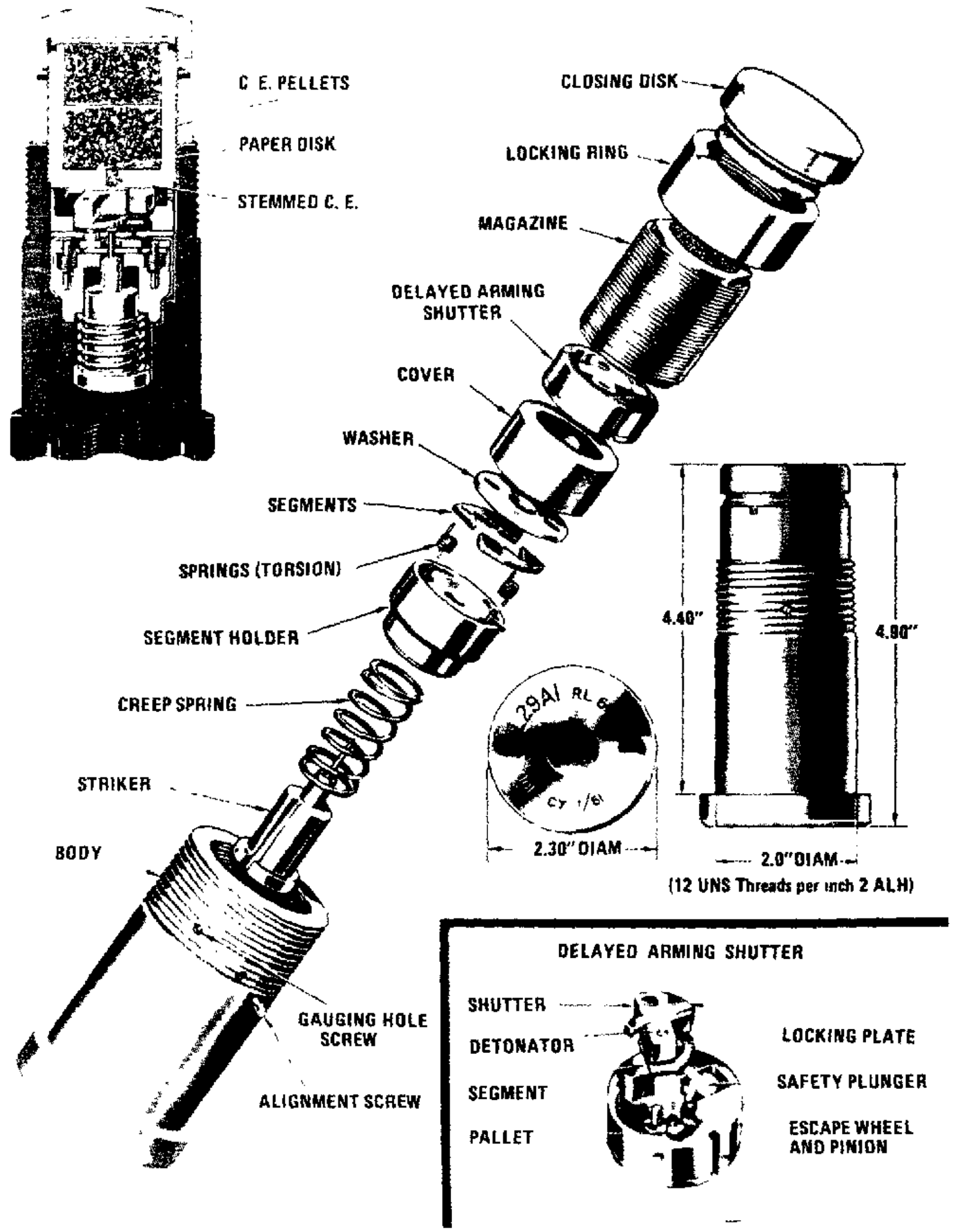

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Figure 4-20. Fuze, BD, Model L29A1, exploded, section, and contour views (U).

Fuze, BD, Model L29A1
FOM No. 1390-35-1-28

(C) Description

The L29A1 (fig 4-20) is a delayed-arming, graze-sensitive, BD fuze designed to function upon impact with the target. It is intended for use with HESH projectiles fired from tank guns or howitzers. The delayed-arming shutter employed provides a slight delay of 0.02 to 0.55 second at 9000 r/min.

(C) Unique Features (if applicable)

- Shutter housing out-of-line detonator.
- Escapement controlling movement of shutter.
- Spring-loaded plunger engaging locking plate of the shutter provides bore safety and muzzle safety.

(C) Characteristics

Fuze assembly:

Body material	Anodized aluminum alloy
Weight	654 g (1.44 lb)
Markings	L29A1
Length	4.90 in (124.5 mm)
Major diam	2.30 in (58.8 mm)
TPI	12

Booster:

Body material	Anodized aluminum alloy
Body length	48.3 mm (1.90 in)
Explosive	Tetryl
Explosive weight	71 g (0.16 lb)

(C) Characteristics (Continued)

Functional data:

Arming method	Setback & centrifugal force
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	0.02 to 0.06 s

(C) Design Details

General. The L29A1 BD fuze (fig 4-20) incorporates a delayed-arming shutter and a striker-locking assembly. It consists principally of a body, magazine and cap, striker assembly, creep spring, striker-locking segment, locking ring, and delayed-arming shutter No. 3 series containing a 2.8 gr (0.18 gram) "AZ" detonator.

Body. The body is made of anodized aluminum alloy and is cylindrical in shape with a wide flange formed at the base. It is externally threaded to 2.0-inch (50.8-mm) diameter (12 UNS TPI-2A left hand) gage for approximately a quarter of its length from the top; the remainder of the body is left plain. A hole is drilled in the center of the base and threaded to accept a tracer-adapter. Two holes, diagonally opposite, are also formed in the base to enable the fuze to be inserted or removed from the shell. Internally, the body is bored from the top in four diameters. The smaller, at the base, accommodates the striker and creep spring; the second and third, which are slightly larger in diameter, accommodate the striker-locking segment; while the fourth and largest is screw threaded at the mouth. This larger recess accommodates the delayed-arming shutter, above which the base portion of the magazine is assembled. The base and flange of the body are coated with varnish after the marking has been stamped on. Two threaded holes are formed in the body: the lower for the delayed-arming shutter alignment screw and the upper for shutter gaging.

Striker. The striker consists of a cylindrical, tinned, brass body. Above the flange at the base, it is formed on three decreasing diameters; a recess is formed in the top of the smallest diameter for the tin- or zinc-coated steel needle, the stem of which protrudes through the center of the striker-locking segment.

*Safety plunger, safety locking plate, out-of-line detonator.

Fuze, BD, Model L29A1
FOM No. 1390-35-1-28

(C) Design Details (Continued)

The needle, the base of which is flanged, is retained in the recess in the top of the body by a tin-coated, brass washer which is secured by spinning over a lip at the top of the recess. The needle is free to move sideways in its recess.

The striker is inserted into the cavity in the base of the fuze body together with the creep spring, which is assembled around the larger diameter of the striker body, the bottom coil resting on the flange. The creep spring is retained under initial compression by seating the top coil in a recess and bearing it against the base of the striker-locking segment assembly.

Creep spring. The creep spring is a cylindrical-coiled, tinned, steel-wire spring, with five effective coils of 0.048-in (1.2-mm) diameter (18 SWG) (16 AWG) wire, one coil at each end being close coiled and ground square with the axis of the spring. It is assembled around the larger diameter of the striker body and prevents the assembled striker from creeping forward when the shell is in flight.

Striker-locking segment assembly. This is assembled in the fuze body, the lower portion fitting over the top of the striker. It is retained in position by the delayed-arming shutter and the magazine. The striker-locking segment assembly comprises a holder, two electrotin-plated steel pins, two springs, two segments, a washer, and a cover.

Segment holder. The cylindrical segment holder is made of aluminum alloy. Externally it is formed in two diameters, the larger being at the top. The bottom portion of the larger diameter is chamfered to blend with the smaller. The bottom of the smaller diameter is also chamfered. Internally, from the base it is bored out in two diameters, while a recess is formed in the top face to house the two locking segments, leaving a platform of metal between the top and bottom. A hole is drilled through the center of the platform to permit the striker to pass through. In the base of this recess near the periphery two holes, diametrically opposite, are drilled to accept the steel pivot pins, over which are assembled the coiled torsion springs and the segments. This assembly is contained by the washer and cover, and when assembled, the tops of the two pins protrude above the top surface of the holder.

(C) **Design Details (Continued)**

Segments. The segments, made of aluminum alloy, are flat, irregular, arc-shaped fitments. One end is in the form of a toe machined to act as a working surface when the two segments are assembled in the unarmed or locked position; the other end is wider and acts as a weight which, under the influence of centrifugal force, overcomes the springs and allows the two segments to open out. Two holes are drilled near the toe, the larger fitting over the pin on which the segment pivots, the smaller accommodating the turned up end of the segment spring. In the closed or unarmed position the top portion of the striker bears against the underside of the closed segments, thus preventing the striker from moving forward until the segments are opened by centrifugal force. The needle of the striker assembly protrudes through the hole formed by the two semicircular slots, one in each segment, through the washer and cover, and into the pivot tube of the delayed arming shutter.

Segment spring. The segment springs are made of 0.024-inch (0.61-mm) diameter (23 SWG) tinned steel wire, with a 5.2 close-wound coils; the ends of the wire are bent up at right angles to the coils. The springs are assembled over the pivot pins and underneath the segments, the lower end of the spring fitting into a small hole drilled in the holder adjacent to the pin, while the upper end is located in a small hole drilled in the segment.

Washer. Made of anodized aluminum alloy, the washer is a flat disk with a hole formed in the center and two slots, diametrically opposite, near the periphery. It is assembled on top of the holder, the protruding ends of the pivot pins being located in the slots, and the point of the striker needle protruding through the central hole.

Cover. The cover is made of aluminum alloy, formed with a large hole in the center. It fits over the top of the holder and retains the washer in position above the segments. It is secured in position by spinning or pressing the bottom edge over the external chamfer of the larger diameter portion of the segment holder.

Locking ring. The locking ring is made of anodized aluminum alloy. It is cylindrical in shape, formed plain on the outside and screw-threaded inside. Two slots, diametrically opposed, are cut across the mouth to facilitate assembly. It is screwed onto the upper part of the magazine, locking against the top of the body.

Fuze, BD, Model L29A1
FOM No. 1390-35-1-28

(C) Design Details (Continued)

Delayed-arming shutter No. 3B. This consists of four main components: the body, the escapement, a safety plunger with spring, and a shutter containing a 2.8-gr (0.18-gram) "AZ" lugless (tinned copper alloy cup) detonator assembled in a circular-shaped shutter body over which a cover plate fits. The shutter is held in the unarmed position by the spring-loaded, aluminum-alloy, safety plunger which engages in one end of a locking plate. The safety plunger is retained in a recess in the side of the shutter body by a plunger retaining strip. On spin, the safety plunger overcomes its spring and disengages from the recess in the end of the locking plate by centrifugal force; the lead-weighted, biased shutter rotates until the detonator is in a central position over the striker hole. The plunger retaining strip, which engages in a slot cut in the side of the plunger, retains the plunger in its recess in the shutter body. The locking plate, which fits into a slot made across the face of the shutter, moves out and engages in a recess made in the outer side of the shutter body, thus locking the shutter in the armed position. The delay is obtained by means of a pallet-and-pinion mechanism positioned beneath the shutter that oscillates a segment by means of a 'scape wheel and pinion, retarding the opening of the shutter. The shutter commences to open when the shell is spinning between 7000 and 8500 r/min. The time of opening is between 0.02 and 0.055 second when the shell is spinning at 9000 r/min.

The closed (lower) face of the delayed-arming shutter rests on the segment holder. When the magazine is screwed home, it clamps both the delayed-arming shutter and segment holder in position, with the creep spring located between the striker flange and the face of the larger recess in the holder. The correct position of the delayed-arming shutter is controlled by the engagement of a screw with the vertical slot in the body. The fuze body and the delayed-arming shutter body are provided with safety-gaging holes that are in alignment in the assembled fuze and through which the "SAFE" position of the shutter is gaged at the filling stage. After gaging, the hole is closed by a screw. The threads of this screw are coated with cement; the thread is stabbed after assembly and the slotted end of the screw is then coated with cement.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy. It is cup-shaped and threaded externally except for an undercut at each end. Two slots are formed in the outer rim to facilitate assembly. Internally, the magazine is bored out to take a prepressed pellet of CE (tetryl) and a small recess, which is filled with loose CE pressed in, is drilled in the center at the bottom, leaving a thin diaphragm of metal between the recess and the outer surface at the base of the magazine. The magazine is screwed into the open

(C) Design Details (Continued)

end of the fuze body, with the magazine base resting on the delayed-arming shutter. The outer end of the magazine protrudes above the body of the fuze; it is locked into the body by the locking ring and closed by the magazine cap.

Magazine cap. The cap is made of anodized aluminum alloy. It is cup-shaped and internally threaded to screw over the mouth of the magazine. The threads are coated with RD 1286 prior to assembly. It is then secured by crimping the outer rim in three or more equi-spaced positions. A box-cloth disk is attached to the inner surface by shellac adhesive.

(C) Safety

Safety is provided as follows:

- The rotating delayed-arming shutter is retained in the safe or unarmed position by the spring-loaded safety plunger, which engages in the safety locking plate. This provides bore and muzzle safety to cover a specified minimum distance from the gun when arming commences.

- When the shutter is in the unarmed position, its detonator is screened off from the striker and from the stemmed CE (tetryl) channel leading to the CE pellet in the body of the magazine.

- The shutter is designed to provide a slight delay before it reaches the armed position. The approximate time of operation is 0.02 to 0.055 second at 9000 r/min.

- The striker locking segments prevent the striker from moving forward before firing and hold the striker in the "SAFE" position in transit, handling, and loading.

- The creep spring prevents the tendency of the striker to move forward during flight due to deceleration after leaving the muzzle.

Fuze, BD, Model L29A1
FOM No. 1390-35-1-28

(C) Functioning (Fig 4-21)

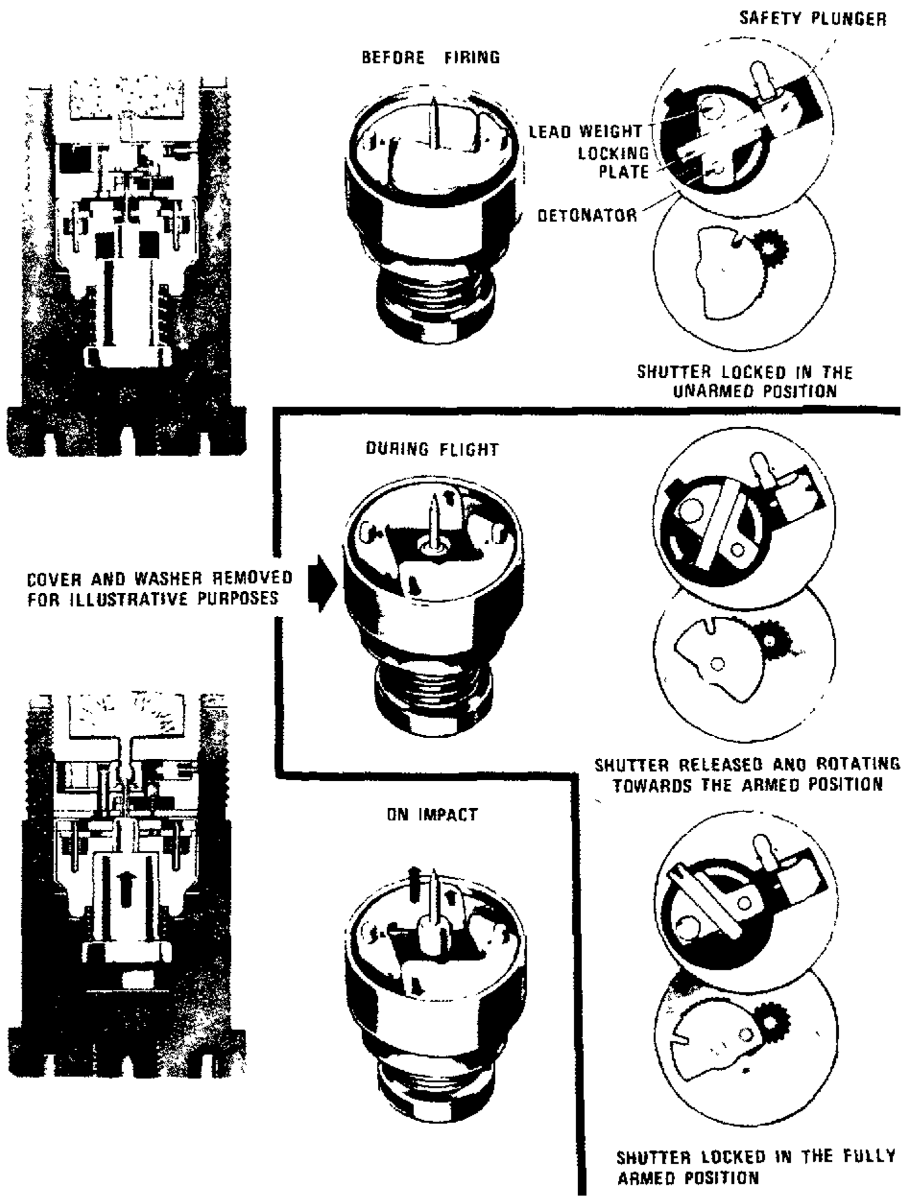

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Figure 4-21. Fuze, BD, Model L29A1, functioning views (U).

(C) Functioning (Continued)

On firing, the shutter, striker-locking segments, and striker setback are retained in the unarmed position by friction.

During flight, the segments in the striker-locking assembly move outward against their springs, leaving a clear passage for the striker to move forward. The safety plunger overcomes its spring and moves outward to release the shutter. The shutter rotates until its detonator reaches a central position directly in alignment with the striker needle and the stemmed CE (tetryl) channel leading to the magazine. The delay is obtained by means of a pallet and escape wheel mechanism positioned beneath the shutter. The escape wheel is fitted with a pinion which is in mesh with a segment on the side of the shutter. The pallet acts as a pendulum and engages successive teeth in the escape wheel to retard the rotary movement of the shutter. When the shutter reaches the fully armed position, it is locked by the locking plate, which moves outward along its slot in the top face of the shutter to engage in a recess in the shutter housing.

On impact or graze, the momentum of the striker holder overcomes the creep spring and carries the striker needle forward to pierce the detonator. The resultant wave is transmitted through the stemmed CE in the magazine channel, to the CE pellet in the magazine, and thence to the bursting charge in the shell.

(C) Summary of Differences

- **Model A1 fuze** (obsolescent). The model A1 is fitted with delayed-arming shutter No. 3B.

- **Model A2 fuze**. This model is fitted with delayed-arming shutter No. 3C, 3C/1, or 3C/2.

These shutters differ from the 3B in that they incorporate a 2.6 gr (0.17 gram) "LZ" detonator in lieu of a 2.8-gr (0.18-gram) "AZ" detonator. In addition these shutters differ in the following way:

- No. 3C – same body as No. 3B, i.e., die cast.

Fuze, BD, Model L29A1
FOM No. 1390-35-1-28

(C) Summary of Differences (Continued)

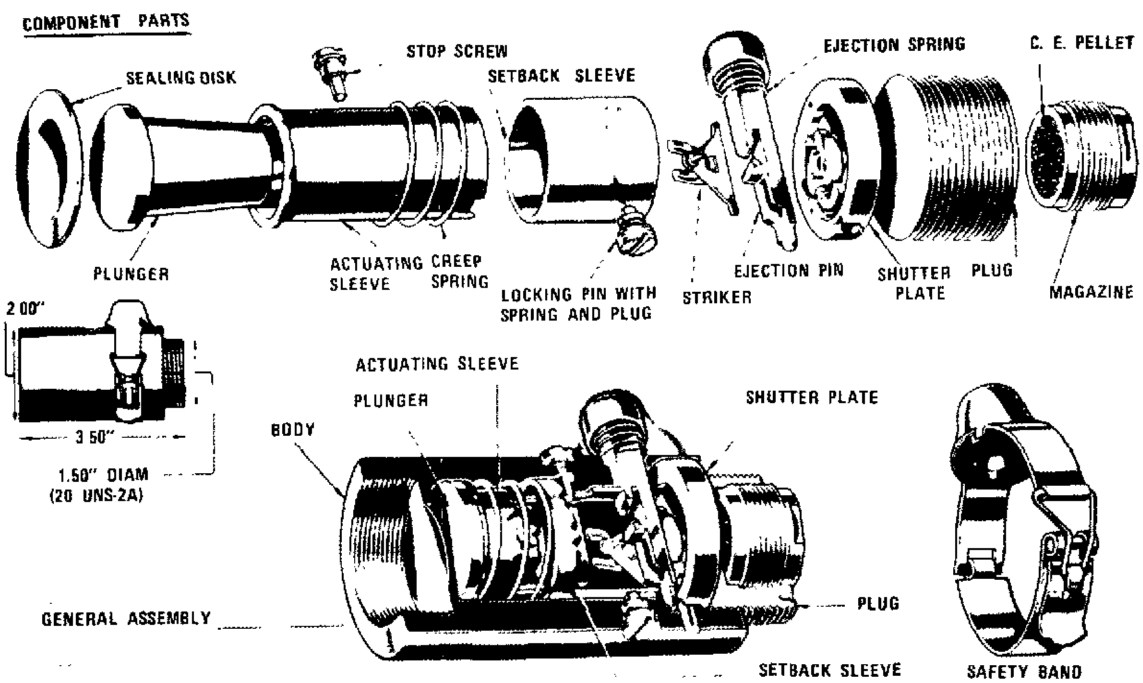
- No. 3C/1 – body machined from bar, it also incorporates a shutter-gaging hole of increased diameter.

- No. 3C/2 – body die cast, but incorporating a shutter-gaging hole of increased diameter.

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
105-mm HESH projectiles, Models L35A2, L37A2, L43A1	105-mm tank gun, Model L7A1; 105-mm howitzer, Model L10A1
120-mm HESH projectiles, Model L31A1	120-mm tank gun, Model L11A1

Fuze, BD, Model L16A1
FOM No. 1390-35-2-1



Neg. 552506 (CONFIDENTIAL)

Figure 4-22. Fuze, BD, Model L16A1, exploded and cutaway views (U).

(C) Description

The L16A1 (fig 4-22) is a setback-armed, BD fuze designed to function upon impact with the target. Safety is provided by a steel safety band and a bore-riding pin. This fuze was developed for use with the 88.9-mm (3-inch) HEAT warhead fired from the UK rocket launcher. This fuze is considered bore safe by US standards.

(C) Unique Features

- Bore-riding pin and safety band.
- Out-of-line detonator.

Fuze, BD, Model L16A1
FOM No. 1390-35-2-1

(C) Characteristics

Fuze assembly:	
Body material	Anodized aluminum alloy
Weight	?
Markings	L16A1
Length	3.5 in (88.9 mm)
Maj thread diam	2.00 in (50.8 mm)
Booster:	
Body material	Anodized aluminum alloy
Body length	20.3 mm (0.80 in)
Explosive	Tetryl
Explosive weight	?
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	*
Arming distance	?
Arming time	?

(C) Design Details

General. The L16A1 fuze (fig 4-22) consists principally of a body, plug, magazine, sealing disk, plunger, creep spring, actuating sleeve, setback sleeve, striker, shutter assembly, detonator, stop screw, locking pin and spring, ejection pin, and safety band.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape and formed plain, with an external diameter of 2 inches (50.8 mm). Internally, a shoulder is formed towards the rear of the body on which an aluminum disk seats, and beyond the shoulder the body is threaded to receive a body closing adapter. The rocket motor screws into the adapter. The front portion of the body is internally threaded at the mouth to accept a plug into which is screwed the magazine. In the side of the body a slot is cut for the ejection pin, and adjacent to it a hole is drilled and threaded for a stop screw. Opposite to

*Bore-riding pin and safety band.

(C) **Design Details (Continued)**

the slot for the ejection pin, a recess is made to house the locking pin and spring, which are retained in the recess by a small screwed plug. Adjacent to the locking pin, another pin is inserted through the side of the fuze body to locate the shutter assembly and prevent it from rotating.

Plug. The plug is made of anodized aluminum alloy. It is cylindrical in shape and externally threaded (left handed) to 1.5-inch (38.10-mm) diameter (20 TPI, UNS-2A) partially to screw into the front of the body and partially to engage in the screw threads formed in the rocket head. Internally, it is recessed on two diameters, the larger being threaded to accept the magazine; the smaller is filled with loose tetryl stemmed in, leaving a thin diaphragm of metal between the base of the recess and the outer surface at the base of the plug. Two key holes are drilled in front to facilitate assembly.

Magazine (i.e., booster). The body is made of anodized aluminum alloy. It is cup-shaped and externally threaded to screw into the plug. Internally, it houses the prepressed tetryl pellet. Two flats are formed on the base to facilitate assembly into the plug.

Sealing disk. This is a dished disk of anodized aluminum alloy. It is assembled into the rear of the body, with the flattened rim pressed against the shoulder formed in the body.

Plunger. The zinc-plated brass plunger is cone-shaped with a flange formed at the rear. It is housed inside the body, the flange resting against the inner side of the shoulder formed toward the rear of the body.

Creep spring. This is a cylindrical-coiled, tinned, steel-wire spring, formed with 2½ effective coils of 0.02-inch (0.50-mm) diameter wire. One coil at each end is close-coiled and square with the axis of the spring. It is assembled around the actuating sleeve.

Actuating sleeve. The actuating sleeve is made of zinc-plated steel. It is cylindrical in shape and formed with a small external flange at the rear. A longitudinal slot is formed near the center, and three slots are cut in the forward end. It is assembled around the plunger.

Setback sleeve. The setback sleeve is made of zinc-plated steel. It is cylindrical in shape with longitudinal and radial slots cut in one side. It is assembled over and around the actuating sleeve.

Fuze, BD, Model L16A1
FOM No. 1390-35-2-1

(C) Design Details (Continued)

Striker. The striker consists of a zinc-plated steel pin formed with a needle point, above which is a flange and a shank; a flat double phosphor-bronze spring; and a steel triangular-shaped plate lever formed with a lug at each side. The pin is riveted to the center of the apex of the lever and to one end of the spring.

Shutter assembly. This comprises a shutter plate, shutter, shutter spring, shutter-retaining spring, shutter-spring pin, shutter-hinge pin, and shutter-retaining-spring pin. The shutter plate is a flat circular disk, with a slot formed on the outside to fit over a locating pin inserted through the side of the fuze body adjacent to the locking pin. The end of this pin positions the plate and keeps it from rotating. The front surface of the plate is cut away and shaped to act as a guide for the shutter; around the periphery a slot is made to accommodate the retaining spring. The shutter-hinge pin, shutter-spring pin and shutter-retaining-spring pin are also assembled in the front surface of the plate. The rear surface of the plate is recessed, leaving a small portion of metal to act as a stop to the shutter when it is in the armed position. The shutter which is a flat, irregular-shaped component has a hole drilled through the center, and the rear portion of the hole is enlarged to house the detonator. On one side, near the detonator recess, are two small pins. These pins bear against the side of the ejection pin which, when ejected, allows the shutter, under the influence of the shutter spring, to swing into the armed position, thereby bringing the detonator into alignment over the point of the striker. The shutter is assembled over the hinge pin on which it pivots; it is moved into the armed position, when the ejection pin is ejected, by a double-armed spring, which is assembled under tension over a pin positioned to one side of the shutter plate. One arm of the spring bears against the side of the shutter, while the other bears against the side of the shutter plate. In the armed position, a shoulder on the shutter locks behind a projection on the free end of the shutter-retaining spring.

Detonator. This is a 0.18-gram (2.8-gr) "AZ" lugless (tinned copper alloy cup) detonator that is assembled with the open end toward the striker. It is assembled in a recess formed in the shutter and is held in position by a retaining washer secured by burring over an upstand formed around the recess.

Stop screw. The screw, which is made of zinc-plated steel, has a screwdriver slot in the head. It is assembled in the side of the body and acts as a guide for the setback sleeve and a stop for the actuating sleeve.

(C) Design Details (Continued)

Locking pin and spring. The locking pin is made of zinc-plated brass and formed with a flange around the center. It is assembled in the side of the fuze body, followed by a small cylindrical-coiled, steel-wire spring, and is retained in the fuze body by a small screwed plug.

Ejection pin. The ejection pin is made of zinc-plated steel. It is formed from a square bar, with a number of steps or keyways. A dome-shaped cup welded to the outer end of the pin houses one end of a coiled steel-wire ejection spring when the pin is assembled in the fuze. The ejection pin passes through the fuze body and is held in position by the safety band which encircles the body. This pin prevents any movement of the internal parts during storage, transit, and handling; it also retains the shutter in the unarmed position, precluding any accidental functioning.

Safety band. The safety band is made of zinc-plated steel. It is formed from a flat steel strip and is hinged in the center, the ends being fitted with an eyelet and an engaging lever for securing purposes. The band is varnished over the zinc plating. Printed in red on one side are the words "SAFETY BAND–NOT TO BE REMOVED UNTIL ROCKET HEAD HAS BEEN LOADED INTO LAUNCHER." On the opposite side the legend is a raised boss fitted with a hard rubber washer around the underside. The washer is retained by lugs turned over onto its outer edges. Earlier versions had a loop instead of an eyelet and were painted green.

(C) Safety

Safety is provided as follows:

- The safety band secures the ejection pin in position.
- The ejection pin, which is held in position by the safety band during transit and storage, passes between the striker and fuze shutter, preventing contact between them. The ejection pin also keeps the shutter in the unarmed position until after firing.
- The shutter is made with two metal stops which bear against the side of the ejection pin and keep the shutter in the unarmed position until the pin is ejected. In the unarmed position, the detonator is held away from the striker and is out of alignment with the tetryl channel in the fuze plug.

Fuze, BD, Model L16A1
FOM No. 1390-35-2-1

(C) Functioning

The safety band is *not* removed until just before the rocket head is finally pushed home into the launcher. Under the influence of its spring, the ejection pin moves out of the safe into the locked position. The fuze cannot arm when the ejection pin is moving or when the ejection pin is in either the safe or locked position. As the rocket enters the launcher, the bore of the launcher depresses the ejection pin into the intermediate position, freeing the setback sleeve to move upon firing. Until the rocket is fired the fuze is still safe, since the ejection pin prevents the actuating sleeve, firing pin, and shutter from moving. If it becomes necessary to remove the rocket from the launcher, the ejection pin will move outward under the influence of its spring and reengage the setback sleeve, thus returning the fuze to its locked position. The safety band can then be replaced, thereby returning the ejection pin to its original safe position.

When the rocket is fired. The force of setback opposing the strength of the creep spring moves the setback sleeve to its rearward position where it is retained by the locking pin.

When the rocket leaves the muzzle of the launcher. The ejection pin is thrown clear of the fuze, the shutter revolves under the influence of its spring. The pin is locked in the armed position when a shoulder on the shutter locks behind a projection on the end of the shutter-retaining spring. The fuze is thus fully armed.

During flight. The setback sleeve and the actuating sleeve are prevented from rotating by the stop screw which passes through a slot provided in both sleeves. The striker spring also prevents the striker from impinging on the detonator, and the creep spring retards the forward movement of the plunger and actuating sleeve. The strength of the creep spring is strong enough to retard the plunger and actuating sleeve and to prevent the fuze from firing should the rocket strike a light object such as light brush or undergrowth.

Upon impact or graze with a heavy object. The inertial plunger and actuating sleeve overcome the strength of the creep spring and move forward. The actuating sleeve, aided by the weight of the plunger, bears on the lugs of the triangular frame on which the striker is mounted. The striker spring is depressed and the striker point forced into the detonator which, in turn, detonates the tetryl pellet in the magazine and the filling in the rocket head.

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
88.9-mm (3.5-in) HEAT warhead	UK M20 Mk 2 rocket launcher

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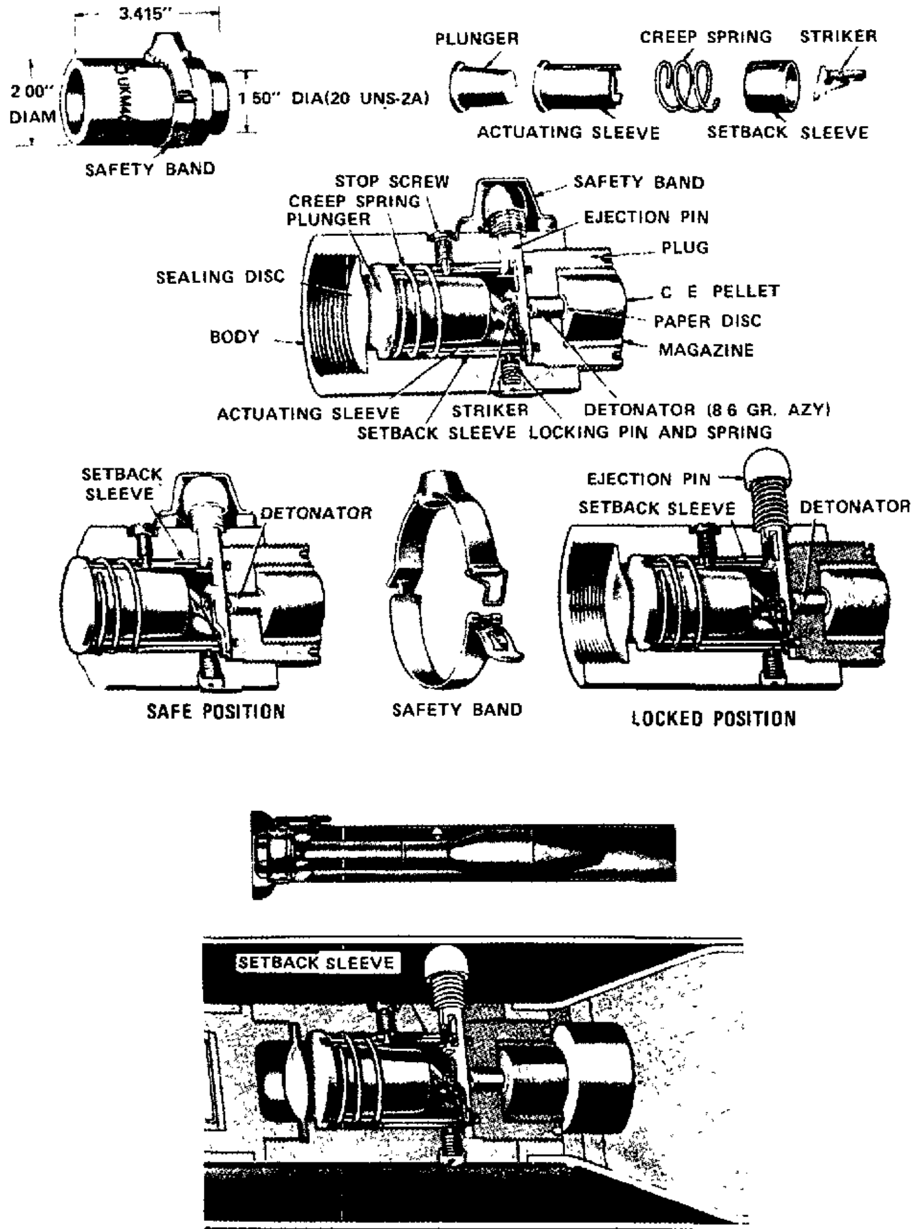

Neg. 552507 (CONFIDENTIAL)

Figure 4-23. Fuze, PD, Model L5, M404, Mk 1, exploded and cutaway views (U).

Fuze, BD, Model L5, M404, Mk 1
FOM No. 1390-35-2-2

(C) Description

The L5 fuze (fig 4-23) is a setback-armed, BD type designed for use with HEAT ammunition fired from the UK, M20, 3.5-inch rocket launcher. This fuze is obsolescent.

(C) Unique Features

- Bore-riding ejection pin and safety band.
- Actuating and setback sleeve.

(C) Characteristics

Fuze assembly:	
Body material	Anodized aluminum alloy
Weight	?
Markings	L5, UK, M404 Mk 1
Length	3.145 in (79.88 mm)
Max diam	2.00 in (50.8 mm)
Plug thread diam	1.50 in (38.1 mm)
Booster:	
Body material	Anodized aluminum alloy
Body length	?
Explosive	Tetryl
Explosive weight	?
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	Safety band & ejection pin
Arming distance	?
Arming time	?

(C) Design Details

General. The L5, UK M404 Mk 1 fuze (fig 4-23) is a base percussion detonating type functioning with non-delay action on impact. It consists principally of a body, plug, magazine, sealing disk, plunger, creep spring, actuating sleeve, setback sleeve, striker, detonator, stop screw, locking pin and spring, ejection pin, and safety band.

Body. The body is made of anodized aluminum alloy. It is cylindrical in shape, formed plain, with an external diameter of 2 inches (50.8 mm). Internally, a shoulder is formed toward the rear of the body on which an aluminum disk seats, and beyond the shoulder the body is threaded to receive a body-closing adapter onto which the rocket motor is screwed. The front portion of the body is threaded internally at the mouth to accept a plug into which the magazine is screwed. In the side of the body a slot is cut for the ejection pin, and adjacent to it a hole is drilled and threaded for a stop screw. A recess is made opposite the slot for the ejection pin to house the locking pin and spring, which are retained in the recess by a small screwed plug.

Plug. This plug is made of anodized aluminum alloy. It is cylindrical in shape and threaded externally (left handed) to 1.5-inch (38.1-mm) diameter (20 TPI UNS-2A) partially to screw into the front of the body and partially to engage in the screw threads formed in the rocket head. Internally, it is recessed on two diameters, the larger being threaded to accept the magazine, the smaller housing the detonator. A circumferential recess is formed around the face of the rear of the plug, and two holes are drilled in the front to facilitate assembly. A paper disk is inserted between the plug and the magazine, being secured to the face of the plug by shellac.

Magazine (i.e., booster). The magazine is made of anodized aluminum alloy. It is cup-shaped and threaded externally to screw into the plug. Internally, it houses the prepressed tetryl pellet. Two flats are formed on the base to facilitate assembly into the plug.

Sealing disk. This is a dished disk of anodized aluminum alloy. It is assembled into the rear of the body, and the rim of the disk is flattened by the shoulder formed in the body.

Plunger. The plunger is made of zinc-plated brass. It is cone-shaped with a flange formed at the rear. It is housed inside the body, the flange resting against the inner side of the shoulder formed toward the rear of the body.

Fuze, BD, Model L5, M404, Mk 1
FOM No. 1390-35-2-2

(C) Design Details (Continued)

Creep spring. This is a cylindrical-coiled, tinned, steel-wire spring, formed with two and one-half effective coils of 0.02-inch diameter wire, one coil at each end being close-coiled and ground square with the axis of the spring. It is assembled around the actuating sleeve.

Actuating sleeve. The actuating sleeve is made of zinc-plated steel. It is cylindrical in shape and formed with a small external flange at the rear. A longitudinal slot is formed near the center and three slots are cut in the forward end. It is assembled around the plunger.

Setback sleeve. The setback sleeve is made of zinc-plated steel. It is cylindrical in shape and a longitudinal and radial slot are cut in one side. It is assembled over and around the actuating sleeve.

Striker. The striker consists of a zinc-plated steel pin formed with a needle point, above which is a flange and a shank; a flat double phosphor-bronze spring; and a steel triangular-shaped plate lever formed with a lug on each side. The pin is riveted to the center of the apex of the lever and to one end of the spring.

Detonator. This is a 0.56-gram (8.6-gr) "AZY" (copper alloy cup) detonator that is assembled with the open end toward the striker, behind a glazed board washer in a hole formed in the center of the plug.

Stop screw. The screw is made of zinc-plated steel with a screwdriver slot in the head. It is assembled in the side of the body and acts as a guide for the setback sleeve and a stop for the actuating sleeve.

Locking pin and spring. The locking pin is made of zinc-plated brass formed with a flange around the center. It is assembled in the side of the fuze body with its small, cylindrical-coiled, steel-wire spring, which is retained in the fuze body by a small screwed plug.

Ejection pin. The ejection pin is made of zinc-plated steel. It is formed from square bar, with a number of steps or keyways. A dome-shaped cup is welded to the outer end and houses one end of a coiled, steel-wire ejection spring when the pin is assembled in the fuze. The ejection pin passes through the fuze body and is held in position by the safety band

(C) Design Details (Continued)

that encircles the body. This pin prevents any movement of the internal parts during storage, transit, and handling; it also masks the detonator from the striker, thus precluding any accidental functioning.

Safety band. The safety band is made of zinc-plated steel. It is formed from flat spring strip, hinged in the center, and the ends are fitted with a loop and engaging lever for securing purposes. The band is painted green and printed in red on the side are the words "SAFETY BAND–NOT TO BE REMOVED UNTIL ROCKET HEAD HAS BEEN LOADED INTO LAUNCHER." On the side opposite the legend is a raised boss, around the underside of which is fitted a neoprene washer, which is retained by lugs turned over on to the outer edges.

(C) Safety

The ejection pin, which is held in position by a hinged safety band, prevents any movement of the internal parts during storage and handling and, in addition, masks the 8.6-gr (0.56-gram) "AZY" detonator from the striker.

Fuze, BD, Model L5, M404,Mk 1
FOM No. 1390-35-2-2

(C) Functioning (Fig 4-24)

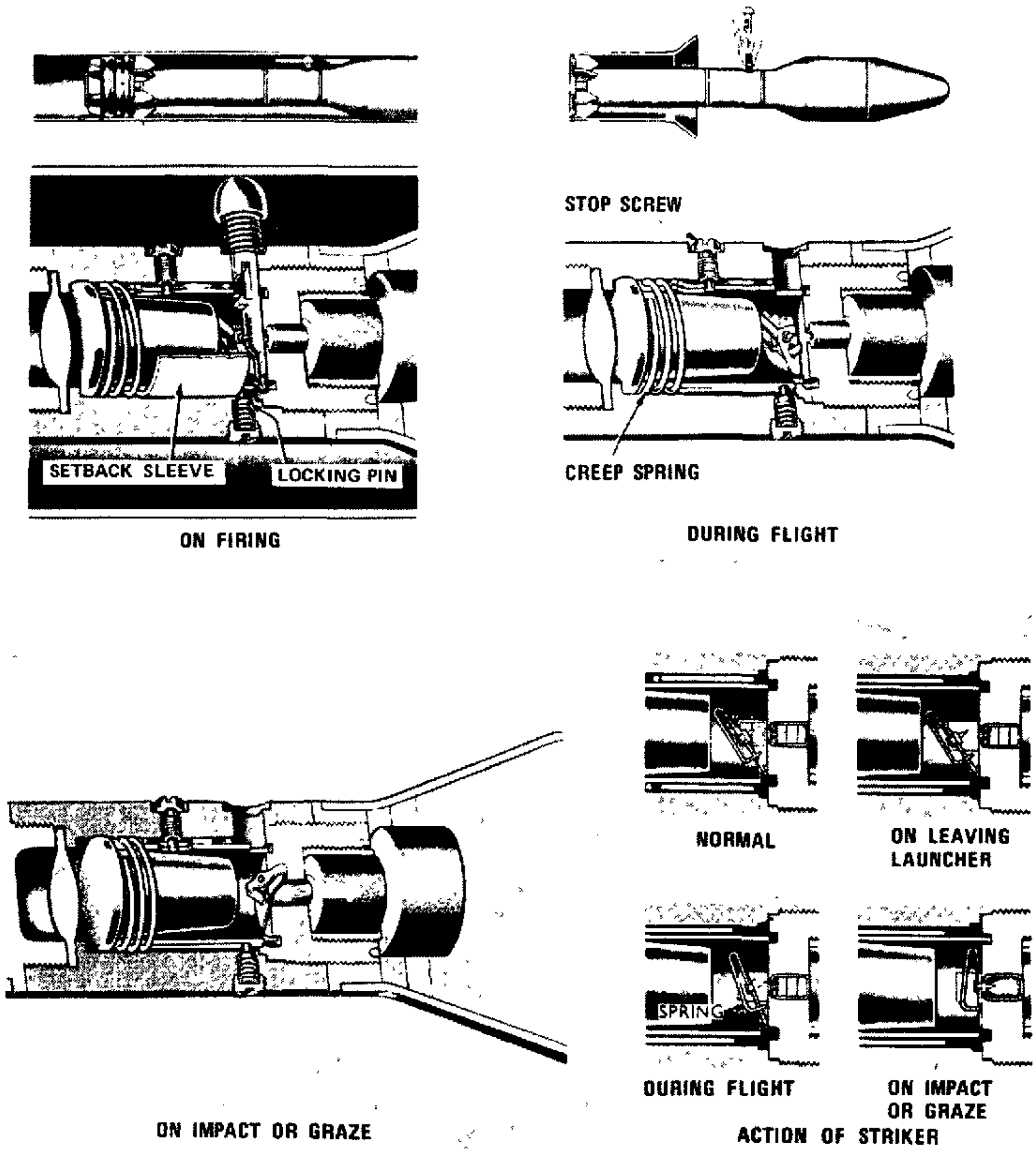

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Figure 4-24. Fuze, BD, Model L5, M404,Mk 1, functioning views (U).

(C) **Functioning (Continued)**

The safety band is not removed until just prior to the rocket head finally being pushed home into the launcher, and under the influence of its spring the ejection pin moves out of the safe position to lock in the setback sleeve. The fuze cannot arm when the ejection pin is in either the safe or locked position. The bore of the launcher depresses the ejection pin into the intermediate position as the rocket enters the launcher. The setback sleeve is then free to move upon firing. Until the rocket is fired the fuze is still safe, since the ejection pin prevents movement of the actuating sleeve and firing pin. If it becomes necessary to remove the rocket from the launcher, the ejection pin will move outward and re-engage the setback sleeve, thus returning the fuze to its locked position. The safety band can then be replaced, thereby returning the ejection pin to the original safe position.

When the rocket is fired. The force of setback opposing the action of the creep spring moves the setback sleeve to its rearward position, where it is held by the locking pin.

When the rocket leaves the muzzle of the launcher. The ejection pin is thrown clear of the fuze and the fuze is fully armed.

During flight. The setback sleeve and the actuating sleeve are prevented from rotating by the stop screw, which passes through a slot provided in both sleeves. The striker spring also prevents the striker point from impinging on the detonator, and the creep spring retards the forward movement of the plunger and actuating sleeve. The strength of the creep spring is sufficient to retard the plunger and actuating sleeve and to prevent the fuze from firing should the rocket strike a light object such as light brush or undergrowth.

Upon impact or graze with a heavy object. The inertial plunger and actuating sleeve overcome the force of the creep spring and move forward. The actuating sleeve, aided by the weight of the plunger, bears on the lugs of the triangular frame on which the striker is mounted. The striker spring is depressed and the striker forced into the detonator which, in turn, detonates the tetryl pellet in the magazine and the filling in the rocket head.

(C) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
3-in HEAT warhead	3.5-in rocket launcher, UK Model M20 Mk 2

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Declassified and Approved For Release 2014/03/04 : CIA-RDP09-01333R000100030001-0

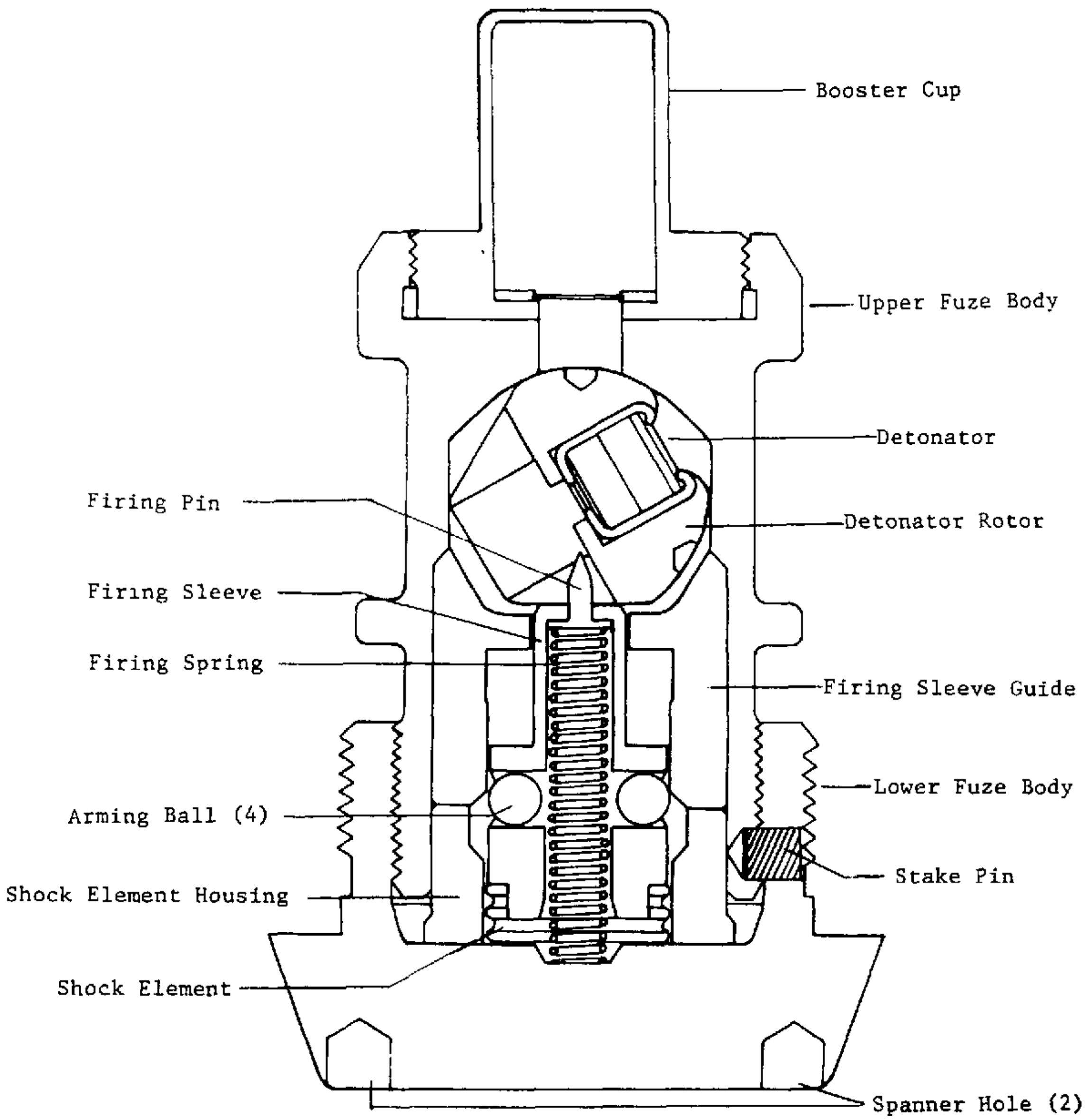

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Figure 4-25. Fuze, BDSD, Type ?, section view (U).

Fuze, BDSD, Type ?
FOM No. 1390-37-1-8

(C) Description

This (fig 4-25) is a conventional, BD fuze with a self-destruct feature actuated by projectile spin decay. The out-of-line detonator is mounted in a ball rotor. This fuze is used with the 30x113 mm B APHEI cartridge, Type 9532, which is designed for air-to-air use in DEFA, Type 552 aircraft guns. The fuze is a copy, with minor modifications, of the Oerlikon BDSD fuze, Type BZD-0236, which was developed prior to 1962. The fuze is unmarked.

(C) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	41.3 g (0.09 lb)
Markings	None

Booster:

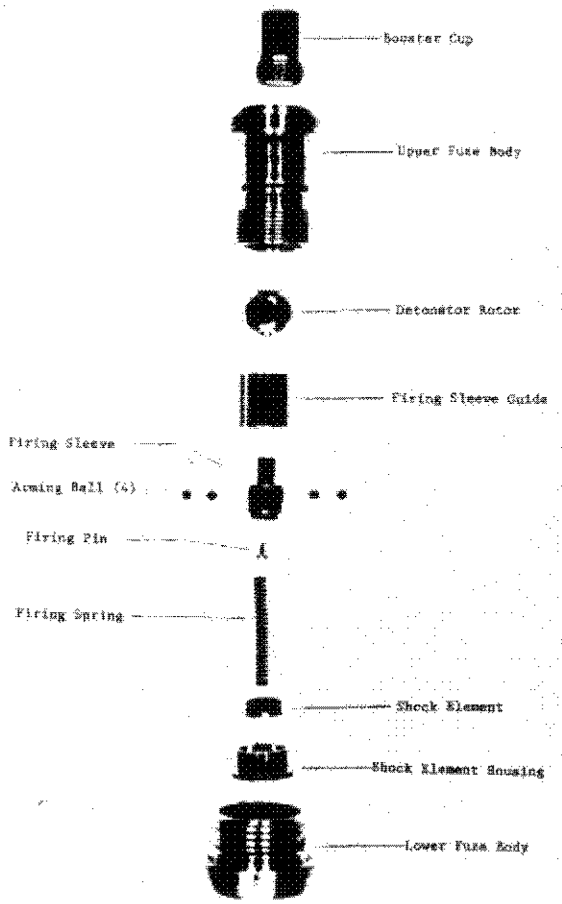
Body material	Steel
Body length	15.2 mm (0.60 in)
Explosive	?
Explosive weight	0.8 g (12.3 gr)

Functional data:

Arming method	Spin
Firing method	Impact
Safety devices	Out-of-line detonator in ball rotor
Arming distance	~3 m (est)
Arming time	?
Self-destruct time	5-13 s (est)
Delay time	?

(C-NFD) Design Details

Except for two minor internal changes, this fuze is a copy of the Oerlikon fuze, BDSD, Type BZD-0236. Changes include provision of a separate firing pin instead of the Oerlikon one-piece firing pin and firing-pin bushing, and a booster cup that projects into the explosive cavity. The fuze (fig 4-26) consists of an aluminum fuze body that contains a self-destruct mechanism, a firing pin, a ball rotor that contains an out-of-line detonator, and a booster. In storage and shipment the fuze is kept safe by the out-of-line position of the detonator in the rotor. Rotor position is maintained by pressure from the self-destruct spring and the shock element, acting through the firing-pin bushing.



Neg. 552246 (CONFIDENTIAL-NFD)
Figure 4-26. Fuze, BDSD, Type ?, exploded view (U).

NO FOREIGN DISSEM

Fuze, BDSD, Type ?
FOM No. 1390-37-1-8

(C-NFD) Functioning

Upon firing, setback forces cause the firing pin bushing to move to the rear, crushing the shock element and further compressing the self-destruct spring. At this point centrifugal force causes the arming balls to move outward and rearward, against the conical interior surfaces of the self-destruct housing. This action moves the firing pin bushing further rearward and restrains the self-destruct spring. Pressure on the rotor is now released. Centrifugal force causes the unbalanced rotor, now free, to rotate until the detonator is aligned with the firing pin. Upon impact, inertia added to the pressure of the compressed self-destruct spring overcomes centrifugal force, acting on the arming balls. These balls are forced inward into their recess in the firing-pin bushing, and the firing pin is driven into the detonator, initiating detonation of the booster. If impact does not occur, projectile spin will decay and centrifugal force decrease until the compressed self-destruct spring overcomes the spin force on the arming balls and drives the firing pin into the detonator.

(C-NFD) Applications (Ammunition and Weapons)

Ammunition	Weapons
30x113-mm B APHEI cartridge, Type 9532	30-mm aircraft gun, DEFA, Type 552

Section V.

TIME FUZES

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Section V.

TIME FUZES

GENERAL

(U) Time fuzes have been designed or are under development for artillery, rocket, mortar, and recoilless ammunition applications. These fuzes are designed to function after a predetermined time. "Time" refers to the length of time from the instant of firing the weapon to the instant of functioning of the fuze. Some of the older obsolescent fuzes utilize pyrotechnic time train rings, while the most recent developments utilize clockwork-type time mechanisms.

(U) The mechanical timers employed are usually detented or restrained by a trigger mechanism which is released on setback during firing or, in the case of the older types, the pyrotechnic time train rings are initiated on setback by a stab-type firing pin.

(U) Recent mechanical time (MT) fuzes include a backup impact function, usually incorporating a superquick action upon impact.

(U) The fuzes described in this section are for either high- or low-"g" acceleration, and for fin- or spin-stabilized projectiles or warheads. Most of these fuzes require either setback or centrifugal force environmental stimulus for arming.

(U) With the exception of some older obsolescent types, the fuze designs presented in this handbook are well within the current state-of-the-art and, in some instances, incorporate unique features.

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*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

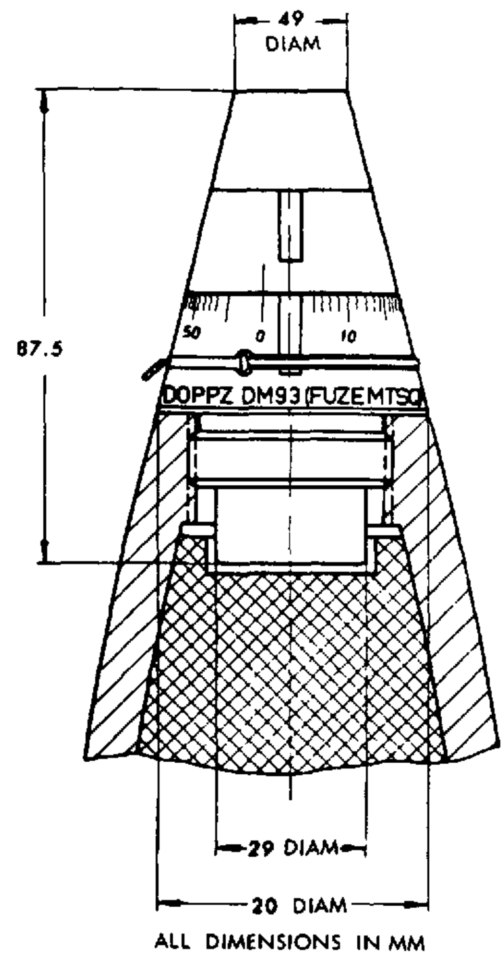

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Figure 5-1. Fuze, MTSQ, Model DM 93, contour view (U).

(U) **Description**

The DM 93 fuze (fig 5-1) is a delayed-arming-type MT fuze designed with a backup SQ impact function. It was developed by Junghans of West Germany for use with illumination and colored-marker mortar projectiles. The clockwork employed is a 60-second timer with 2-second graduations indexed on the fuze body. The backup impact function is provided by a protruding-type striker, permitting a graze-sensitivity feature.

Fuze, MTSQ, Model DM 93
FOM No. 1390-16-1-8-1

(U) **Unique Features**

- Pull wire for positive safety during handling.
- Spring-loaded eccentric rotor housing out-of-line detonator.
- Locking shaft-pinion-gear arrangement for delay arming.
- Protruding striker-firing pin assembly.
- Double-safety mechanism via two setback pins.

(U) **Characteristics**

Fuze assembly:	
Body material	Aluminum (est)
Weight	202 ±5 g (0.44 lb ± 77 gr)
Markings	DOPPZ DM 93
Length	87.7 mm (3.45 in)
Body diam	49 mm (1.93 in)
Expelling charge cup:	
Body material	Aluminum
Body length	?
Explosive	Black powder
Explosive weight	?
Functional data:	
Arming method	Setback
Firing method	Mechanical time & impact
Safety devices	*
Arming distance	50 m
Arming time	1 s

*2 setback pins, 2 locking balls, locking spring, pull wire, and out-of-line detonator.

Fuze, MTSQ, Model DM 93
FOM No. 1390-16-1-8-1

(U) **Design Details**

The DM 93 MTSQ fuze (fig 5-2) consists primarily of a two-piece movable setting cap (1), a fuze body (2), a rear plug (3), and an expelling charge cup (4).

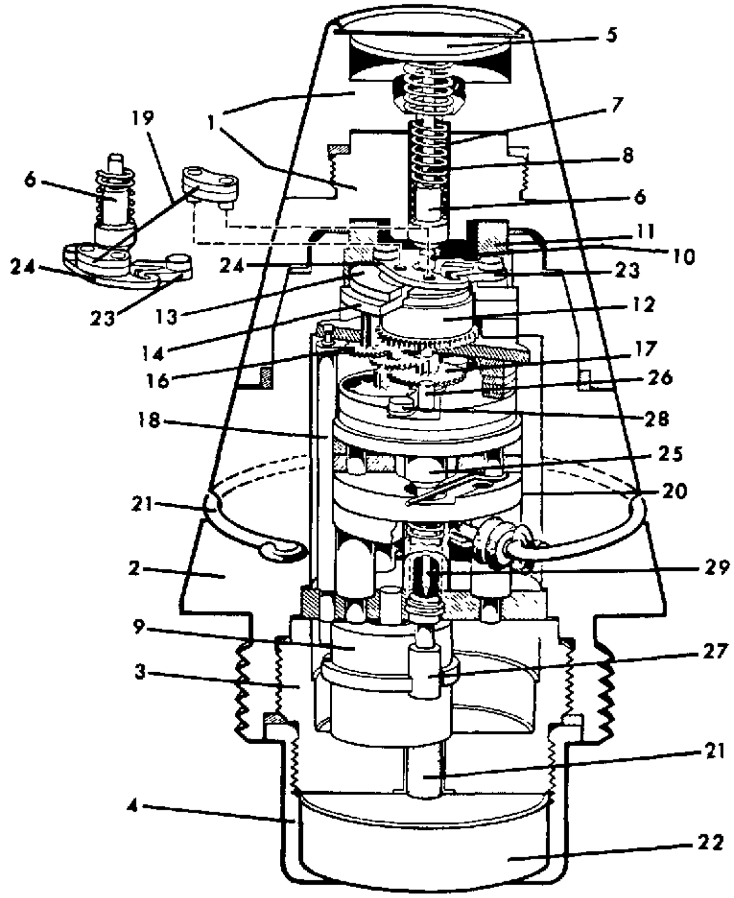

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Figure 5-2. Fuze, MTSQ, Model DM 93, section view (U).

The movable nose cap is bored out to house the protuding-type striker-firing pin assembly which consists of a striker head (5), conical-shaped striker bushing (6), striker-bushing compression spring (7), striker stem (8), bushing support (19), firing-pin

(U) **Design Details (Continued)**

head (10), and firing pin (29). The firing pin extends through the timer drum (12), setback device (20) and engages a blind hole of the eccentric rotor (9) when in the safe position.

The mechanical timer (see sec VIII for detailed illustrations) includes the release lever (24) connected to the firing lever (23), which has a bent tongue that leans downward against a cam on the timer drum cover (14), which is riveted to the timing ring (13). Other components include a coupling ring (11), setting stop pin (not shown), timer drum (12) housing a wound band spring, and pinion-gears (17). The first of the pinion gears (16) meshes with a toothed segment of the rotors' locking shaft (18) that engages a slotted keyway of the eccentric rotor (9). The anchor or pallet (28) of the clockwork is held in check by the two upper stems (26) of the two setback pins (25).

The setback device (see sec VIII for design illustration) is a double-safety mechanism including two setback pins (25) with an upper stem (26) and a lower collar (27), two setback springs, and a setback sleeve. The setback pins are locked in place by two locking balls held in position by a V-shaped locking spring. For positive safety during handling, a pull wire (21) secures the setback pins.

The rear plug (13) is bored out to house the eccentric rotor (9). The rotor has a slotted keyway for engaging the locking shaft (18). Two holes are drilled around the periphery of the rotor: one houses the SQ detonator; the other is a blind hole for the firing pin (29). In addition, a central hole has been drilled for housing the torqued spring that rotates the rotor until it is stopped by a pin. The rotor is then in the armed position (i.e., the detonator is in line with the firing pin).

The rear plug (3) is threaded externally to facilitate assembly into the fuze body (2) and assembly of the expelling charge cup (4) housing a black powder expelling charge (22).

(U) **Functioning**

Prior to firing, the movable nose cap is turned to the desired time setting indicating time of flight and the pull-wire is released.

Upon firing, setback force moves the setback sleeve (3) of the setback device (fig 5-3) rearward, forcing the two locking balls and V-shaped locking spring outward. This undetents the two setback pins (4), which move rearward compressing their springs. This allows the anchor or pallet of the timer (see fig 5-2) to swing free as a result of the upper stems (2) of the setback pins (4) moving rearward on setback.

(U) Functioning (Continued)

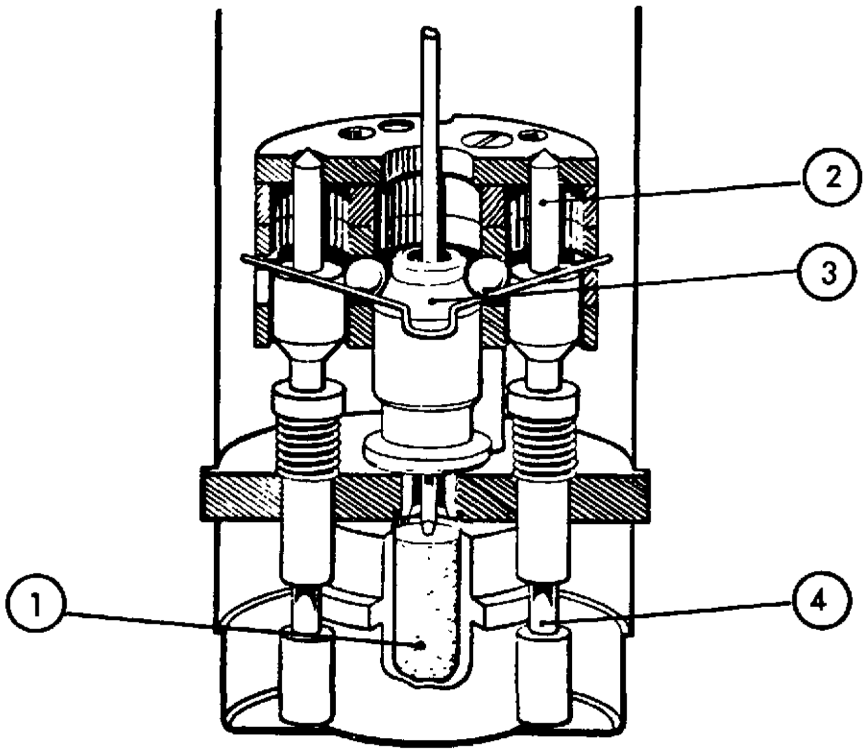

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Figure 5-3. Fuze, MTSQ, Model DM 93, setback device (U).

In the meantime, the lower collars of the setback pins (4) disengage from their seats in the eccentric rotor, undetenting the rotor which is freed to rotate to the armed position. Arming is delayed until the locking shaft moves out of the slot of the rotor. This takes about 1 second.

As soon as the timer has reached the prescribed time delay, according to the setting on the fuze body, the striker bushing spring moves downward, pushing the firing-pin lever and release lever apart and hitting the firing-pin head. The firing pin is driven into the detonator (1), which initiates the relay charge and, in turn, the black powder expelling charge.

Fuze, MTSQ, Model DM 93
FOM No. 1390-16-1-8-1

(U) Packaging

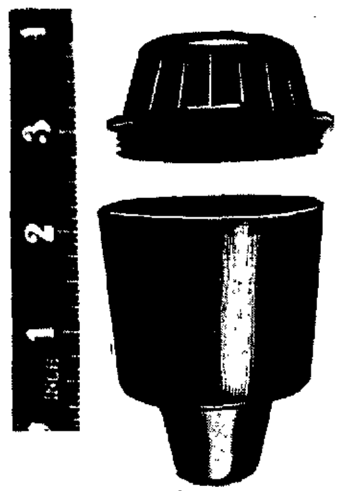

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Figure 5-4. Fuze, MTSQ, Model DM 93, packaging container (U).

The DM 93 fuze is individually packaged in a special contour-shaped plastic container (fig 5-4).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
60-mm illumination projectiles; 60-mm colored smoke projectiles	60-mm mortars
81-mm illumination projectiles; 81-mm colored smoke projectiles	81-mm mortars
120-mm illumination projectiles; 120-mm colored smoke projectiles	120-mm mortars

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Figure 5-5. Fuze, MTSQ, Model DOPPZ DM 53, full view with packaging container (U).

Fuze, MTSQ, Model DOPPZ DM 53
FOM No. 1390-16-1-14

(FOUO) Description

Fuze DOPPZ DM 53 is a West German (Diehl) produced copy of US fuze, MTSQ, M501A1. No booster is used. This fuze was standard in the West German Armed Forces at least as late as 1969. See pertinent US publications (e.g., TM-9-1300-203) for a functioning description and technical data for this fuze.

(FOUO) Applications (Ammunition and Weapons)

Ammunition	Weapons
Various illuminating, smoke, and colored smoke rounds from 76 mm to 203 mm	76-mm to 203-mm guns and howitzers

(FOUO) Interchangeability

Fuze DOPPZ DM 53 has no booster. Fuze DOPPZ DM 53 is redesignated DOPPZ DM 63 when booster ZDL DM 12 is used. Fuze DOPPZ DM 53 is redesignated DOPPZ DM 103 when German booster ZDL DM 32 (a copy of US booster M125A1) is used. Fuze DOPPZ DM 53 is redesignated DOPPZ DM 113 when German booster ZDL DM 42 is used.

(U) Packaging

Each fuze is packed in an individual watertight can. Each fuze can is equipped with a pull-ring opener to ensure easy access to the fuze for firing. Fifteen or 40 fuze cans are packed into each shipping box. Although definite information is not available, the packaging described here may be standard for all fuzes manufactured by Diehl.

Fuze, MTSQ, DM 123
FOM No. 1390-16-1-18

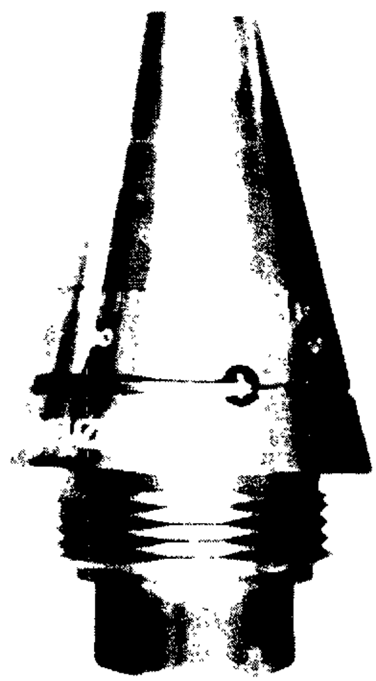

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Figure 5-6. Fuze, MTSQ, Model DM 123, full view (U).

(U) Description

The DM 123 fuze (fig 5-6) is a setback, delayed-arming MT fuze with an SQ impact function. It was developed by Junghans for use with 60-, 81-, and 120-mm high explosive projectiles. It is similar in design and functioning to that of the DM 93 fuze (FOM No. 1390-16-1-8-1), except that the black powder expelling charge has been replaced by a tetryl booster.

(U) Unique Features

- Pull-wire for positive safety during handling.

Fuze, MTSQ, DM 123
FOM No. 1390-16-1-18

(U) Unique Features (Continued)

- Locking shaft-pinion-gear arrangement for delay arming.
- Protruding striker-firing pin assembly.
- Double-safety mechanism via two setback pins.

(U) Characteristics

Fuze assembly:

Body material	Aluminum (est)
Weight	202 ±5 g (0.44 lb ± 77 gr)
Markings	DOPPZ DM 123
Length	87.7 mm (3.45 in)
Body diam	49 mm (1.93 in)

Booster:

Body material	Aluminum (est)
Body length	?
Explosive	Tetryl
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Mechanical time and impact
Safety devices	*
Arming distance	50 m
Arming time	1 s

*2 setback pins, 2 locking balls, locking spring, pull-wire, and out-of-line detonator.

(U) **Design Details and Functioning**

Design details and functioning are the same as the DM 93 MTSQ fuze (FOM No. 1390-16-1-8-1). See Section VIII for further details on the 60-second timer employed. The contour of the DM 123 fuze being the same as the DM 93 permits packing in the special contour plastic container developed for the DM 93 fuze.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
60-mm HE projectiles	60-mm mortar
81-mm HE projectiles	81-mm mortar
120-mm HE projectiles	120-mm mortar

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Fuze, BD, Model BDZ DM 701
FOM No. 1390-16-1-29

(FOUO) **Description**

According to an official West German source, fuze BDZ DM 701 is a German-produced copy of US fuze, BD, M68 A1. This fuze was standard in the West German Armed Forces, at least as late as 1969. See pertinent US publications (e.g., TM 9-1300-203) for technical details of this fuze.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90x602-mm HE cartridge, Model PBK-LS	90-mm guns

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Fuze, MTSQ, Model DOPPZ DM 43
FOM No. 1390-16-1-32

(FOUO) **Description**

Fuze DOPPZ DM 43 is a West German-produced copy of US fuze, MTSQ, M502A1. This fuze was standard in the West German Armed Forces at least as late as 1969. See pertinent US publications (e.g., TM 9-1300-203) for technical details of this fuze.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90x602-mm HE cartridge, Model (?)	90-mm antiaircraft guns

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Fuze, MTSQ, Model DOPPZ DM 63
FOM No. 1390-16-1-33

(FOUO) **Description**

Fuze DOPPZ DM 63 is a DOPPZ DM 53 fuze (see FOM No. 1390-16-1-14) with a German booster, Model ZDL DM 12, attached. The characteristics of the ZDL DM 12 booster are not known to US intelligence elements. Except for this booster assembly, which may be of German design, the characteristics of fuze DOPPZ DM 63 are those of US fuze, MTSQ, M501A1. This fuze, manufactured by Diehl of West Germany, was standard in the West German Armed Forces, at least as late as 1969.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90x602-mm practice cartridge, Model (?)	90-mm antiaircraft guns
105x373-mm cartridges, Models (?)	105-mm guns or howitzers
155-mm projectiles, Models (?)	155-mm howitzers
175-mm practice projectile, Model (?)	175-mm gun, M107 (US)
203-mm HE projectile, Model (?)	203-mm howitzers

(U) **Interchangeability**

Fuze DOPPZ DM 63 is redesignated DOPPZ DM 53 when used without a booster. Fuze DOPPZ DM 63 is redesignated DOPPZ DM 103 when German booster ZDL DM 32 (a copy of US Booster M125A1) is used. Fuze DOPPZ DM 63 is redesignated DOPPZ DM 113 when German booster ZDL DM 42 is used.

Fuze, MTSQ, Model DOPPZ DM 63
FOM No. 1390-16-1-33

(U) Packaging

Packaging for this fuze is believed to be the same as for fuze DOPPZ DM 53 (see FOM No. 1390-16-1-14) except for slight differences necessary to accommodate the different lengths of the different fuze models.

Fuze, MTSQ, Model DOPPZ DM 73
FOM No. 1390-16-1-34

(FOUO) **Description**

According to an official West German Government publication, this is the No. 554 fuze, designed by the Dixi Company of Switzerland, assembled with German booster, Model ZDL DM 42. It is uncertain whether the fuze body is Swiss manufactured or merely Swiss designed. Diehl is known to produce booster ZDL DM 42, but it is unknown whether Diehl is the sole producer of this booster. We presently hold no information on the Dixi No. 554 fuze. Some information on booster ZDL DM 42 is available in the article on PD fuze, Model AZ DM 211 (see FOM No. 1390-16-1-26) elsewhere in this handbook. This fuze was standard in the West German Armed Forces, at least as late as 1969.

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
105x373-mm cartridges, Models ?	105-mm guns or howitzers
155-mm HE projectile, Model ?	155-mm howitzers

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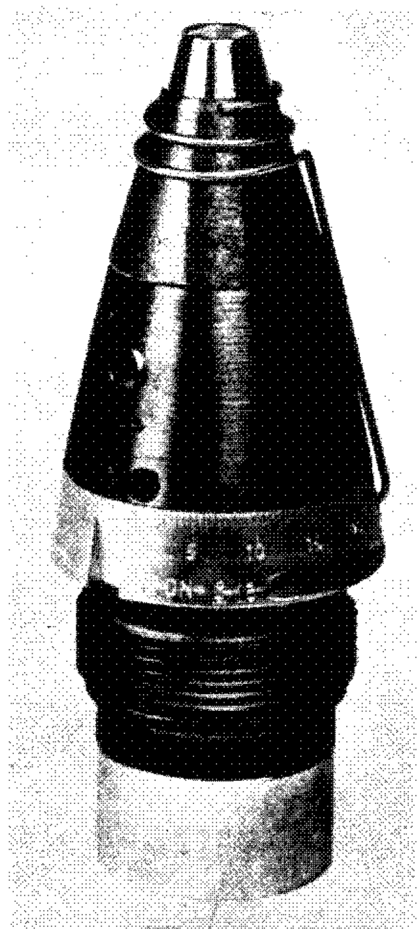

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Figure 5-7. Fuze, MTSQ, Model DOPPZ DM 103, full view (U).

(FOUO) **Description**

Fuze DOPPZ DM 103 (fig 5-7), a West German-manufactured (Diehl) copy of US fuze, MTSQ, M520A1, was standard in the West German Armed Forces at least as late as 1969. German booster ZDL DM 42 (a copy of US booster M125A1) is used. Times between 2 and 75 seconds may be set in 0.5-second increments. When no time is set (fuze setting "S"), this fuze functions as an SQ PD fuze. This fuze contains a clockwork mechanism (see fig 5-8) to

Fuze, MTSQ, Model DOPPZ DM 103
FOM No. 1390-16-1-35

(FOUO) Description (Continued)

ensure delayed arming. A safety wire is used during transport as an additional safety feature. See pertinent US publications (e.g., TM 9-1300-203) for additional technical data.

(U) Characteristics

Material used:

Nose portion	Aluminum
Central body portion	Brass
Timing ring and lower body	Aluminum
Timing mechanism	Brass and aluminum
Booster (except booster cup)	Brass
Booster cup	Aluminum

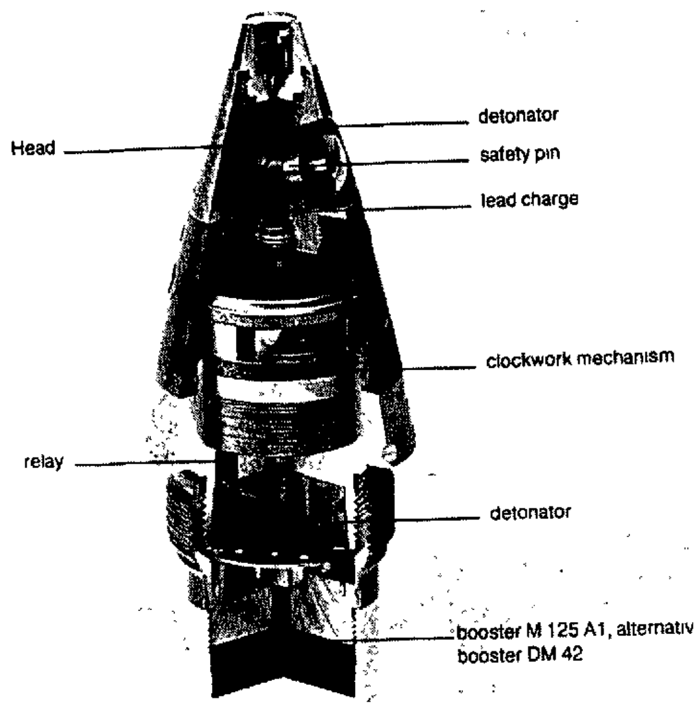

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Figure 5-8. Fuze, MTSQ, Model DOPPZ DM 103, section view (U).

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
105x373-mm smoke ("fog") cartridge, Model (?)	105-mm guns or howitzers
155-mm HE projectile, Model (?)	155-mm howitzers
175-mm practice projectile, Model (?)	175-mm guns (US M107)
203-mm HE projectile, Model (?)	203-mm howitzers

(FOUO) **Interchangeability**

Fuze DOPPZ DM 103 is redesignated DOPPZ DM 53 when used without a booster. Fuze DOPPZ DM 103 is redesignated DOPPZ DM 63 when reassembled with German booster ZDL DM 12. Fuze DOPPZ DM 103 is redesignated DOPPZ DM 113 when reassembled with German booster ZDL DM 42.

(U) **Packaging**

It is believed that this fuze uses the same packaging (with minor changes in container dimensions) as is described in the article on fuze DOPPZ DM 53 (FOM No. 1390-16-1-14) elsewhere in this handbook.

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Fuze, MTSQ, Model DOPPZ DM 113
FOM No. 1390-16-1-36

(FOUO) **Description**

Fuze DOPPZ DM 113 is a West German-manufactured (Diehl) US fuze, MTSQ, M501A1 (German Model DOPPZ DM 53) with a German-designed booster, Model ZDL DM 42, attached. This fuze was standard in the West German Armed Forces at least as late as 1969. For information on booster ZDL DM 42, see the article on fuze AZ DM 211 (FOM No. 1390-16-1-26). For technical details of this fuze (except for the booster), see pertinent US publications (e.g., TM 9-1300-203).

(FOUO) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90-mm practice cartridge, Model (?)	90-mm guns
105x373-mm cartridges, Models (?)	105-mm guns or howitzers
155-mm projectiles, Models (?)	155-mm howitzers
175-mm practice projectile, Model (?)	175-mm guns (US M107)
203-mm HE projectile, Model (?)	203-mm howitzers

(FOUO) **Interchangeability**

Fuze DOPPZ DM 113 is redesignated DOPPZ DM 53 when used without a booster. Fuze DOPPZ DM 113 is redesignated DOPPZ DM 63 when reassembled with German booster ZDL DM 12. Fuze DOPPZ DM 113 is redesignated DOPPZ DM 103 when reassembled with German booster ZDL DM 32 (a copy of US booster M125A1).

(U) **Packaging**

It is believed that packaging for this fuze is the same as for fuze DOPPZ DM 53 (see FOM No. 1390-16-1-14), except for small differences in package dimensions necessary to accommodate the DOPPZ DM 113.

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Fuze, Time, Model ?
FOM No. 1390-17-1-15

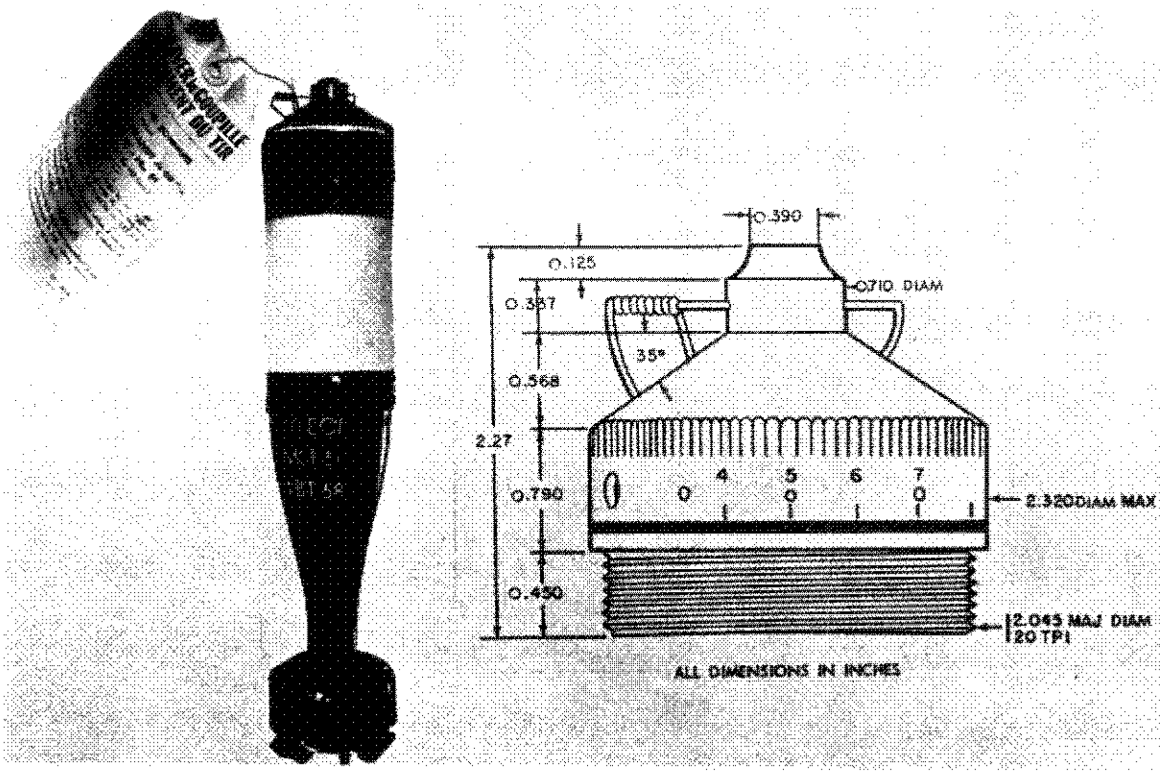

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Figure 5-9. Fuze, time, Model ?, contour view with 60-mm mortar projectile (U).

(C) Description

The French time fuze, Model ? (fig 5-9), was developed for the M50 illuminating mortar projectiles. It is a setback-initiated fuze with an adjustable pyrotechnic time train delay from 4 to 20 seconds. It also has a night adjustment of 12, 15, and 20 seconds delay. The fuze is not bore safe. The only safety device is a pin that passes through the body and firing pin.

Fuze, Time, Model ?
FOM No. 1390-17-1-15

(C) Characteristics

Fuze assembly:	
Body material	Aluminum
Weight	0.89 lb (403 g)
Length (overall)	2.27 in (57.6 mm)
Length (exposed)	2.05 in (46.3 mm)
Max diam	2.32 in (59 mm)
Thread diam	2.05 in (51.8 mm)
TPI	20
No. of vent holes	9
No. of relay pellets	2
Relay pellet expl.	Black powder
Relay expl. weight	0.08 g (1.23 gr)
Expulsion charge expl.	Black powder
Expulsion charge weight	2.55 g (39.27 gr)
Time train ring explosive	Black powder
Time train ring material	Brass
Functional data:	
Arming method	Setback
Firing method	Impact
Safety devices	Safety pin
Arming distance	?
Arming time	?
Delay time	4 thru 20 s

(C) **Design Details**

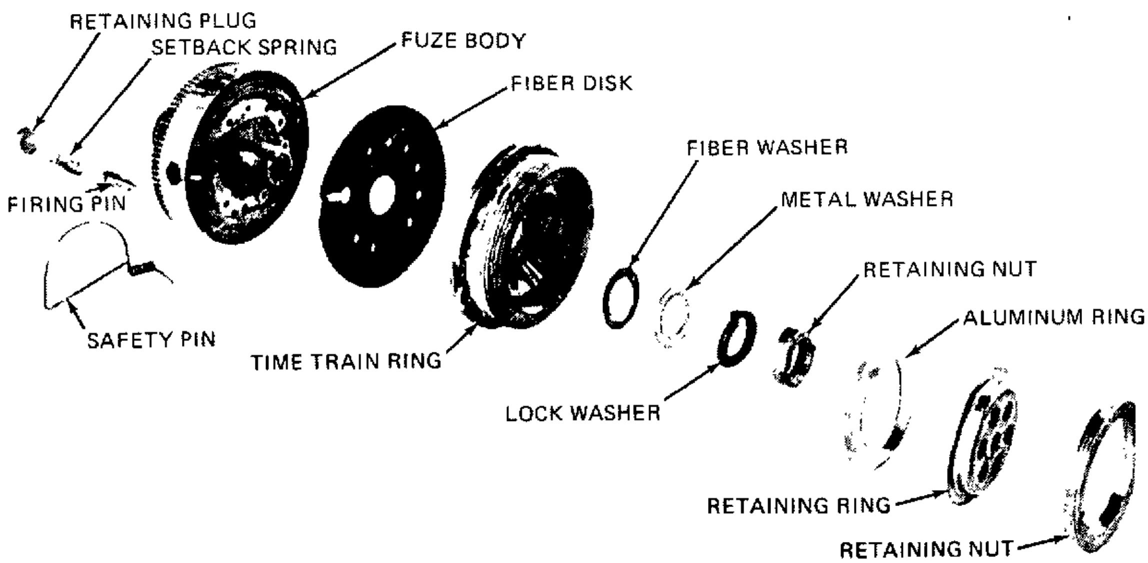

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Figure 5-10. Fuze, time, Model ?, exploded view (U).

The fuze (fig 5-10) consists of an aluminum fuze body and a movable brass time train ring.

The nose portion of the fuze body is counterbored to house the stab-type primer, setback spring, and firing pin, which are secured by a retaining plug.

The fuze body has nine vent holes drilled into the outer surface and downward to vent the black powder charge located in the circle groove of the time train ring.

The movable time ring can be manually set to any of the locations marked on the fuze body. There is a niche-and-groove arrangement on the time ring. A spring-wire pin enters the niche dictated by the indenting arrangement. The delay settings for night use are 12, 15, and 20 seconds.

Fuze, Time, Model ?
FOM No. 1390-17-1-15

(C) Design Details (Continued)

The time ring houses the black powder relay, black powder time train, and another black powder relay crimped into the passage through the time ring. The lower portion of time ring contains the black powder expulsion charge, held in place by an aluminum ring, and a cloth-covered disk and retainer that screws into the time ring.

(C) Functioning

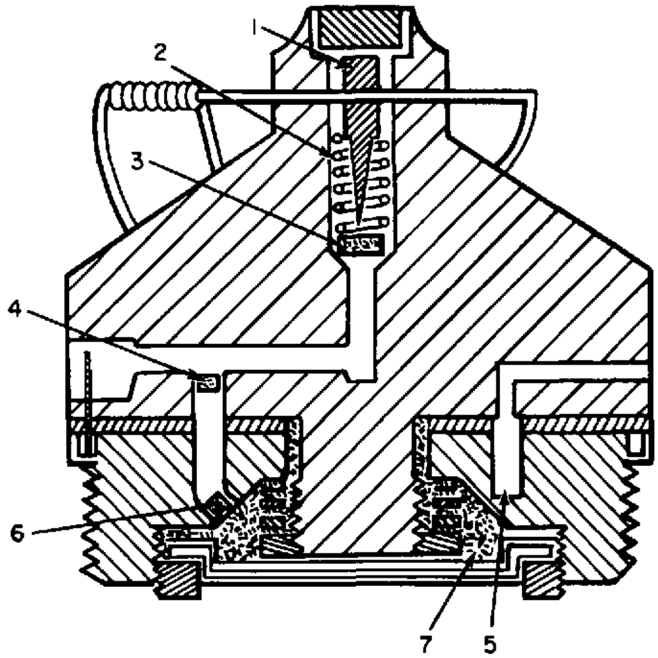

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Figure 5-11. Fuze, time, Model ?, section view (U).

Prior to firing the safety pin is removed.

Upon firing, setback causes the firing pin (1) to compress the setback spring (2) and to stab the primer (3), which ignites the black powder relay (4), initiating the black powder time train (5). After the time train burns its prescribed delay time according to the fuze

(C) **Functioning (Continued)**

setting, the black powder relay pellet (6) is ignited, initiating the black powder expelling charge (7) which ejects the parachute and the ignited candle.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
60-mm illuminating projectile, Model 51	Brandt 60-mm mortar

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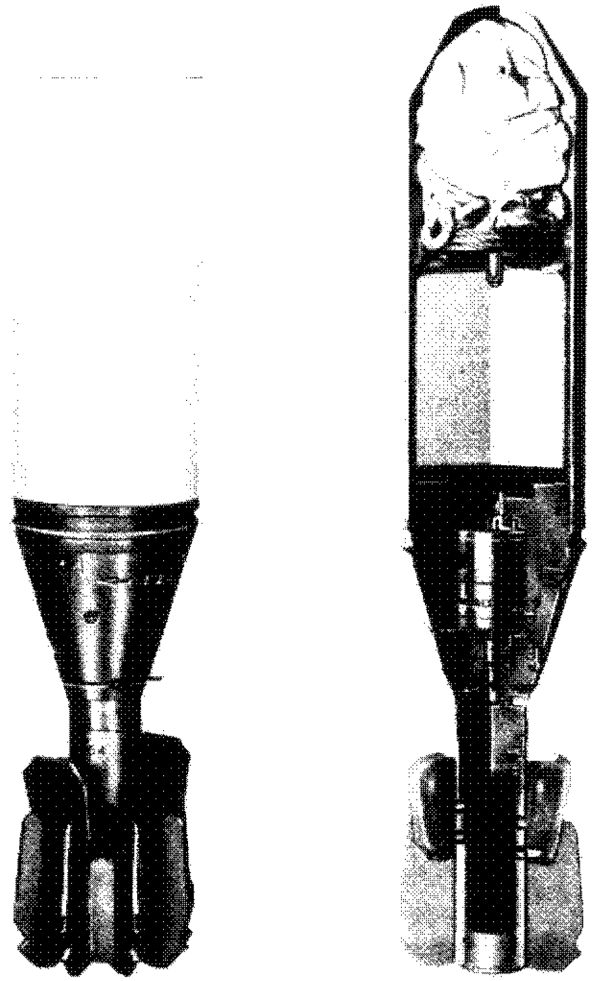

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Figure 5-12. Fuze, MT, Model MH 55, with 60-mm illumination projectile (U).

Fuze, MT, Model MH 55
FOM No. 1390-17-1-20

(U) **Description**

The French MH 55 MT fuze (fig 5-12) was developed by Hotchkiss-Brandt for 60-mm illumination projectiles fired from the Commando mortar. It employs a 35-second mechanical timer graduated from 7 to 35 seconds.

(U) **Design Details**

The fuze consists of three principal parts: the fuze body, the clockwork mechanism (i.e., timer), and a movable head.

The fuze body is secured to the body of the projectile by steel rivets. It contains a stab-type detonator and a black powder expelling charge. A spring plunger, located between the body and movable head, enables the fuze to be set at any of three pre-selected click-stop settings (18, 22, or 24 1/2 seconds).

The clockwork mechanism or timer contains a striker, mainspring, gear train, and escapement, together with several mechanical devices controlling safety and arming.

The movable head of the fuze is keyed to the fuze body and pinned to the lower part of the clock mechanism.

(U) Safety

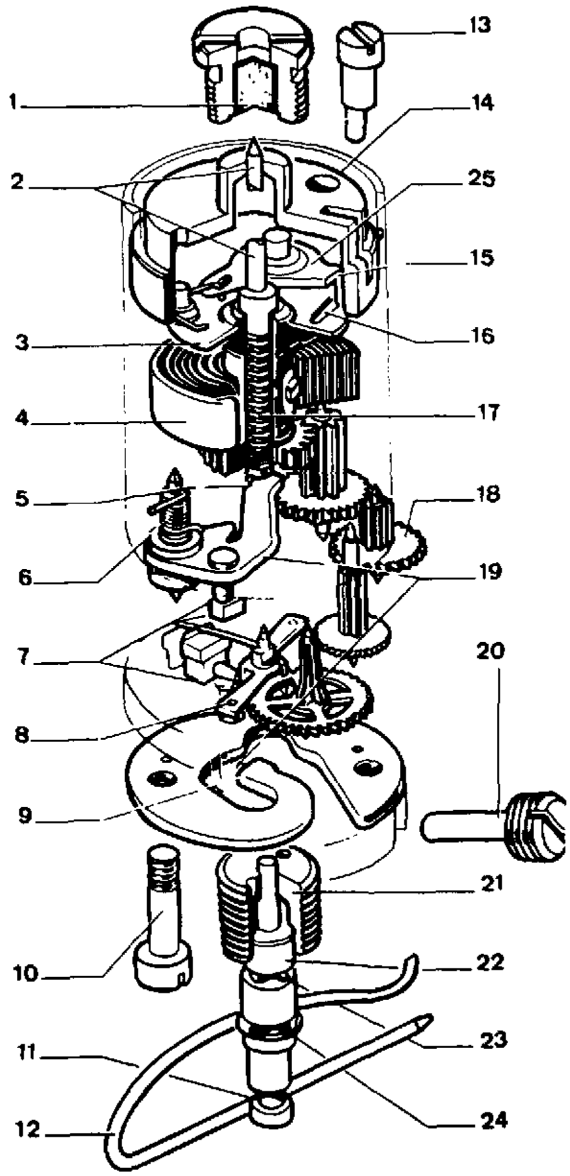

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Figure 5-13. Fuze, MT, Model MH 55, exploded view (U).

Fuze, MT, Model MH 55
FOM No. 1390-17-1-20

(U) Safety (Continued)

Safety of the fuze (fig 5-13) is provided as follows:

- The spring-loaded striker (17,2) is prevented from striking the detonator (1) by its flange, which engages firing arm (25). A cutout slot in rear of the striker (2) engages an arm of the safety lever (19).
- The firing arm (25) is held in position by a torsion spring, and the safety lever (19) is held by the tongue of the steel plate (9).
- A dowel pin (7) of the safety lever (19) prevents movement of the pellet (8).
- A gas-operated piston (23), whose function is to bend the tongue of the spring steel plate (9) away from the safety lever (19), is prevented from moving by a safety pin (12) passing through the tail of the projectile.

(U) Functioning (fig 5-13)

Prior to firing. Before the projectile is loaded in the mortar, the safety pin (12) is removed from the fuze. Variations in time setting are obtained by altering the relative positions of the pin of the firing lever and the perforations in the timing disk.

Upon firing. When the mortar is fired, gases from the burning propellant enter the rear of the fuze and force the piston (23) forward. The top of the piston strikes the tongue of the spring steel plate (9) and bends it upward free of the downward projecting arm of the safety lever (19). Once the safety lever is free of the steel plate, the torsion spring (6) turns the safety lever about its pivot point. As the safety lever turns, its upward projecting arm (5) moves out of the cutout recess in the tail of the striker, and its dowel pin (7) moves clear of the pallet (8).

Time mechanism operation. The pallet is then free to oscillate, driven by the prewound mainspring (4) and controlled by its hair spring. As the mainspring runs down, it turns the timing disk (3). A pin (15) in the firing arm (25) bears on the upper surface of the rotating timing disk. When the set time has elapsed, a perforation (16) in the timing disk coincides with the pin which drops into the recess. Further movement of the timing disk causes the firing arm to swing about its pivot, overcoming the torsion spring and moving clear to the flange of the striker.

(U) Functioning (Continued)

Striker operation. The striker (2) is then free and is thrown forward into the detonator (1) by its spring (17).

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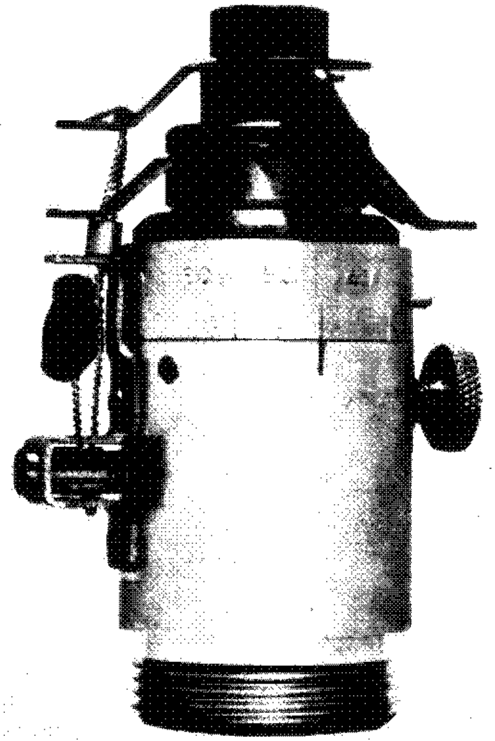

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Figure 5-14. Fuze, MT, Model CD-17, full view (U).

(U) Description

The CD-17 mechanical time fuze (fig 5-14) was developed by the French for use with photo flash or cluster bombs. It is a vane arming type employing a mechanical timer. Fuze may be set from 5 to 90 seconds time of flight by loosening a knurled head set screw and rotating setting dial to prescribed time. Safety during handling and transportation is accomplished via a sealed wire inserted through the fuze nose clamp lever and timing disk pin stop.

Fuze, MT, Model CD-17
FOM No. 1390-17-3-1

(U) Unique Features

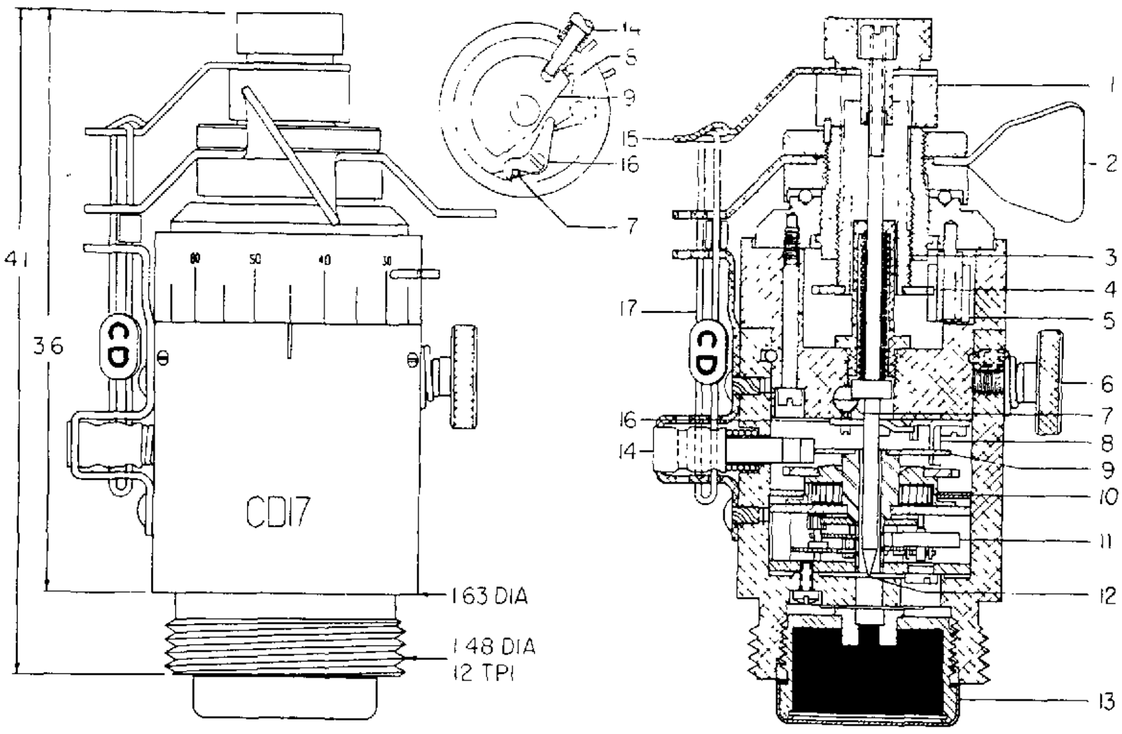
- Clockwork mechanism driven by runaway escapement detented by a stop pin.
- Spring-loaded firing pin detented by a safety block and locking ball.
- Air vane armirig technique.
- Sealed wire locking nose clamp and timing disk stop pin.

(U) Characteristics

Fuze assembly:	
Body material	Aluminum
Weight	0.83 lb (376 g)
Length	4.10 in (104 mm)
Max diam	1.63 in (41 mm)
Max thread diam	1.48 in (37.6 mm)
Booster:	
Body material	Aluminum
Type	Stab
Explosives:	
1st charge	Potassium chlorate, antimony sulfide, nitride
2d charge	Nitride
3d charge	Tetryl
Explosive wt:	
1st charge	0.03 g (0.46 gr)
2d charge	0.275 g (4.23 gr)
3d charge	0.1 g (1.5 gr)
Functional data:	
Arming method	Air vane
Firing method	Impact
Safety devices	*
Arming distance	**
Arming time	?

*Sealed wire locking fuze nose clamp and timing disk stop pin, safety block detent on spring-loaded firing pin, ball detent on spring-loaded firing pin.
**Fuze arms after 10 revolutions of arming vanes.

(U) **Functioning** (fig 5-15)



Neg. 517124 **(UNCLASSIFIED)**

Figure 5-15. Fuze, MT, Model CD-17, contour and section views (U).

Arming during handling and transportation is prevented by means of a sealed arming wire (17), which has to be replaced by another wire prior to bomb insertion. The fuze may be set for 5 to 90 seconds by loosening the knurled head set screw (6) and rotating the setting dial to desired time of flight.

Upon bomb release, the wire replacing the arming wire (17) must be removed to release the spring-loaded timing-disk stop pin (14) and nose clamp (15). As the bomb drops, the arming vanes (2) rotate in the air stream, and the threaded bushing (3) moves down to free the safety block (1). With safety block drop off, the spring-loaded firing pin (12) is armed.

Fuze, MT, Model CD-17
FOM No. 1390-17-3-1

(U) **Functioning** (Continued)

The fixed pinion (5) and gear (4) on the threaded bushing act as stops so that the bushing will not rotate with the arming vanes. At completion of arming, gear (4) is no longer engaged with the fixed pinon; therefore, the bushing (3) rotates freely with the arming vanes. The disengaged gear prevents disarming once arming is accomplished.

Time delay is achieved by the mainspring (10) driven movement with runaway escapement (11). With the pin stop (14) removed, the timing disk (9) rotates until the prescribed time is reached. A segment (8) then drops into the slot in the timing disk. This releases another segment (16), which releases the firing-pin detent pin (7). The detent pin (7) then moves out, and the spring-loaded firing pin (12) is released, stabbing the booster (13) and initiating the photo flash bomb.

(U) **Applications** (Ammunition and Weapons)

Ammunition	Weapons
150-lb photo flash bombs; 500-lb cluster bombs	Fighter bombers or bombers.

Fuze, MTSQ, Model 544 (Dixi)
FOM No. 1390-18-1-8

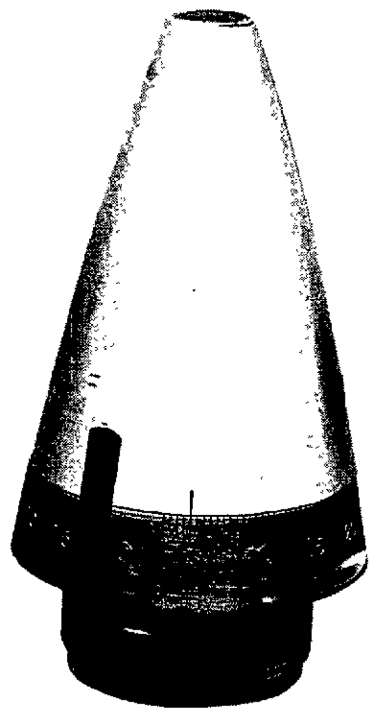


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Figure 5-16. Fuze, MTSQ, Model 544, full view (U).

(U) **Description**

The Dixi MTSQ fuze, Model 554 (fig 5-16), was designed to be used primiarly in US 105-mm howitzer ammunition. The fuze is bore safe inasmuch as it is unarmed until it reaches maximum rotational velocity at the muzzle of the weapon. Grooves in the nose and body permit the fuze to be set in a fuze setter. Settings can be read to 0.2 second.

(U) **Unique Features**

Dixi will modify this fuze to accommodate gravitational forces ranging from a low of 3,000 r/min to a high of 40,000 r/min to satisfy customer requirements.

Fuze, MTSQ, Model 544 (Dixi)
FOM No. 1390-18-1-8

(U) **Characteristics**

Fuze assembly:

Body material	Brass w/aluminum base
Weight	0.65 kg
Markings	544

Booster:

Body material	?
Body length	?
Explosive	?
Explosive weight	?

Functional data:

Arming method	Setback & spin
Firing method	Time/impact
Safety devices	Spin-freed firing pin
Arming distance	?
Arming time	0.2 s for SQ
Variable time	3 to 75 s
Delay time	none

(U) **Functioning** (fig 5-17)

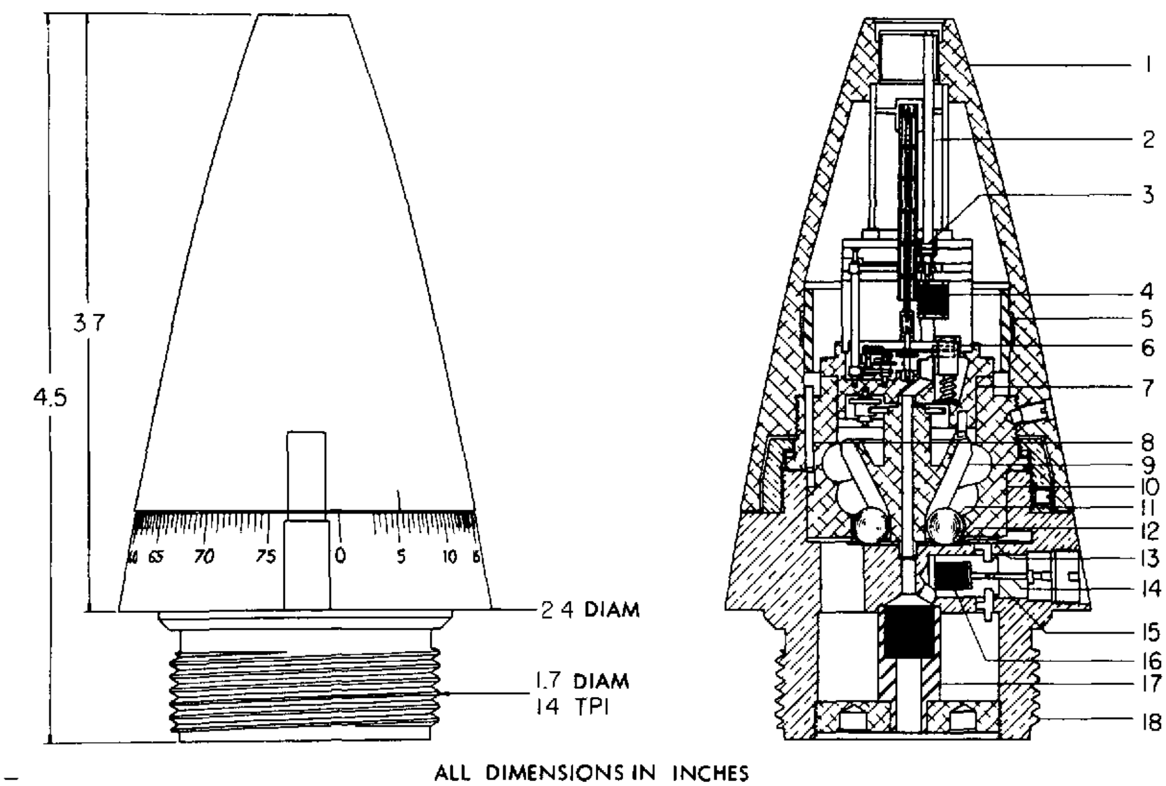

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Figure 5-17. Fuze, MTSQ, Model 544, section view (U).

To set the fuze, the nose (1) and the escapement housing (7) that are fixed on the grooved base (10) in which the driving balls (11) are housed form a unit that is rotated in respect to the body (18). When the nose is turned right or left, the distance between the notch on the timing disk (12) and the trigger (13) is changed. The setting indicated on the nose corresponds directly with the time that the disk needs to travel until the trigger falls into the notch of the timing disk. On firing, inertia causes the setback weight (5) to press against the locking pins (8), which fit into a recess between the body and the grooved base. At the same time, the escapement lock (6) is moved rearward, unlocking the movement. Spin causes the escapement lock to tip the side, preventing its return when acceleration

Fuze, MTSQ, Model 544 (Dixi)
FOM No. 1390-18-1-8

(U) Functioning (Continued)

ceases. When acceleration ceases, the mechanism is driven by the driving balls. At the end of the set time, the notch of the timing disk reaches the place where the point of the trigger, driven by spin enters the notch. This action unlocks the detonator housing (15), which moves outward under the effect of spin. This motion drives the detonator (16) against the firing pin (14), initiating the round.

During both transportation and the first few seconds of flight, the PD firing pin (2) is blocked from the primer (4) by the washer (3). At the end of the designated time, the movement unlocks the firing pin, arming the fuze. On impact of the projectile, the firing pin is driven into the primer, initiating the relay, which is contained in the housing (17).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
105-mm HE cartridge	US M101/M101A1 howitzers, Italian 105-mm pack howitzer, Model M14

Fuze, MTSQ, 30 second (Tavaro)
FOM No. 1390-18-1-16

(U) **Description**

The Tavaro MTSQ fuze was designed to be fired with high-explosive projectiles from 90-mm antiaircraft guns. It can be set in 0.2-second increments to function from 1 to 30 seconds after firing. Safety during handling is achieved by means of pin-activated detents on the clock escapement mechanism. This fuze is similar to the US M43A5 fuze.

(U) Characteristics

Fuze Assembly:

Body material	Steel
Weight	0.60 kg (1.32 lb)
Markings	Does not apply

Booster:

Body material	Does not apply
Body length	Does not apply
Explosive	Does not apply
Explosive weight	Does not apply

Functional data:

Arming method	Setback & spin
Firing method	Time/impact
Safety devices	Spin-activated detents
Arming distance	Does not apply
Arming time	Does not apply
Variable time	1 to 30 s
Delay time	None

Fuze, MTSQ, 30 second (Tavaro)
FOM No. 1390-18-1-16

(U) Functioning (fig 5-18)

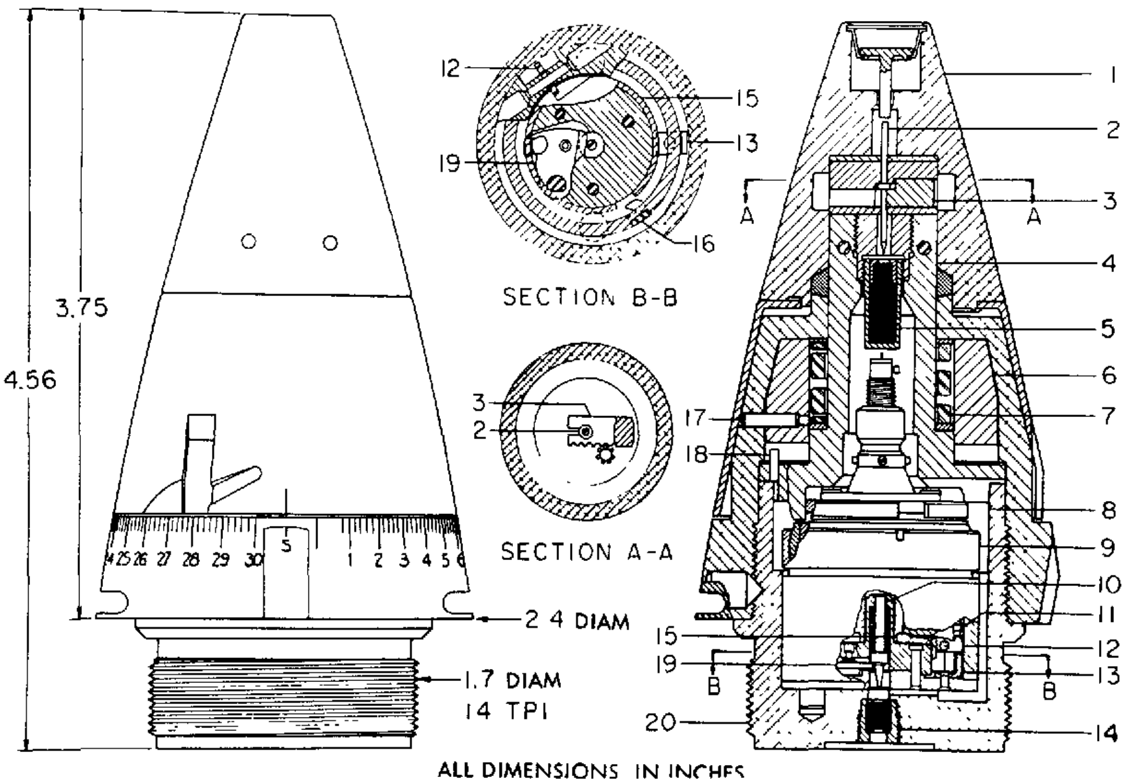

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Figure 5-18. Fuze, MTSQ (Tavaro), contour and section views (U).

Upon firing, centrifugal force moves the rack (3) outward, freeing the upper plunger (2) for impact action. Friction in the rack-and-pinion system retards the rack's motion. If impact should occur before the timing device has freed the lower plunger (10), the upper plunger will fire the detonator (5). The shock wave from the detonator follows a free path around the timer to set off the primer (14).

(U) **Functioning (Continued)**

The MT function is provided by a mainspring-driven clock mechanism (9) that incorporates a cylindrical pallet and torsion bar escapement system. The fuze is set to the desired time by rotating the nose (1). Torsion-spring action provides constant setting torque. During setting, the timing cup of the clock mechanism rotates with the center section (4) and the nose. Upon firing, setback causes the weight (6) to shear off the pin (17) and drive the locking pin (18) into the fuze body (20). The set position of the fuze is then fixed. The mainspring, regulated by the timing mechanism, drives the timing cup. The stop (13) prevents the timing-cup pin from rotating. After setting, the stop is no longer an obstacle. Setback causes the weight (11) to move back and rotate the timing-cup pin clear. The spin-activated detents on the escapement are now liberated. As time elapses, the timing cup rotates to set the location where the segment (19) moves into the opening in the timing cup under centrifugal force; thus freeing the lower plunger (10). The spring-loaded plunger then ignites the primer. The segment (16) rotates with the opening during setting, thus preventing the segment (19) from moving out before the set time.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
90-mm HE projectile ?	90-mm AA guns

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Fuze, MT, Model STIDR M/70, URVgrk
FOM No. 1390-18-1-19

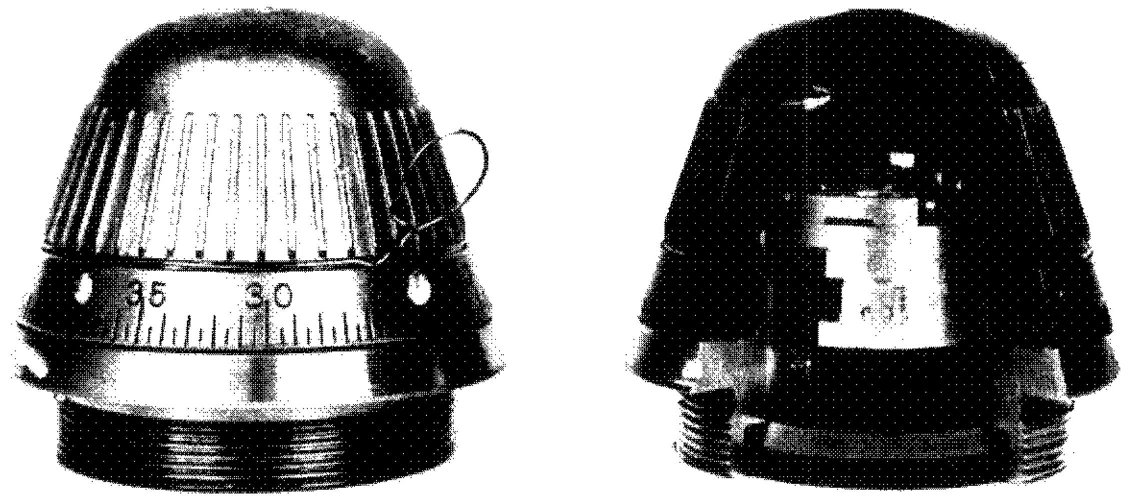

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Figure 5-19. Fuze, MT, Model STIDR M/70, URVgrk (U).

(C) Description

The M/70 MT fuze (fig 5-19) was developed by Forenade Fabriksverken of Eskitstuna, Sweden, for use with smoke and illumination mortar projectiles. It employs a 60-second timer developed by Thiel of Sweden. The fuze is graduated in 0.5-second increments and is reportedly accurate up to a ±0.3 second.

It employs three safeties to preclude early start of the clockwork. Upon elapse of the time setting, a firing pin initiates a percussion cap, setting off a 10-gram (0.022-lb) black powder expelling charge. Exact design details are not known at this time.

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Fuze, MTSQ, Model No. 213 Mk 5
FOM No. 1390-35-1-6

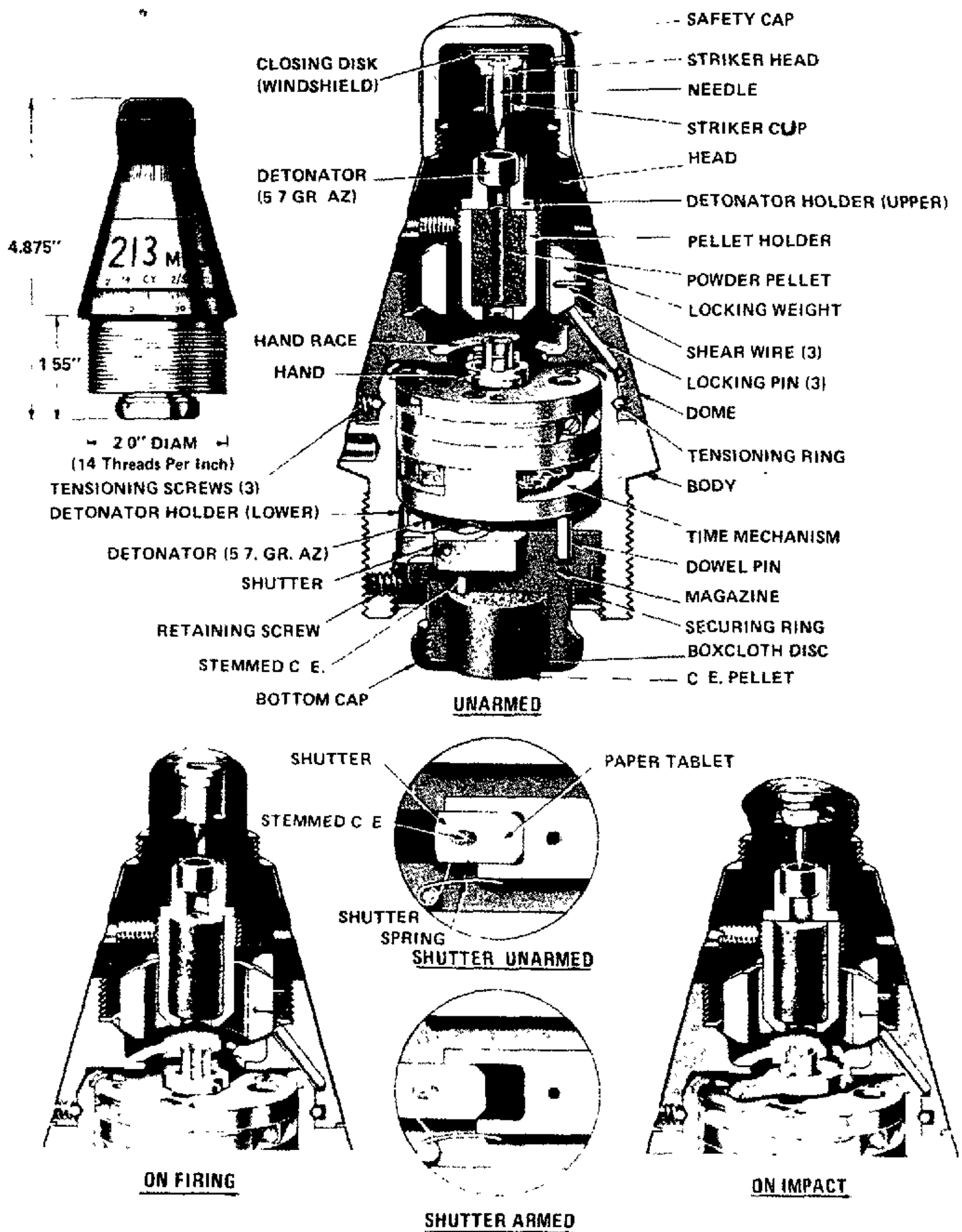

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Figure 5-20. Fuze, MTSQ, Model No. 213 Mk 5, full and section views (U).

Fuze, MTSQ, Model No. 213 Mk 5
FOM No. 1390-35-1-6

(C) **Description**

The Mk 5 No. 213 fuze (fig 5-20) is an MT fuze with a backup impact function. It employs an 80-second time mechanism (FOM No. 1390-35-10-1). (See section VIII for detailed description.) This fuze was designed by the United Kingdom for use with high-explosive and color bursting artillery projectiles.

(C) **Characteristics**

Fuze assembly	
Body material	Steel or brass
Weight	?
Markings	213 Mk 5
Max length	4.875 in (123.8 mm)
Thread diam	2.00 in (50.8 mm)
TPI	14
Booster:	
Body material	Brass
Body length	?
Explosive	Tetryl
Explosive weight	?
Functional data:	
Arming method	Setback & centrifugally armed
Firing method	Time & impact
Safety devices	Safety cap & out-of-line detonator
Arming distance	?
Arming time	?

(C) **Design Details** (fig 5-20)

General. The Mk 5 No. 213 fuze is fitted with a mechanical timing mechanism which is operated by a mainspring and controlled by an escapement. The time of bursting of the shell can be varied to actuate between 0 and 80 seconds after the gun is fired. The upper part of the fuze is arranged for direct percussion action on impact. The fuze consists principally of a body, dome, head, locking weight, striker head with needle, detonator

(C) Design Details (Continued)

holders (upper and lower), pellet holder, shutter, magazine and cap, tensioning ring, timing mechanism (80 seconds) No. 1A, and a safety cap. The exterior of the body is threaded at the bottom to 2-inch diameter (14 TPI, right hand) to screw into the nose of the shell. The top of the body is enlarged and shaped to conform to the contour of the shell: this contour is maintained by the dome and lower portion of the head of the fuze; the upper portion of the head is shaped to the same contour as the No. 117 and 119 (b) (cap off) fuzes.

A platform divides the interior of the body. The upper part contains the movement, a recess in the underside of the platform takes the lower detonator holder, and the bottom part contains the shutter and magazine.

A brass dome covers the top of the clock and can be rotated in the fuze body. The dome is retained by a spring-tensioning ring which fits in an internal groove near the foot of the dome. Inside the head of the fuze is a locking weight. On firing, the setback of this weight breaks the shear wires and drives the locking pins downward. The locking pins cut through the upper edge of the body surrounding the time mechanism, thus locking the dome in the position in which it has been set. Beneath the locking weight is a platform or hand race, across which a shaped slot is cut. Rotation of the dome positions the slot and thereby sets the fuze.

The clockwork mechanism rotates a spring-loaded hand beneath the hand race; it is driven by a mainspring and controlled by an escapement through a train of gear wheels. The clockwork mechanism is started by firing the gun, the hand being released for rotation by the setback of a trigger.

Clockwork mechanism. The clock is assembled as a complete unit and fixed to the top of the platform in the fuze body. The "Mechanism, time, 80 seconds, No. 1A" is described in section VIII.

Head. The head, made of an aluminum alloy, is shaped to fit the contour of the fuze dome into which it screws. The top is threaded externally to accommodate the safety cap. Internally, it is bored from the bottom to accommodate the locking weight, a pellet holder, and, on a smaller diameter, to accommodate the upper detonator holder. From the top it is bored to accommodate the striker cup and striker head with needle (firing pin). After assembly of the striker, the recess in the top of the head is closed by a closing disk and washer which are secured by turning over a lip formed in the top of the head.

Fuze, MTSQ, Model No. 213 Mk 5
FOM No. 1390-35-1-6

(C) Design Details (Continued)

Body. The body, made of brass or steel, is formed with a shoulder, below which it is threaded to 2-inch diameter [14 threads per inch (TPI), right hand] to fit the fuze hole of the shell. Above the shoulder is an inclined surface graduated "0" to "80" and engraved in black with an arrow head and the word "SAFE" and filled in with red in the ungraduated space between the figures "80" and "0". Internally, the upper body contains the clockwork mechanism, below which is the lower detonator holder. A slot in the top of the magazine houses a movable shutter retained in the unarmed or safe position by a steel spring.

Striker. The striker consists of a steel striker head and needle. The needle formed with a flange, seats in a recess formed in the striker head and is secured by turning over a lip. The striker is held from the upper percussion detonator by a striker cup through which the needle protrudes.

Detonator holder. (Upper). This is a cylindrical aluminum alloy holder with a flange formed at the base. Internally, the top is recessed to take a varnished 5.5-gr (0.36-gram) "LZ" detonator (QX 216 AF); below this it is bored to form a flash channel. It is inserted in the fuze head from underneath, with the detonator immediately beneath the striker needle.

Detonator holder. (Lower). This is assembled off center on the underside of the platform above the sliding shutter. The brass holder is recessed to accommodate a 5.5-gr (0.36-gram) "LZ" detonator, which is secured in position by burring over a lip formed on the holder. A hole is bored through the bottom of the detonator recess to permit the flash from the detonator to pass to the oblique channel in the shutter when in the armed position.

Pellet holder. The cylindrical pellet holder is made of aluminum alloy. Externally, it is threaded at the top, and a hole is formed in the base. It contains a perforated black power pellet. It is assembled in the head below the flange on the detonator holder (upper).

Shutter (i.e., slider). The brass shutter slides in a slot on top of the magazine (i.e., booster). At one end is an oblique channel filled with tetryl. A small hole in the side takes the end of a steel shutter spring, which pivots on a dowel pin and keeps the shutter at the center in the unarmed or safe position. In this position the oblique channel is clear of both the detonator and magazine channel.

(C) Design Details (Continued)

When the shell is in flight, centrifugal force overcomes the spring and pulls the shutter outward to the open or armed position. In this position the lower detonator, shutter channel, and magazine channel are all in alignment.

Detonators. The upper detonator is a 5.5-gr (0.36-gram) "LZ" percussion detonator in a lugless, tinned, copper-alloy cup. The disk is varnished and colored blue for identification purposes. The lower detonator is a 5.5-gr(0.36-gram)"LZ" time detonator in a lugless, tinned, copper-alloy cup. It differs from the upper detonator in that the disk is NOT varnished and it is colored red.

Magazine (i.e., booster) securing ring. This is a brass collar threaded on the outside to enter the fuze body from underneath. It surrounds the magazine and secures it by bearing on the undersurface of the flange formed on the upper part of the magazine. The ring is secured by a No. 2 BA steel set screw inserted from the side of the threaded portion near the bottom of the fuze body. Four slots at the bottom are for an assembly tool.

Magazine (i.e., booster). The magazine is made of brass and threaded externally at the bottom to take a bottom cap. It is bored from the underside to form a recess to take a tetryl pellet sealed by a box-cloth disk, and retained in position by the bottom cap. A flange is formed towards the top of the magazine, the undersurface of which forms a bearing for the magazine securing ring. The top forms a platform for the shutter assembly. A slot across the top accommodates the sliding shutter. A dowel pin in the recess forms a pivot for the shutter spring, and another positions the magazine to the fuze body platform. A small channel off center, with a diaphragm of metal left at the top, leads from the shutter slot to the recess in the magazine. It is filled with tetryl. The magazine is held in position by the magazine securing ring.

Magazine cap (QX 1599). Made of lead-free brass designed to withstand the required closing torque, the magazine cap is internally threaded. It screws over the bottom of the magazine and retains the tetryl pellet and box-cloth disk in position. After filling the magazine, the cap is screwed on and then crimped in two or more equidistant-spaced places to prevent it unscrewing.

Fuze, MTSQ, Model No. 213 Mk 5
FOM No. 1390-35-1-6

(C) Design Details (Continued)

Safety cap. Made of steel or malleable cast iron, the safety cap is dome shaped with a flattened top and a flat steel spring riveted into an oblique slot on one side. The free end of the spring engages in the milling on the fuze head and retains the cap in position. The cap is formed with a milled ring around its circumference and is internally threaded at its lower end for engagement with the threads formed on top of the fuze head. The cap is painted or lacquered black externally.

Tin-plating. Some components are tin-plated to overcome possible deterioration of the fuze during storage and thus improve its safety. The components so treated are magazine, body (internal), detonator holders, shutter, and striker cup.

(C) Safety

- The safety cap protects the windshield and striker head during storage and transit.
- When the fuze is set at SAFE, the hand race in the dome is coincident with the hand that is prevented from rising by the muzzle safety device bridge.
- The tensioning ring prevents the dome being accidentally moved during storage and transit.
- Three equidistant-spaced shear wires secure the locking weight to the wall of the head, preventing movement of the locking weight before firing.
- When in the unarmed position, the shutter masks off the stemmed tetryl in the magazine channel and prevents a prematurely fired lower detonator from initiating the tetryl pellet in the magazine.
- The trigger prevents the hand from rotating and the time mechanism from starting until the gun is fired.

(C) Safety (Continued)

- The centrifugal safety catch is housed under the striker cam until the shell rotates in flight. It serves a dual purpose:

  (1) In the event of the clockwork mechanism being set in action accidentally the catch prevents the striker reaching the detonator.

  (2) If a fuze with the clockwork mechanism accidentally set in action were loaded and the gun fired, the centrifugal safety catch would be prevented from swinging out from under the cam as the latter would, immediately as the hand is lifted, jam down on to a step cut in the catch for this purpose.

- The muzzle safety bridge prevents the hand rising until the shell is well clear of the muzzle. This device operates if the fuze is set too short.

(C) **Functioning**

Prior to loading, the fuze is set to the time required, and the safety cap is removed.

Timing mechanism operation:

On firing. The locking weight in the head sets back, shearing the copper pins and forcing the locking pins downward. The pins cut through the top lip in the body and enter the recess formed in the dome. This locks dome and body together and prevents movement from the time set position. The trigger sets back and the trigger locking bolt is forced outward by its spring to retain the trigger. The hand is now released from the trigger, but prevented from rising by the muzzle safety device bridge. During acceleration in the bore, it is unlikely that the pellet will oscillate owing to the force of the setback. When the muzzle is reached, the hand begains to rotate in a counter-clockwise direction by the action of the mainspring. When acceleration ceases, the centrifugal safety catch flies outward, due to centrifugal force, and leaves the striker supported by its cam resting on the pillar.

Fuze, MTSQ, Model No. 213 Mk 5
FOM No. 1390-35-1-6

(C) Functioning (Continued)

During flight. The shutter moves outward against its springs, by centrifugal force, bringing the fire channel coincident with the lower detonator and the channel leading to the magazine. When the clockwork mechanism has run the prescribed time according to the setting, the hand has been brought immediately under the slots in the hand race and rises under the influence of its spring to release the lever that controls the striker. The release of the lever allows the spring to rotate the cam off the pillar and force the striker down on the detonator. The striker is forced by its spring into the detonator, which fires. The flash passes through the stemmed tetryl channel in the shutter to the tetryl pellet in the magazine.

Percussion arrangement:

On firing. The acceleration of the shell in the bore causes the shutter to set back and set up sufficient frictions in its recess to retain the shutter in the unarmed position while the shell is in the bore.

During flight. When acceleration ceases, the shutter moves forward by momentum and outward by centrifugal force, to bring its fire channel in alignment with the lower detonator and the channel to the magazine.

On impact. The cap having been removed before loading, the striker head is crushed in and the needle pierces and fires the upper detonator. The resultant wave ignites the gunpowder pellet, the flash from which passes through the dome and fuze body to detonate the lower (time) detonator. The subsequent action is described under "Timing Mechanism."

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
HE and color-bursting projectiles	25-pounder gun, 5.5-in gun, and 7.2-in howitzer

Fuze, Time, Model No. 390 Mk 1
FOM No. 1390-35-1-29

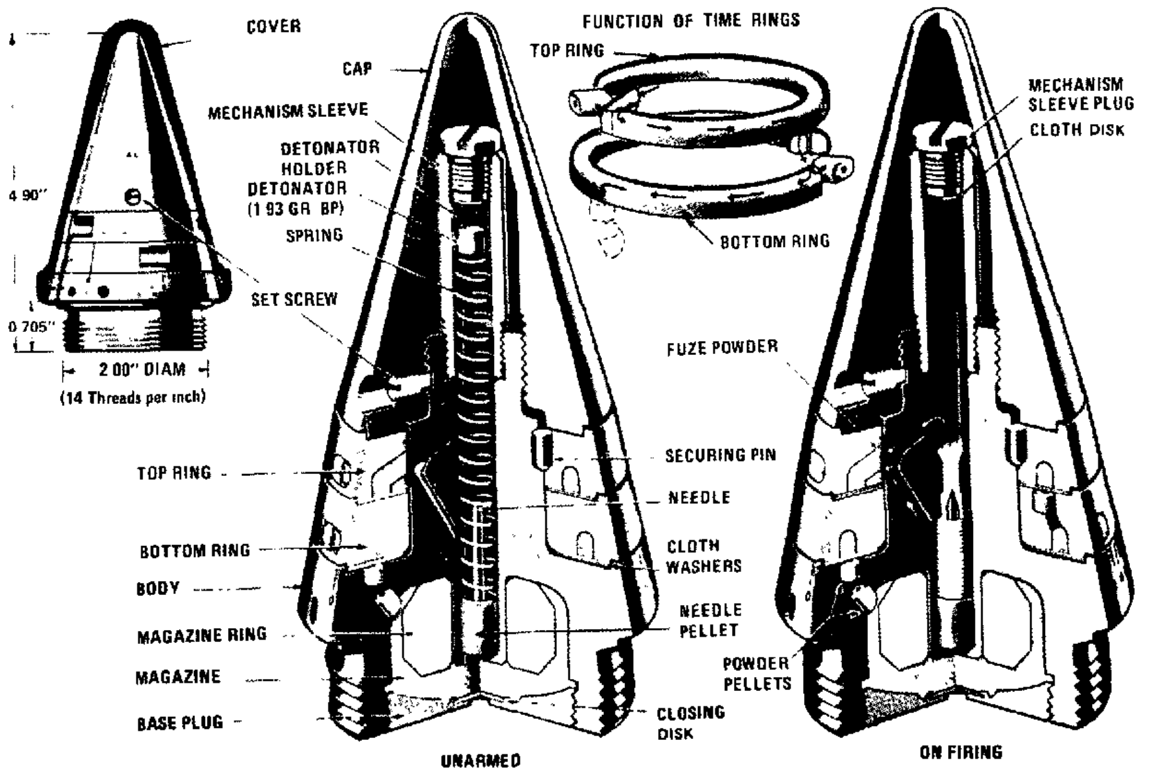

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Figure 5-21. Fuze, time, Model No. 390 Mk 1, full and section views (U).

(C) Description

The UK No. 390 Mk 1 fuze (fig 5-21) was designed for base-ejection smoke projectiles fired from mortars and field guns. It is a pyrotechnic time train fuze with a top and bottom ring designed to give a burning time between 0 and 23 seconds time of flight. The fuze has a cover secured by a wire that has to be removed prior to setting the fuze to the desired time of flight.

Fuze, Time, Model No. 390 Mk 1
FOM No. 1390-35-1-29

(C) **Characteristics**

Fuze assembly:

Body material	Brass
Weight	?
Markings	390 Mk 1
Length	4.90 in (12.416 mm)

Expelling charge magazine:

Body material	?
Body length	?
Explosive	Black powder
Explosive weight	?

Functional data:

Arming method	Setback
Firing method	Setback
Safety devices	*

(C) **Design details** (fig 5-21)

General. The Mk 1 No. 390 fuze consists principally of a body, base plug, needle, spring, detonator-holder, mechanism sleeve and plug, magazine ring, detonator, bottom ring, top ring, cap, and cover.

Body. The body is made of brass. The main feature of the body is the platform, below which it is reduced in diameter and threaded 14 TPI right handed to fit a 2-inch-diameter hole. A stepped shoulder may or may not be formed on the lower edge of the platform. Above the platform, the body is formed with a stem, which is reduced in diameter at the upper end and threaded externally to receive a cap. The side of the platform is bevelled and graduated in quarter divisions for almost its entire circumference, the divisions reading from 0 to 30. At the center of the ungraduated portion, between the figures 30 and 0, is engraved a setting mark (a red arrowhead) below which appears the word "SAFE." The graduations are read in conjunction with a line engraved on the bottom ring; when the fuze is set at "safe," the setting mark engraved on the bottom ring coincides with

*When fuze is set on safe, the ridges of the upper and lower time rings provide a mechanical block of the flash holes between the lower ring and the black powder expelling charge.

(C) Design Details· (Continued)

the arrowhead. A hole is bored in the side of the platform for use with a fixing key. The stem is bored centrally from the top to receive the needle, spring and mechanism sleeve, and the detonator-holder and its detonator. Two oblique flash channels lead from the center bore (i.e., the detonator channel) to the top time ring to allow the flame and gas from the detonator to circulate in the fuze body, thus ensuring less violent ignition of the time ring. The lower end of the body is bored and recessed to form a magazine and prepared with threads to receive a base plug; a short oblique and vertical channel, containing perforated powder pellets, connects the magazine with the top surface of the flange. The magazine is filled with not less then 80 grains of G.20 gunpowder. A wooden, plastic, or compressed paper ring fitted over a boss formed on the body inside the magazine recess serves to reduce the weight and also the capacity.

Base plug. The base plug is made of either brass or zinc-alloy. It is dished on the inner surface and has a flash hole drilled in the center which is closed by a thin brass disk to which a paper disk is affixed with shellac. The plug is screwed into the base of the body and retains the gunpowder charge in the magazine recess, the base of the fuze being sealed with shellac varnish colored red.

Needle. The steel needle (i.e., firing pin) is formed with an enlarged head, which acts as a needle pellet, and a long shank. The upper end of the shank is pointed to pierce the detonator. When assembled, it is housed in the center of the body.

Spring. This is a spiral of 15 coils of 0.02-inch (0.51 mm) circular section steel wire. It is assembled between the base of the detonator-holder and the head of the needle and surrounds the needle shank.

Detonator holder. The brass detonator holder is bored vertically and prepared to house the detonator.

Mechanism sleeve. The brass mechanism sleeve is in the shape of a cylindrical tube. It is threaded externally at its lower end to screw into the top of the stem formed on the fuze body and threaded internally at the other end to accept the mechanism sleeve plug.

Mechanism sleeve plug. The brass mechanism sleeve plug is formed with a flange, below which it is screw-threaded to engage in the top of the mechanism sleeve. A cloth disk

Fuze, Time, Model No. 390 Mk 1
FOM No. 1390-35-1-29

(C) Design Details (Continued)

is shellacked to its inner face, and a screwdriver slot is formed in the head to facilitate insertion. It is screwed into the upper end of the sleeve where it retains the detonator-holder with its detonator, spring, and needle in position. The spring, being in initial compression, prevents the detonator-holder from setting back and the needle from moving forward until the gun is fired.

Magazine ring. The magazine ring is a shaped ring of either wood, plastic, or compressed paper. It is inserted and positioned over a boss formed in the magazine portion of the body.

Detonator. The "BP" detonator weighs 1.93 grains (0.13 grams) and is assembled in the base of the detonator-holder.

Bottom ring. The brass bottom ring is bevelled externally to conform to the shape of the flange of the fuze body. It has a concentric groove, filled with composition SR.227, pressed in and covered by a paper disk washer extending nearly all around its undersurface. A small recess is bored in the top surface and houses a perforated powder pellet. This recess, coincident with the beginning of the groove, is connected to the latter by an oblique channel. A gas escape hole, with an oval, aluminum-alloy sealing disk, is formed in the side of the ring. The ring has setting slots for engagement by a fuze-setting key, and a "setting" line is engraved for reading against the graduations on the flange of the fuze body. It is assembled over the stem of the body on which it is free to rotate, for setting purposes.

Top ring. The brass top ring is similar to the bottom ring, but the external circumference is slightly smaller. The oblique channel is filled with pressed-in meal powder and connects the concentric groove with the port in the stem of the fuze body when the ring is assembled in position. A gas escape hole, containing a gunpowder pellet retained by an oval, brass sealing disk, is formed in the side of the ring and also connects with the concentric groove and the oblique channel filled with the mealed powder. The concentric groove is filled with fuze powder SR 227 and covered by a paper washer shellacked over the base. Setting slots, for use in conjunction with those in the bottom ring, are cut in the periphery. The ring is assembled over the stem of the fuze body and on top of the bottom ring; it is prevented from rotating by a brass pin which fits coincident recesses prepared in the ring and stem.

(C) **Design Details (Continued)**

Cap. The cone-shaped cap is made of aluminum alloy. Internally, at the base, it is screw-threaded for assembly over the stem formed on the fuze body. Two holes are drilled radially in the sides to facilitate assembly. After the cap is screwed onto the fuze body, and the fuze is tensioned at 450 ±50 inch-ounces, a hole is drilled through into the stem, the inner portion of the hole in the cap being threaded. A set screw is then inserted and screwed home, the recess behind the screw being sealed with waterproofing composition.

Cover. At the time of issue, a 2-inch cover (50.8 mm), time or time and percussion fuze No. 5, is assembled to the fuze. Made of brass and conical in shape, it is fitted with a rounded rubber ring at its lower end, the cover and ring being clamped to the fuze body by a securing band. The band fits under the platform of the body and is pressed tightly around and the ends secured by copper wire; the ends of the wire are twisted and tucked under the band. Alternatively, the cover may be held in position by a securing band secured by a tongue engaging in a slot, the tongue being turned over. A hole in the band coincides with one of the tommy holes in the body of the fuze. When issued, the cover is hermetically sealed.

Waterproofing. The joints between the time rings, body and between ring and top cap, escape hole disks, and the set screw in the cap are sealed with Mark 8 Luting.

Washers - time rings. Cloth, all wool, melton finish washers are affixed to the upper surface of the platform and of the bottom time ring to ensure a tight joint when assembled and also to prevent any flash-over.

Washer for joint between shell and fuze. In the case of fuzes manufactured without a stepped shoulder formed on the fuze body, a brass or tin-plate washer 2.3 inches in diameter is placed under the flange of the fuze body before the fuze is assembled in the shell. This is to prevent pinching the securing band between the flange of the fuze and the lip of the shell, which would make removal difficult.

(C) Safety

- Initial compression of needle spring keeps the detonator clear of the needle.

Fuze, Time, Model No. 390 Mk 1
FOM No. 1390-35-1-29

(C) Safety (Continued)

- When the fuze is set at safe, the flash holes in the lower time ring and to the magazine are blocked by the ridges of the upper and lower time rings, respectively. This provides a double safety device against ignition of the magazine, should the initiating mechanism (i.e., detonator) function prematurely.

(C) Preparation for Firing

The cover must remain on the fuze until immediately before firing, when it is removed by using pliers on the securing wire or tongue of the cover band. The cover should then be eased off the fuze with a screwdriver. The fuze is then set to the required graduation on the body by rotating the setting mark on the bottom ring.

(C) Functioning

On firing. The detonator sets back on the needle, compressing the spring. The detonator is detonated, and the flash passes through the flash channels in the stem of the body and ignites the mealed powder in the oblique channel in the top ring. This, in turn, ignites the fuze composition, which blows out the closing disk in the gas-escape hole and thus provides a vent for the gases generated as the burning of the time train progresses.

During flight. The composition in the top ring burns around until, after an interval of time determined by the setting, the flame reaches the powder pellet in the bottom ring; the pellet is fired and ignites the composition in the bottom ring, which blows out the closing disk in the gas escape hole. The composition in the bottom ring burns around in the reverse direction until, after an interval of time determined by the setting, the flame reaches the powder pellet in the vertical portion of the channel in the body of the fuze which is fired and ignites the pellet in the oblique channel and, in turn, the powder in the magazine. The powder in the magazine explodes, blows out the brass disk in the base plug and the resultant flame passes through to ignite the bursting charge in the head of the shell.

(C) Summary of Differences

- Body. A stepped shoulder will always be formed on the underside of the platform of this fuze. A washed 2.3-inch (58.4-mm) diameter is therefore not required when fitting this fuze to a mortar bomb.

(C) Summary of Differences (Continued)

- **Bottom time ring.** This fuze is filled with RD 202 instead of SR 227, making this fuze a 46-second fuze; the circular gas escape hole is sealed with an aluminum disk.

- Cap. Tensioned at 750 ±50 inch-ounces before being secured.

(C) Notes

Prior to mid-1949, to distinguish them from Mk 1 No. 390 fuzes, the bottom rings of Mk 2 and 2A fuzes were painted or lacquered red to denote that they were filled with slow-burning composition; after that date, this identification was dispensed with.

Approval has been given for all marks of fuze, other than those manufactured with a stepped shoulder, to have a brass or tinned-plate 2.3-inch (58.4-mm) diameter washer (QX/88) assembled, at the time of production, under the flange of the fuze to prevent pinching the securing band between the flange of the fuze and the lip of the projectile, thus making removal difficult. This washer was never introduced as a separately demandable item of supply.

(C) Applications (Ammunition and Weapons)

Ammunition	Weapons
BE smoke shell or mortar bomb	Mk 1 for QF 20-pounder gun, Mk 2 and 2A for 3-in ML mortar

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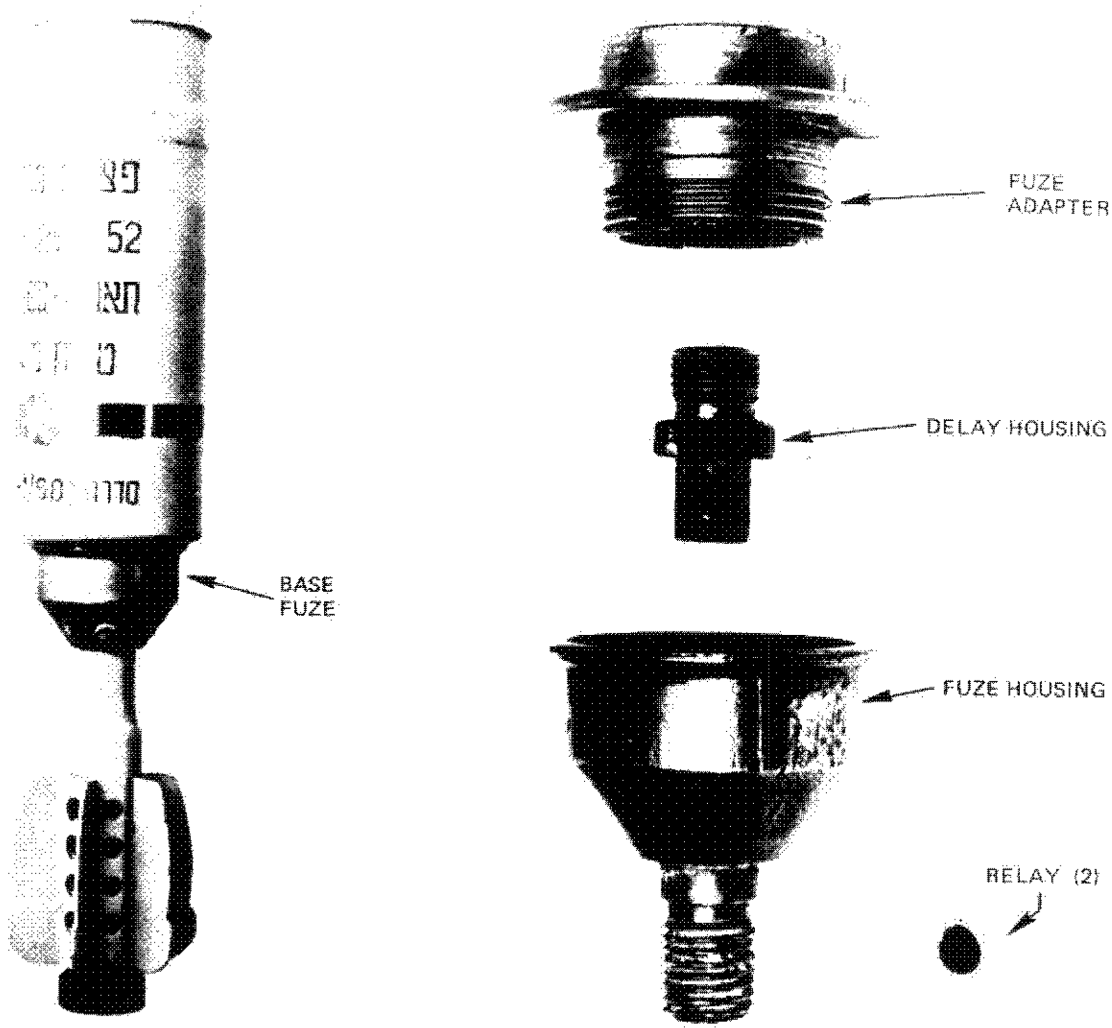

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Figure 5-22. Fuze, time, Model ?, exploded view and 52-mm projectile (U).

Fuze, Time, Model ?
FOM No. 1390-37-1-4

(C) **Description**

The Israeli pyrotechnic time fuze is a base-delay type designed to initiate the black powder expelling charge of 52-mm illuminating mortar projectiles. It consists of the fuze adapter, delay housing, and fuze housing.

(C) **Unique Features**

Uses hot gases during firing to initiate two relay elements (dualized for reliability) that in turn initiates the pyrotechnic delay.

(C) **Characteristics**

Fuze adapter:	
Length	1.06 in (26.9 mm)
Max diam	1.80 in (45.7 mm)
Thread diam	1.19 in (30.2 mm)
TPI	16
Fuze housing:	
Material	Steel
Length	1.93 in (49.0 mm)
Max diam	1.66 in (42.2 mm)
Thread diam	0.49 in (12.0 mm)
TPI	16
Delay holder housing:	
Length	1.05 in (26.7 mm)
Max diam	0.63 in (16.0 mm)
Thread diam	0.50 in (12.7 mm)
TPI	20
Explosive	Black powder ?
Relay elements:	
No.	2
Type	Heat sensitive
Explosive	Black powder ?

(C) Characteristics (Continued)

Functional data:

Firing method	Hot gases
Safety devices	Pyrotechnic delay
Delay time	8.25 s

(C) Functioning

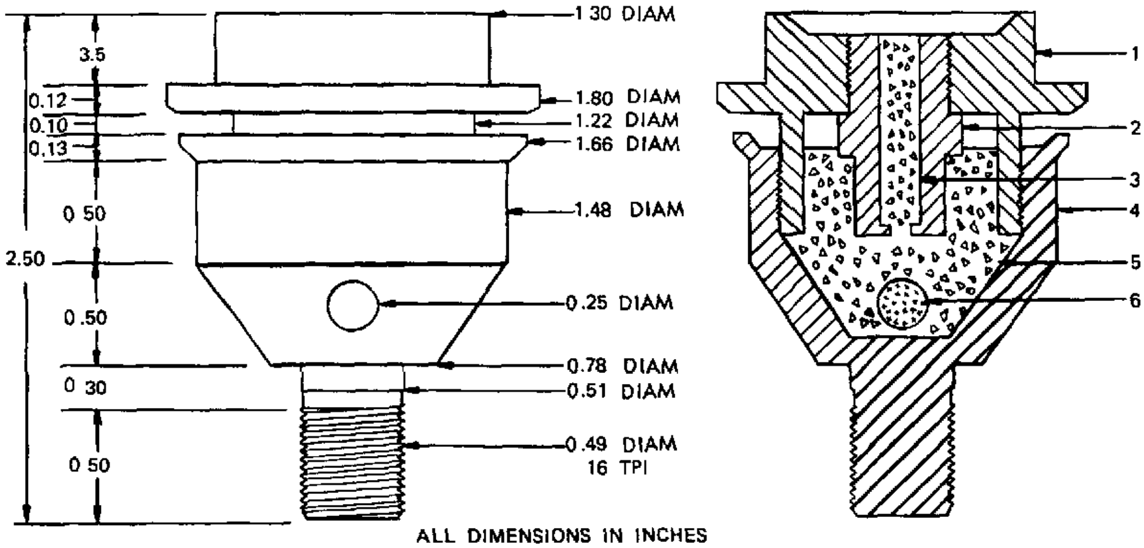

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Figure 5-23. Fuze, time, Model ?, contour and section views (U).

Upon firing, the hot gases generated initiate two relay elements (6) located in the fuze housing (4). This, in turn, initiates the delay composition (3) contained in the delay housing (2), which screws into fuze adapter (1). After burning for about 8.25 seconds, the expelling charge (5) is initiated. The gas generated upon burning propels the illuminant candle and parachute assembly from the projectile.

Fuze, Time, Model ?
FOM No. 1390-37-1-4

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
52-mm illuminating projectiles	52-mm mortar

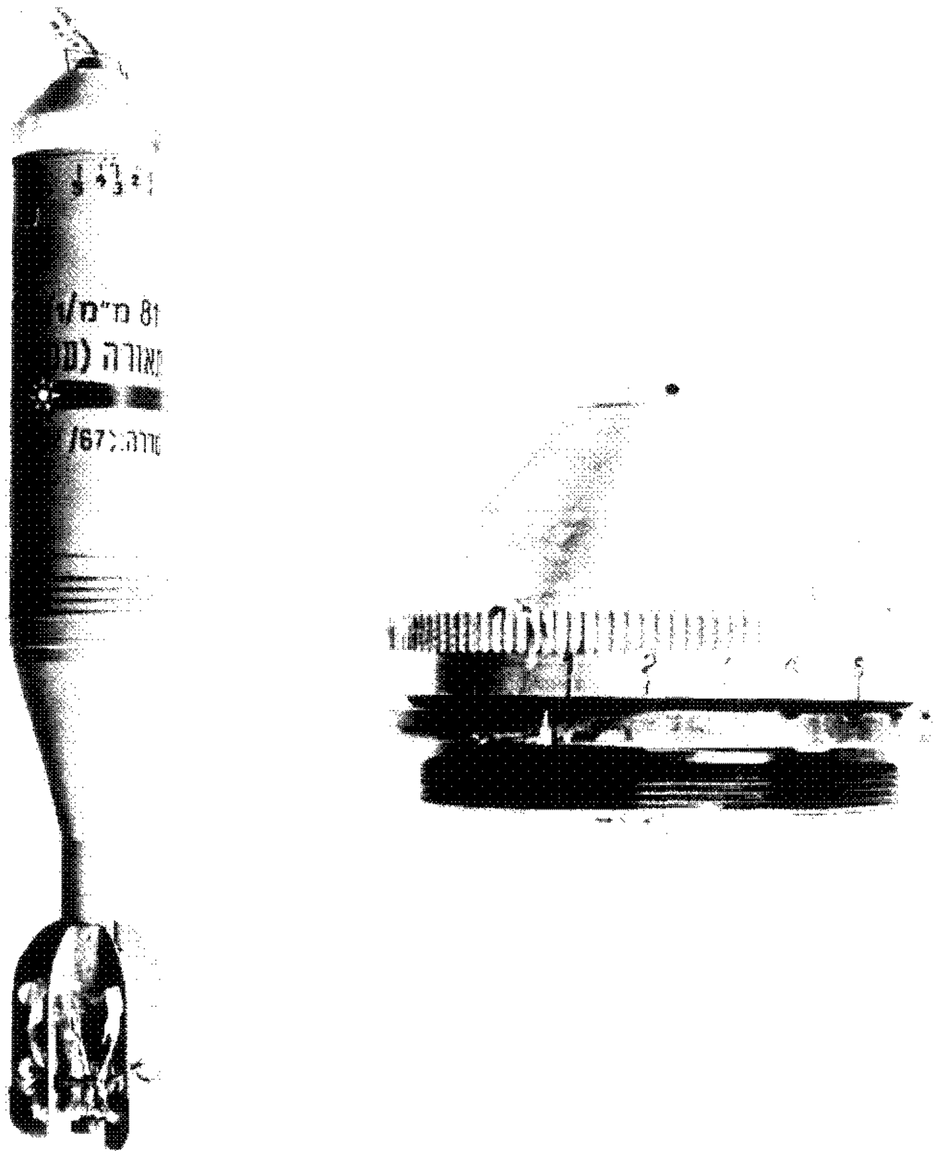

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Figure 5-24. Fuze, time, Model ?, full view with projectile (U).

Fuze, Time, Model ?
FOM No. 1390-37-1-6

(C) Description

The Israeli time fuze, Model ? (fig 5-24), was designed for use with 81-mm illuminating mortar projectiles. It utilizes a black powder time ring. The fuze can be set to provide time delays of 17.3, 19.2, 20.7, and23.9 seconds, respectively. A safety pin, used to prevent the firing pin from moving during handling, also locks the time setting cap.

(C) Characteristics

Fuze assembly:

Body material	Aluminum
Weight	?
Length	2.68 in (68 mm)
Time ring material	Brass
Time train type	Black powder
Time train wt.	0.05 lb (22.7 g)
Expulsion charge type	Black powder
Expulsion charge wt.	0.068 lb (30.8 g)
Relay pellets (no.)	2
Relay pellets (type)	Black powder

Functional data:

Arming method	Setback
Firing method	Hot gases
Safety devices	Safety pin
Arming distance	?
Arming time	?
Delay time	17.3, 19.2, 20.7, and 23.9 s

(C) Design Details (fig 5-25)

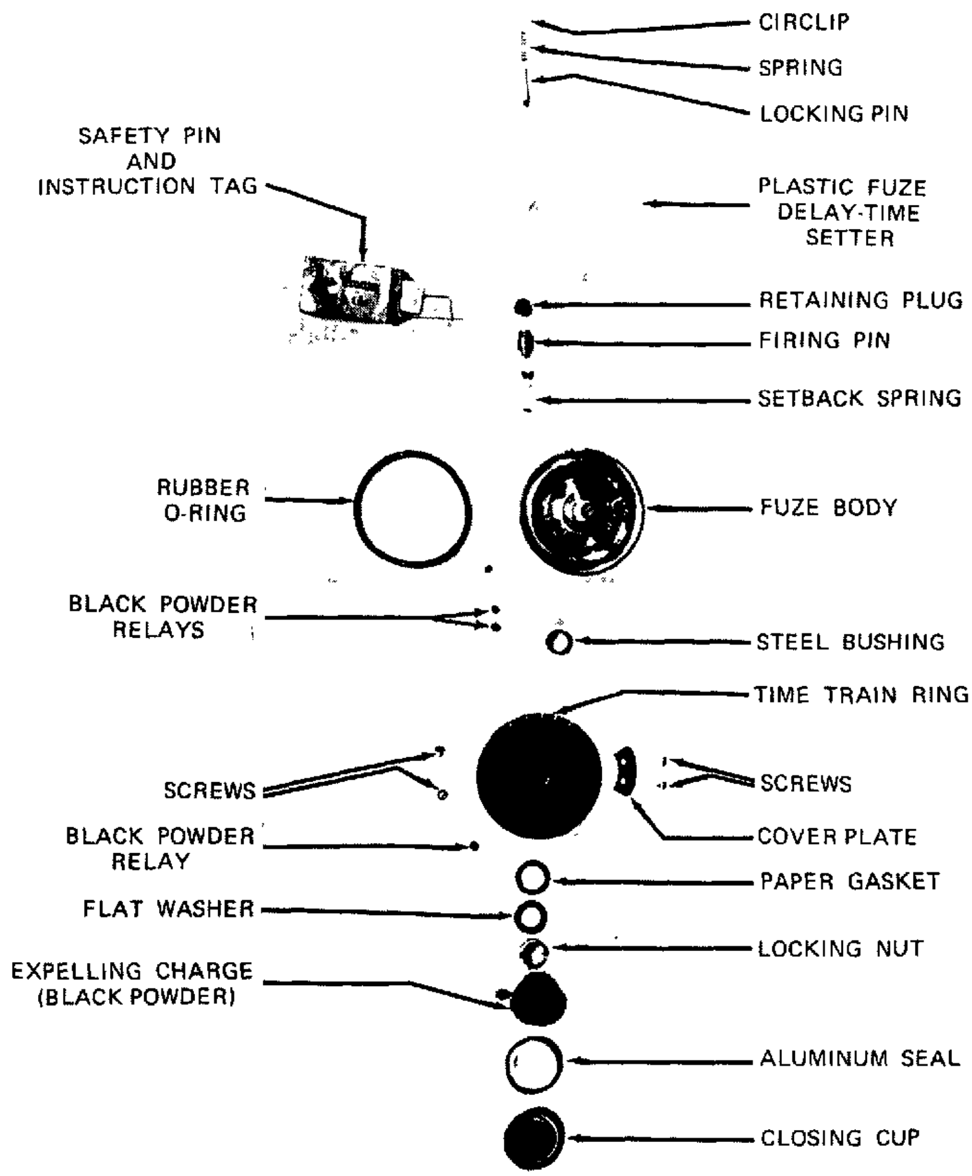

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Figure 5-25. Fuze, time, Model ?, exploded view (U).

Fuze, Time, Model ?
FOM No. 1390-37-1-6

(C) Design Details (Continued)

The time fuze consists of two major assemblies: a conical-shaped aluminum body and a brass time train ring. A cylindrical steel insert, counterbored at the top and threaded at the bottom, is pressed axially through the fuze body. The joint between the fuze body and the time train ring is sealed with an O-ring. A closure assembly is threaded into the base of the time train ring and moisture-proofed with varnish. The fuze body has one vent, which is sealed with epoxy. A transparent plastic time setting cap covers the fuze body. It locks into a slot provided and is ribbed longitudinally on the circumference for gripping purposes. A safety pin prevents movement of the setting cap and firing pin.

(C) Functioning (fig 5-26)

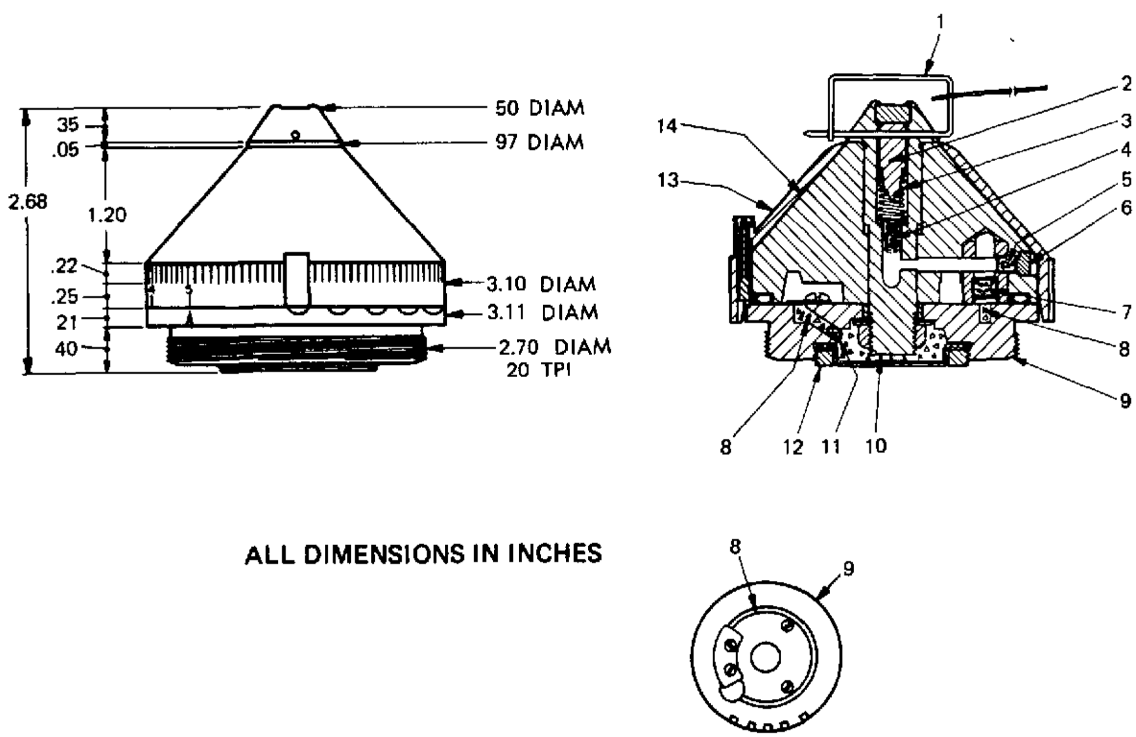

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Figure 5-26. Fuze, time, Model ?, contour and section views (U).

(C) Functioning (Continued)

Prior to firing, the plastic time setting cap (13) and fuze body (14) are rotated to align the arrow (see fig 5-24) on the cap with the selected number on the projectile. The safety pin (1) and plastic time cap are then removed.

Upon firing, setback forces causes the firing pin (2) to compress the spring (3) stabbing the primer (4). The flash from the primer ignites relay pellets (5 and 7) in succession. Heat from the flash melts the epoxy (6), opening the vent in the fuze. The burning relay pellet (7) then ignites the black powder charge (8) in the time ring (9).

After the time ring charge completes the burning cycle predetermined by the fuze time setting, it ignites a relay pellet (11) in the time train ring. This, in turn, ignites the black powder expelling charge (10) for expulsion of the illuminant candle and parachute assembly of the projectile.

(U) **Applications (Ammunition and Weapons)**

Ammunition	Weapons
81-mm illumination projectiles	81-mm mortar

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Section VI.

PROXIMITY (VT) FUZES

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Section VI.

PROXIMITY (VT) FUZES

GENERAL

(U) Proximity (VT) fuzes have been designed or are under development for artillery, rocket, mortar, and bomb applications. These fuzes normally operate on the doppler or infrared principle by proximity sensing of the target; however, in the case of the indirect fire role, some designs are capacitance operated to provide lower burst and minimize electro-countermeasure detection.

(U) Some of the earlier fuzes use tube electronics and chemical power, while some of the later ones are transistorized and in some cases use integrated-circuit chip technology and are mechanically powered via a turbine generator concept.

(U) Most of the fuze developments included in this handbook require setback or centrifugal force environmental stimulus for arming; almost all have delayed arming—usually accomplished by mechanical, electrical, or pyrotechnic means.

(U) Some of the fuzes described in this section surpass the current state-of-the-art of both tube electronic and chemically-powered fuzes. The fuzes presented in this handbook are designed for either high- or low-"g" acceleration and for fin-(nonrotated) and spin-(rotated) stabilized projectiles or warheads.

(U) Proximity fuzes are sometimes designated as variable time (VT). Although "VT" is a misnomer, it has become an accepted term for proximity fuzing.

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INDEX

*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

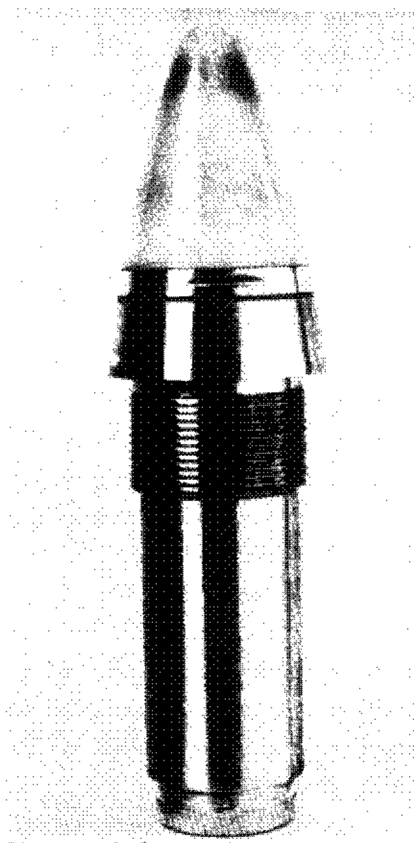

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Figure 6-1. Fuze, proximity, Model FU-RA-F1, full view (U).

(U) Description

The FU-RA-F1 proximity fuze (fig 6-1) was developed by Telecommunications Radioelectriques et Telephoniques (TRT) of Paris for use with French 155-mm, high-explosive, artillery projectiles, Model 1956. The fuze, which operates on the doppler principle, is standard for use by the French Army and is intended to increase the lethality of the French howitzer firepower. The fuze incorporates an hf, radioelectric head composed of a detecting oscillator. The receiving element is an lf amplifier terminating in a firing circuit. The fuze is powered by a battery and includes pyrotechnic delayed arming. Fuze functioning is initiated upon setback during firing.

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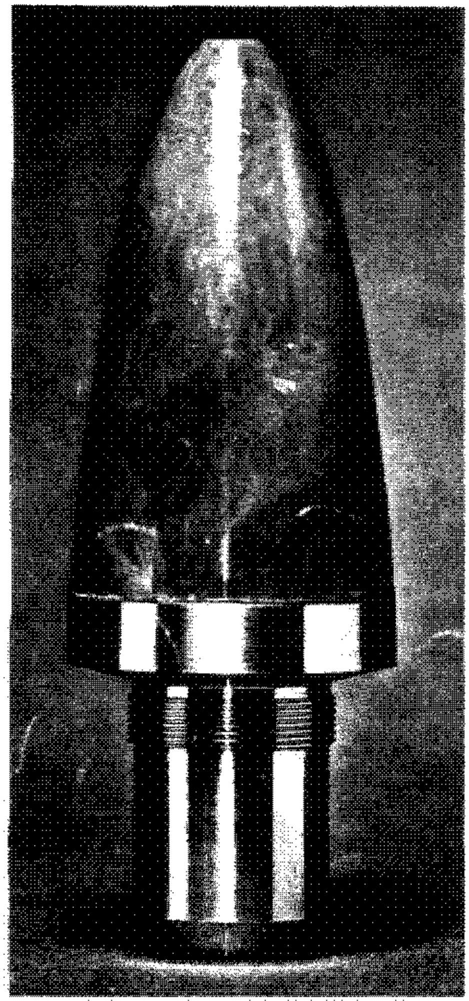

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Figure 6-2. Fuze, proximity, Model FFV574, full view (U).

(U) Description

The FFV574 proximity fuze (fig 6-2) is manufactured by Förenade Fabriksverken of Sweden. It is a transistorized, battery-powered fuze used with 75- through 150-mm artillery projectiles.

Fuze, Proximity, Model FFV574
FOM No. 1390-19-1-4

(U) Characteristics

Functional data:

Arming method	Setback and centrifugal force
Firing method	Impact and proximity
Safety devices	S&A
Arming distance	?
Arming time	0.4 s
Self-destruct time	?
Delay time	0.12 s for impact

(U) Design Details

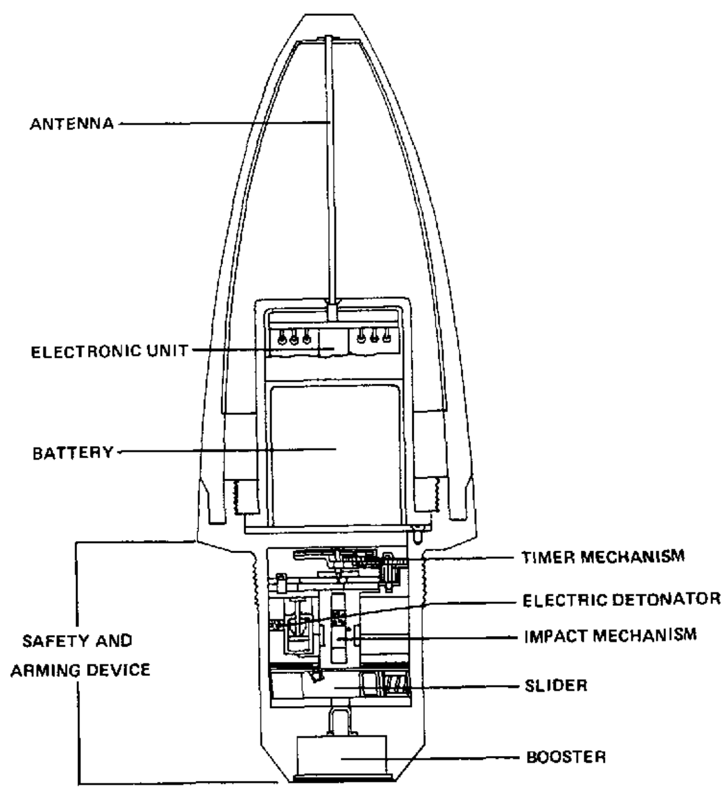

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Figure 6-3. Fuze, proximity, Model FFV574, section view (U).

(U) Design Details (Continued)

The FFV574 VT fuze (fig 6-3) consists of an antenna, electronic unit (which includes an oscillator, frequency detector, amplifier, and noise filter), firing circuit, chemical battery, and S&A device.

The S&A device, which functions on setback, includes a mechanical timer for delaying the movement of a spring-loaded slider housing an electric detonator.

Figure 6-4 illustrates the component interface of the timer with the shutter (i.e., slider).

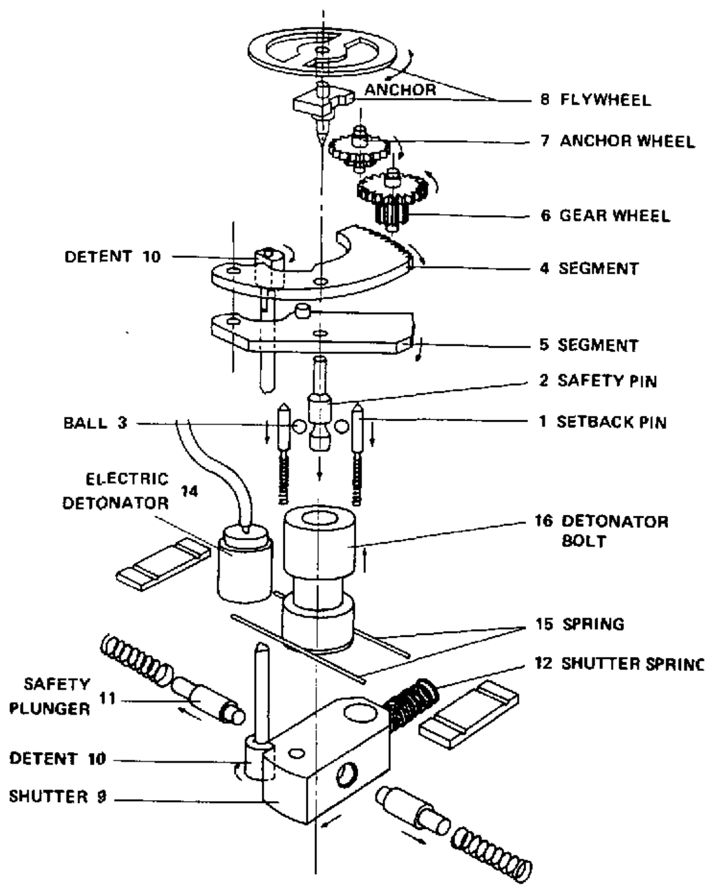

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Figure 6-4. Fuze, proximity, Model FFV574, S&A device (U).

Fuze, Proximity, Model FFV574
FOM No. 1390-19-1-4

(U) Unique Features

The manufacturer claims that the capacitance principle insures a uniform 1-meter height of burst (HOB) for a wide variety of soil conditions and is relatively impervious to electronic countermeasures. Figure 6-5 illustrates HOB of dobbler versus capacitance VT fuzing over different soil conditions.

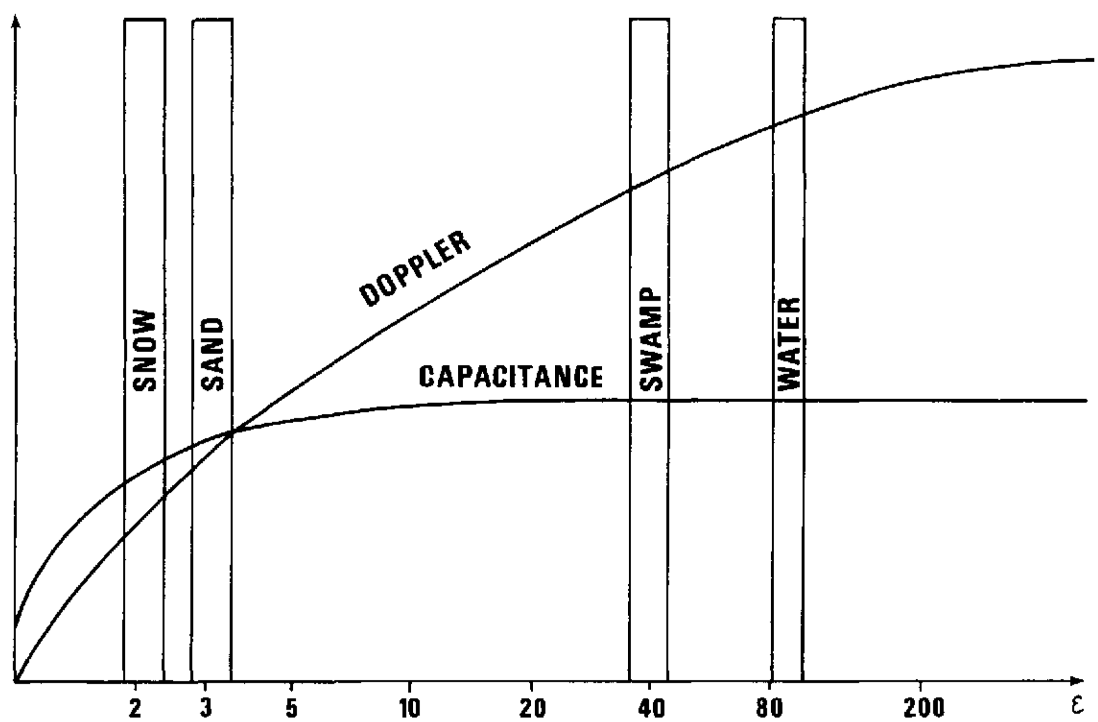

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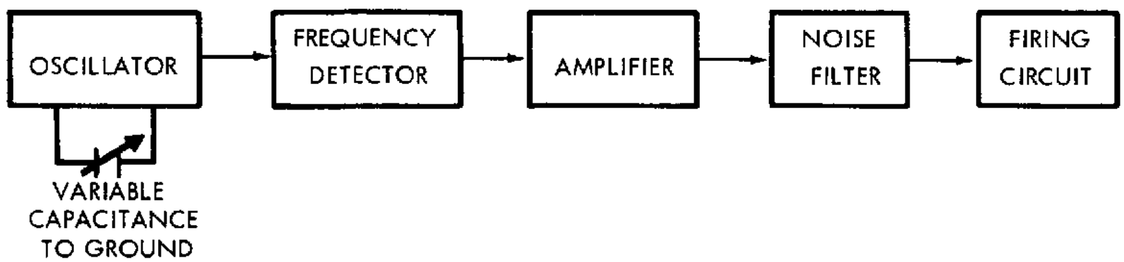
Figure 6-5. Comparison of HOB of doppler vs.capacitance fuzing (U).

While the 1-meter HOB is less than optimum, it offers a significant improvement over impact detonation, and the FFV574 fuze is said to be considerably cheaper than doppler-type proximity fuzes.

(U) **Functioning**

The fuze is capacitance operated. The oscillator is tuned by the capacitance between the projectile and the isolated fuze "antenna." As the projectile approaches impact, the effective capacitance between these elements (element-to-ground capacitance) changes very rapidly, thus detuning the oscillator.



The frequency shift is detected, amplified, and conditioned to provide a trigger signal for the firing circuits.

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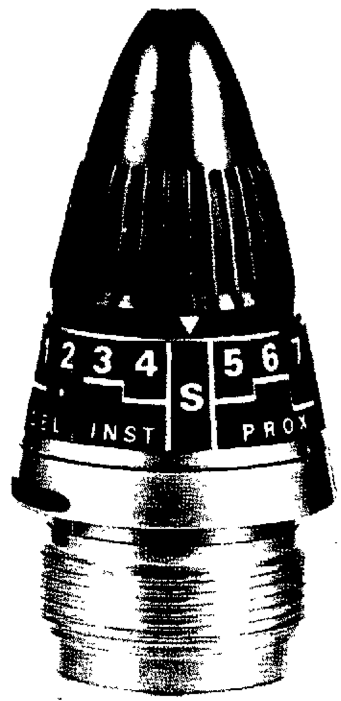

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Figure 6-6. Fuze, proximity, Model ZELAR, full view (U).

(U) **Description**

The ZELAR (fig 6-6) is manufactured by AB Bofors and Phillips AB of Sweden. It is a transistorized, battery-powered, proximity fuze used with 75- and 155-mm artillery projectiles.

Fuze, Proximity, Model ZELAR
FOM No. 1390-19-1-5

(U) Unique Features

The ZELAR permits selection of four impact delays and three proximity sensitivity settings, plus a safe position.

Impact delays

- Position 1 provides a delay not to exceed 200 ms for producing ricochet bursts.
- Position 2 provides a delay not to exceed 25 ms for penetration of light fortifications.
- Position 3 provides SQ functioning with high sensitivity. This feature would permit surface bursts on snow.
- Position 4 provides a low-sensitivity SQ functioning for use in heavy rain.

Proximity delays

- Position 5 provides a proper burst height for normal soil conditions.
- Positions 6 and 7 provide a proper burst height for very dry and very wet soil conditions, respectively.

(FOUO) Functioning

The proximity function is based on the doppler principle, powered by a reserve battery. A loop-type antenna is used, making the proximity function independent of projectile size.

(U) S&A Features

The battery electrolyte is encased in a glass ampule which is crushed at firing. When the selector is set at "SAFE," all electrical connections between the electronic assembly and the pyrotechnic chain are broken and initiation circuitry is short circuited. A spin-dependent contact prevents power from reaching the ignition circuit before firing. One delayed-arming

(U) **S&A Features** (Continued)

device is not released until the projectile is at least 75 meters from the muzzle. A second delay prevents initiation of the proximity function until 3 seconds after firing.

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	900 g (1.98 lb)
Markings	?

Functional data:

Arming method	Initial setback
Firing method	Impact and proximity
Safety devices	Acceleration, rotation, delay
Arming distance	75 m (impact)
Arming time	3 s (proximity)
Self-destruct time	Impact
Delay time	Selectable
Frequency (for VT fuze only)	?

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Fuze, VT, Model ZONAR 70 grk-12
FOM No. 1390-19-1-1f

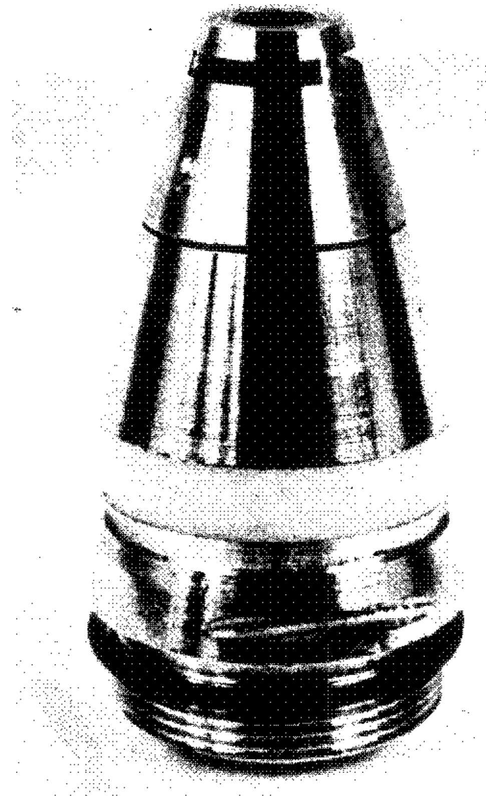

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Figure 6-7. Fuze, VT, Model ZONAR 70 grk-12, full view (U).

(C) **Description**

The ZONAR 70 grk-12 (fig 6-7) was designed by A/S Kongsberg Våpenfabrik of Norway for use with the Swedish M58, 120-mm, HE, mortar projectile. The fuze is similar in design to the Norwegian NVT-24 (FOM No. 1390-20-1-6). The ZONAR 70 operates mechanically from the time of firing until 1 second has elapsed on the descending leg of the trajectory; the fuze then operates on the doppler principle. In Swedish tests using high-powered and directional jammers, the ZONAR 70 could be jammed; however, Swedish planners assume that the enemy is not likely to concentrate jamming signals of the required magnitude on the battlefield.

Fuze, VT, Model ZONAR 70 grk-12
FOM No. 1390-19-1-18

(C) Description (Continued)

The normal malfunction rate was 4% to 5% under no-jamming conditions. Reportedly, ZONAR 70 gave a more consistent HOB (4.5 meters at 65° angle of fall) than the FFV574, capacitance-type, VT fuze. The ZONAR 70 will be used by the Norlands brigades only, because of deep snow country.

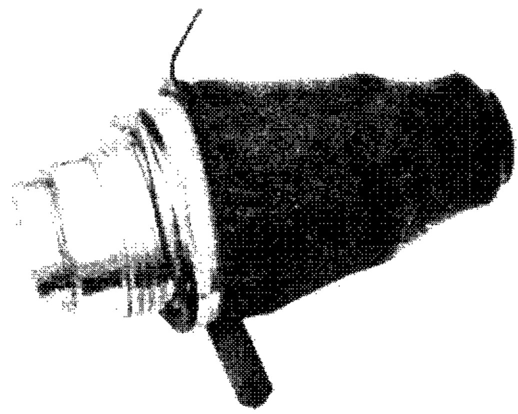

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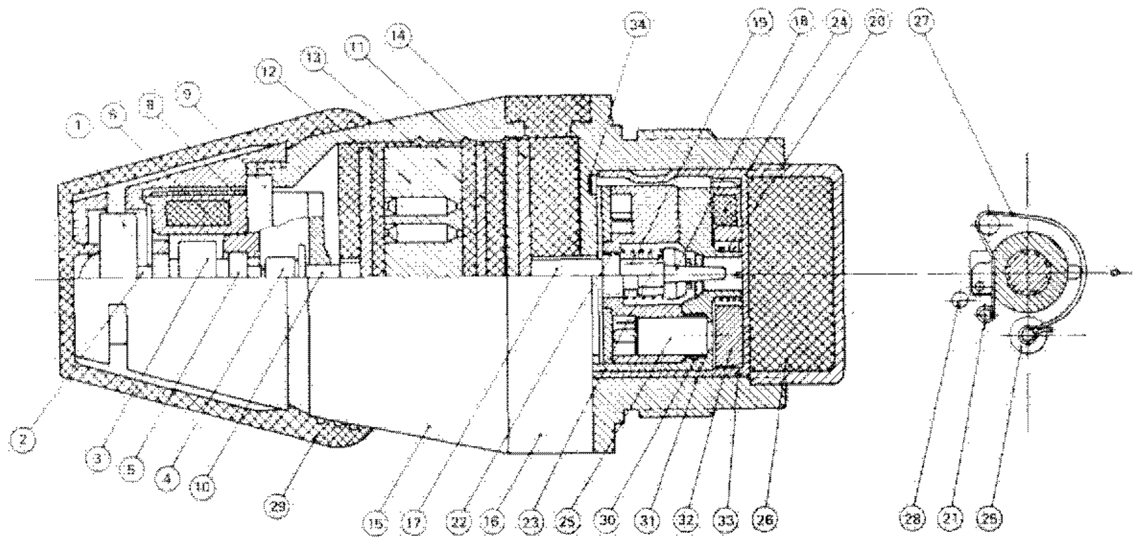
Figure 6-8. Fuze, proximity, Type NVT-23, full view (U).

(U) Description

The NVT-23 (fig 6-8), which is manufactured by Kongsberg Vapenfabrik of Norway, is a specific development of the NVT-2 prototype, self-powered, proximity fuze for use with the M43/M43Al 81-mm mortar projectiles. The features are the same as the NVT-2 (FOM No. 1390-20-1-4) (see app III).

Fuze, Proximity, Type NVT-23
FOM No. 1390-20-1-1

(U) Design Details



1 – TURBINE	10 – GEAR V	18 – ARMING FORK	26 – BOOSTER
2,3 – ROTOR	11 – SCREEN PLATE	19 – ARMING SHAFT THREADS	27 – CONTACT SPRING
4 – GEAR I	12 – ELECTRONIC PACKAGE	20 – ARMING SPRING	28 – HOLE FOR CONTACT PIN
5 – BEARING	13 – PRINTED CIRCUIT	21 – LOCKING PIN	29 – NOSE COVER
6 – COIL FORMER	14 – OSCILLATOR PLATE	22 – ARMING SHAFT THREADS	30 – DETONATOR CONTACT
8 – STATOR	15 – ELECTRONIC HOUSING	23 – FORK SPRING	31 – DETONATOR HOUSING
9 GEAR BOX	16 – INSULATOR	24 – TETRYL CHARGE	32 – SHUTTER
	17 – ARMING SHAFT	25 – DETONATOR T77	33 – SA CONTAINER
			34 – CONNECTION SPRING

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Figure 6-9. Fuze, proximity, Type NVT-23, section view (U).

Figure 6-9 illustrates the components of the NVT-23 design.

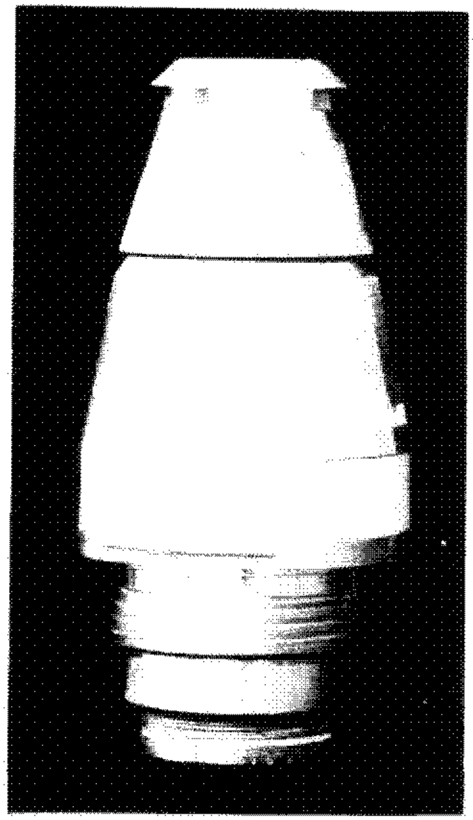

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Figure 6-10. Fuze, proximity, Type NVT-26, full view (U).

(C-NFD) Description

The NVT-26 (fig 6-10) is a modification of the Kongsberg Våpenfabrik NVT-23, self-powered, proximity fuze for use with the M49A2 60-mm mortar projectile. The modification consists of a better match of the antenna to the M49A2E2, 60-mm shell with the object of obtaining nearer optimum burst height for all charges (see app III).

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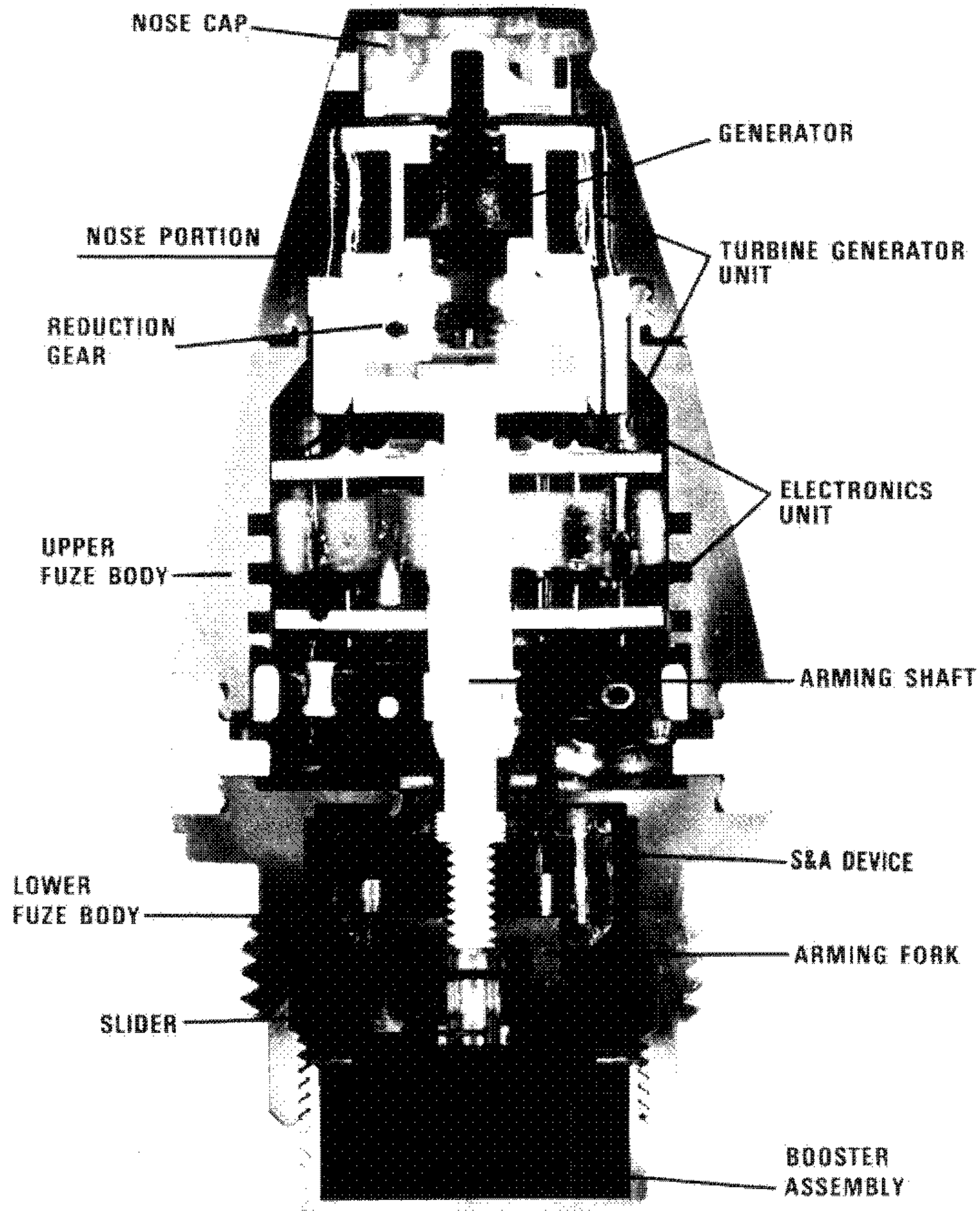

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Figure 6-11. Fuze, proximity, Type NVT-227, section view (U).

Fuze, Proximity, Type NVT-227
FOM No. 1390-20-1-3

(U) Description

The NVT-227 (fig 6-11), which is manufactured by Kongsberg Våpenfabrik of Norway, is a specific adaptation of the NVT-224, self-powered, proximity fuze for use with the M49A4, 60-mm mortar projectile. This adaptation was pursued because of the generally unsatisfactory performance of the NVT-26 fuze (see app III).

(U) Modifications to NVT-224

- Lowering the start and stop torques of the turbine generator to accommodate the lower muzzle velocity of the 60-mm projectile.

- Removing the apex sensor from the safety and arming chain to accommodate the very low velocity change associated with the apex of charge-2 trajectories.

- Raising the oscillator frequency to improve antenna performance and increase doppler sensitivity.

Fuze, Proximity, Type NVT-2
FOM No. 1390-20-1-4

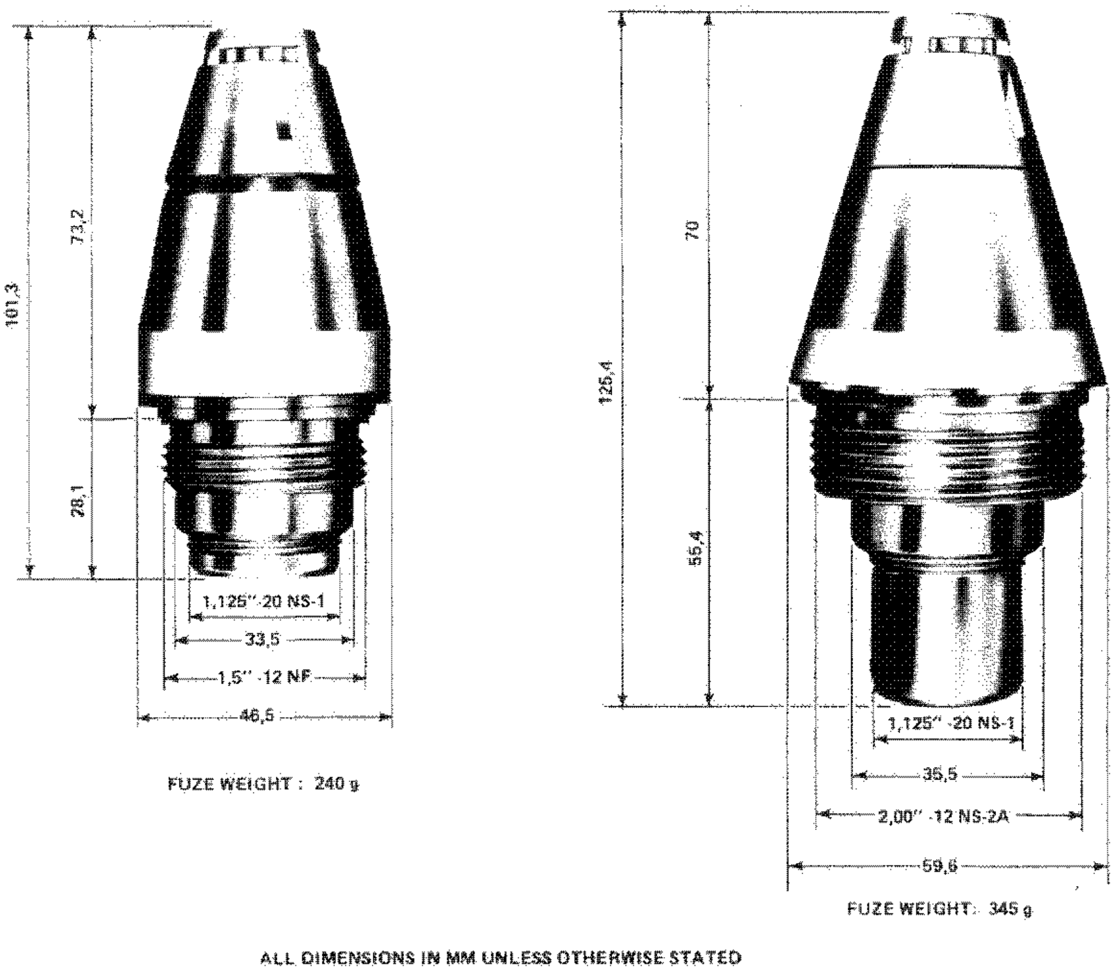

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Figure 6-12. Fuze, proximity, Type NVT-2, contour and full views (U).

(U) Description

The NVT-2 (fig 6-12) is a prototype, transistorized, self-powered, proximity fuze for mortar projectiles. Kongsberg Våpenfabrik of Norway manufactures the NVT-2 in two different sizes and weights to accommodate different size projectiles. Both fuzes function identically.

Fuze, Proximity, Type NVT-2
FOM No. 1390-20-1-4

(U) Unique Features

The most distinguishing feature of the NVT-2 is the use of a turbine that generates the electrical energy necessary to operate the fuze, and provides the mechanical energy to activate the S&A mechanism. The storage life of the fuze is thus indefinite. (See fig 6-13 for main components.)

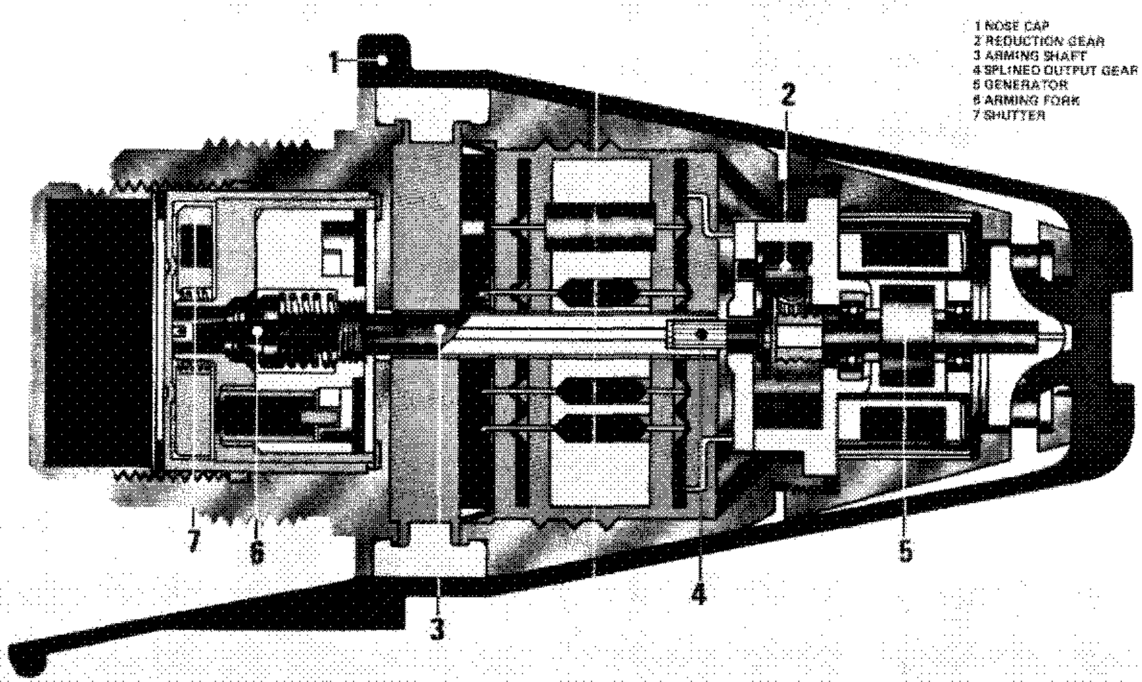

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Figure 6-13. Fuze, proximity, Type NVT-2 section view (U).

(U) Functioning

The NVT-2 is a CW/doppler-type fuze. The doppler signal is passed through a two-stage amplifier, filter, and pulse-shaping circuit. A cumulative signal effect drives the amplifier output into saturation, triggering the thyristors which ignite the tetryl primer. The height of detonation is set during production for the optimum height for the projectile to be used.

(U) **Functioning** (Continued)

Thus, otherwise interchangeable fuzes will produce different heights of burst for different projectile types. An impact switch is used to provide an electrical backup detonation in case the proximity sensing electronics should fail.

(U) **S&A**

The high-speed turbine drives a rotating arming shaft through a suitable reduction gear. This, in turn, withdraws the arming fork, permitting a tetryl pellet lead-through to rotate into position, and also permitting electrical connections to the primer. This technique is independent of setback and, within limits, muzzle velocity. The turbine requires a sustained projectile velocity of at least 50 m/s so that mechanical arming takes place approximately 150 meters from the muzzle. The newest model incorporates an apex sensor to insure that arming will not take place until after the projectile has passed the maximum trajectory ordinate.

(U) **Characteristics**

Fuze assembly:

Body material	?
Weight	240 g (0.53 lb), 345 g (0.76 lb)
Markings	?

Booster:

Body material	?
Body length	?
Explosive tetryl	?
Explosive weight	?

Functional data:

Arming method	Sustained projectile velocity
Firing method	CW doppler
Safety devices	Protective nose cap locks turbine
Arming distance	150 m
Arming time	Independent of muzzle velocity
Self-destruct time	Impact
Delay time	≈0.5 s
Frequency (for VT fuze only)	?

Fuze, Proximity, Type NVT-2
FOM No. 1390-20-1-4

(U) Applications* (Ammunition and Weapons)

Ammunition	Weapons
60-mm M49	60-mm US
81-mm M43, 81-mm L15A1	81-mm US, 81-mm UK L16A1
120-mm DM11 120-mm PEPA-LP (rocket-assisted)	120-mm Tampella, 120-mm Hotchkiss-Brandt
107-mm M329	107-mm US

*The NVT-2 is a prototype fuze. These applications reflect manufacturer's claims. Specific adaptations have been developed for a number of projectiles (see app III).

Fuze, Proximity, Type NVT-224
FOM No. 1390-20-1-5

(U) **Description**

The NVT-224, which is manufactured by Kongsberg Våpenfabrik of Norway, is a version of the NVT-23, self-powered, proximity fuze used with the M43A1 81-mm mortar projectile. While the basic concept is the same as the NVT-23, the design is more flexible, permitting modification for use with other weapons. The NVT-224 also incorporates silicon transistors for greater reliability and a much stronger antenna insulating ring.

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Fuze, Proximity, Type NVT-24
FOM No. 1390-20-1-6

(U) **Description**

The NVT-24 is manufactured by Kongsberg Våpenfabrik of Norway. It is a specific adaptation of the NVT-23, self-powered, proximity fuze for use with 120-mm mortar projectiles.

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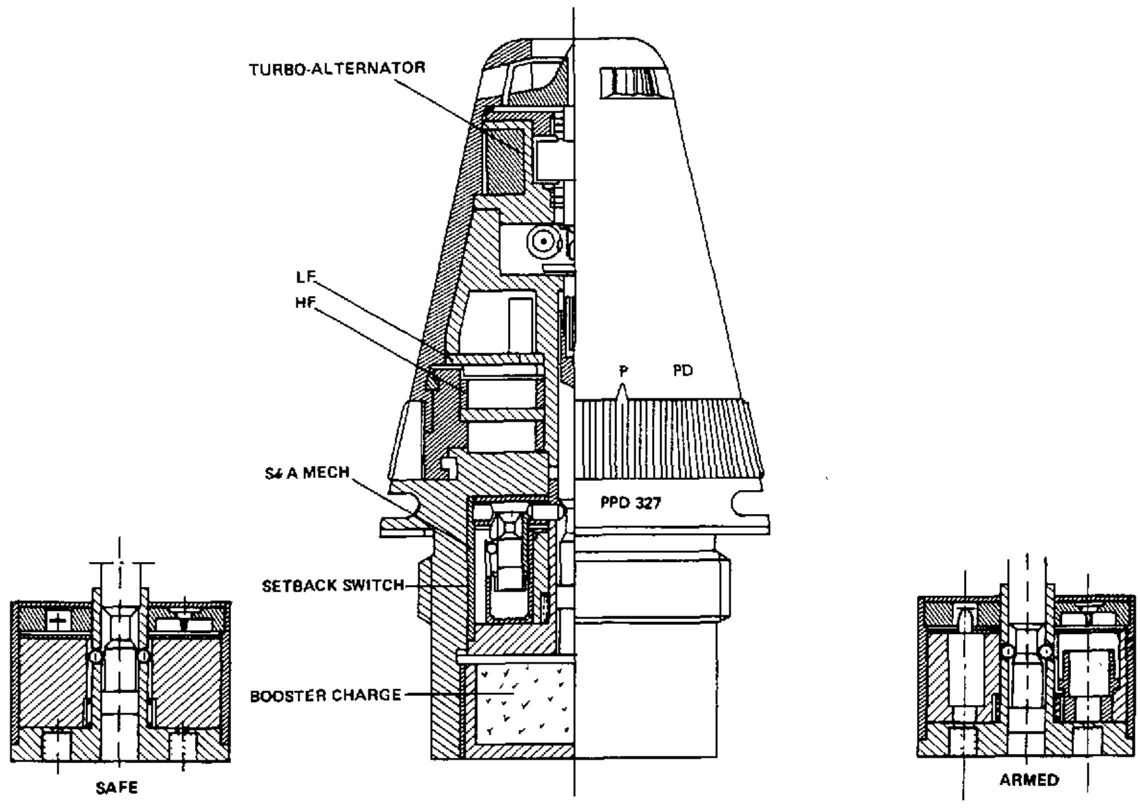

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Figure 6-14. Fuze, VT, Model PPD 327, section and contour views (U).

(U) Description

The proximity/PD fuze PPD 327 (fig 6-14) is based on the CW/doppler principle. The fuze is designed to detonate the 60-mm mortar projectile at an optimum height above the target in open terrain. If the proximity function fails, a sensitive stab detonator initiates the explosive filling at impact. The fuze can be set (externally) for point detonation and can be reset back to proximity function if desired.

Fuze, VT, Model PPD 327
FOM No. 1390-20-1-7

(U) **Design details**

Fuze arrangement. The fuze arrangement is shown in figure 6-14. The fuze consists of an electronic section and a pyrotechnic section; the two section are joined just ahead of the wrench slot. The turbo-alternator is placed in the front of the electronic section, then the LF unit and the HF unit. The electronic section forms the front half of the antenna. The pyrotechnic section contains the S&A mechanism and booster charges. The pyrotechnic section together with the projectile forms the rear half of the antenna, which is a skew dipole (fig 6-15).

The option switch is placed outside the electronic section and is resettable. For the PD function, the alternator is shortcircuited.

Turbo-alternator. The turbo-alternator is an improved version of the existing KV models, which have proved to have a very high reliability. The turbo-alternator is fitted with a gearbox by which mechanical energy is transferred to the S&A mechanism.

LF unit. The generator ac voltage is rectified and ripple-filtered before regulator input. The regulator is a part of a silicon integrated circuit specially designed for turbine-powered proximity fuzes. A fixed-time delay in conjunction with a special apex sensor makes the fuze safe for several seconds of flight. Another part of the integrated circuit is an amplifier. The band-pass characteristics are set to the doppler signal band. The amplifier is used to fire the detonator via the trigger and firing circuits. The amplifier gain and the trigger-threshold level are well defined by the use of feedback technique.

S&A unit. The S&A mechanism is connected to the turbo-alternator via an arming shaft with spline coupling. The S&A mechanism consists of a spring-loaded rotor with one electric detonator and one stab detonator. In the safe position the rotor is locked with two rollers held in two grooves in the rotor by the arming shaft, the explosive chain is out-of-line, the electric detonator is short circuited, and the stab detonator is out-of-line with its firing pin.

An integrating, setback detent is also contained in the rotor, so that in the safe position the rotor is locked and the arming shaft prevented from rotation. This feature greatly increases the safety of the system, since the setback detent must be released before the arming shaft can be rotated. This prevents rotation of the turbine arming shaft, either accidentally or by sabotage.

(U) **Functioning**

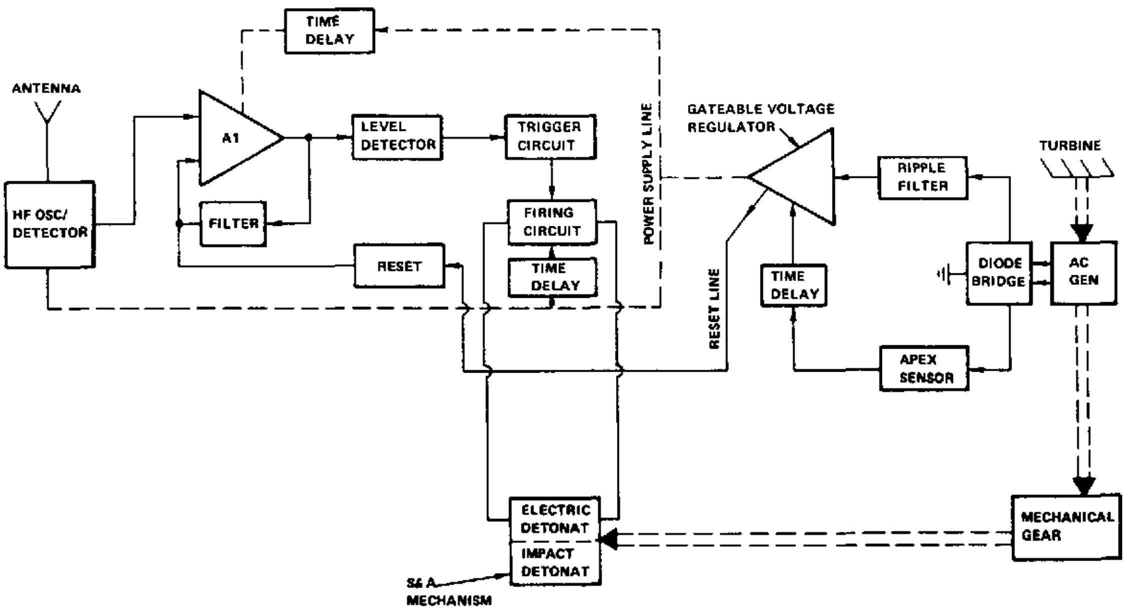

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Figure 6-15. Fuze, VT, Model PPD 327, functioning sequence (U).

Mechanical arming. When the projectile is fired, the setback detent is released (500-g minimum), the blocking pin is free to move radially, and the arming shaft may be rotated. When the projectile is outside the barrel, the turbine begins to rotate. Then the arming shaft begins to rotate at a speed 1/312 times the turbine speed. After approximately five revolutions, the rotor is free to rotate to the armed position, where it is locked. In this position the electric detonator is switched from shortcircuiting, and the mechanical detonator is positioned in line with its firing pin. Both detonators are in their explosive line. The projectile has now travelled at least 100 meters from the tube.

Fuze, VT, Model PPD 327
FOM No. 1390-20-1-7

(U) Functioning (Continued)

Proximity arming. Due to the incorporated apex sensor, the whole fuze, including the HF unit and firing circuit, is de-energized during the first half of the trajectory until the apex is reached. Then the generator speed increases, turning on a time delay of 3 seconds. Following this delay, the regulator comes on, energizing the HF unit and giving power to the LF unit. The firing capacitor begins charging when the regulator comes on. This capacitor has a separate delay which can be determined by the customer and set during production.

By using three separate time delays, together with an apex sensor, the fuze is extremely safe against early bursts in the first part of the trajectory. This safety is partly reduced as the target is approached.

Proximity function. As the fuze approaches the target, the doppler signal from the HF detector increases and is amplified. When the amplitude reaches a certain level, set by the level detector, the trigger circuit is activated. This turns on the firing circuit, discharging the firing capacitor and firing the detonator.

Point detonation. When the fuze is set for point detonation, the turbo-alternator is shortcircuited and no electric power is fed to the electronic sections. After mechanical arming, the stab detonator is in line with its firing pin. When an object is hit, the stab detonator is initiated and the projectile explodes.

(C) **Description**

(C) The NINA proximity fuze is a prototype development being undertaken by Phillips USFA of Eindhover, Netherlands, for use on all rotating artillery and mortar projectiles fired from the 120-mm rifled mortar, 105-mm howitzer, 155-mm howitzer, 175-mm gun, and 8-inch howitzer.

(C) The fuze operates on the doppler principle and utilizes a loop antenna. It is intended to function at accelerations from 800 to 22,000 g at 2800 to 20,000 r/min.

(U) The fuze is powered by a chromic acid battery molded in glass-filled nylon and sealed against leakage by an ultrasonically-molded cover. The electrolyte is contained in a glass ampoule with an attached weight to facilitate breakage under setback. The power is voltage regulated and filtered.

(C) The fuze can be set for different arming times and HOB. An electrical setter contacts seven pads near the base of the fuze, permitting selection of a proximity arming time of 1.5 or 3 seconds and one of three HOB; 5, 8, or 10 meters. Turn on time is determined by a resistor-capacitator (RC) timer. Accuracy is enhanced by the setter, which measures the value of the R, the C, and the detector threshold and then applies an appropriate charging voltage through two open lead relays in order to minimize bleed off. Required time accuracy is maintained at least 15 min after setting.

(C) Impact functioning is provided by an exposed crush switch in the nose which is connected to the firing circuit through choked leads to a double-element, locking, setback switch and firing circuit. The S&A device, which establishes minimum arming distance, was adopted directly from the Swiss Dixie fuze. A four-element explosive train is employed. The first element is a low-output electric primer attached to the E head. This is followed by a sensitive lead, an out-of-line tetryl lead, and a tetryl booster.

(C) The NINA VT fuze utilizes a longitudinal, one-turn loop with a circuitboard mounted coplanar with the loop. A field effect transistor chip mounted at the top of the board is the principal active device in the circuit. Doppler signals are amplified by an integrated circuit (IC) with a 280 active device mounted on a two-sided printed circuit board. Firing occurs when the first doppler cycle exceeds a set threshold. No integration or other sophistication is used for signal processing.

Fuze, VT, Model NINA
FOM No. 1390-29-1-4

(C) Description (Continued)

(C) Protection against countermeasures is provided by circuitry that permanently reduces the HOB to half or to impact, depending on the severity of the jamming before electrical arming takes place. This is performed by switching and sensing functions in the IC. A limiter circuit provides protection against radar pulses.

(C) Characteristics

Functional data:

Antenna	Loop
Principle	Doppler
Acceleration	Min 800 g Max 22,000 g
Rotation	Min 2800 r/min Max 20,000 r/min
Applicable Mil. Std.	Mil. Std. 333, Mil. Std. 331
Base safety	Pyrotechnic train armed between a min of 40 m and a max of 300 m (between 0.5 and 1 s)
Impact	Superquick Impact action armed between a min of 0.5 s and a max of 1 s Functioning at impact angles of 0° - 75° with normal electric switch
Proximity action	After 3 s if no time setting, or 1 s after time set, last 3 s of flight
Time setting	Min 4 s, max 120 s in steps of 0.1 s Accuracy ±2.5%, or min of 1 s RC timer
HOB	5, 8, or 10 m at reflection coefficient 0.5
Operating temperature range	32° to +52°C according to Stanag 2831 (-25° to +125°F)
Storage temp. range	-34° to +63°C
Anti-jamming devices	By timing and by "ASPRO" system of detection and reducing jamming
Reliability	85%
Battery	Chromic acid
Stage of development	Prototype production mid 1974; full production 1976

(C) **Characteristics (Continued)**

Safety devices	Electric and pyrotechnic
Primer	Electric
Electronic components	Integrated circuits & transistors
Price	N fl. 120

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Fuze, VT, Model I.P.
FOM No. 1390-37-1-1

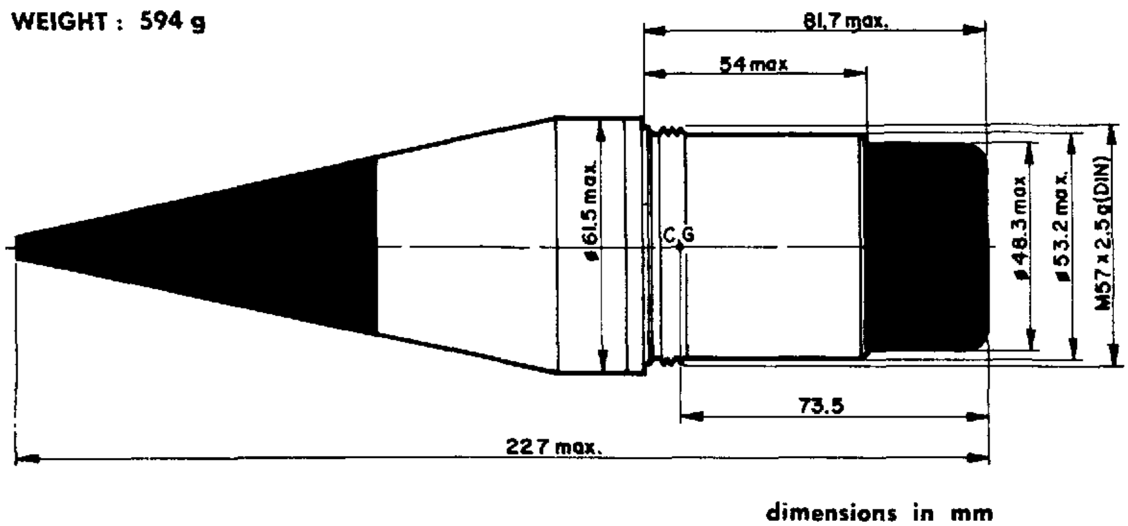

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Figure 6-16. Fuze, VT, Model I.P., contour view (U).

(U) Description

The Israeli Military Industries (IMI) fuze, Model I.P. (fig 6-16) is a transistorized, electric-powered, VT fuze with a reliable arming mechanism and an electronic target-detection unit to assure effective airburst above the target. The fuze operates on the doppler principle. Due to the absence of a chemical power source, the storage life of the fuze is practically unlimited. The fuze was designed for use with nonrotating ammunition.

(U) Unique features

- Back-up impact function in case of electronic failure.
- Electronic target-detection unit.
- Delayed-arming mechanism.
- Electrical arming.

Fuze, VT, Model I.P.
FOM No. 1390-37-1-1

(U) Characteristics

Fuze assembly:

Body material	?
Weight	594 g (1.31 lb)
Markings	?
Length	227 mm (8.94 in)
Max diam	61.5 mm (2.42 in)

Booster:

Body material	?
Body length	27.7 mm (1.09 in)
Explosive	?
Explosive weight	?

Functional data:

Arming method	Electric
Firing method	Electronic or impact
Safety devices	Delayed arming
Arming distance	?
Arming time	?

(U) Design Details

The Model I.P. proximity fuze (fig 6-17) consists of an electronic unit of solid-state components, electrical power supply, firing capacitor, electric squib, impact-switch delayed arming mechanism, electric detonator, and booster assembly, as well as a back-up impact detonator. The impact detonator has been incorporated in the fuze in case of electronic failure.

(U) Design Details (Continued)

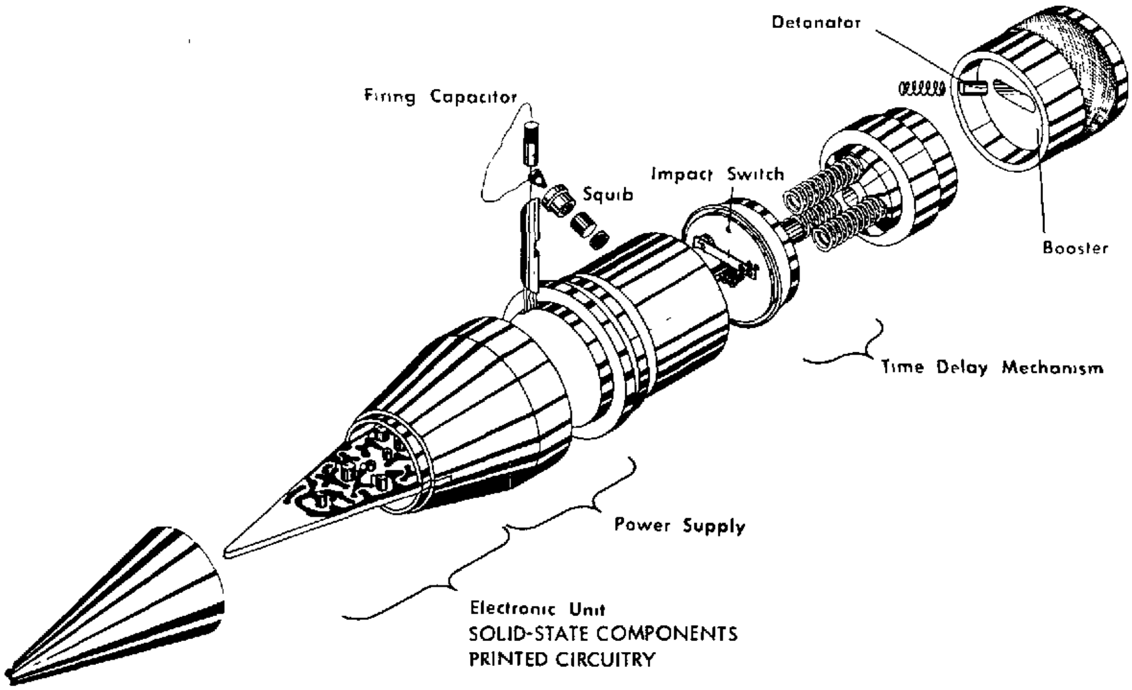

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Figure 6-17. Fuze, VT, Model I.P., exploded view (U).

(U) Functioning

Upon firing, the fuze is electrically powered; the altitude detector functions on the doppler principle to generate an impulse to the thyristor-type firing circuit. Simultaneously at launch, the time-delay mechanism is electrically initiated. (See fig 6-18 for firing sequence.)

Fuze, VT, Model I.P.
FOM No. 1390-37-1-1

(U) **Functioning** (Continued)

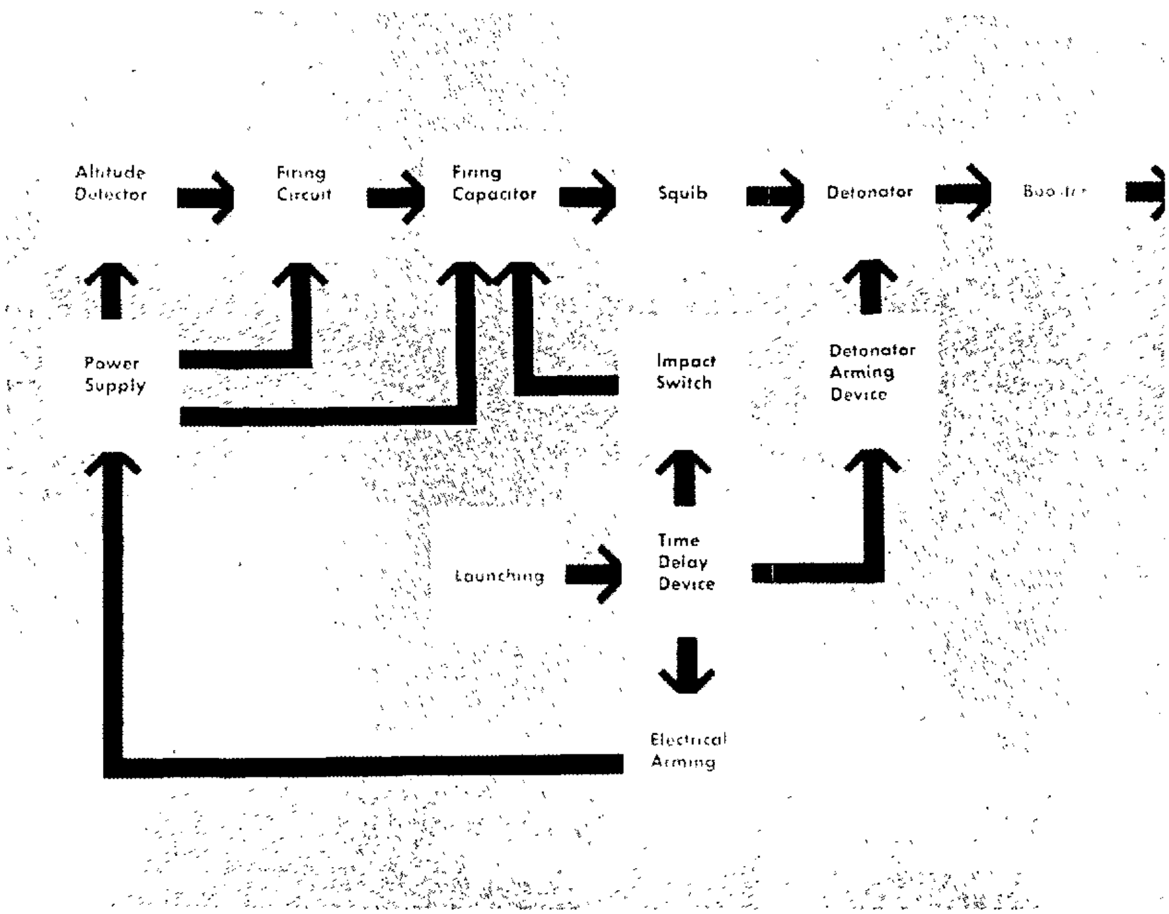

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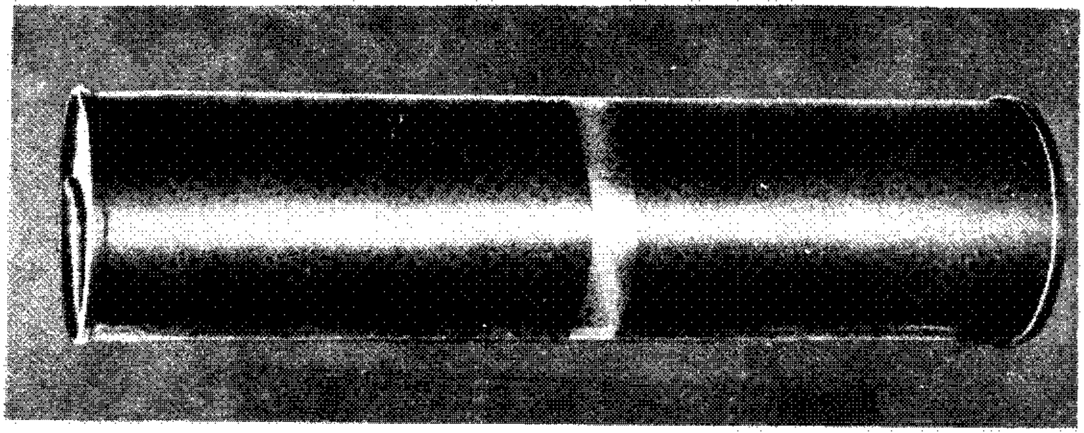
Figure 6-18. Fuze, VT, Model I.P., firing sequence (U).

(U) Applications (Ammunition and Weapons)

Ammunition	Weapons
120-mm HE projectiles	120-mm mortars

(U) Packing



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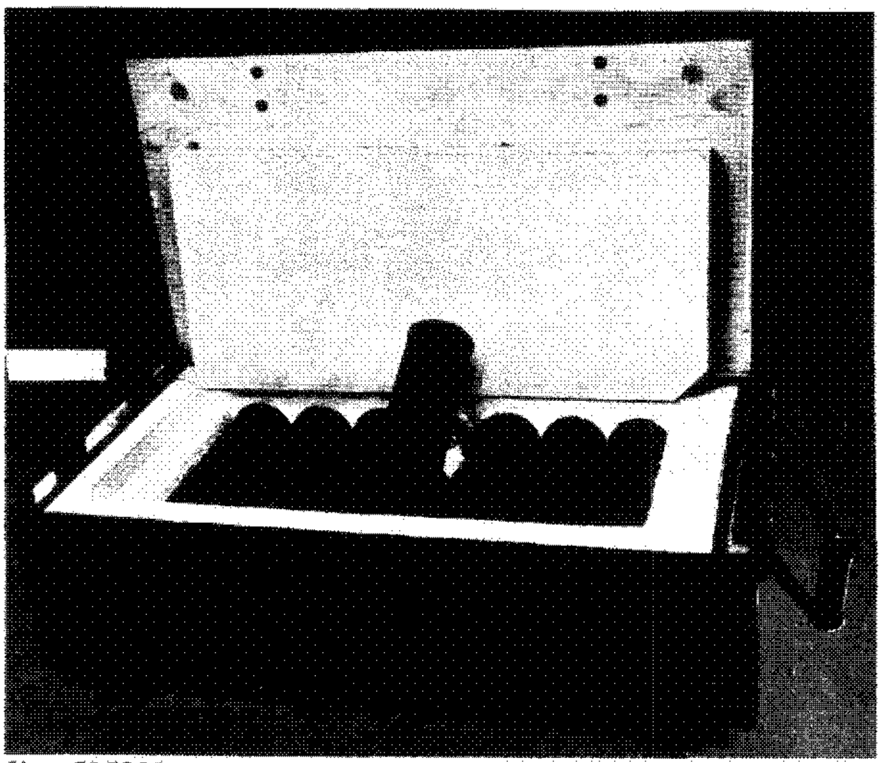

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Figure 6-19. Fuze, VT, Model I.P., hermetically-sealed container and wooden box (U).

Fuze, VT, Model I.P.
FOM No. 1390-37-1-1

(U) Packing (Continued)

Each fuze is packed in a hermetically-sealed, sheet-metal container (fig 6-19). Fifteen fuzes are overpacked in a rigid, foam-lined, wooden box with a volume of 0.08 m^3 and weight of 24 kg.

Section VII.

MINE AND GRENADE FUZES, IGNITERS, AND NONELECTRIC FIRING DEVICES

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Section VII.

MINE AND GRENADE FUZES, IGNITERS, AND NONELECTRIC FIRING DEVICES

GENERAL

(U) Mine and grenade fuzes have been designed or are under development for antitank and antipersonnel applications. Mine fuzes usually are contact-type fuzes that are actuated by direct application of pressure when tanks or personnel cross over the buried mines. Grenade fuzes are of the pyrotechnic delay-type, in which a cocked striker stabs a detonator after the delay element burns out.

(U) Removable safety clips are used with mine fuzing to keep the mines in the unarmed state until they are laid or implanted; a safety ring and pin normally keep the grenade in an unarmed state until removed prior to throwing or launching from the grenade launcher.

(U) Igniters and firing devices are used with mines, grenades, and explosive charges in a variety of applications including mine clearance, antipersonnel, antitank, and booby trap operations.

(U) The fuzes and igniters described in this section are considered within the state-of-the-art; in some instances, they incorporate unique features.

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INDEX

*All fuze nomenclatures are UNCLASSIFIED.

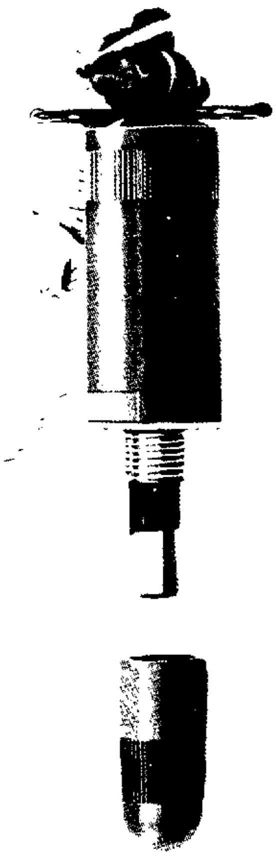
INDEX (Continued)

*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

Fuze, Mine, Pressure/Pull, Model DM 56
FOM No. 1390-16-5-1



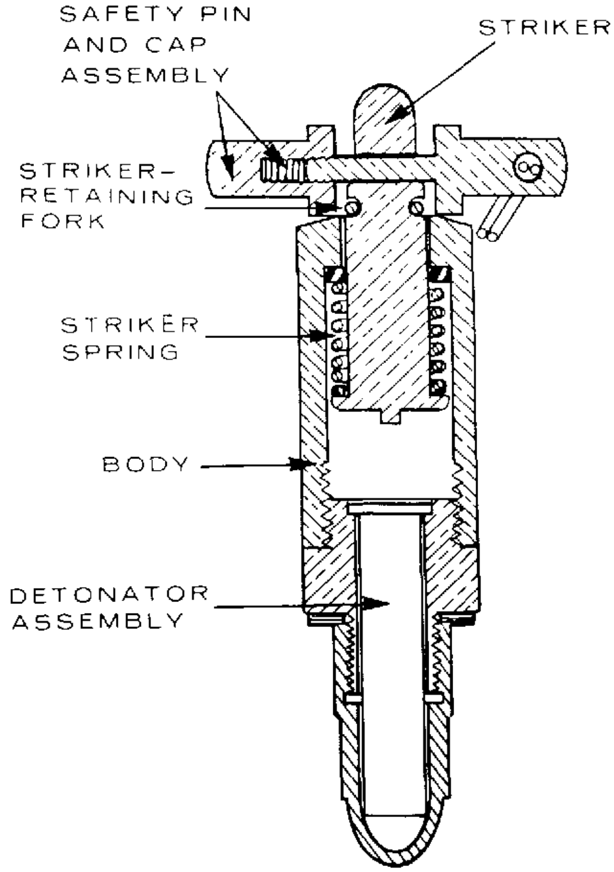


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Figure 7-1. Fuze, mine, pressure/pull, Model DM 56, general and section views (U).

(U) Description

The DM 56 (fig 7-1) is a combination pressure- or pull-activated fuze used with the DM 31 antipersonnel mine. Except for the aluminum detonator assembly, the fuze is made of brass. The external fuze threads are protected by a red, molded-plastic shipping cap. A safety-pin assembly insures safety until the fuze is to be armed.

Fuze, Mine, Pressure/Pull, Model DM 56
FOM No. 1390-16-5-1

(U) **Functioning**

The fuze is armed by unscrewing the safety-pin cap from the safety-pin assembly and removing the safety pin from the striker. The striker is then held against the compressed striker spring by the striker retaining fork. A pressure of 12 lb (5.5 kg) applied to the striker head forces open the lugs of the retaining fork, allowing the striker spring to drive the striker forward. Removal of the retaining fork by a trip wire will also initiate fuze action.

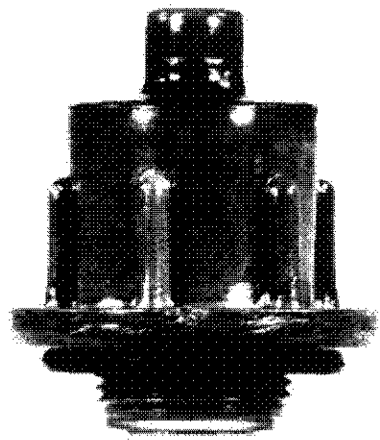

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Figure 7-2. Fuze, mine, pressure, chemical, Model 1951, general view (U).

(U) Description

This universal, nonmetallic (plastic), pressure fuze (fig 7-2) is armed by removing the detonator retaining ring, inserting a Model 50 detonator in the fuze well, and replacing the ring. The fuze may be used in any antitank mine.

(U) **Functioning**

Pressure on the plunger ruptures the shear collar, allowing the plunger to move and crush a vial of acid. The acid reacts with a chemical pellet and initiates the detonator by hypergolic reaction.

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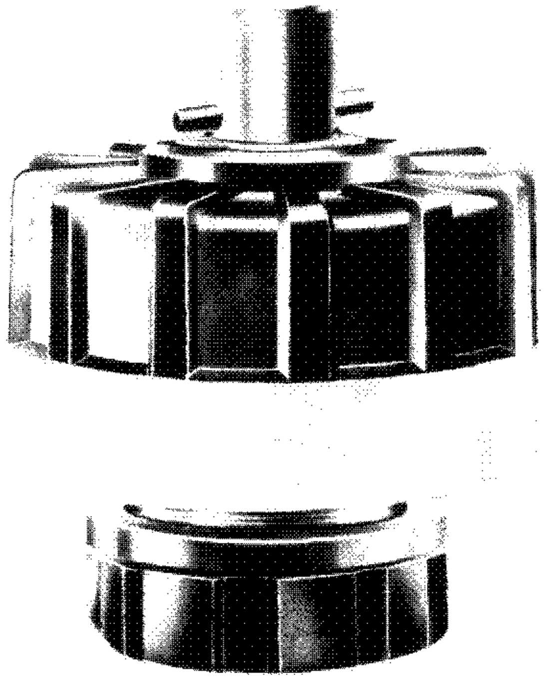
Fuze, Mine, Pressure, Nonmetallic, Model 50
FOM No. 1390-17-5-5



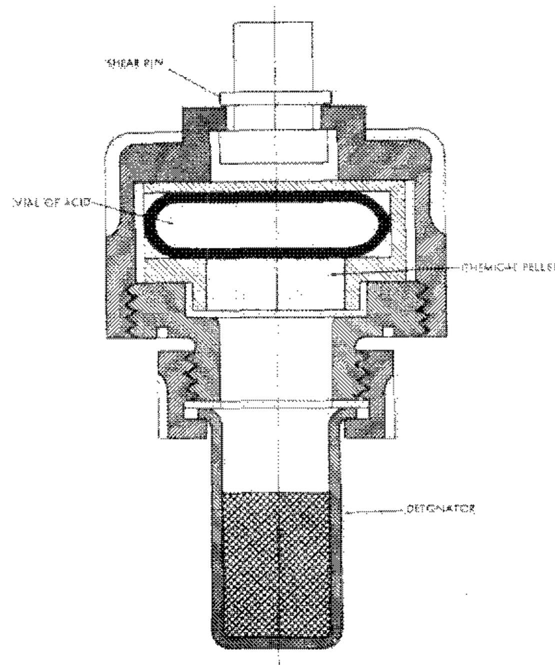


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Figure 7-3. Fuze, mine, pressure, nonmetallic, Model 50, general and section views (U).

(U) Description

The Model 50 fuze (fig 7-3) is made of plastic, with no metallic components; it is practically undetectable by electronic mine detectors. It was designed for use in the Model 51 antitank mine. The fuze is armed by installing the detonator; it has no safety devices.

(U) Functioning

When a force of 75 lb (34 kg) is applied to the plunger, the shear pin fails and the plunger moves downward, crushing a vial of acid. The acid reacts with a chemical pellet to produce a flame which initiates the detonator.

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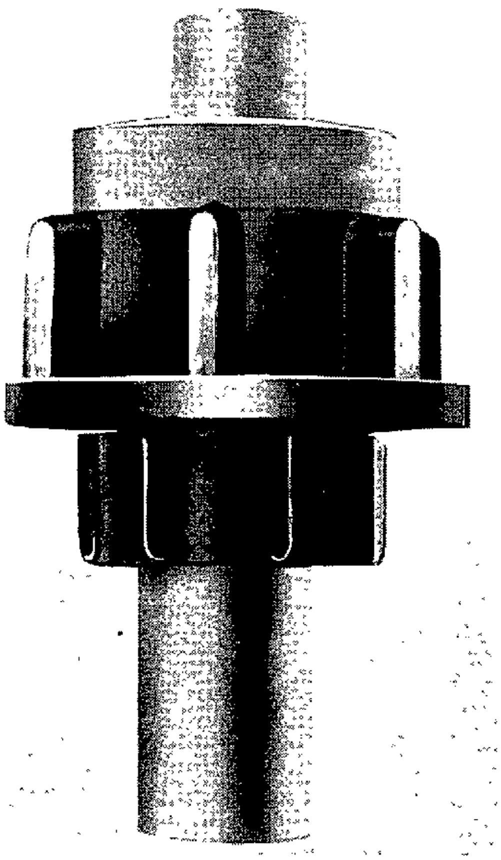

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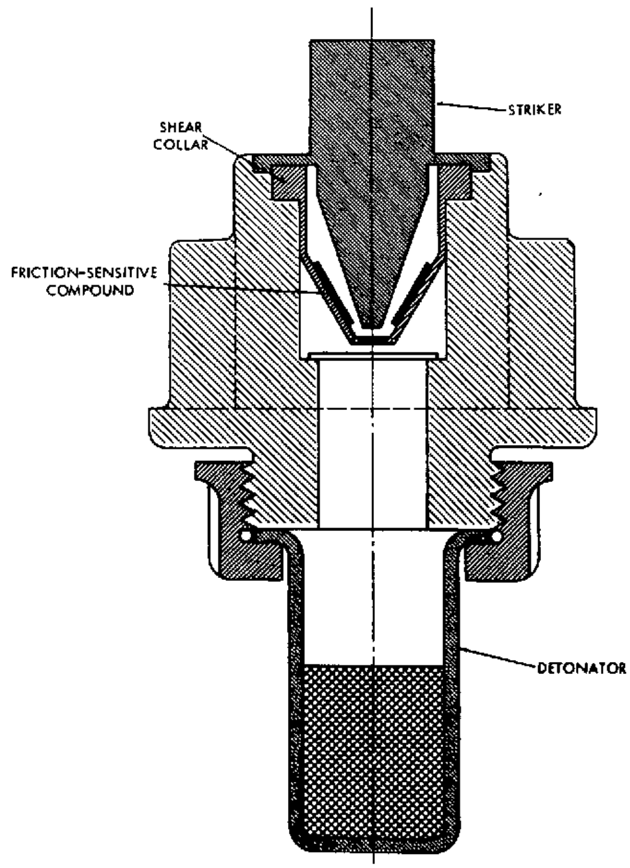

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Figure 7-4. Fuze, mine, pressure, nonmetallic, Model 52, general and section views (U).

(U) **Description**

The Model 52 fuze, like the Model 50, is made of plastic with no metallic components (fig 7-4). It is designed for use in nonmetallic antitank mines. The fuze is armed by installing the detonator; it has no safety devices.

Fuze, Mine, Pressure, Nonmetallic, Model 52
FOM No. 1390-17-5-6

(U) **Functioning**

When a force of approximately 33 lb (15 kg) is applied to the striker, the integral shear collar fails. The conical lower end of the striker, which is charged with a mixture of red phosphorus and ground glass, is forced against a mating surface. The resulting friction ignites the red phosphorus, in turn initiating the detonator.

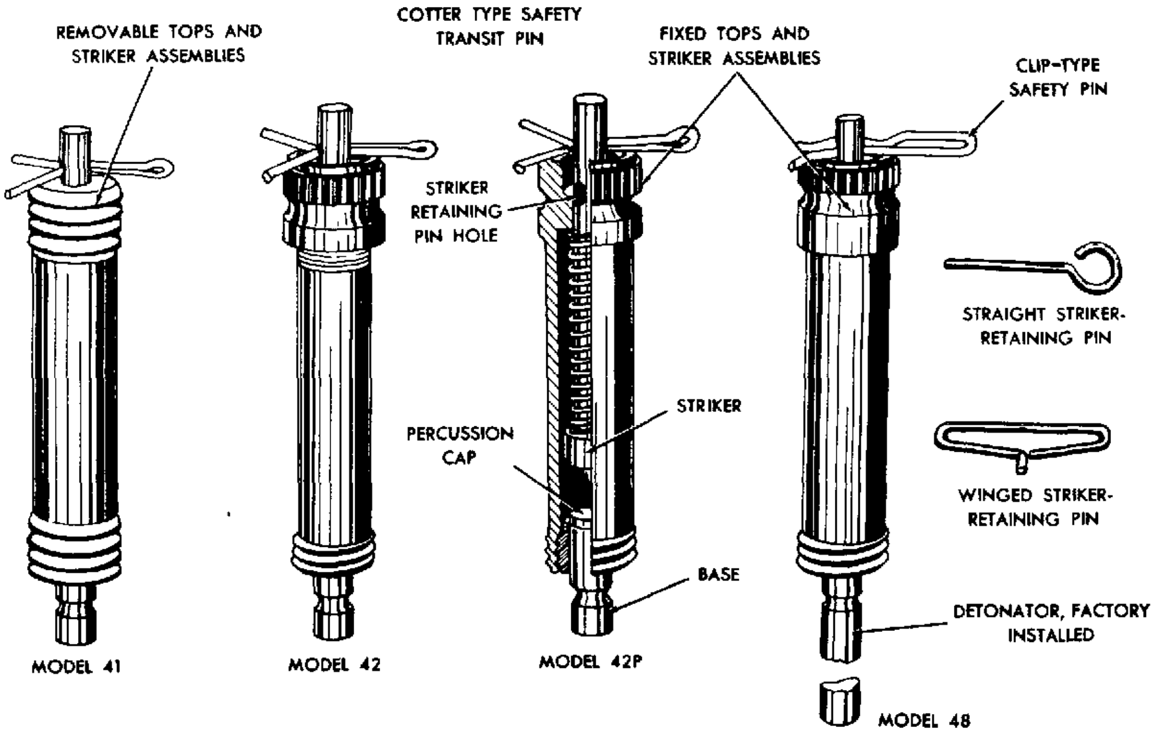

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Figure 7-5. Fuze, mine, pull, Models 41, 42, 42P, and 48, general and section views (U).

(U) Description

The Swedish Models 41, 42, 42P, and 48 pull fuzes (fig 7-5) are basically the same; all are simple pull fuzes with spring-loaded strikers. They are activated by a pull of from 5 to 11 lb (2.27 to 5 kg) on the striker retaining pin. These fuzes are used on Models 41, 42, and 42P trip flare antipersonnel mines.

(U) Functioning

When a pull of from 5 to 11 lb (2.27 to 5 kg) is exerted on the striker retaining pin, the pin is withdrawn, allowing the spring-loaded striker to snap forward, striking the stab primer and initiating fuze action.

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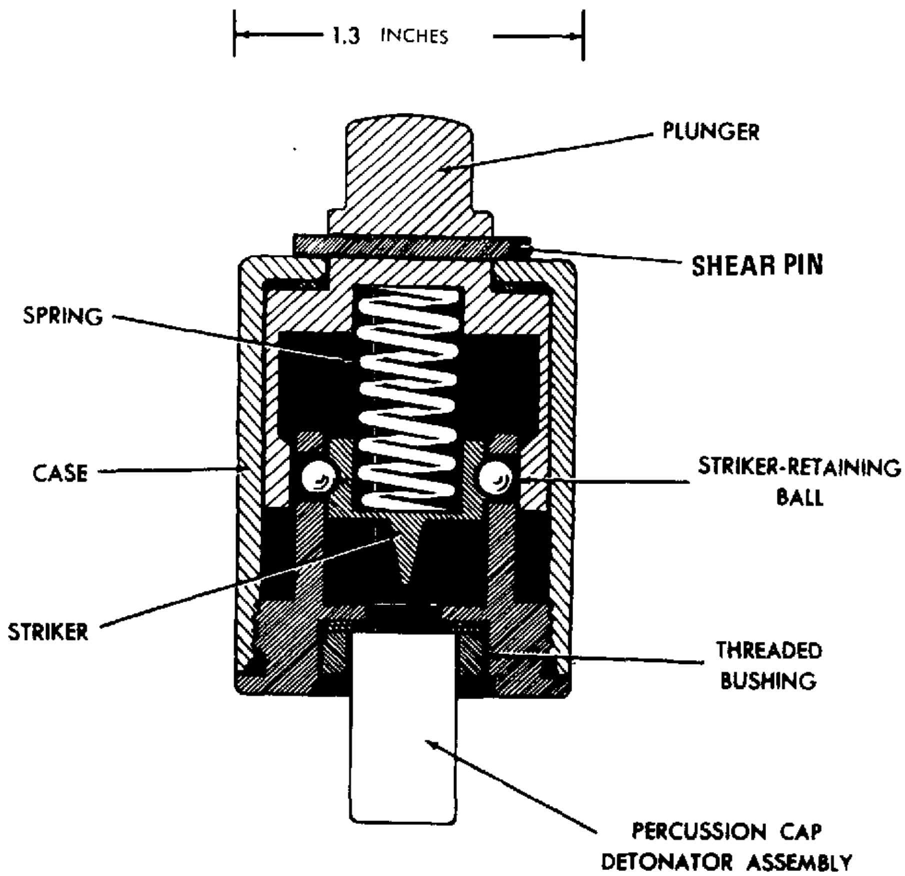

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Figure 7-6. Fuze, mine, pressure, Model 47, section view (U).

(U) **Description**

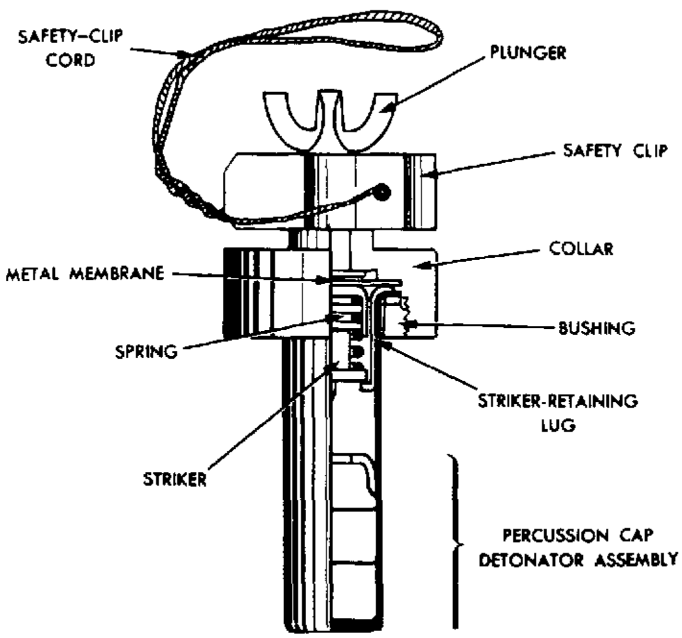
The Model 47 pressure fuze (fig 7-6) consists of a cylindrical metal case that houses a plunger retained by a shear pin and a spring-loaded striker retained by balls. The plunger protrudes through the top of the case; the shear pin passes through the plunger and rests on the top of the case. A threaded bushing screwed into the bottom of the fuze retains the stab primer and detonator assembly. The fuze is used in antitank mines.

Fuze, Mine, Pressure, Model 47
FOM No. 1390-19-5-2

(U) **Functioning**

When a pressure of 440 lb (200 kg) is applied to the top of the plunger, the shear pin fails, freeing the plunger. When a second pressure pulse of 44 lb (20 kg) is applied, the retaining balls are freed and the spring-loaded striker drives the firing pin into the stab primer, initiating fuze functioning.

Fuze, Mine, Pressure, Model 49
FOM No. 1390-19-5-3



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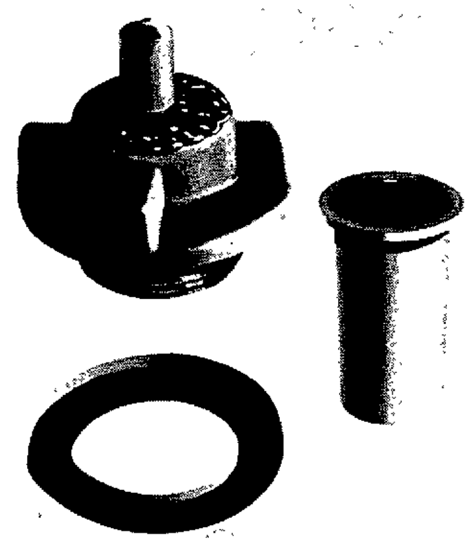

Neg. 509529 (UNCLASSIFIED)

Figure 7-7. Fuze, mine, pressure, Model 49, section and exploded views (U).

(U) Description

The lower part of the Model 49 fuze (fig 7-7) contains an integral primer-detonator assembly and a spring-loaded striker retained in position by small lugs. The top of the assembly is covered by a thin metal membrane. The entire assembly is held within a cylindrical collar by a threaded bushing. A four-pronged plunger, held in position by a safety clip, is set into the cylindrical collar. This fuze is used in antitank mines.

(U) Functioning

The fuze is armed by removing the safety clip. Pressure applied to the plunger forces the latter through the metal membrane, compressing the striker spring. Sufficient pressure will cause the lugs retaining the striker to fail, allowing the striker spring to drive the primer-detonator, initiating fuze functioning.

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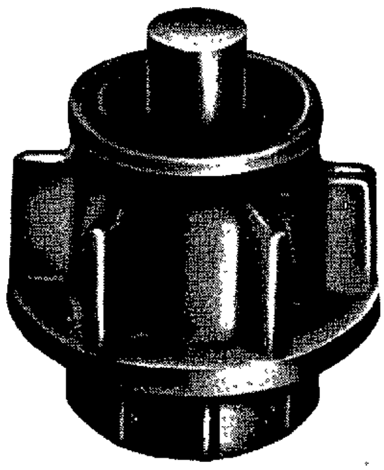
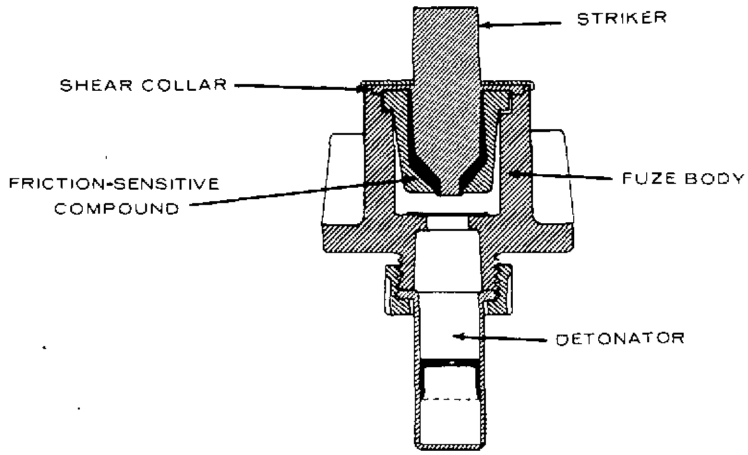
Fuze, Mine, Pressure, Nonmetallic, Model 26
FOM No. 1390-29-5-2





Neg. 509527 (UNCLASSIFIED) Neg. 509528 (UNCLASSIFIED)

Figure 7-8. Fuze, mine, pressure, nonmetallic, Model 26, general and section views (U).

(U) **Description**

The Model 26 fuze (fig 7-8) resembles the French Model 52 fuze. Made almost entirely of plastic, this fuze is used in the Model 26 heavy antitank mine. The absence of metallic components makes this fuze/mine combination extremely difficult to detect with electronic mine detectors. Model 26 fuzes and their detonators are packed in individual plastic containers.

(U) **Functioning**

The fuze is armed by installing a detonator when the fuze is assembled to the mine. When pressure between 35 and 100 lb (16 to 45 kg) is applied to the top of the striker, a shear collar fails, allowing the striker's tapered end, which is coated with a friction-sensitive compound, to enter a mating tapered recess within the fuze body. Friction creates a flame which initiates the detonator.

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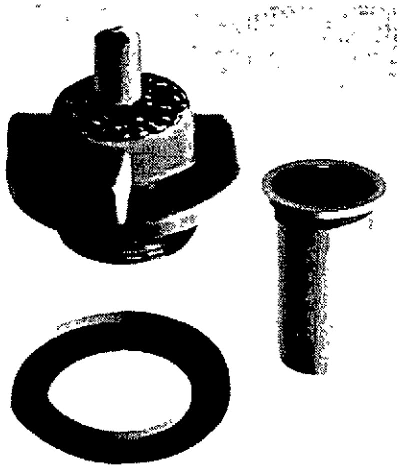
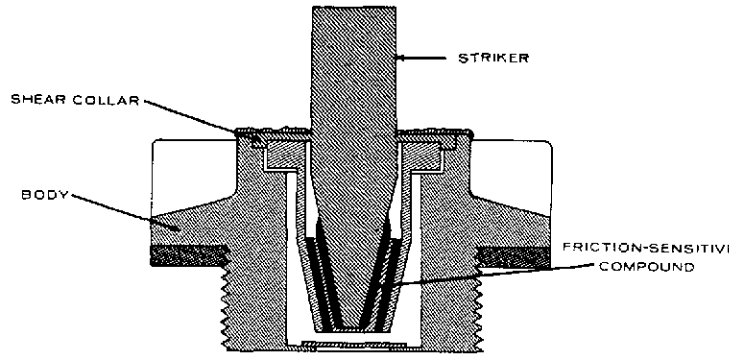
Fuze, Mine, Pressure, Nonmetallic, Model 22
FOM No. 1390-29-5-3





Neg. 509530 (UNCLASSIFIED)

Neg. 509529 (UNCLASSIFIED)

Figure 7-9. Fuze, mine, pressure, nonmetallic, Model 22, general and section views (U).

(U) Description

The Model 22 fuze (fig 7-9) consists of a plastic body, a cone-shaped cup, and a striker with an integral shear collar. The bottom end of the striker is conical to mate with the cup. Both conical surfaces are coated with a friction flash compound. The fuze is used in the Model 22 antipersonnel mine.

(U) Functioning

When a force of 11 to 55 lb (5 to 25 kg) is applied to the upper end of the striker, the shear collar fails and the striker is forced downward. Friction between the conical mating surfaces results in a flame which initiates the detonator.

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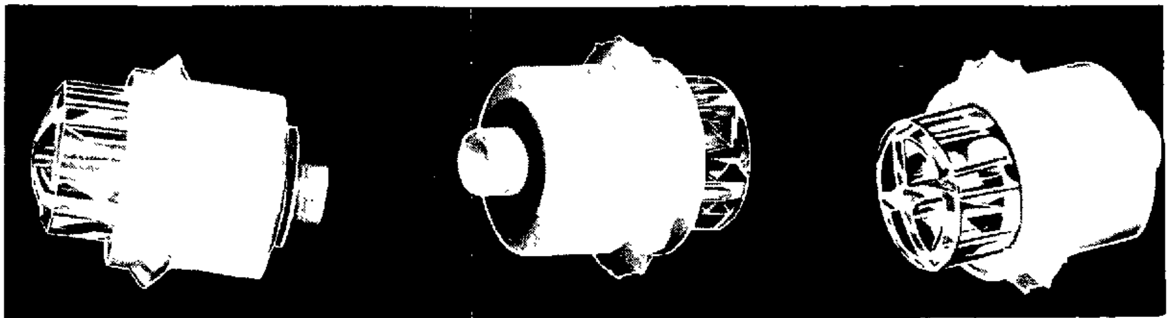
Fuze, Mine, Pressure, Chemical, Plastic, Model 52
FOM No. 1390-33-5-3



Neg. 508445 (UNCLASSIFIED)

Figure 7-10. Fuze, mine, pressure, chemical, plastic, Model 52, external views (U).

(U) **Description**

This polystyrene fuze (fig 7-10) encloses two chemical-filled vials. Four of these fuzes are used in the Model 52 antitank mine (FOM No. 33-1345-1-5). A plastic plunger, retained over the vials by a plastic shear collar, fits into the top of the fuze.

(U) **Functioning**

Pressure applied to the top of the mine breaks the mine's shear lugs, transferring pressure to at least one of the four fuze plungers. The fuze's shear collar fails under pressure, and the plunger crushes the two vials. The chemicals (sulphuric acid and potassium perchlorate) react, causing a flame that initiates the detonator-booster and the main charge.

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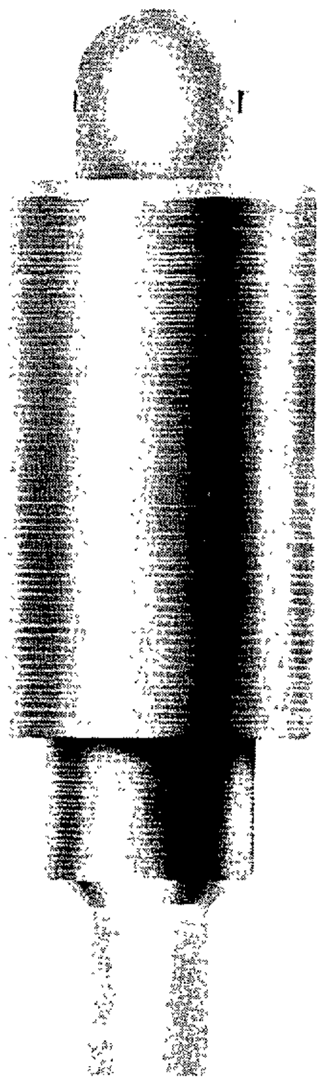
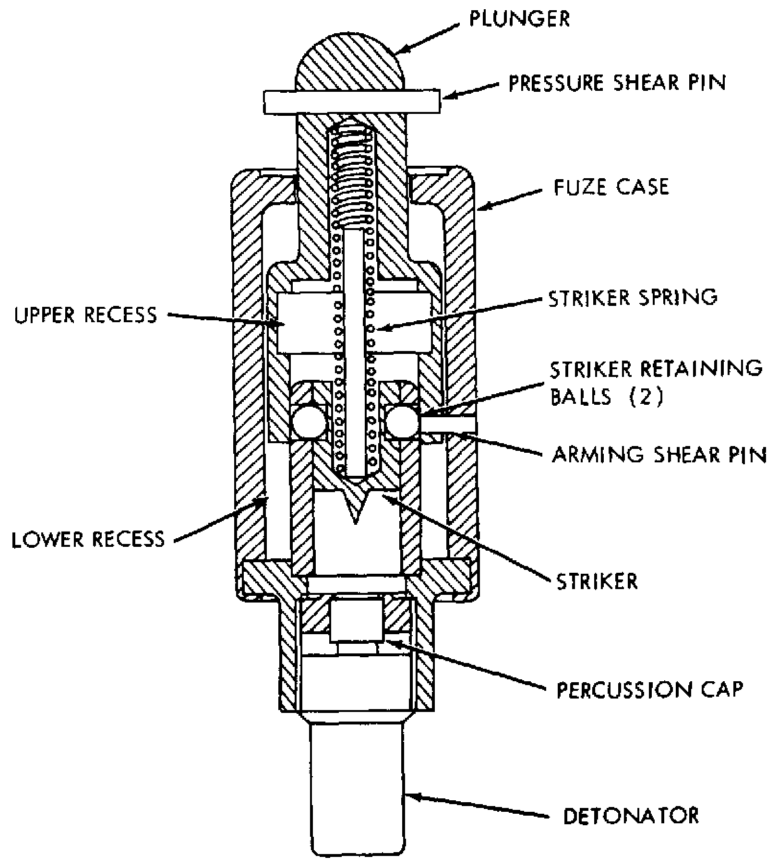
Fuze, Mine, Pressure/Pressure Release, Model 47-11
FOM No. 1390-33-5-5





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Neg. 508443 (UNCLASSIFIED)

Figure 7-11. Fuze, mine, pressure/pressure release, Model 47-11, general and section views (U).

Fuze, Mine, Pressure/Pressure Release, Model 47-11
FOM No. 1390-33-5-5

(U) Description

The Model 47-11 fuze (fig 7-11) is quite similar to the World War II German Tellermine fuze 43. The fuze weighs 127.5 grams (0.28 lb). The fuze body is of steel. The Model 47-11 fuze is used in the Model 47-1 antitank mine (FOM No. 33-1345-1-2).

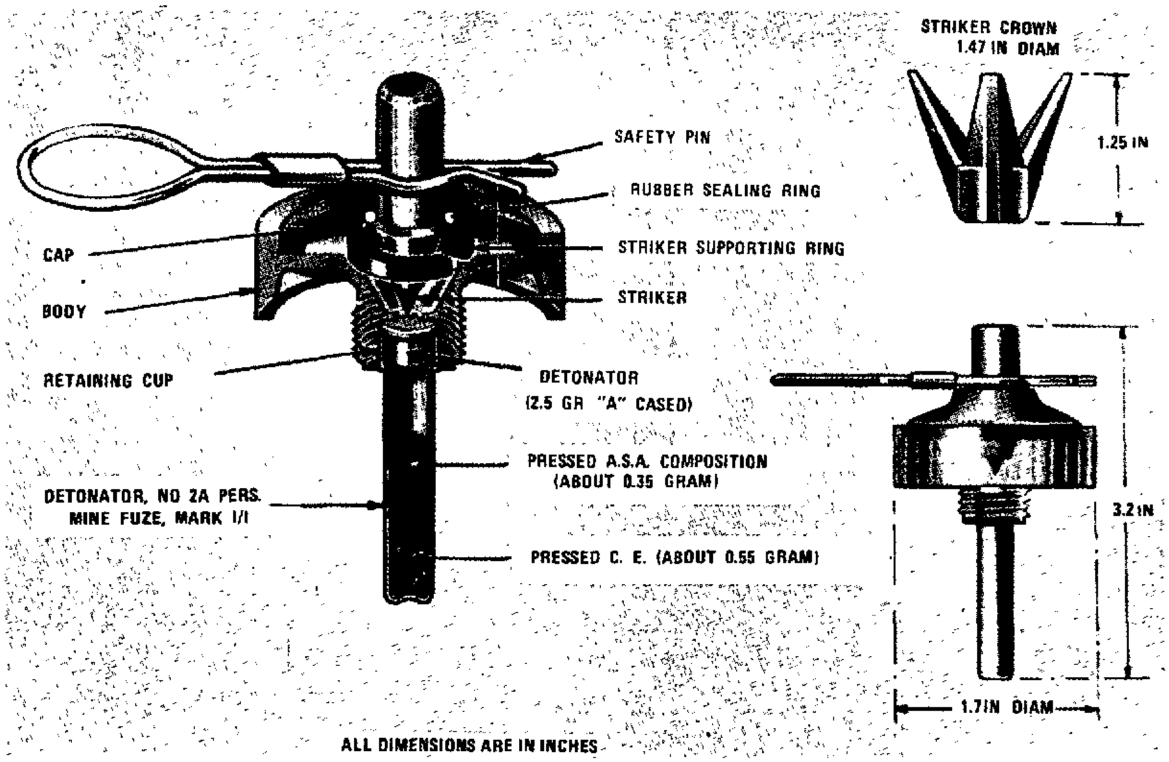
(U) Functioning

The fuze is armed upon installation in a mine by screwing down the pressure plate. This action forces the plunger down, causing the arming shear pin to fail. The fuze is then armed; the striker spring, which is partially compressed, keeps the plunger in contact with the pressure plate. The latter limits further upward movement of the plunger, while two striker retaining balls prevent the striker spring from forcing the striker down into the stab primer. In this position the fuze cannot function by the addition or release of pressure.

If a load of 550 lb (250 kg) or greater is applied to the pressure plate, the plunger is forced downward and the pressure shear pin fails, allowing further downward movement. When the upper recess within the plunger becomes aligned with the striker retaining balls, the balls are free to be cammed outward by the spring-loaded striker. This action frees the striker to snap downward under pressure of the striker spring, so that it impacts the stab primer and initiates the detonator.

Should the pressure plate be removed, the striker spring forces the plunger upward until the lower edge of the plunger clears the striker retaining balls. The spring-loaded striker then cams the balls outward into the lower recess, freeing the striker to snap downward and impact the stab primer to initiate the detonator. The fuze has no other safety devices.

Fuze, Mine, Pressure, No. 2 Mk 2/1
FOM No. 1390-35-5-1



Neg. 552522 (CONFIDENTIAL)

Figure 7-12. Fuze, mine, pressure, No. 2 Mk 2/1, general and section views (U).

(C) Description

The No. 2 Mk 2/1 mine fuze (fig 7-12) is a pressure-operated type developed by the United Kingdom for use with the No. 6 Mk 1 antipersonnel mine. Except for the detonator housing and the tip of the striker, the fuze assembly is made of nonmetallic materials. The fuze is designed to resist activation by the blast of an antitank mine detonated not less than 6 ft away. The fuze consists principally of a body, cap, striker, striker supporting ring, safety-pin sealing ring, retaining cup, and a 2.5-gr (0.16-gram) detonator.

Fuze, Mine, Pressure, No. 2 Mk 2/1
FOM No. 1390-35-5-1

(C) Design Details

Body. The body is made of clear unpigmented polystyrene. Externally it is cylindrical in shape with ribs formed around the circumference. A large boss is formed in the center of the base, and a recess is formed in this boss to house the assembled detonator. The external portion of the boss is threaded to screw into the adapter of the mine; around the boss, the body is hollowed out. A recess is also formed in the top surface of the body, and in the center of this recess a cone-shaped hole is formed, the base of the hole connecting with the detonator recess.

Cap. Made of polystyrene, colored camouflage brown, the cap is roughly dome-shaped; the surface above where it fits into the body is left hatched. A hole is formed in the center to take the striker. Before the cap is assembled in the top of the body, the rim is coated with RD 1279 cement, and the two components are compressed until the cement has hardened.

Striker. Made of polystyrene, colored camouflage brown, the striker consists of a stem with the lower portion formed into a truncated cone, the tip of which is fitted with a brass striker pin. A 3/32-inch-diameter hole is drilled through the stem at right angles to the axis to accommodate the safety pin. To obviate the possibility of the safety-pin hole being fouled by the ingress of adhesive composition, a hole is drilled concentrically through the stem and is closed at the upper end with a parallel polystyrene plug secured in position with RD 1279 cement.

Striker supporting ring. A split supporting ring of ebonite, molded in the form of a horseshoe and tapered internally to suit the cone of the striker, is positioned just below the highest diameter of the cone and rests on the fuze body. The striker is designed so that when assembled in the fuze the truncated cone is clear of the supporting ring.

Safety pin. The safety pin consists of a length of No. 14 SWG 2.03-mm (0.08-inch) (equivalent to No. 12 AWG) phosphor-bronze wire bent to form two separate arms: one straight for insertion through the hole in the stem of the striker, the other with a semicircular bend in it to clip around the external circumference of the striker. A finger loop is also formed to facilitate extraction.

Sealing ring. A small rubber sealing ring fitted around the striker stem, just above the truncated cone, is under radial compression between the stem of the striker and fuze cap, providing a watertight seal.

(C) Design Details (Continued)

Retaining cup. This is of white polystyrene, in the form of a cup, with a hole formed in the base. It fits over the head of the No. 106 detonator and also accommodates the 2.5-gr (0.16-gram) "A" detonator, which is assembled in the top of the open end of the former. The cup with detonators assembled is coated with RD 1221 A cement, covered with a tin foil disk, and then pushed home in the hole in the center of the body where the cement is allowed to set hard.

Detonator 2.5-gr (0.16-gram) "A" cased. This is a tinned brass, cased cup formed with an external flange and filled with 2.5 gr (0.16 gram) of "A" mixture. It is distinguished by being marked with a green spot. It is assembled in the open end of the No. 106 detonator, the flange resting on the rim or mouth of the No. 106 detonator.

Detonator No. 2 Mk 1/1, antipersonnel mine fuze. This consists of the retaining cup (see above) and a No. 106 Mk 1 detonator. Before the No. 106 detonator with the 2.5-gr (0.16-gram) "A" cased detonator assembled in the top is pushed down through the hole in the cup, approximately two turns of waterproof fabric adhesive tape 0.17 inch (4.32 mm) in width is wrapped around the No. 106 detonator above the flange and coated with RD 1219 composition. The flange of the detonator is also coated with RD 1219 composition, and the detonator is then pushed into the retaining cap until the flange rests on the base of the cup. A fillet of RD 1219 composition is applied to the joint where the detonator emerges from the base of the cup.

Detonator No. 106 Mk 1. This is in the form of a tube with an inverted domed base with a flange formed just below the open end. It is filled, commencing from the base, with about 0.55 gram (8.4 grains) of CE (i.e., tetryl) pressed in, above which is about 0.35 gram (5.3 gr) of A.S.A. composition also pressed in, leaving the top portion of the tube empty.

(C) Laying of Mine

To facilitate actuation of the fuze when assembled to the mine, a striker crown is provided. The striker crown, of brown polystyrene, consists of a crown-shaped piece having three equispaced diverging prongs. It is positioned over the projecting end of the fuze striker to increase the effective area of the head after laying. There are two current marks of striker crown, the Mark 1/1 and the Mark 2. The differences are as follows:

Fuze, Mine, Pressure, No. 2 Mk 2/1
FOM No. 1390-35-5-1

(C) Laying of Mine (Continued)

Mark 1/1. - This is a Mark 1 pattern modified by the insertion into the recess of a 0.1-in (2.54-mm) thick white polystyrene disk, thereby reducing the depth of the recess to that of the Mark 2 pattern.

Mark 2. - The Mark 2 is generally similar to the Mark 1/1, and differs from the original Mark 1 pattern by having the depth of the body recess reduced from 0.4 to 0.3 inch (10.6 to 7.62 mm) and a recess 0.156x0.1 inch (3.96x2.54 mm) deep formed in the center of the base of the larger recess. A 1/4-inch (6.25-mm) figure '2' is moulded on top of the body.

(C) Functioning

The fuze is pressure-activated. The amount of pressure required to activate the fuze is unknown.

Fuze, Mine, Pressure, No. 4 Mk 2
FOM No. 1390-35-5-2

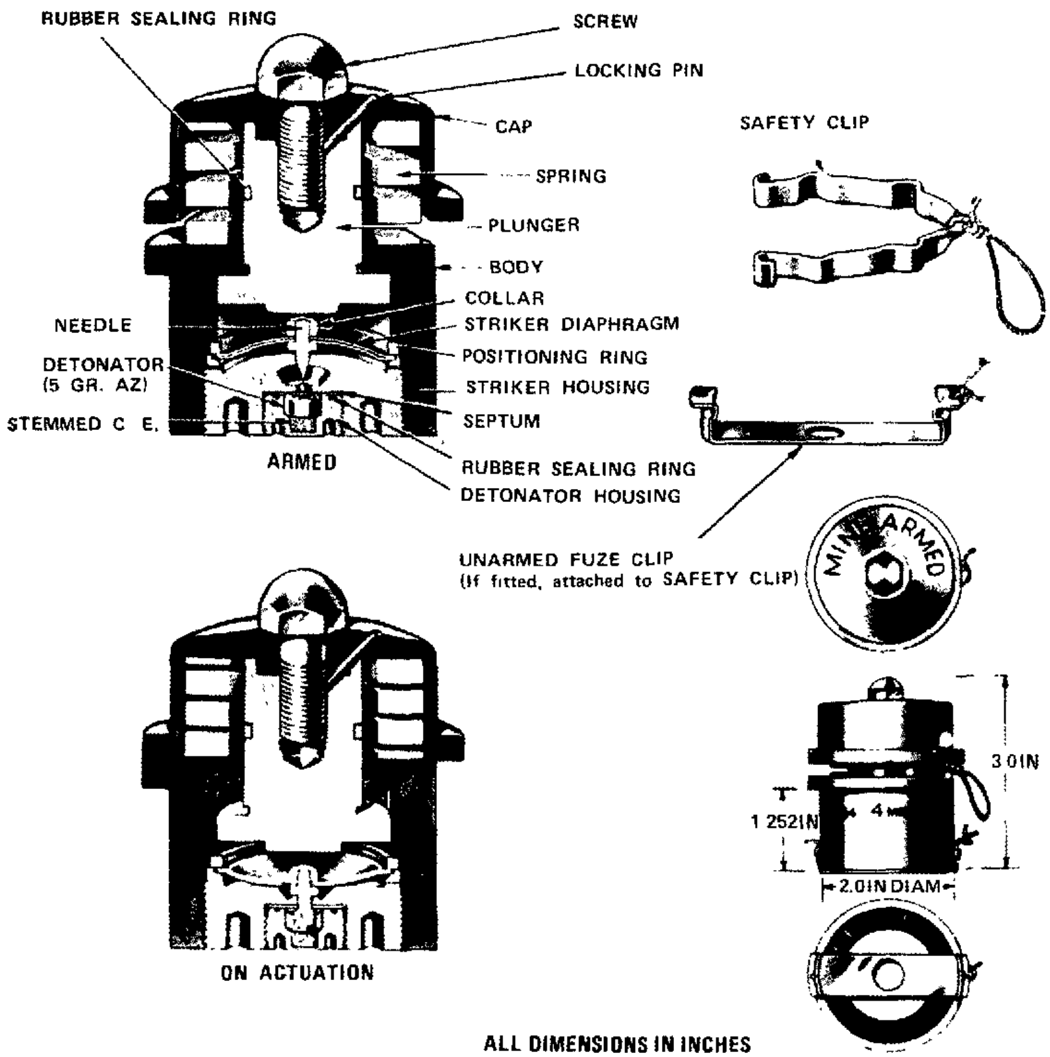


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Figure 7-13. Fuze, mine, pressure, No. 4 Mk 2, general and section views (U).

Fuze, Mine, Pressure, No. 4 Mk2
FOM No. 1390-35-5-2

(C) **Description**

The No. 4 Mk 2 fuze (fig 7-13) is a pressure-operated fuze developed by the United Kingdom for use with the Mk 7 series antitank mines. It consists principally of a body, main spring, cap, screw, plunger, striker assembly, positioning ring, striker housing, detonator housing, and a 5.7-gr (03.7-gram) "AZ" detonator and safety clips.

(C) **Design Details**

Body. Made of aluminum alloy anodized, the body is cylindrical in shape and is reduced in diameter at the top to form a guide, below which is a flange to support the spring. A hole is formed centrally to accommodate the plunger, positioning ring, and striker diaphragm–below which the body is screw-threaded to accept the striker housing. The words "MINE UNARMED" are stamped around the bottom face of the body and filled in with red.

Cap. The cap is made of electrozinc-plated steel. Externally, it is dome shaped with a flat top and is formed with a flange at the base. The words "MINE ARMED" are stamped on the top and filled in with red. Internally, it is hollowed out to accommodate the spring; it has a boss formed in the center to fit into the recess made in the top of the plunger and a central clearance hole drilled through the top to allow the screw to pass through and engage in the top of the plunger. When the cap is assembled and the screw is screwed home in the top of the plunger, a pin of hard brass is driven obliquely through the cap, plunger, and screw, locking these three components together, after which the end of the pin is stabbed to retain it in position.

Plunger. The plunger is made of electrozinc-plated steel. Externally, it is cylindrical in shape and is formed with a flange near the base, below which it is reduced in diameter to form a small boss. A small recess is formed in the top face to fit over the boss formed inside the cap, and a hole is drilled in the center and threaded to accept the shank of the hexagon-head screw which secures the cap in position. A rubber sealing ring seats in a groove around the plunger and seals the mating surfaces between the body and the plunger.

Spring. The spring is a cylindrical coiled spring of rectangular-section spring steel. It is composed of two working coils, the ends being close coiled and ground flat. It is rustproofed by a phosphate process and coated with lanolin. It is assembled under the cap and seats around the top portion, with the bottom coil resting on the flange of the body.

(C) **Design Details (Continued)**

Shutter assembly. The shutter assembly comprises a diaphragm, point (i.e., needle), and collar.

- The diaphragms, made of beryllium copper, are dome-shaped disks with a hole drilled in the center. Two diaphragms are placed one on top of the other; the shank of the point passes through the center of the diaphragms from underneath, after which the collar is placed over the shank, which is then opened up with a center punch to secure it in the collar. The whole assembly is then chamfered.

- The steel point is formed with a sharp needle point, above which is formed a flange and a shank.

- The steel collar is cylindrical in shape with an internal chamfer formed at both top and bottom.

Striker housing. The housing is made of electrotin-plated brass. Externally, it is cylindrical in shape, formed plain at the top and screw-threaded below. A hole is drilled and screw-threaded in the center of the base to accept the detonator housing. Two diametrically opposed holes are also drilled in the base to facilitate assembly. It is bored out on several diameters from the top, and a small hole is drilled through the center to connect with the recess formed in the base. Eight equidistant-spaced slots are cut in the rim of the upper face.

Detonator housing. The detonator housing is also made of electrotin-plated brass. Externally, it is cylindrical in shape and threaded to screw into the base of the striker housing. Two diametrically opposed holes are also drilled in the base to facilitate assembly. Internally, it is bored out on two diameters, leaving a thin diaphragm of metal at the base. The smaller cavity at the base is filled with loose CE stemmed in, the detonator being assembled in the larger cavity above. A circular recess is formed in the upper face to accept a rubber sealing ring.

Detonator. This 5.7-gr (0.37-gram) "AZ" lugless (tinned copper alloy cup) detonator is assembled in the detonator housing base downwards. After assembly, a lead/tinfoil septum is placed over the top of the housing.

Fuze, Mine, Pressure, No. 4 Mk 2
FOM No. 1390-35-5-2

(C) Functioning

The fuze functions upon contact with tank tracks. The exact pressure for functioning is not known.

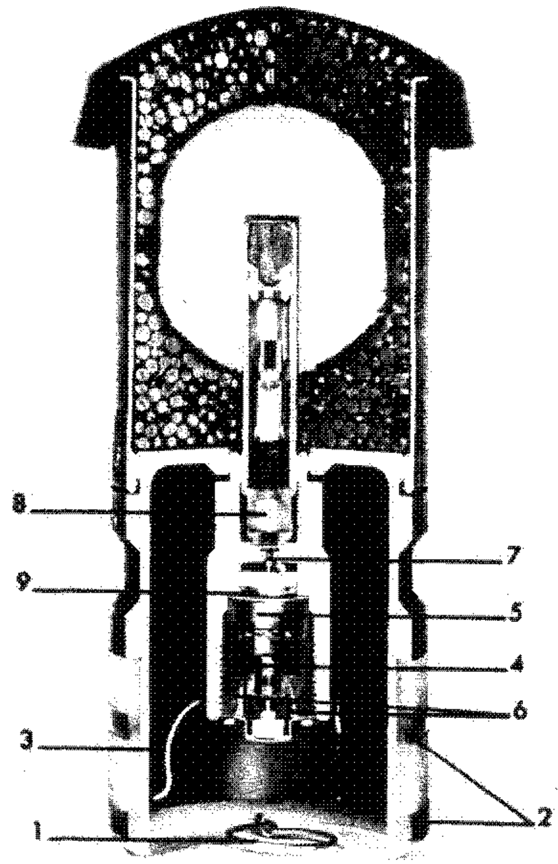

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Figure 7-14. Grenade, HE, 76 mm, Model (Diehl), section view (U).

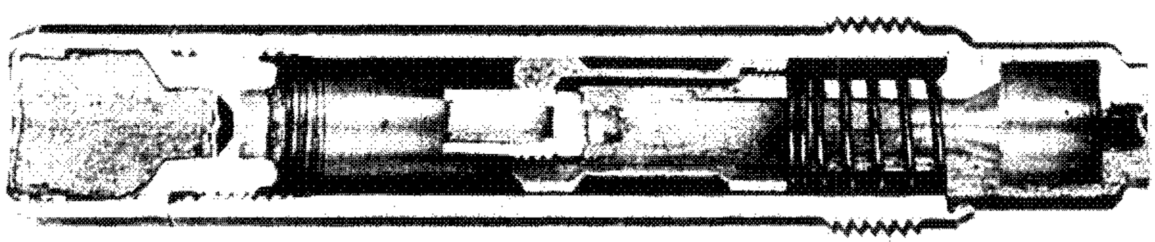

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Figure 7-15. Fuze, grenade, pyrotechnic delay, integral, Model (Diehl) (U).

Fuze, Grenade, Pyrotechnic Delay, Integral, Model (Diehl)
FOM No. 1390-16-4-8

(U) Description

The Diehl pyrotechnic delay fuze is an integral design used with 76-mm fragmentation grenades (fig 7-14). It is intended for use with grenades electrically fired from a modified smoke grenade projector mounted on armored vehicles. The fuze uses the high pressure generated from the grenade's propelling charge for arming and initiation of the pyrotechnic delay. Safety is provided by a safety pin (1) and a shear collar (9) which detents the cocker-type striker (7). The illustration shown on the right (fig 7-15) is a section view of the pyrotechnic delay and detonator assembly.

(U) Functioning

Prior to loading, the safety pin (1) must be removed. The ignition current from the electrical firing unit flows through contact rings (2) and the cable (3) to the igniter cap (4), which then ignites the propellant (5). The gas pressure generated by the combustion of the propellant expands through the gas ports (6) into the remaining space in the launcher, propelling the grenade. Simultaneously, the initial pressure shears off the collar (9), undetenting the cocker striker (7), which then initiates the fuze (8). The pyrotechnic delay burns for 3 seconds, resulting in the initiation of the detonator which, in turn, detonates the high-explosive filler of the grenade.

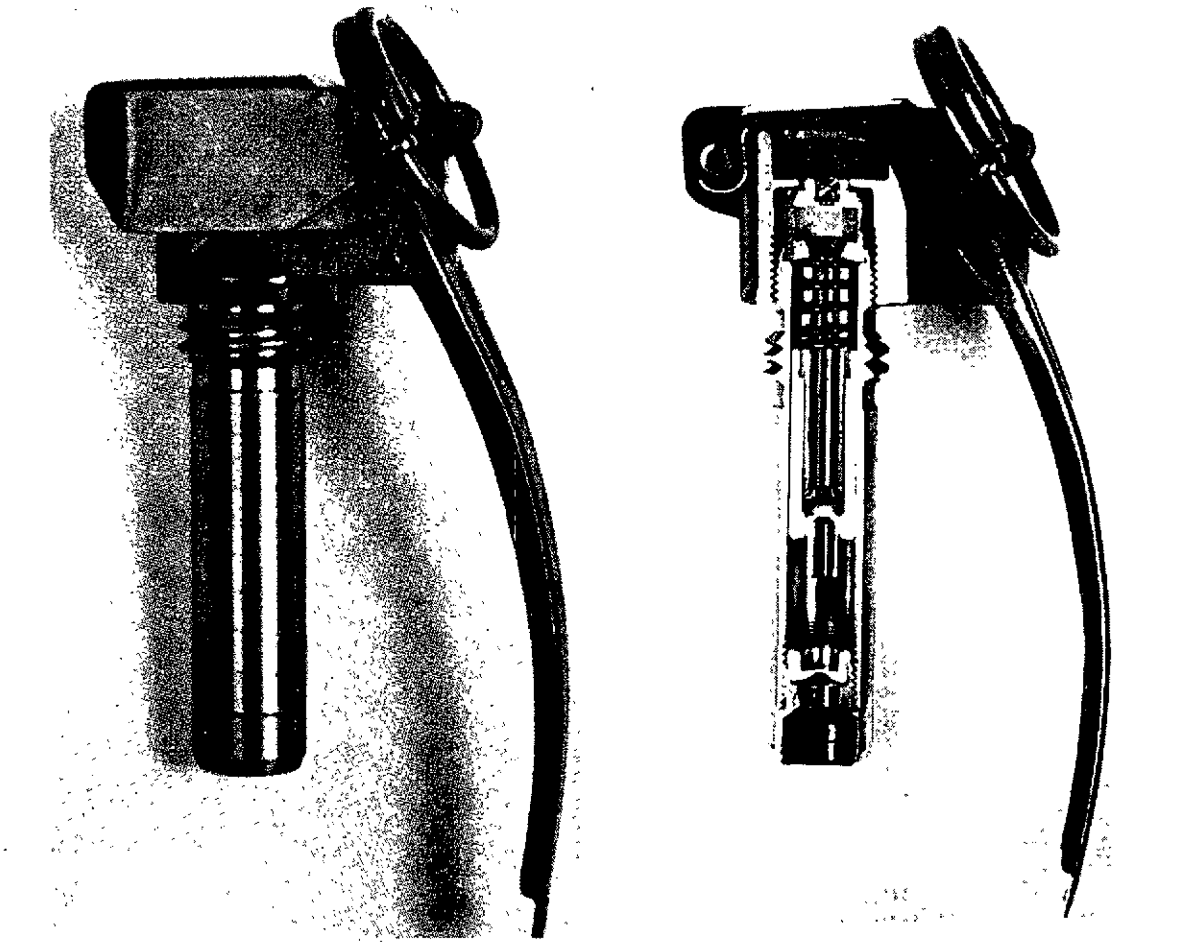

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Figure 7-16. Fuze, grenade, pyrotechnic delay, Model DM 82, general and section views (U).

(U) **Description**

The Diehl hand grenade fuze, Model DM 82 (fig 7-16), was developed to insure maximum safety to the soldier throwing the grenade. It is a pyrotechnic delay-type that burns for 4 seconds. The DM 82 has been tested to function at -40° to +50°C with a 99.9% reliability. It uses a 5/8-inch (15.9-mm) 11 UNC-2A thread, allowing use with most conventional grenades. The fuze is currently being used with the FRG DM 51 HE/fragmentation grenade.

Fuze, Grenade, Pyrotechnic Delay, Model DM 82
FOM No. 1390-16-9-1

(U) **Unique Features**

- Detonator
- Throwback safety.

(U) **Functioning**

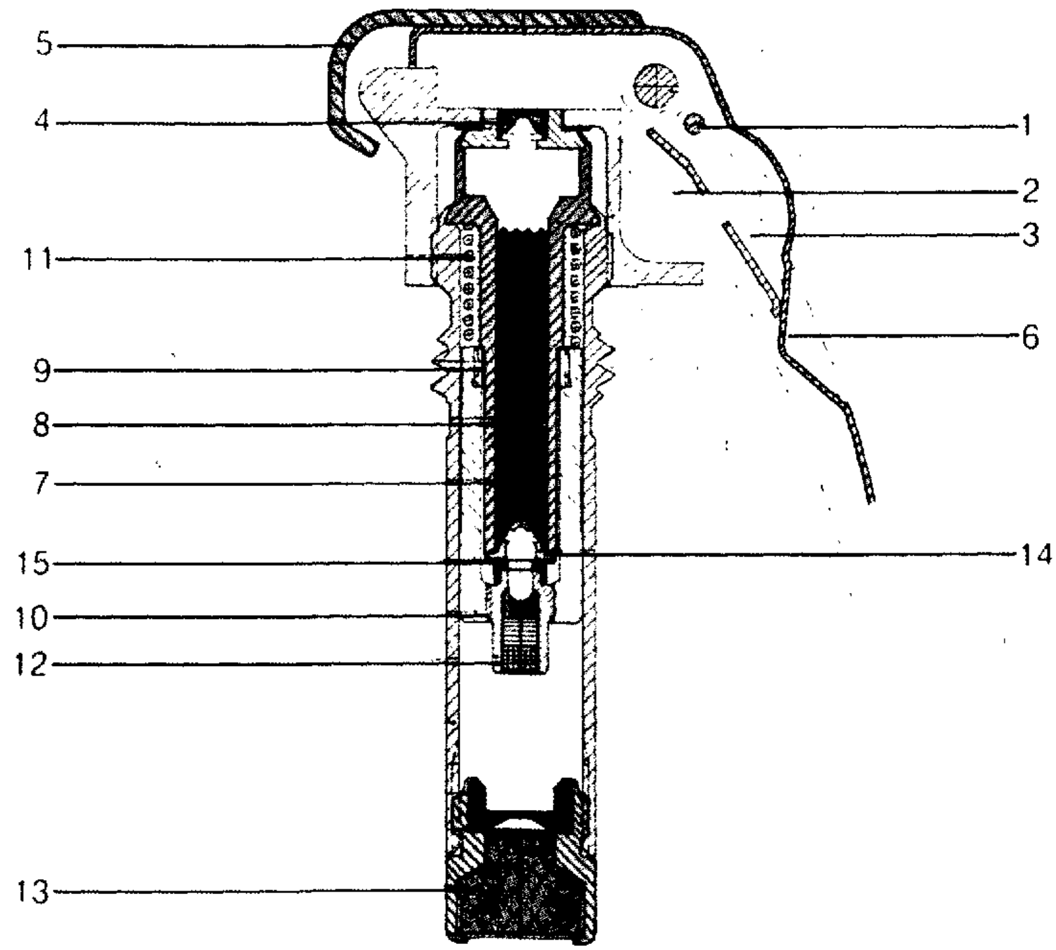

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Figure 7-17. Fuze, grenade, pyrotechnic delay, Model DM 82, cutaway view (U).

(U) Functioning (Continued)

Prior to throwing the grenade, the safety cotter pin (1) is removed. After the grenade leaves the thrower's hand, the hammer (3)* hits the DM 1024 primer cap (4) of the primer charge as a result of pressure applied by the torsion spring (2). Simultaneously, the protective cap (5) and safety cover (6) are thrown off.

The flash of the percussion primer initiates the delay charge (7) in the delay tube (8). After burning for 2.5 seconds, the heat generated melts the soldering joint between the soldering wing (9) and the delay tube (8) and detonator holder (10). This allows the pressure spring (11) to push the detonator holder rearward against the booster (13).

After the delay charge has burned out (4.0 seconds), the flash penetrates two bores of the throttle clip (14), bending the flap valve (15) up, enabling the flash to initiate the detonator (12) and, in turn, the booster (13).

*Note. The bead against which the hammer (3) rests prevents the hammer from completing its rotation and hitting the primer until the safety lever reaches an opening angle of 65°.

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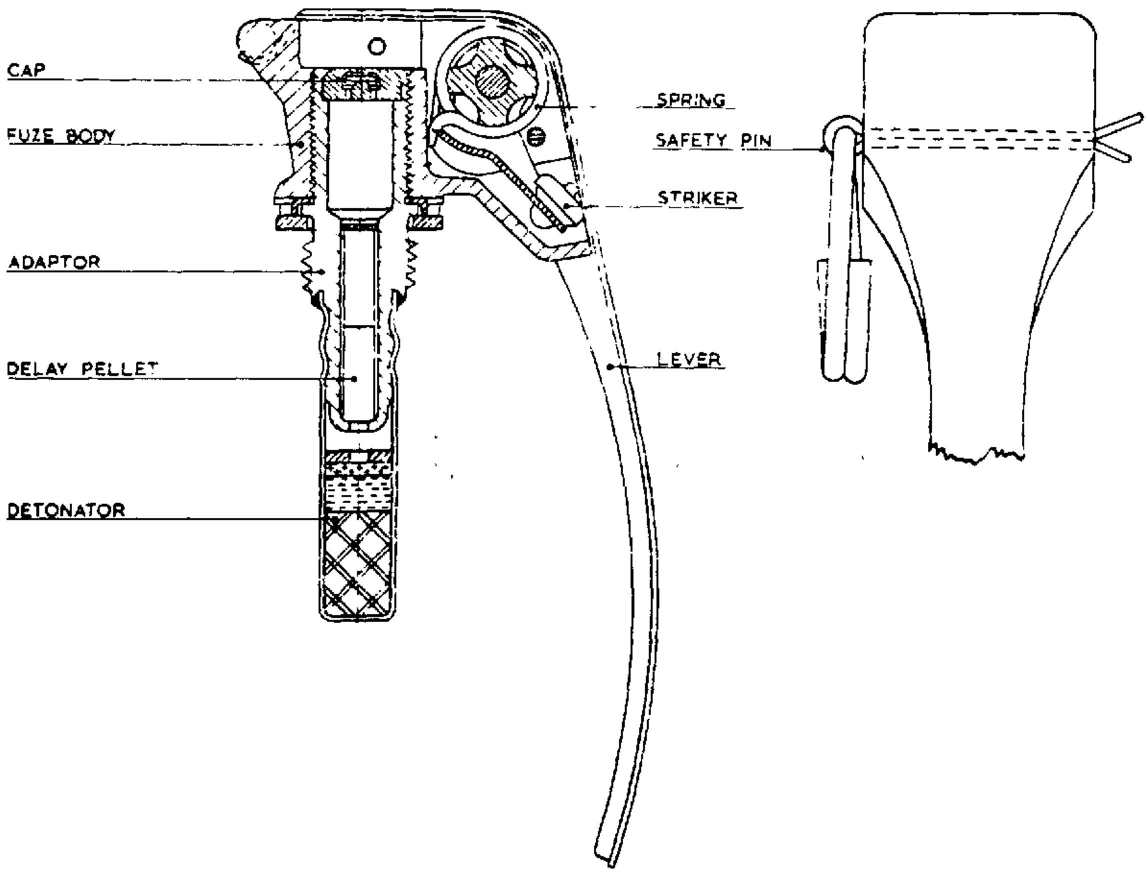

Figure 7-18. Fuze, grenade, Model L5A2, section view (U).

(U) **Description**

The L25A2 fuze (fig 7-18) was designed for use with the controlled-fragmentation grenade, Model L2A1. The fuze incorporates a conventional lever release mechanism with a safety pin and a percussion cap which fires a pyrotechnic delay that burns for 4.3 ±0.3 seconds. The grenade with its fuze is marketed by the Director of Sales, Ministry of Defense, SStuart House 23-25 Soho Sq., London WIV5FS.

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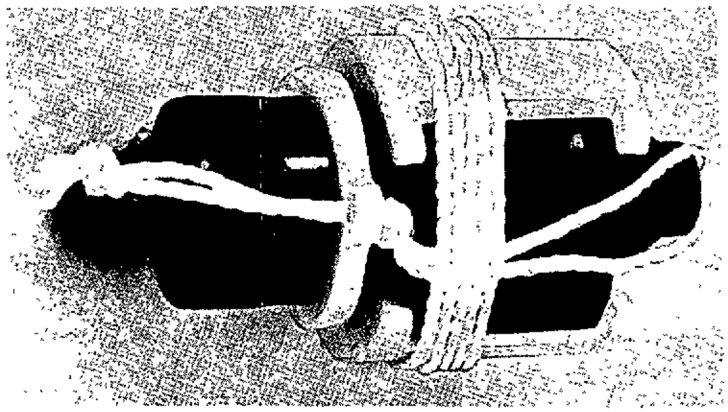

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Figure 7-19. Igniter, pull type, Model Mk F2, general view (U).

(U) Description

This pull-type igniter (fig 7-19) contains two safety devices to insure safety in transport, storage, and handling. It can initiate standard mines and booby traps by means of a percussion primer. Two versions of this igniter exist: the metal version, now in production and in use by the French Army, weighs 48 grams (0.10 lb); its diameter is 26.6 mm (1.05 in) and its overall height is 63.5 mm (2.5 in). A nonmetallic, nondetectable version is undergoing standardization tests. This igniter is manufactured by Société E. Lacroix, Muret, France.

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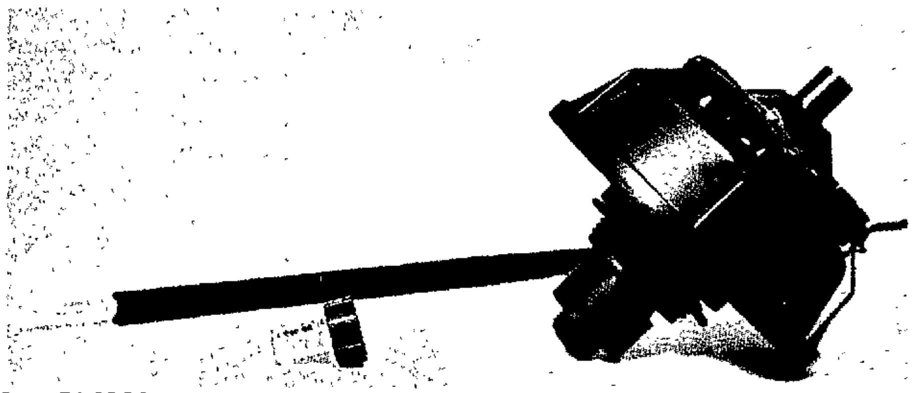

Neg. 516982 (UNCLASSIFIED)

Figure 7-20. Igniter, nondetectable, Model ALBACID, general view (U).

(U) **Description**

This omnidirectional swinging igniter (fig 7-20) is initiated by a swinging antenna, which delays functioning of the fuze until the tank hull is directly above the mine, thus increasing the effectiveness of the explosive charge. When used with Model 51 and 52 nondetectable antitank mines, this igniter makes them effective as tank belly mines. The igniter weighs approximately 210 grams (0.46 lb); is approximately 110 mm (4.33 in) in diameter and 105 mm (4.13 in) long, and extends 55 mm (2.17 in) above the mine body. The antenna, which extends 0.64 meter (25 in) above the top of the mine, can be locked at its base to provide safe handling. All components are made of plastic, sealed against adverse environmental conditions. This igniter was under development in 1973 by Societe Alsatienne d'Etudes et d'Exploitation (ALSETEX).

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Firing Device, Pull type, Nondetectable, Model ALSETEX
FOM No. 1375-17-3-3

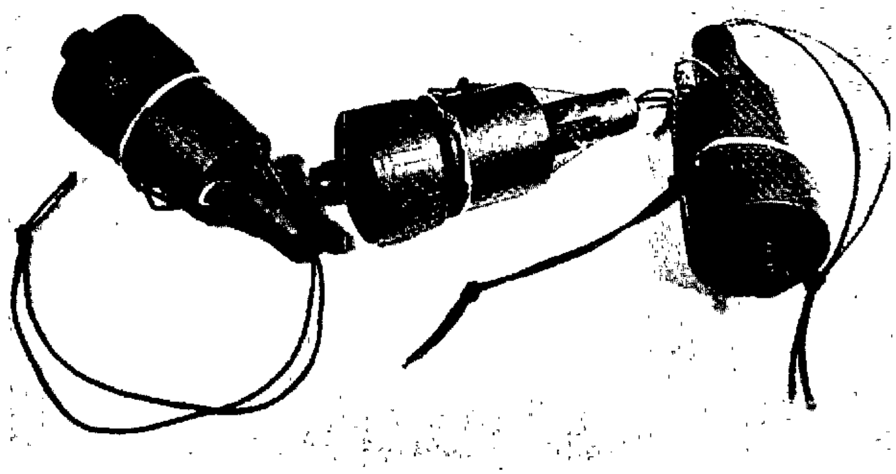

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Figure 7-21. Firing device, pull type, nondetectable, Model ALSETEX, general view (U).

(U) **Description**

This device (fig 7-29) has a plastic body, with all pyrotechnic elements hermetically sealed to prevent deterioration in storage or in service. Overall length including the threaded portion is 72 mm (2.82 in); the visible (external) portion is 64 mm (2.52 in). Diameter is 25 mm (2.95 in) and weight is approximately 20 grams (0.044 lb). This pull-type firing device can be used with all types of metallic or nonmetallic mines or other explosive devices with a standard fuze well. Safety is provided by a safety pin, which can be removed at a distance. This device is under development by the Societe Alsacienne d'Etudes et d'Exploitation (ALSETEX).

(U) **Functioning**

After arming, the device functions when the trip wire is pulled.

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Section VIII.

DELAY-ARMING MECHANISMS, TIMERS, AND S&A DEVICES

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Section VIII.

DELAY-ARMING MECHANISMS, TIMERS, AND S&A DEVICES

GENERAL

(U) Time mechanisms, delay-arming mechanisms, and S&A devices are used in a number of different fuzes. This section provides a more detailed description and functioning of components which are cross referenced to the individual fuze described in other sections of the handbook.

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*All fuze nomenclatures are UNCLASSIFIED.

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LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED.

*All figure titles are UNCLASSIFIED.

Delay-Arming Mechanism for
Fuze, PD, Model AZ DM 111A3
FOM No. 1390-16-10-4

DELAY-ARMING MECHANISMS

(U) General

The delay-arming mechanism for the AZ DM 111A3 (FOM No. 1390-16-1-9-1) consists of an interface of the fuze's firing-pin assembly, escapement, rotor, selector stud, and detent system. The escapement, rotor, and detent system of the AZ DM 111A3 is similar to that of the AZ DM 111 and AZ DM 111A1 fuzes (FOM Nos. 1390-16-1-1 and 1390-16-1-2). The AZ DM 111A3 differs in that it employs a protruding-type firing-pin assembly which permits supersensitivity functioning upon impact. The fuze is considered so sensitive that it will function when grazing thin branches or brushwood after the fuze has been armed. The protruding-type striker ensures a high-fragmentation effect from the high-explosive projectiles it is used with. Except for this action, the AZ DM 111A3 fuze functions like the AZ DM 111 and AZ DM 111A1 fuzes.

(U) Design Details

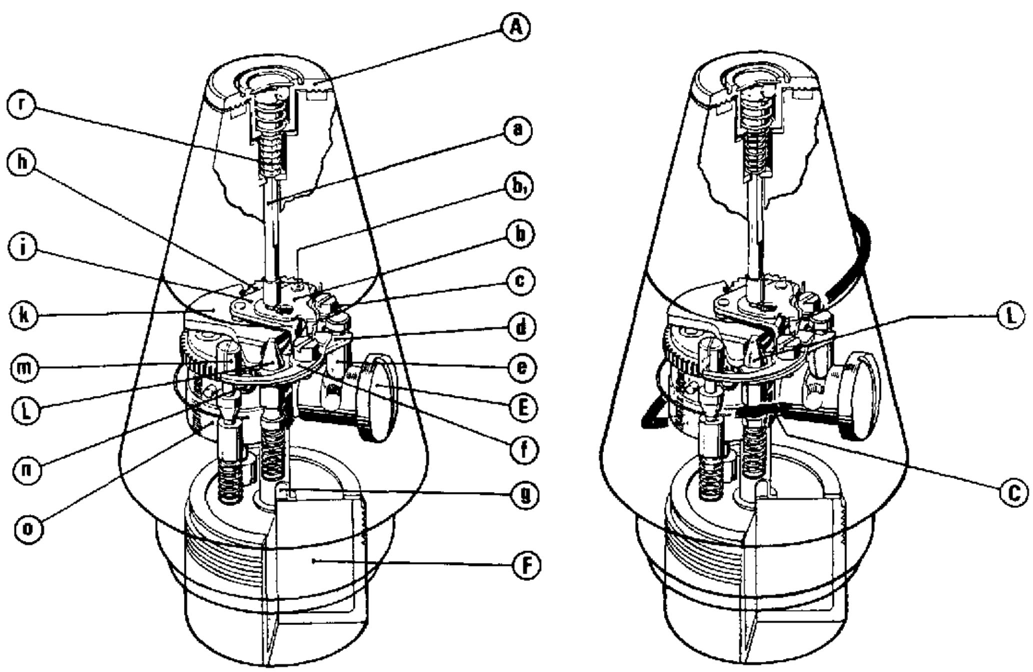

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Figure 8-1. Interface of delay-arming mechanism components for fuze, Model AZ DM 111A3 (U).

Delay-Arming Mechanism for
Fuze, PD, Model AZ DM 111A3
FOM No. 1390-16-10-4

(U) Design Details (Continued)

Figure 8-1 illustrates the interface of the escapement, firing-pin assembly, rotor, selector stud, and detent system.

The escapement run-off safety (shown on the left) is provided by the ball release pin (L) and the safety pin (m), which prevents the escapement lever (k) from oscillating. This, in turn, prevents the rotor (o) containing the delay or SQ detonators from rotating to the in-line position. As an additional safety feature of the escapement, the firing pin (a) engages in a matching hole in the rotor (o). The firing pin (a) is pressed rearward against the compression spring (r) by the interlock of the firing-pin recess and the radial slot in the firing-pin locking lever (b).

The firing-pin locking lever (b), which is swivel mounted and preloaded by the torsion set-screw spring (c), is locked in place by the pressure of the trigger lever (f) against the safety pin (m). In this position, the firing-pin locking lever (b) cannot release the firing pin (a), thereby preventing it from moving forward.

The setback-type pins (m and L) represent a double safety mechanism. The pins are connected in series by means of a locking ball (n). When the projectile is fired, the ball release pin (L) is first pushed rearward. Due to the cone on this detent pin, the locking ball (n) can release the safety pin (m) which then moves rearward. The trigger lever (f) and the escapement are then released.

As shown on the right of figure 8-1, the engagement of the pull wire (C) in the recess of the ball release pin (L) blocks the movement of this detent pin in the axial direction. The pull wire (C) provides a positive safety during handling. It must be removed prior to firing.

Other components shown in figure 8-1 include the projecting striker head (A), the escape wheel (h), the selector stud (E) and its stop pin (e), the booster lead (g), and the tetryl booster (F).

(U) Design Details (Continued)

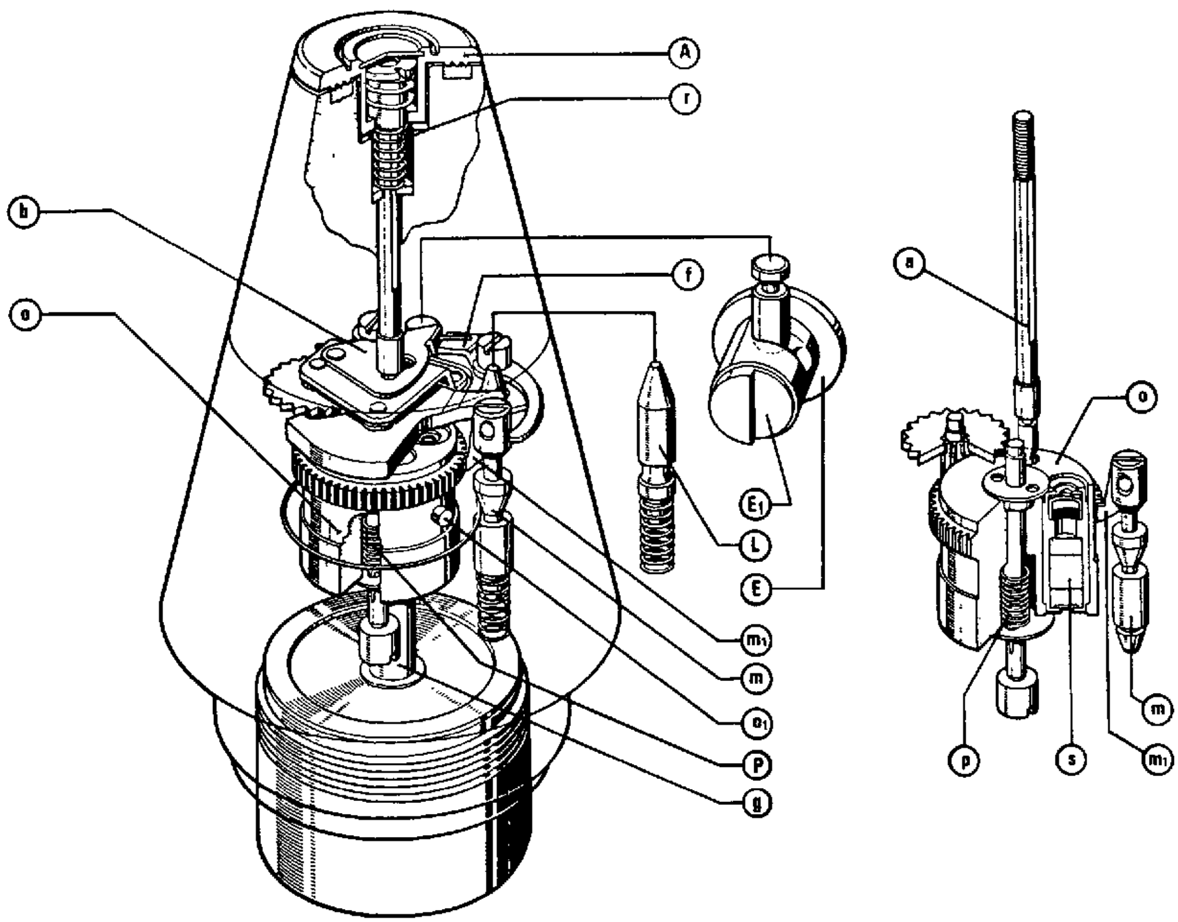

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Figure 8-2. Interface of delay-arming mechanism components for fuze, Model AZ DM 111A3, unarmed position (U).

Figure 8-2 depicts additional design details of the firing-pin assembly, escapement, rotor, selector stud, and detent system interface. The safety leaf (m_1) (shown at right) mounted on the safety pin (m) engages a deepened toothed space of the rotor (o) and

(U) Design Details (Continued)

consequently prevents it from rotating to the armed position. This ensures, from a production standpoint, that the rotor (o) can only be mounted in the unarmed position.

The firing-pin locking lever (b) resting against the trigger lever (f) and the pressure of the trigger lever against the safety pin (m) are clearly visible.

If the fuze is set to OV (superquick action), the selector stud (E) is in the position depicted by its bisected tap (E_1). In this position, when the rotor (O) is disengaged to rotate to the armed position, it can only rotate until the stop pin (O_1) meets the bisected tap (E_1) of the selector. In this position, the OV detonator is in line with the firing pin.

If the selector stud (E) is set for MV (delay action), the rotation of the rotor (O) to the armed position is not obstructed by the stop pin (O_1) and continues until it is locked by the interrupted gearing of the rotor (O). The MV detonator is then inline with the firing pin (i.e., the fuze is armed).

Shown at the right in figure 8-2 is the rotor (O) with the MV detonator (S). This view depicts the firing pin engaging a hole in the rotor. Also depicted is the rotors torsion spring (P) which drive the escapement and consequently causes the rotor to rotate to the armed position after it has been disengaged.

Figure 8-3 depicts the interface of the most important fuze components in the armed position.

Following a minimum acceleration of approximately 500 g's during a period of at least 0.01 second, the double safety mechanism (i.e., safety pin [m], locking ball [n], and ball release pin [L]) is disengaged. The locking spring (q) engages the recess of the safety pin (m). The ball (n) locks the ball release pin (L). In this manner both detent pins are retained in their rear position.

Together with the detent pin (m), the safety leaf (m_1) has also been disengaged from the rotor gearing (see view at right in figure 8-3). In addition, the trigger lever (f) is also released. The firing-pin locking lever (b) is free to turn, and the firing pin (a) is released. It jumps forward together with the striker head (A) as the result of the expansion of

(U) Design Details (Continued)

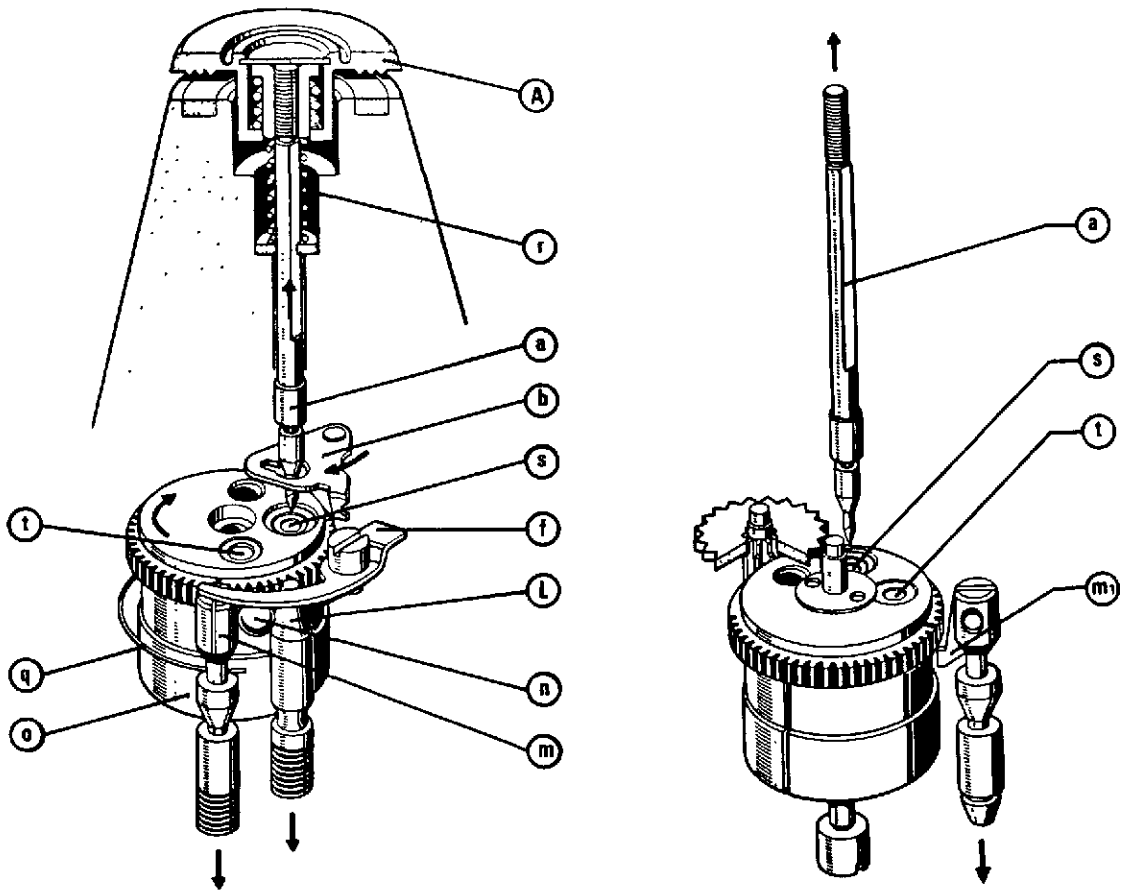

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Figure 8-3. Interface of delay-arming mechanism components for fuze, Model AZ DM 111A3, armed position (U).

compression spring (r). The rotor (O) has also been released by the firing pin (a) and within approximately 1 second rotates to the preset OV or MV position (i.e., SQ or delay action). The fuze is armed within 1.01 seconds.

Delay-Arming Mechanism for
Fuze, PD, Model AZ DM 111A3
FOM No. 1390-16-10-4

(U) Design Details (Continued)

Direct-action (i.e., SQ) ignition requires a minimum energy of 1.8 kg/cm on the projected or protruding striker. The same amount of energy is achieved on a 1-mm cardboard disk (specific weight-0.65 kg/cm^3) at a projectile velocity of 45 m/s. On the same target, the direct-action ignition requires a minimum energy of 3.6 kg/cm, which necessitates a projectile velocity of 60 m/s. Below a projectile velocity of 350 m/s, the air drag is not sufficient to prevent arming of the fuze.

Delay-action functioning occurs 0.05 second after impact.

The explosive train runs from detonators (s or t) through the booster lead (g) to the booster charge (F) (see fig 8-1).

Delayed-Arming Shutter, No. 3B
FOM No. 1390-35-10-3

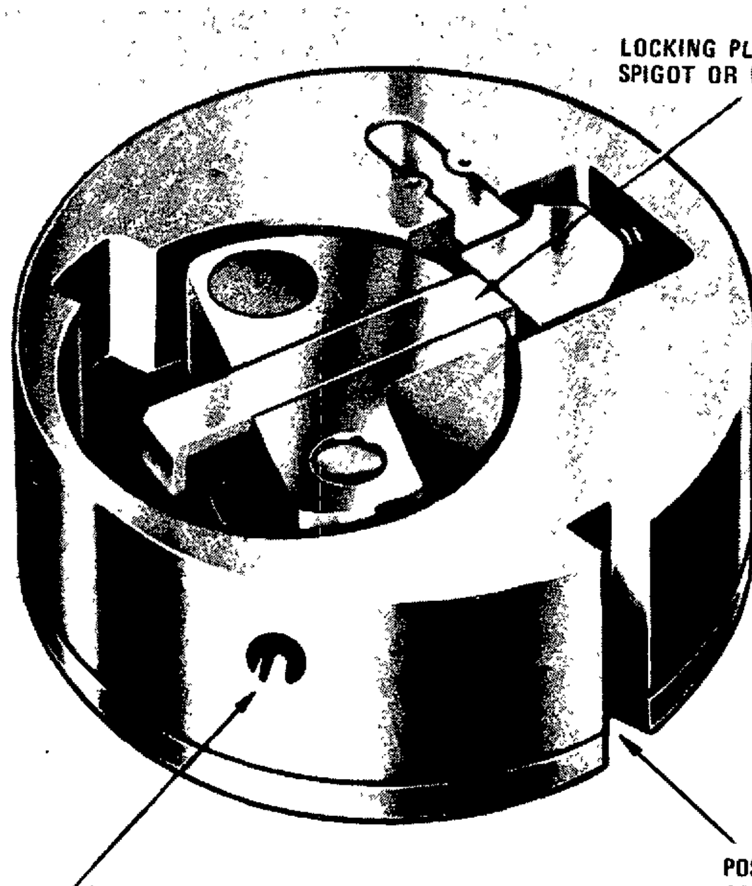

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Figure 8-4. Delayed-arming shutter, No. 3B, external view (U).

(C) **General**

The No. 3B delayed-arming shutter (fig 8-4) is a mechanical safety unit. When it is assembled to a fuze, it insures that the projectile will not arm until it has travelled a predetermined distance from the weapon. Although this shutter is obsolete, it is incorporated in this handbook for review by fuze designers.

Delayed-Arming Shutter, No. 3B
FOM No. 1390-35-10-3

(C) Design Details

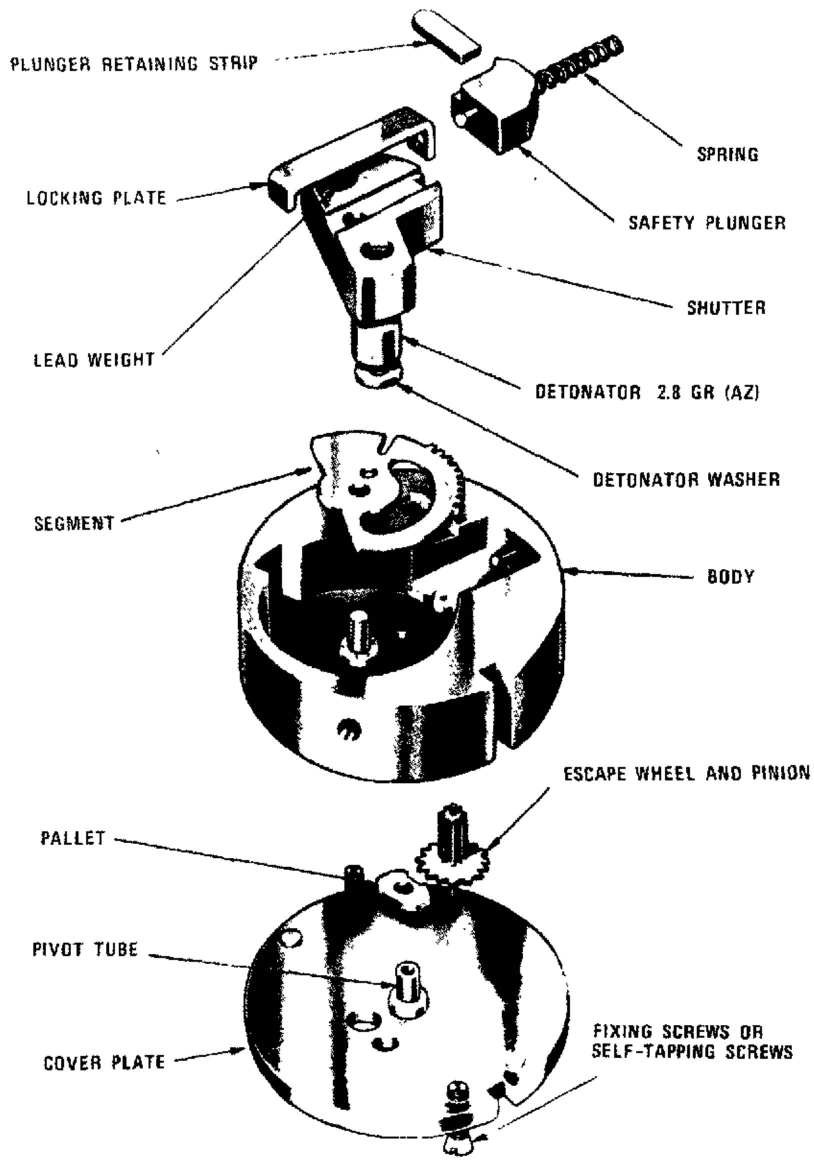

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Figure 8-5. Delayed-arming shutter, No. 3B, exploded view (U).

(C) **Design Details (Continued)**

General. The shutter (fig 8-5) consists primarily of a body, a shutter assembly, and an escapement mechanism. The body (QX 1795 or QX 1823) is made of anodized aluminum alloy and is circular in shape. The body is recessed from the top and the bottom to form a platform. From the top, the recess is generally circular in shape with a pivot pin set in its center to take the shutter and escapement segment. Two rectangular recesses are formed: the larger, which is not as deep as the main recess, is for the safety plunger; and the smaller is for the shutter locking plate. A stop to position the shutter in the armed position is formed in the bottom of this recess. On the underside, the body is recessed to take the pallet and escape pinion. A positioning slot is cut on the outside of the body and a shutter gauging hole is bored from the outside into the shutter recess.

Shutter assembly. The shutter assembly consists of the shutter, locking plate, safety plunger, and detonator.

Made of aluminum alloy and anodized, the shutter (QX 1615) is semicircular in shape with a segment removed to form a projecting arm. Three holes are formed in the shutter: one for the detonator located in the projecting arm, another at the opposite end for the lead weight; and a third near the center for the pivot. Slots are cut in the upper surface and down the curved side for the locking plate and the pin of the safety plunger. There are two projecting pins on the underside which engage a hole and a slot formed in the escapement segment.

The locking plate (QX 1614) is a metal strip bent down through 90° at each end. The turned-down portion at one end is drilled to take the pin of the safety plunger.

Made of anodized aluminum alloy and irregular in shape, the safety plunger (QX 1168) is fitted with a pin on its front edge. It is retained in a recess of the body by the plunger retaining strip and is held against the shutter locking plate by a spring consisting of 18 coils of steel wire of 30 SWG (QX 1706) (i.e., 28 AWG).

The detonator (QX 122 AF) is a 2.8-gr (0.18-gram) "AZ," lugless, tinned copper alloy cup. It is inserted into the appropriate hole of the shutter from the underside and is retained by a zinc-plated washer by either ring or stab punching.

Delayed-Arming Shutter, No. 3B
FOM No. 1390-35-10-3

(C) Design Details (Continued)

Escapement mechanism. The escapement mechanism consists of the pallet, escape wheel and pinion, and segment.

The pallet (QX 1617) is mounted on a pivot tube set in the cover plate. The pallet is roughly oval in shape and has two teeth formed on one long side.

The escape wheel and pinion (QX 1619) are mounted with the lower pivot in a bearing of the cover plate, and the upper pivot in a bearing formed in the platform below the safety-plunger recess. The wheel engages the pallet. The drive from the wheel is transmitted to the segment through the pinion, which engages it through a space formed between the base of the shutter recess and the platform of the safety-plunger recess.

The segment (QX 1618) is semicircular in shape, with teeth formed on part of its circumference. The segment is mounted below and on the same pivot as the shutter. Two holes are formed in the segment: one to take the pivot, the other to engage with one of the pins set in the underside of the shutter. A slot formed radially from the circumference is formed to take the other pin on the shutter.

The cover (QX 120 SA) is a circular plate of anodized aluminum alloy with a pivot tube set centrally. Four holes are drilled in the plate, the main two being the lower bearing for the escape wheel pivot and a tapped hole to take the cover plate fixing screw. Two positioning pins are formed on the top surface of the plate to engage corresponding holes in the base of the body. A slot is also cut to align with the positioning slot in the body.

(C) Functioning (fig 8-6)

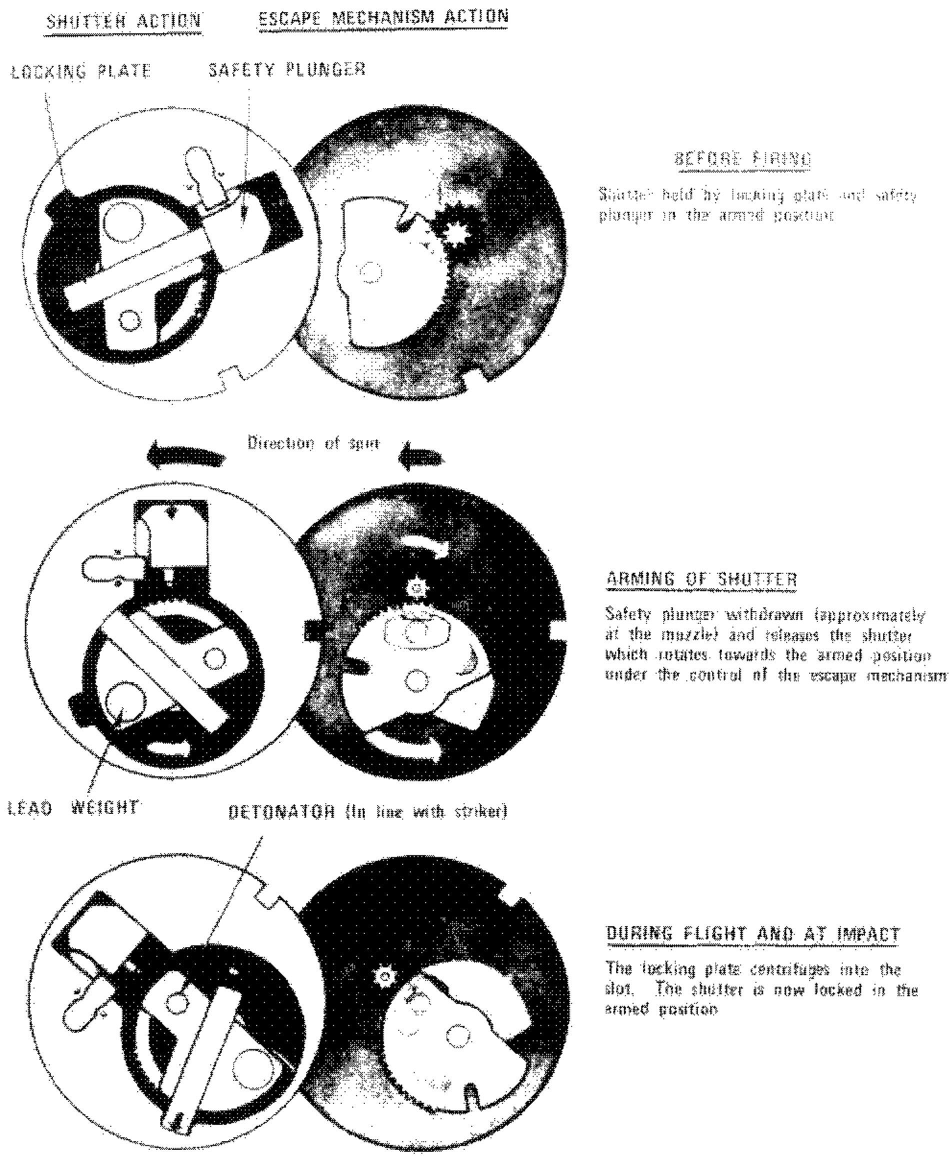

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Figure 8-6. Delayed-arming shutter, No. 3B, functioning view (U).

Delay-Arming Shutter, No. 3B
FOM No. 1390-35-10-3

(C) Functioning (Continued)

On firing. The shutter sets back and is retained in the unarmed position by friction.

During flight. Once setback forces have been overcome, rotation of the shell, at the designed number of revolutions per minute, causes sufficient centrifugal force to withdraw the safety plunger from the locking plate, which itself tends to move toward the shutter. The shutter, controlled by the escapement mechanism, commences to move in the direction of spin. After movement has taken place through 60°, the teeth of the segment disengage the escape pinion and the shutter swings over until the locking plate, which is pulled across the shutter in the opposite direction, engages in the slot formed in the body. The shutter is then against the stop in the shutter recess, and the detonator is in the armed position.

Shutter speed. Shutters in this series commence to open at between 7000 and 8500 r/min, and the time of opening is between 0.02 and 0.055 second at 9000 r/min. It should be noted that in a high speed test at 15,000 r/min all shutters are required to turn through the first 60° (i.e., that part of the movement controlled by the escape mechanism) in a time of 0.01 to 0.03 second.

Delayed-Arming Shutter, No. 4A
FOM No. 1390-35-10-4

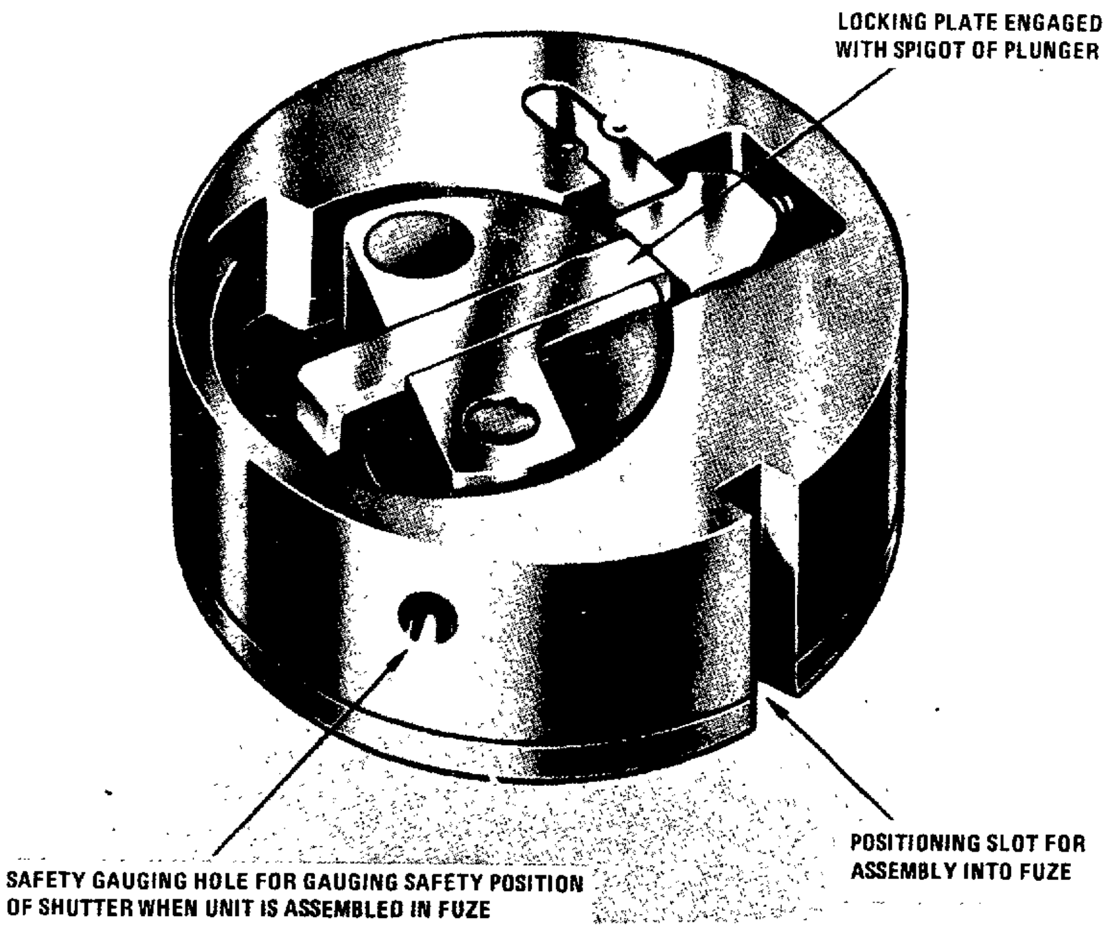

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Figure 8-7. Delayed-arming shutter, No. 4A, external view (U).

(C) General

The No. 4A delayed-arming shutter (fig 8-7) is a mechanical safety unit. When it is assembled to a fuze, it provides the delayed arming essential to ensure that the projectile has travelled a safe distance from the weapon prior to arming. This shutter is considered obsolete; however, the uniqueness of its design is considered to be beneficial for review by fuze designers.

Delayed-Arming Shutter, No. 4A
FOM No. 1390-35-10-4

(C) Design Details

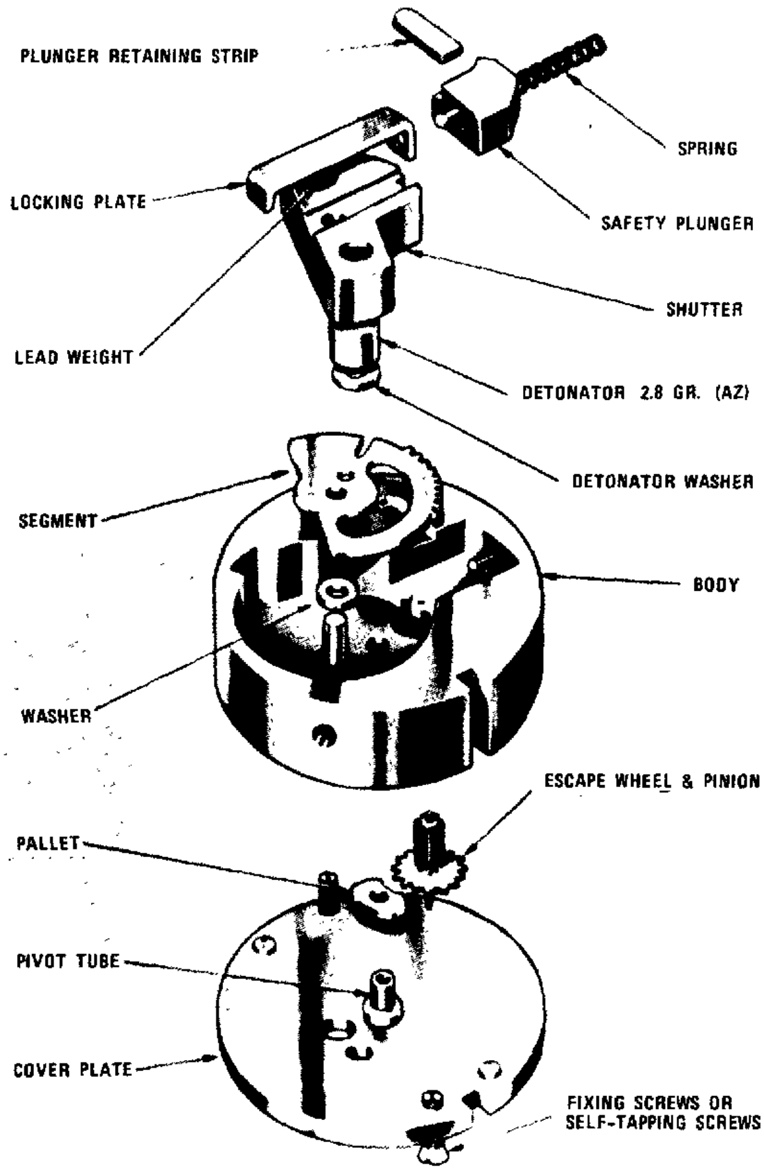

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Figure 8-8. Delayed-arming shutter, No. 4A, exploded view (U).

(C) **Design Details (Continued)**

General. The shutter (fig 8-8) consists primarily of a body, a shutter assembly, and an escapement mechanism. The body (QX 1795 or QX 1823) is made of anodized aluminum alloy and is circular in shape. The body is recessed from the top and the bottom to form a platform. From the top, the recess is generally circular in shape, with a pivot pin set in its center to take the shutter and escapement segment. Two rectangular recesses are formed: the larger, which is not as deep as the main recess, is for the safety plunger; and the smaller is for the shutter locking plate. To position the shutter in the armed position, a stop is formed in the bottom of this recess. On the underside, the body is recessed to take the pallet escape pinion. A positioning slot is cut on the outside of the body, and a shutter gauging hole is bored from the outside into the shutter recess. With body QX 1795 a washer is required for the shutter pivot pin, but with body QX 1823 no washer is required as a raised bearing surface around the pivot pin is formed in the base of the recess.

Shutter assembly. The shutter assembly consists of a shutter, locking plate, safety plunger, and detonator.

Made of aluminum alloy and anodized, the shutter (QX 1615) is semicircular in shape, with a segment removed to form a projecting arm. Three holes are formed in the shutter: one for the detonator located in the projecting arm, another at the opposite end for a lead weight, and a third near the center for the pivot. Slots are cut in the upper surface and down the curved side to take the locking plate and the pin of the safety plunger. There are two projecting pins on the underside which engage in a hole and a slot formed in the escapement segment.

The locking plate (QX 1614) is a metal strip bent down through 90° at each end. The turned-down portion at one end is drilled to take the pin of the safety plunger.

Made of steel and irregular in shape, the safety plunger (QX 1638) is fitted with a pin on its front edge. It is retained in the recess of the body by the plunger retaining strip and is held against the shutter locking plate by a spring consisting of 14 coils of steel wire of 32 SWG (QX 1707) (i.e., 29 AWG).

The detonator (QX 214 AF) is a 2.6-gr (0.17-gram) "LZ," lugless, tinned copper alloy cup. It is inserted into the appropriate hole in the shutter from the underside and is retained by a zinc-plated washer by either ring or stab punching.

Delayed-Arming Shutter, No. 4A
FOM No. 1390-35-10-4

(C) Design Details (Continued)

Escapement mechanism. The escapement mechanism consists of the pallet, escape wheel and pinion, and segment.

Mounted on a pivot tube set in the cover plate, the pallet (QX 1617) is roughly oval in shape and has two teeth formed on one long side.

The escape wheel and pinion (QX 1619) is mounted with the lower pivot in a bearing of the cover plate. The upper pivot is mounted in a bearing formed in the platform below the safety plunger recess. The wheel engages the pallet. The drive from the wheel is transmitted to the segment through the pinion which engages it through a space formed between the base of the shutter recess and the platform of the safety-plunger recess.

Semi-circular in shape with teeth formed on part of its circumference, the segment (QX 1618) is mounted below and on the same pivot as the shutter. Two holes are formed in the segment: one to take the pivot and the other to engage one of the pins set in the underside of the shutter. A slot formed radially from the circumference is formed to take the other pin of the shutter.

The cover (QX 120 SA) is a circular plate of anodized aluminum alloy with a pivot tube set centrally. Four holes are drilled in the plate: the main two are the lower bearing for the escape wheel pivot and a tapped hole to take the cover plate fixing screw. Two positioning pins are formed on the top surface of the plate to engage corresponding holes in the base of the body. A slot is also cut to align with the positioning slot in the body.

(C) **Functioning** (fig 8-9)

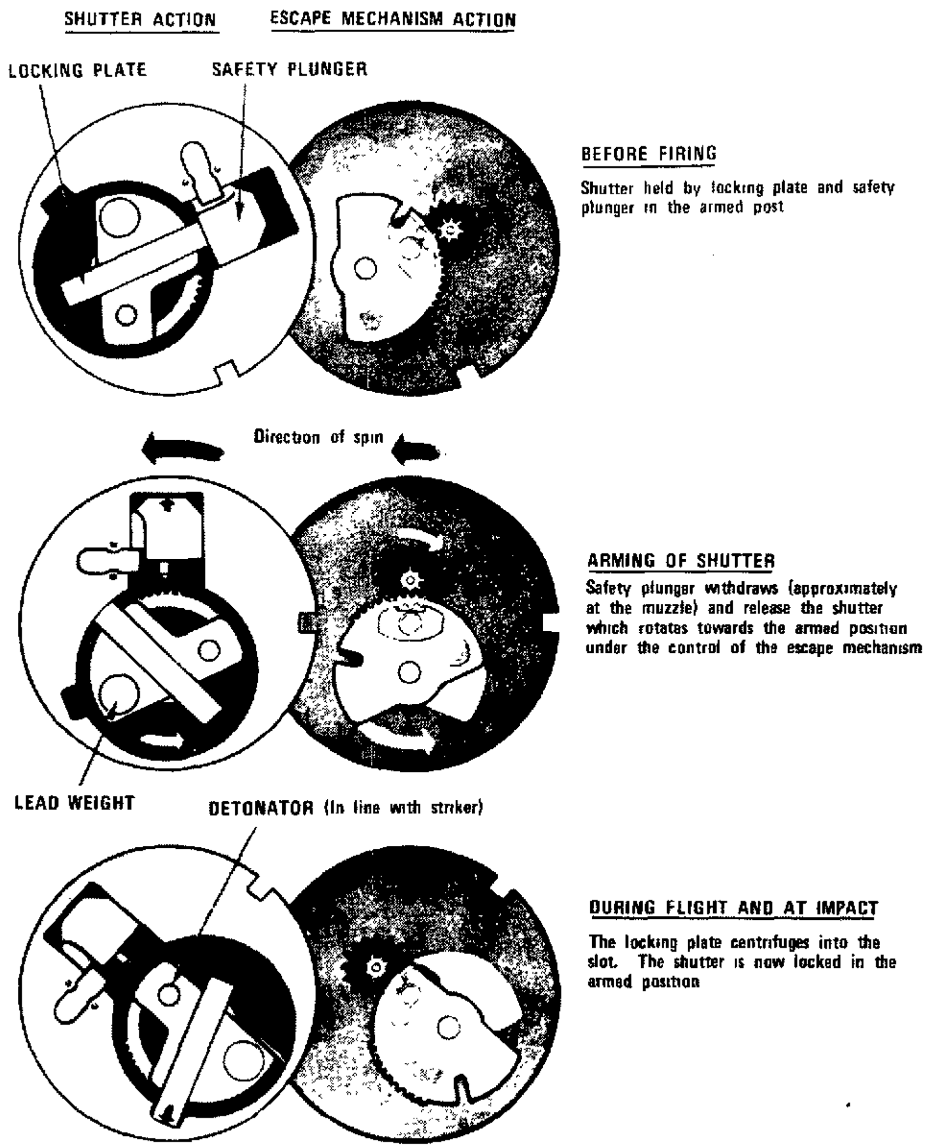

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Figure 8-9. Delayed-arming shutter, No. 4A, functioning sequence (U).

Delayed-Arming Shutter, No. 4A
FOM No. 1390-35-10-4

(C) **Functioning** (Continued)

On firing. The shutter sets back and is retained in the unarmed position by friction.

During flight. Once setback forces have been overcome, rotation of the shell, at the designed number of revolutions per minute, causes sufficient centrifugal force to withdraw the safety plunger from the locking plate, which itself tends to move toward the shutter. The shutter, controlled by the escapement mechanism, commences to move in the direction of spin. After movement has taken place through 60° the teeth of the segment disengage the escape pinion and the shutter swings over until the locking plate, which is pulled across the shutter in the opposite direction, engages in the slot formed in the body. The shutter is then against the stop in the shutter recess, and the detonator is in the armed position.

Shutter speed. Shutters in this series commence to open at between 3700 and 4500 r/min and the time of opening is between 0.045 and 0.075 second at 5900 r/min. It should be noted that in a test at 5900 r/min all shutters are required to turn through the first 60°—i.e., that part of the movement controlled by the escape mechanism—in a time of 0.045 to 0.075 second.

Mechanical Timer, 60 seconds,
Model Junghans
FOM No. 1390-16-10-3

TIMERS

(U) General

The mechanical timer illustrated in figure 8-10 was developed by Junghans of West Germany for use with the DM 93 and DM 123 MTSQ fuzes (FOM Nos. 1390-16-1-8-1 and 1390-16-1-18). It is a 60-second mechanical timer designed to function on setback during firing of the projectile. Although designed for use with low-velocity, low-"g"-accelerated, non-rotating, mortar ammunition, the timer could be used with higher velocity, higher "g"-accelerated, spin-stabilized artillery projectiles.

(U) Design Details

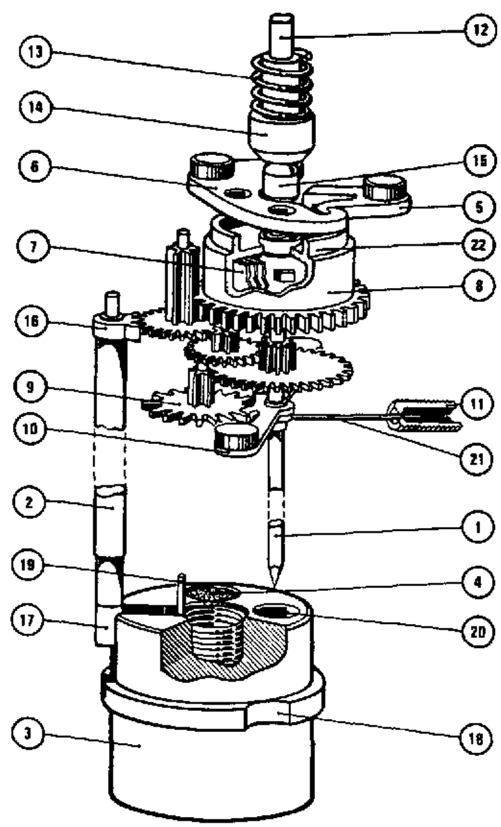

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Figure 8-10. 60-second mechanical timer, Model Junghans, interface of components (U).

Mechanical Timer, 60 seconds,
Model Junghans
FOM No. 1390-16-10-3

(U) **Design Details (Continued)**

Figure 8-10 depicts the interface of the timer with the firing pin (1) and the locking shaft (2) that detents the spring-loaded rotor (3) housing the out-of-line detonator (4).

The mechanical timer consists essentially of a wound band spring (7) contained in a timer drum (8) with the release lever (6) and firing lever (5) resting on the crown (22) of the timer drum. The timer engages a gear train to drive an escape wheel (9) that meshes with the escapement (i.e., anchor or pallet [10] connected to a spring [21]). The escapement is regulated by a regulating screw (11).

Other components depicted in figure 8-10 are the striker stem (12), striker bushing spring (13), cone-shaped striker bushing (14), and the firing-pin head (15). As can be seen, the locking shaft (2) has a toothed segment (16) that meshes with the first pinion-gear of the timer while a flat extension (17) of the locking shaft engages a slot in the rotor (3).

The circumference of the collar of the rotor has two seats (18) cut out for the lower collars of the two setback pins of the setback device (see fig 8-11). As also can be seen in figure 8-10, the rotor has three holes in it: one for the torqued spring (19), one for the detonator (4), and the third, a blind hole (20) for engaging the firing pin (1) when the fuze is in the safe position. Not shown is a stop pin for aligning the detonator when the fuze is armed.

(U) **Functioning** (fig 8-11)

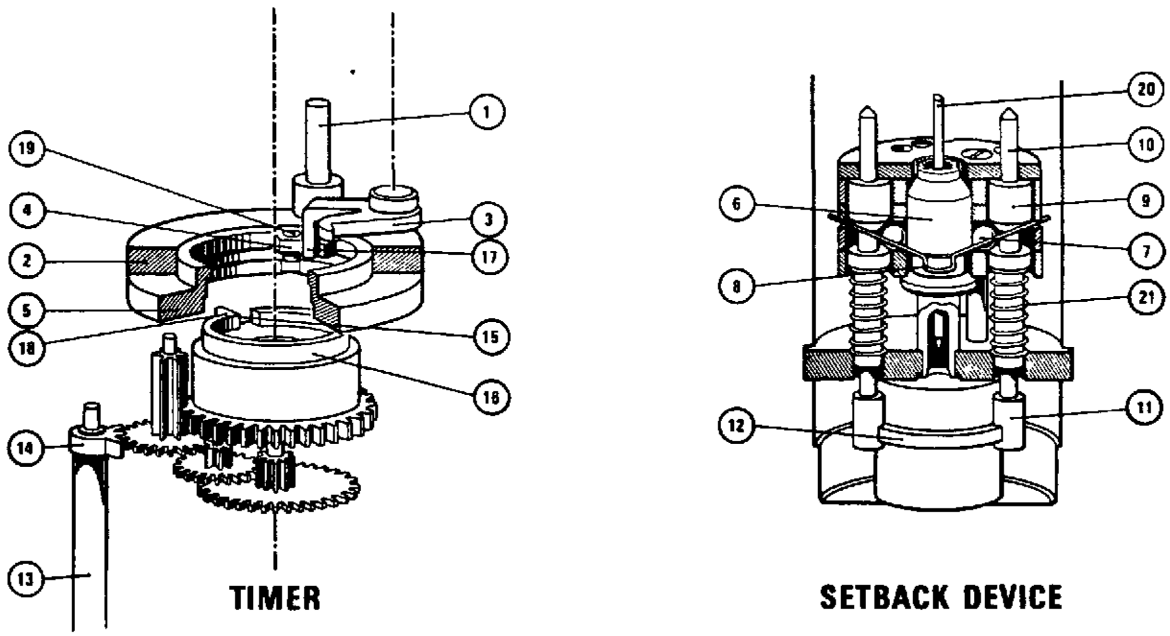

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Figure 8-11. 60-second mechanical timer, Model Junghans, timer and setback device (U).

By turning the movable nose cap to the desired fuze setting, the setting pin (1) takes the timing ring (2) with it and simultaneously takes the firing lever (3) to a new position opposite the cam (4) of the timer drum cover (5). This is because the firing lever is riveted to the timing ring.

When the round of ammunition is fired, the setback sleeve (6) of the setback device moves rearward, forcing the two locking balls (7), which were held in place by a locking spring (8), outward releasing the two setback pins (9). The setback pins move rearward, compressing their springs (21). This in turn allows the two stems (10) of the setback pins to move rearward, releasing the escapement (i.e., anchor) of the timer.

Mechanical Timer, 60 seconds,
Model Junghans
FOM No. 1390-16-10-3

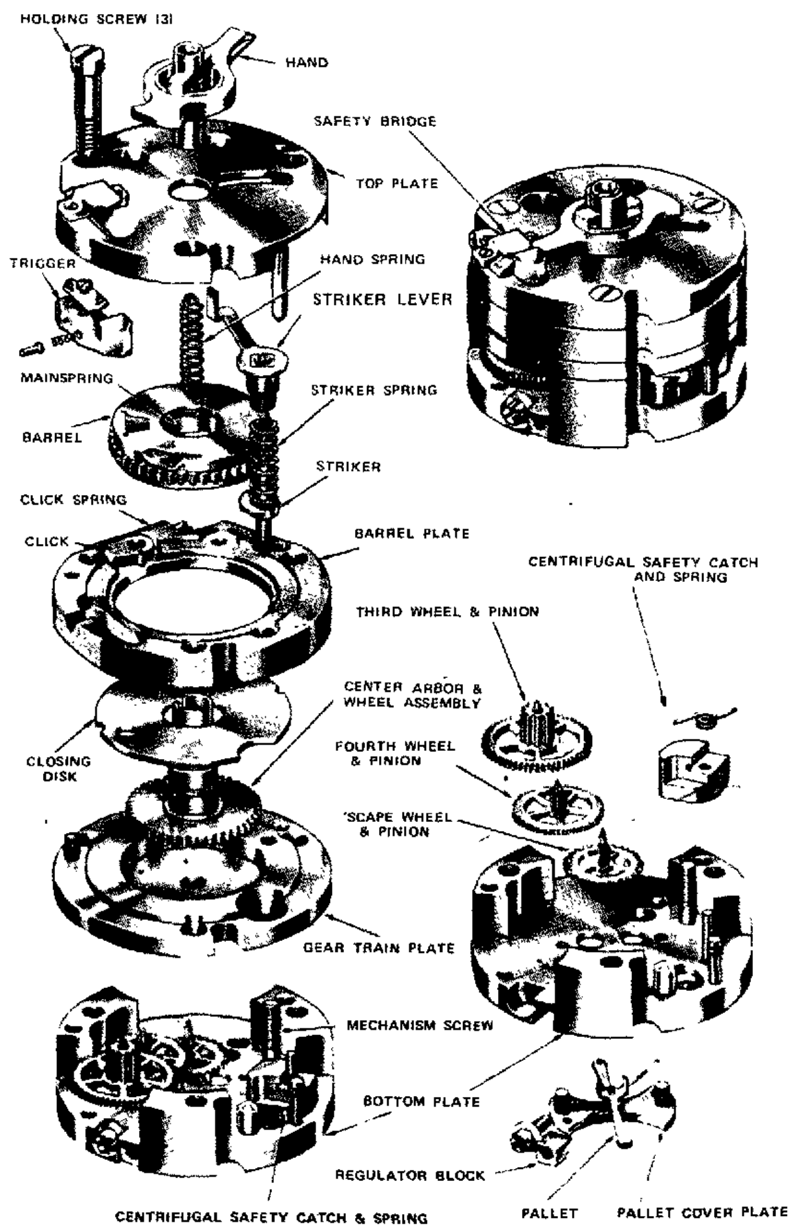
(U) **Functioning (Continued)**

In addition, the setback pins' lower collars (11) are disengaged from their seats in the collar (12) of the spring-loaded rotor, setting the rotor free to turn to the armed position. The arming is delayed, however, for about 1 second until the locking shaft (13) has turned out of the slot of the rotor (see fig 8-10).

As soon as the anchor is set free, the timer band spring drives the pinion gearing through its serrated rim, turning the locking shaft extension by means of its tooth segment (14) out of the slot of the rotor. This frees the rotor, which moves to the armed position by its torqued spring. The detonator is then in the in-line position with the firing pin (20).

In the meantime, the timer drum turns until the nose (18) and the gap (15) in its crown (16) arrive opposite the downward bent tongue (17) of the firing lever (3). At this moment, the striker bushing spring is able to shove the striker bushing downward (see fig 8-11). The latter pushes the firing pin lever and release lever apart, driving the firing pin into the detonator.

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1



(CONFIDENTIAL)

Figure 8-12. 80-second mechanical timer, No. 1, exploded view (U).

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1

(C) General. The No. 1 mechanical timer (fig 8-12) is a 80-second clockwork timer that was designed for the MTSQ fuze No. 213 Mk 5 (FOM No. 1390-35-1-6). A modification, designated Model No. 1A, is described at the end of this section.

(C) Design Details (fig 8-12)

General. Inside the fuze is a platform or hand race, across which a shaped slot is cut. Rotation of the appropriate portion of the fuze positions the slot and thereby sets the fuze.

The clockwork mechanism, which rotates a spring-loaded hand beneath the hand race, is driven by a mainspring and controlled by an escapement through a train of gear wheels. The mechanism is started by the firing of the gun, the hand being released for rotation by the setback of a trigger. A muzzle safety bridge prevents the hand from rising until 0.72 seconds after firing. The minimum arming distance is approximately 366 meters, depending on the weapon being used, and the maximum running time is 80 seconds. Thereafter, the hand bears on the undersurface of the hand race until, at the end of the time as set, it has rotated until it is coincident with the slot in the race into which it rides.

The hand is secured to a hollow hand center, the rim of which engages a tip on the end of the lever fixed to the top of the striker. A cam on the striker rests on a pillar, and the rising of the hand releases the lever, allowing the striker spring to rotate the cam off the pillar and forcing the striker down onto the detonator. The striker is prevented from reaching the detonator before the projectile leaves the muzzle by a centrifugal safety catch.

Clockwork Mechanism.

General. The clockwork mechanism consists of the mainspring, gear train and escapement, the hand and trigger assembly, and the firing mechanism. It is assembled as a complete unit on a frame consisting of bottom, train, barrel, and top plates and is fixed onto a platform in the fuze body.

Drive. The drive is by the mainspring coiled inside a barrel mounted on a center arbor. One end of the spring is fixed to the barrel and the other to the arbor. The arbor is held by the hand until the gun is fired, and the spring is wound up by rotation of the barrel and retained in that state by a click.

(C) Design Details (Continued)

Mainspring. The flat steel mainspring, 378 mm (14.9 in) long and 3.6 mm (0.14 in) wide, is coiled inside the barrel. The inner end has a slot for engagement on a hook formed on the center arbor, and the outer end itself forms a hook to engage a catch on the barrel. The spring is wound before the mechanism is assembled in the fuze by a key inserted through a hole in the top plate.

Barrel. The brass barrel is mounted around the center arbor and has teeth formed on the periphery for engagement with the winding key and the click. The portion of the inner circumference is undercut to form a catch for the outer end of the mainspring. A slot is cut in the bottom to give access to the mainspring, and the top is covered by a circular disk plate.

Click and click spring. The steel click pivots on a pin in the barrel plate. It has a single tooth to engage the teeth on the periphery of the barrel to prevent the mainspring from unwinding. The flat steel click spring is secured to the periphery of the barrel plate by a screw. The spring keeps the click forced inward.

Gear train. The gear train consists of a sequence of gear wheels to give the required step-up ratio from the drive to the escapement. Rotation of the center arbor by the mainspring turns the hand at the top and the center wheel at the bottom. The center wheel causes the third, fourth, and 'scape pinions and wheels to rotate, the steel pinions being mounted above the brass wheels on the same arbors.

Center arbor. The cylindrical steel arbor is reduced in diameter at the bottom to form a pivot that rotates in a bearing hole in the train plate. The arbor passes through a hole in the barrel plate, and the top rotates in a bearing hole in the top plate. It is formed with a flange at its lower end to which the center wheel is secured by three screws. Above this is another flange, part of which is undercut to form a hook for engaging the slot on the inner end of the mainspring. Above this again, the center arbor is reduced in diameter to fit the central pivot hole in the top plate, and again at the top it is reduced and slotted to accommodate the hand center.

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1

(C) Design Details (Continued)

Center wheel. The center wheel is assembled on the lower end of the center arbor with three securing screws. It is housed in a recess in the upper surface of the train plate and drives the third pinion.

Third arbor, pinion, and wheel. The arbor pivots rotate in bearing holes in the bottom and train plates. The steel pinion enters a recess in the train plate and is driven by the center wheel. The brass wheel drives the fourth pinion.

Fourth arbor, pinion, and wheel. The arbor pivots rotate in bearings in the bottom and train plates. The steel pinion is driven by the third wheel, and the brass wheel drives the 'scape pinion.

Escapement.

General. The escapement comprises the scape wheel, pallet, and hairspring. The escapement is the controlling device by means of which the power of the drive is allowed to "escape" only at a steady rate. Vibration of the hairspring and pallet disengages one of the pads from the 'scape wheel. In doing so, the pad receives an impulse from the 'scape tooth as it jumps forward before being eventually locked by the entry of the other pallet pad into an adjacent tooth. This action is repeated by the disengagement of the second pad. The resulting series of impulses is transmitted to the pallet arm and results in an oscillation which is maintained at a rate determined by the weight and length of the pallet arm and the effective length and bending properties of the hairspring.

Escape, arbor pinion, and wheel. The arbor pivots rotate in bearings in the bottom and train plates. The pinion is driven by the fourth wheel. The brass 'scape wheel has specially shaped teeth for engagement by the pallet pads.

Pallet. The pallet consists of a straight steel bar, termed the pallet arm, with a hole in the center for riveting to a steel arbor. On each end of the arm is a circular brass weight; at the center, and at right angles to it, are two short arms with the ends turned upward. The ends of the short arms are termed pallet pads and alternatively engage successive teeth of the 'scape wheel. The arbor has a radial hole to take the hairspring. The pivots of the arbor rotate in bearing holes in the center of the bottom plate and in a cover plate below the bottom plate.

(C) Design Details (Continued)

Hairspring. The center of the straight phosphor-bronze hairspring is fitted between two D-shaped copper strips secured in the radial hole in the pallet arbor. The ends of the spring are held loosely in saw-cuts in the bottom plate and the regulator.

Regulator. The regulator is a metal block which slides in an undercut groove in the bottom plate where it is held by a regulator screw. The regulator screw has a flange which engages a slot in the regulator. Movement of the screw in the tapped hole in the bottom plate slides the regulator in or out and thus alters the effective length of the hairspring.

Hand and trigger assembly.

General. The hand and trigger assembly consists of the hand, hand center and handspring, trigger, trigger locking bolt, and a muzzle safety bridge. The hand is secured to the hand center, which fits loosely in slots formed in the top of the center arbor. The hand center compresses the spiral handspring inside the arbor and also retains the end of the striker lever. The hand and hand center are thus tending to be rotated by the center arbor and pushed up by the handspring. The trigger prevents the hand rotating until the gun is fired, when it sets back to release the hand. The trigger locking bolt locks the trigger in the setback position. The hand is then free to rotate, but is still prevented from rising by the muzzle safety bridge until the projectile is well clear of the muzzle. After clearing the bridge, the hand bears on the undersurface of the hand race. At the end of the time as set and as determined by the positioning of the hand race slot, the hand and hand center are forced up through the slot and release the lever to operate the striker.

Hand. The aluminum hand fits around the hand center, to which it is secured by screws. It has two arms, the longer one being chamfered at the end and with a slot cut in one side to take the end of the trigger locking strip.

Hand center. The brass hand center comprises an inner and outer cylinder connected by a bridgepiece. The cylinders fit loosely over the hollow end of the center arbor, one inside and one outside, with the bridgepiece resting in slots in the top of the arbor. A flange on the inside of the inner cylinder forms a bearing for the top of the handspring. The outer cylinder retains the turned-up end of the striker lever until it is released by the rising of the hand and hand center.

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1

(C) Design Details (Continued)

Handspring. The spiral steel handspring is housed in the center arbor and inner cylinder of the hand center. It is held in compression between the bottom of the center arbor recess and the flange of the inner cylinder of the hand center until the latter is free to rise.

Trigger. The 36-mm (1.4-in) brass trigger works in a slot in the top plate and pivots about one end on a trigger fulcrum pin also in the top plate. The other end has a projection on top to prevent the hand rotating until the trigger sets back on firing. This projection has a bevelled flange to ride over the hand on setback. The inner side of the trigger is slightly chamfered to avoid fouling the barrel. A trigger locking strip is screwed to the top of the trigger.

Trigger locking bolt. A brass bolt is fitted over a steel spiral spring and inserted in a recess in the side of the trigger. When the trigger sets back, the bolt is forced partly out of the recess into a notch in the barrel plate to lock the trigger in the setback position.

Muzzle safety bridge. The brass safety bridge fits across the trigger slot in the top plate and forms a back stop to the trigger. The top is extended forward over the trigger to cover the hand and prevent it from rising until it has rotated an amount equivalent to 0.72 seconds time of running. This insures that a fuze set too short will not burst the projectile until it has travelled a safe distance from the gun.

Firing mechanism.

General. The firing mechanism consists of a striker lever and lever arbor, striker and striker spring, pillar and centrifugal safety catch. The turned-up end of the lever fits inside the outer cylinder of the hand center; the other end is riveted to the top of the lever arbor. The top of the striker slides in a vertical slot in the lower half of the lever arbor; they are keyed in such a way that lever and striker rotate together. A cam on the striker rests on the pillar set in the bottom plate. The rising of the hand center frees the lever, which then flies outward. The striker cam is rotated off the pillar, and the striker is driven down by the striker spring onto the detonator. The centrifugal safety catch will arrest the striker cam and prevent the striker reaching the detonator should the cam be accidentally rotated off the pillar before the gun is fired.

(C) Design Details (Continued)

Striker lever. The striker lever has a square hole in one end to receive the upper end of the lever arbor to which it is riveted. The other end is bent upwards to protrude through the curved slot in the top plate and fit inside the outer cylinder of the hand center.

Lever arbor. The top of the cylindrical steel arbor is squared to fit the mating hole in the striker lever and is fitted with a brass pivot. The lower part of the arbor has a vertical slot to take the upper end of the striker. The arbor rotates in a bearing hole in the top plate and a recess formed in the upper side of the barrel plate.

Striker. The upper end of the cylindrical steel striker has two flats to fit the slot in the lever arbor, and the lower end is pointed to pierce the detonator. A flange toward the lower end is shaped to form a cam, the bottom of which is bevelled to facilitate rotation off the pillar when the lever is freed. The cam would also be engaged by the centrifugal safety catch and the striker thus prevented from reaching the detonator should the cam be rotated off the pillar through any cause, such as a broken lever, before firing. After firing, the downward movement of the striker is limited by a recess in the top of the bottom plate.

Striker spring. This spiral steel spring is fitted to the striker between the top of the cam and the underside of the barrel plate. The release of the lever allows the spring to rotate the cam off the pillar and force the striker down onto the detonator.

Pillar. The steel pillar is fitted on top of the bottom plate and is secured by punching. The upper end is rounded to engage the bevel of the striker cam.

Centrifugal safety catch. This consists of a brass block with a flange on the inner side. An offset hole takes a pivot pin on which the catch rotates. The pivot pin is screwed into the underside of the bottom plate, and the upper end enters a hole in the train plate. A spiral steel spring is assembled on the pivot pin, one end fitting in an undercut to a step on the top of the catch and the other bearing against a stop pin fitted on top of the bottom plate. Before firing, the spring keeps the safety catch in the safe position with the flange under the striker cam. After firing, centrifugal force overcomes the spring and swings the catch clear. Should the movement be accidentally set in motion or the lever break before firing, the striker cam would be rotated off the pillar down onto the flange of the safety catch and thus prevent the striker reaching the detonator. In this case, the downward pressure of the striker spring is sufficient to prevent the catch swinging out in flight.

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1

(C) Design Details (Continued)

Frame. The frame is made up of four brass plates, assembled one above the other and known as the bottom, train, barrel and top plates, respectively. The plates are positioned by dowel pins and secured by screws. There are two dowel pins between the fuze body and the bottom plate. One of the dowel-pin holes in the bottom plate receives one end of a long dowel pin that goes through all four plates. A short dowel pin goes through bottom, train, and barrel plates. Three equidistant screws inserted from the underside of the fuze body platform secure the bottom plate. The same threaded holes in the bottom plate receive the ends of three holding screws inserted from the top plate, to hold all four plates together. Three studs screwed in from the outside of the fuze body fit into equidistant holes on the periphery of the bottom plate. Holes are also provided in bottom and train plates for a movement screw to hold these plates together and retain the movement during assembly.

Bottom plate. Three small holes form bearings for the lower pivots of the third, fourth, and 'scape wheels. A hole in the center forms a bearing for the upper pivot of the pallet arbor. The lower pivot of this arbor operates in a bearing hole in a small cover plate positioned on the underside of the bottom plate by two dowels and secured by two screws. A threaded hole takes the head of the centrifugal safety catch pivot pin and, nearby, two plain holes for the stop pin and pillar and a larger one for the striker to pass through. A recess in the upperside of the plate accommodates the striker cam when in the fired position and thus limits the movement of the striker.

Train plate. Three small holes form bearings for the upper pivots of the third, fourth, and 'scape wheels, and a large recess below the bearings for the third wheel enables the third pinion to engage the center wheel situated in a recess in the top of the plate. A central hole forms a bearing for the center arbor pivot. A small hole is for the centrifugal safety-catch pivot pin and, nearby, a larger one for the striker to pass through.

Barrel plate. The center of the plate, on the upperside, is recessed to house the barrel, and a central hole permits the center arbor to pass through. There is a hole in which the lower end of the winding key can pivot, the hole being enlarged on the upperside to give clearance for the teeth of the key. A hole for the upper end of the striker to pass through is enlarged on the underside to form a seating for the striker spring, the upperside housing the lower end of the lever arbor. A groove in the upperside takes the trigger when it sets back, and a V-notch connects with the groove and receives the spring-loaded trigger locking bolt

(C) Design Details (Continued)

to retain it in the setback position. A recess in the upperside houses the pawl which pivots on a pin set in the barrel plate. The side of the plate has a flat surface to accommodate the pawl spring, which is bent at one end to fit into a notch formed in the periphery of the plate where it is secured by a screw.

Top plate. In addition to three equidistant holes at the edge of the plate to take the holding screws there are three main holes in this plate. The center one forms the top bearing of the center arbor, the second allows access to the click which can be released if necessary, and the third is the entry hole for the mainspring winding key. A curved slot, formed radially from the center, is cut to take the lever and a straight slot is cut at one side of the plate to house the trigger which is pivoted on a pin set into the inner side of the slot. The muzzle safety bridge is positioned over this slot. The long dowel which passes down through the other three plates is fixed in position on this plate. One portion of the plate is reduced in thickness on the underside with a projecting pintle left as the upper bearing for the lever arbor.

(C) Safety Arrangements

Trigger. The trigger prevents the hand from rotating until the weapon is fired.

Centrifugal safety catch. Should the movement be accidentally set in motion, or the lever break before firing, the striker cam would be rotated off the pillar down onto the flange of the safety catch and thus prevent the striker from reaching the detonator. The downward pressure of the striker spring is sufficient to prevent the catch swinging out in flight.

Muzzle safety bridge. The muzzle safety bridge prevents the hand from rising until it has rotated an amount equivalent to 0.72 seconds time of running. This insures that a fuze set too short will not burst the projectile until it has travelled a safe distance from the gun.

Clockwork Time Mechanism,
80 seconds, No. 1
FOM No. 1390-35-10-1

(C) Functioning (fig 8-13)

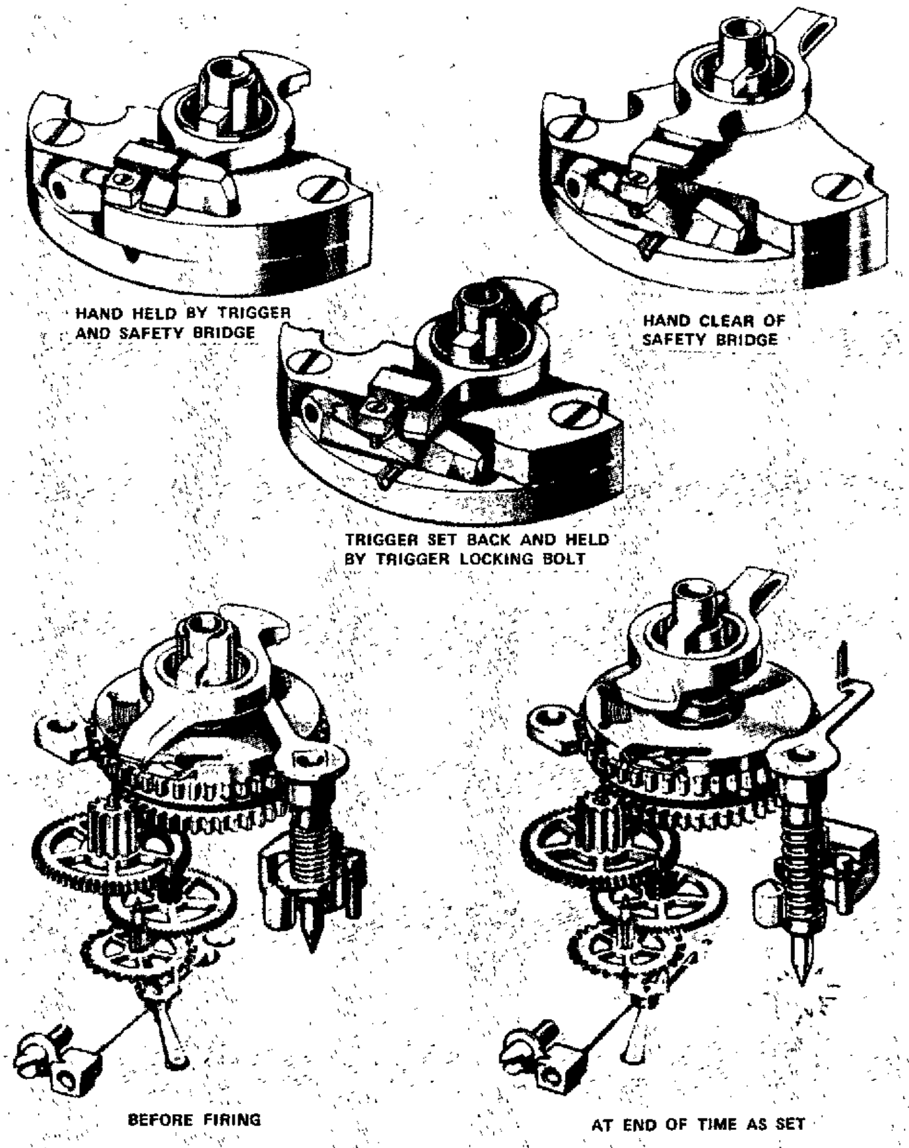


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Figure 8-13. 80-second mechanical timer, No. 1, functioning views (U).

(C) Functioning (Continued)

General. Figure 8-13 depicts components involved in before and after firing.

Before firing. The setting of the fuze positions the hand race slot.

On firing. The trigger sets back until the top projection clears the hand, allowing it to rotate. The trigger locking bolt is forced outward by its spring into the V-groove in the top plate, retaining the trigger in the setback position.

On leaving the bore. The centrifugal safety catch flies outward and leaves the striker supported only by its cam resting on the pillar. The hand is prevented from rising by the muzzle safety bridge until 0.72 second after firing when the projectile is well clear of the muzzle.

At the end of the time as set. The hand has rotated until it reaches the hand race slot into which it rises under action of its spring. This releases the striker lever, which flies outward as the striker spring forces the cam off the pillar and the striker down onto the detonator.

(C) Modifications

The model No. 1A timer differs from the No. 1 timer in the following details:

- Mainspring. In this mechanism, a stronger spring 4.20 mm (0.165 in) wide is fitted.

- Barrel plate. In this mechanism, the barrel plate is recessed on the bottom face to take a closing disk between the bottom of the plate and the top of the train plate.

- Closing disk. This is 0.63 mm (0.0248 in) thick. The disk is fitted as described above.

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Clockwork Time Mechanism,
43 seconds, No. 4
FOM No. 1390-35-10-2

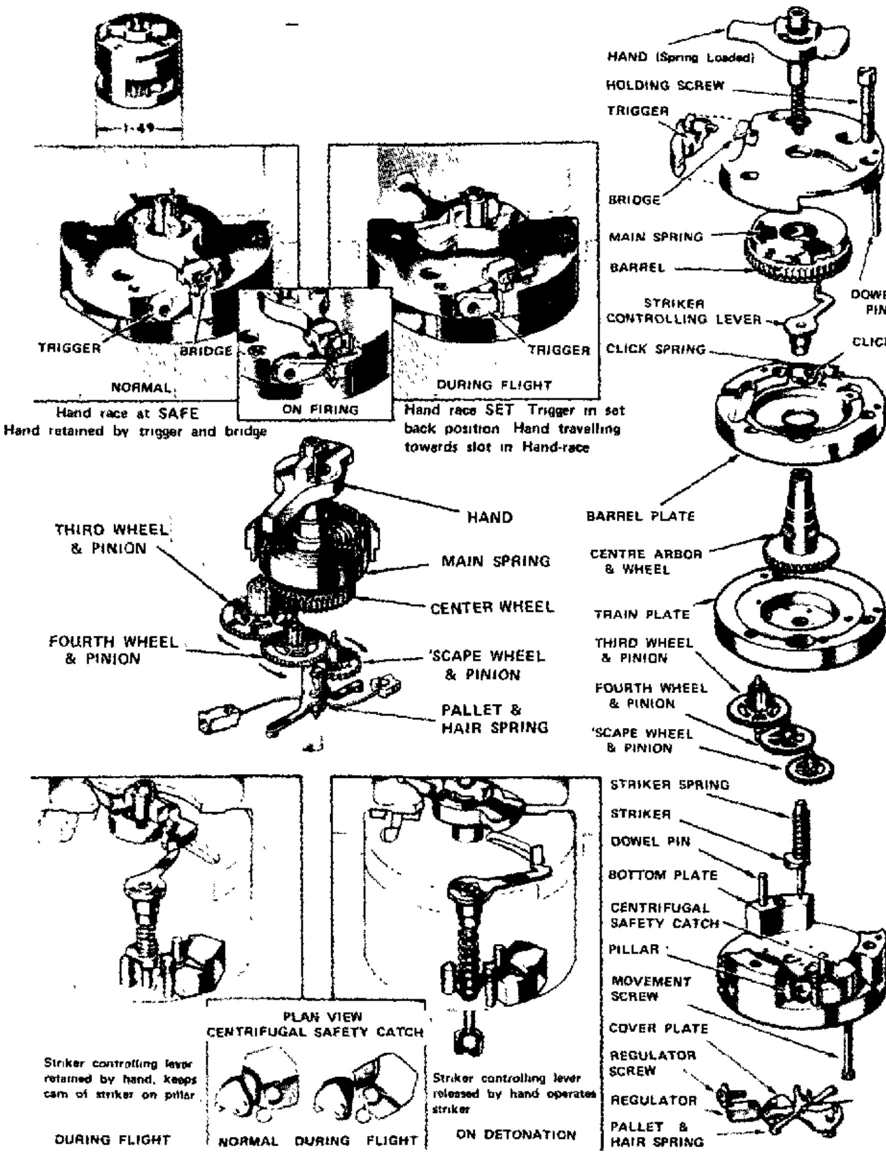

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Figure 8-14. 43-second mechanical timer, No. 4, contour, exploded, and functioning views (U).

Clockwork Time Mechanism,
43 seconds, No. 4
FOM No. 1390-35-10-2

(C) General

The No. 4 mechanical timer (fig 8-14) was designed for the No. 208 Mk 6 MTSQ fuze used in projectiles fired from the 3.7-inch Mk 6 gun.

Inside the fuze is a platform or hand race, across which a shaped slot is cut. Rotation of the appropriate portion of the fuze positions the slot and thereby sets the fuze.

The clockwork mechanism, which rotates a spring-loaded hand beneath the hand race, is driven by a mainspring and controlled by an escapement through a train of gear wheels.

The mechanism is started by the firing of the weapon, the hand being released for rotation by the setback of a trigger. A muzzle safety bridge prevents the hand from rising until 0.72 second after firing. The minimum arming distance is approximately 366 meters, but is dependent on the weapon being used. The maximum running time is 43 seconds.

(C) Design Details, Safety, and Functioning

The No. 4 timer has the same design and safety features and functions in the same manner as the 80-second timer No. 1 (FOM No. 1390-35-10-1) (see page 8-32).

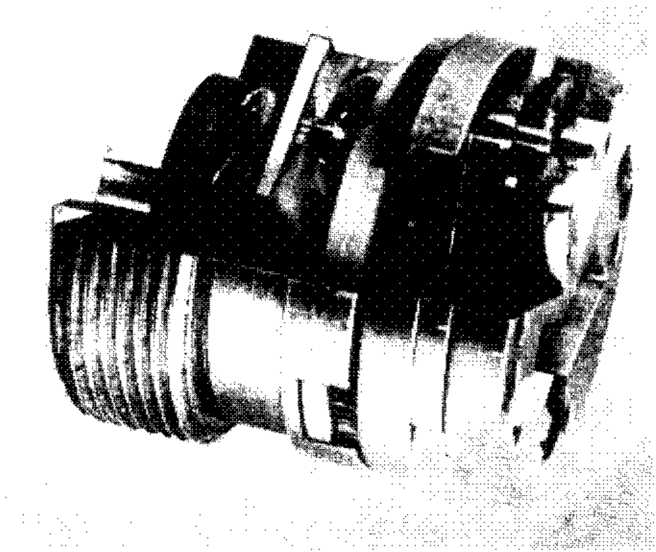

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Figure 8-15. S&A device for VT fuze, Model TRT, section view (U).

(U) **Description**

This S&A device (fig 8-15) is designed to be used with VT fuze, Model FU-RA-F1, for 155-mm howitzer projectiles, made by Telecommunications Radioelectriques et Telephoniques (TRT). The device contains an electric primer and a clockwork mechanism that interrupts the electric firing circuit after the projectile has traveled a specified distance. The mechanism is operated by flyweights, controlled by an inertial governor; the range at which the safe device functions remains approximately constant regardless of the characteristics of the projectile in which used. The device also interrupts the explosive train by shutters actuated by centrifugal force. Two socket contacts connect the device to the fuze battery (power source). Weight is about 190 grams (0.42 lb), diameter is 38 mm (1.49 in), and height is 43.6 mm (1.72 in).

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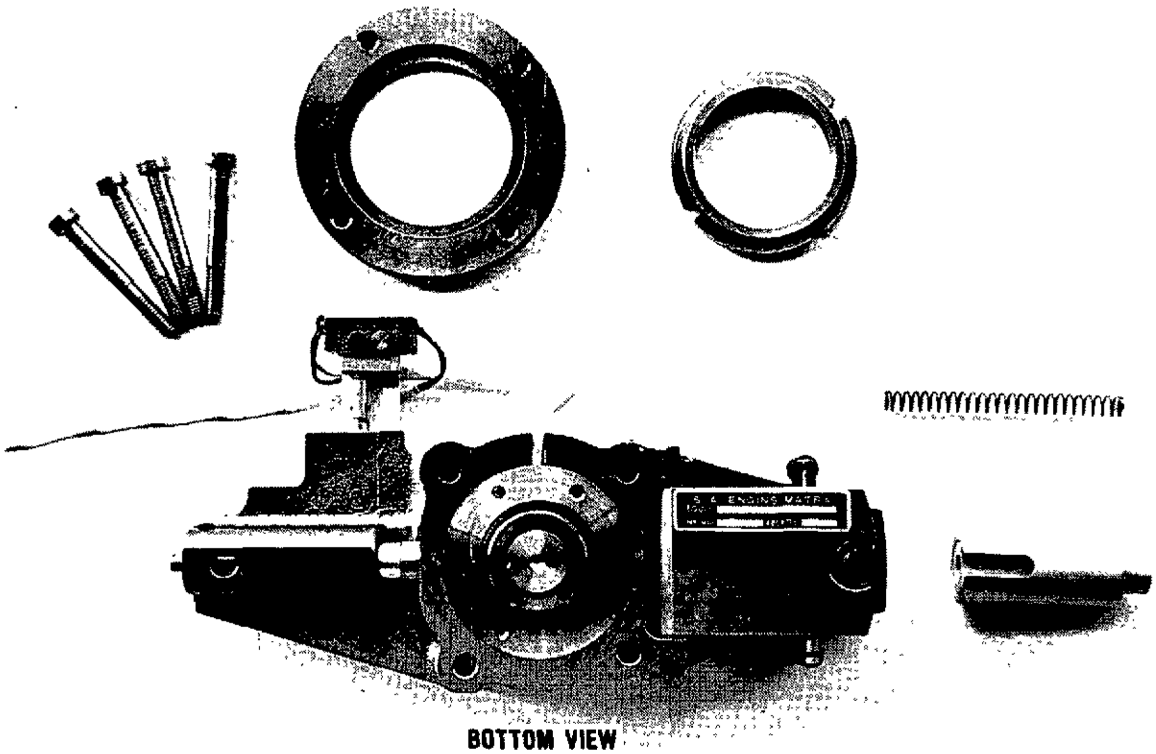

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Figure 8-16. Crotale S&A device, bottom view (U).

(C-NFD) General

This S&A device (fig 8-16) is an uncluttered design that was developed for the infrared-type proximity fuzing used in the French Crotale surface-to-air guided missile. It utilizes three environmental stimuli: electrical impulse, rocket motor pressure, and missile acceleration. The S&A device is connected to the Crotale rocket motor.

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S&A Device for French Crotale SAM
FOM No. 1390-17-10-3

(C-NFD) Detent System

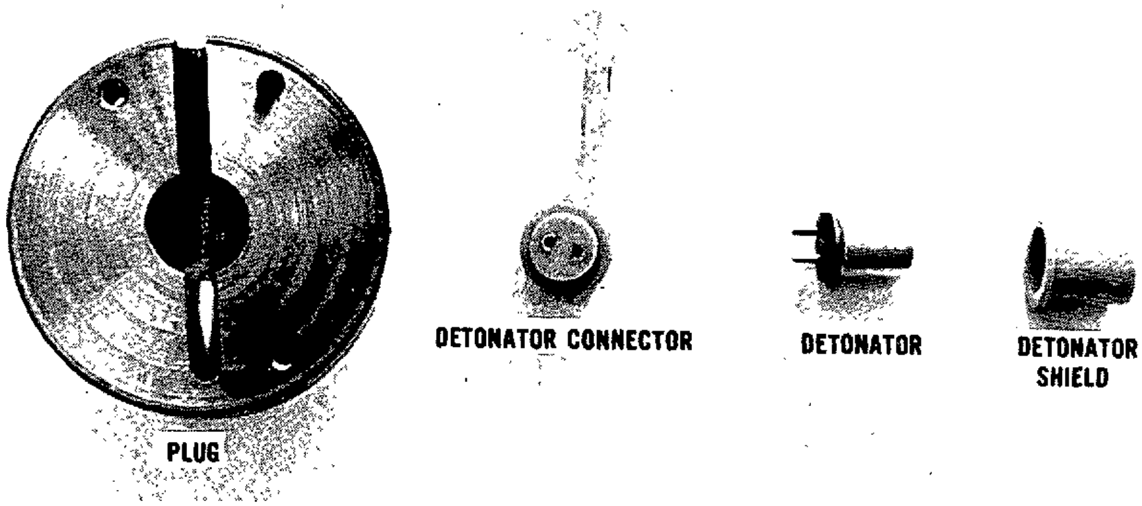

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Figure 8-17. Detonator/pressure plug assembly for Crotale S&A device (U).

The detonator (fig 8-17) of the S&A device is detented or blocked by a titanium barrier piston. The barrier (fig 8-18) is held out of line by a bore rider pin and an accelerometer. Rocket motor pressure pushes a firing pin to ignite a pyrotechnic delay. The propellant pressure at the end of the delay removes the barrier from the detonator, providing the bore rider pin is freed and the accelerometer is depressed.

(C-NFD) **Functioning** (fig 8-18)

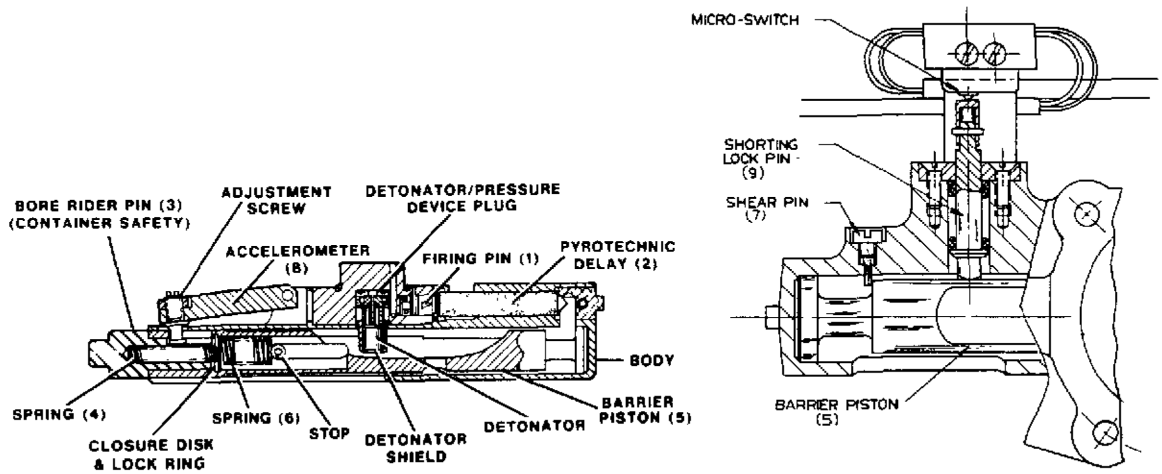

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Figure 8-18. Crotale S&A device, section view (U).

When the rocket motor ignites and a pressure 725 lb/in^2 is obtained, the stab-type firing pin (1) initiates a 1.5-second pyrotechnic delay (2). Upon exit of the missile from the launcher, the bore rider pin (3) is ejected by its spring (4) and the barrier piston (5) is moved by its spring (6) until it rests against the shear pin. The accelerometer (8) releases at 23±2 "g" force.

As soon as the pyrotechnic delay burns out, it ignites an explosive charge that drives the barrier piston (5) in line. Simultaneously, a shorting locking pin enters a recess in the barrier piston, opening a switch that unshorts the electrical detonator. It also locks the barrier in the armed position. Paralleling this is an electrical interlock. Time zero occurs when the umbilical connection separates from the missile. A unijunction device provides a 0.3-second delay; then the detonator's firing capacitor is charged through a resistor; the time constant is such that 0.7 second elapses before the charge is sufficient to initiate the detonator. This provides a parallel path of 1 second, improving the safety of the device.

The S&A functioning sequence is illustrated in figure 8-19.

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S&A Device for French Crotale SAM
FOM No. 1390-17-10-3

(C-NFD) Functioning (Continued)

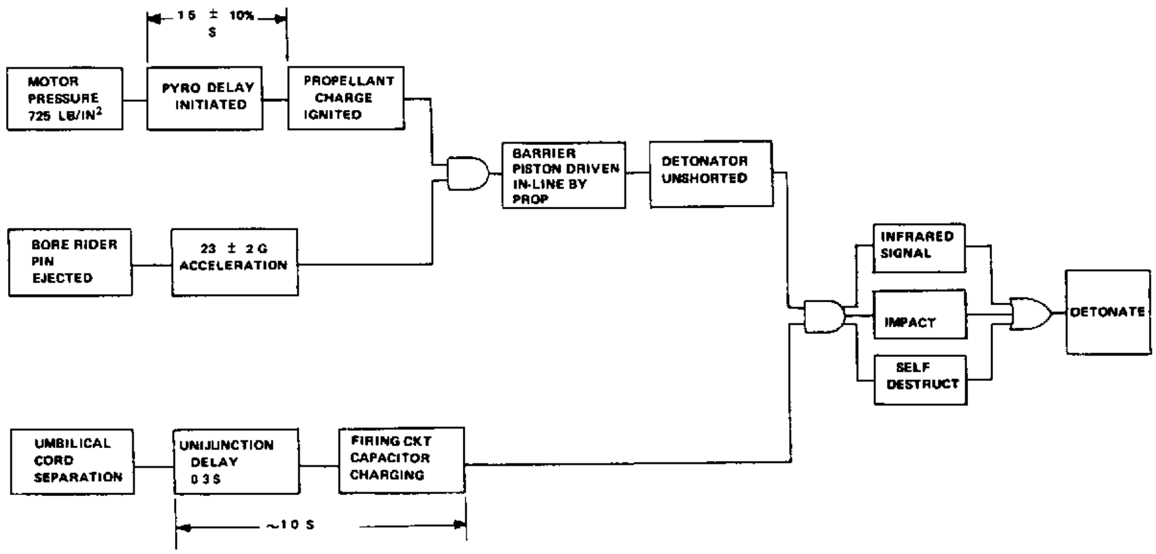

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Figure 8-19. Crotale S&A device, functioning sequence (U).

(C-NFD) Design Details

The S&A device consists of the following major components:

- Body - made from an aluminum sand casting.
- Barrier piston - machined from titanium rod.
- Detonator/pressure piston plug - machined from aluminum bar (see fig 8-17).
- Accelerometer - made from cadmium-plated stainless steel flat stock.
- Bore rider pin - machined from aluminum bar.
- Pyrotechnic delay element - A modular design in a cadmium-plated steel case.

NO FOREIGN DISSEM

(C-NFD) **Design Details (Continued)**

- Detonator shorting plunger - made from aluminum rod.

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(U) General

The S&A device for the Norwegian NVT-227A1 proximity fuze is mechanically powered via a turbine-generator located in the nose portion of the fuze. The generator (see fig 8-20) primarily consists of a rotor, a stator, and a gearbox. The gearbox, whose internal components are molded in an acetal plastic, provides the S&A device with the torque required for arming the fuze.

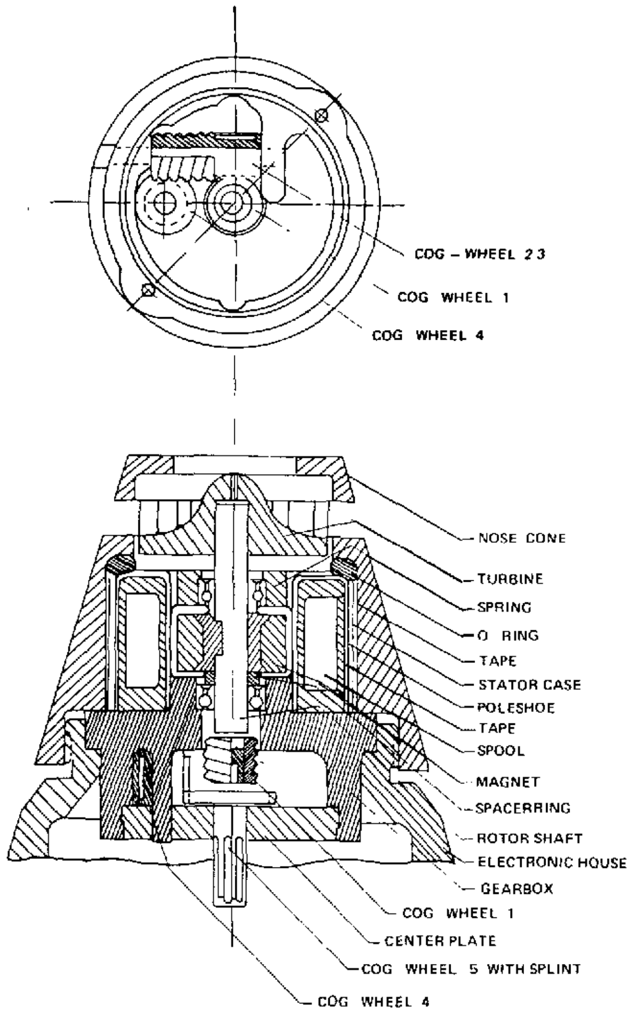

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Figure 8-20. Turbine generator device for fuze, Model NVT-227A1 (U).

S&A Device for VT Fuze, Model NVT-227A1
FOM No. 1390-20-10-1

(U) General (Continued)

The S&A device keeps the fuze in a safe condition from the time of assembly until the fired projectile has travelled a safe distance from the muzzle of the weapon. The device then arms the fuze by aligning the explosive train so that it is ready for the electrical ignition impulse.

(U) Design Details and Functioning

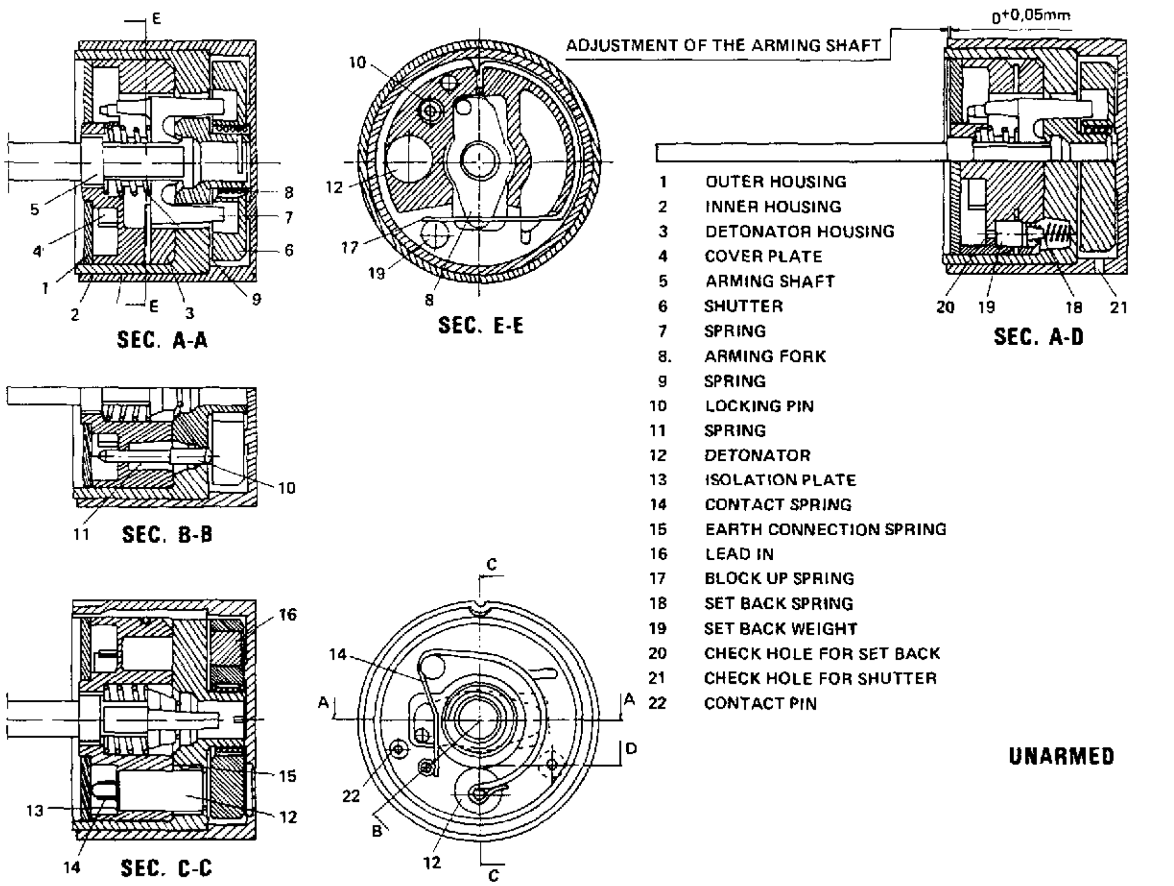

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Figure 8-21. S&A device for fuze, Model NVT-227A1, section view, unarmed position (U).

(U) Design Details and Functioning (Continued)

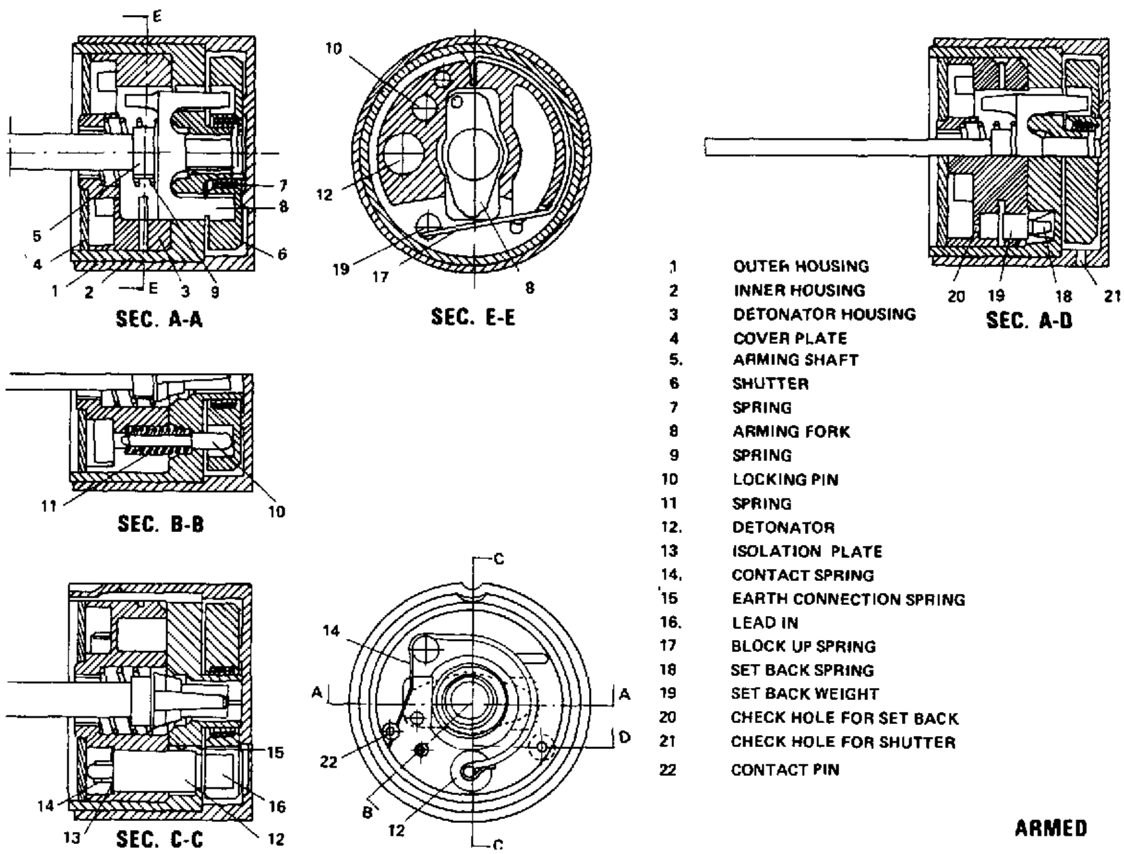

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Figure 8-22. S&A device for fuze, Model NVT-227A1, section view, armed position (U).

Figures 8-21 and 8-22 depict the S&A device in both the unarmed and armed positions.

It operates as follows: After a minimum acceleration of 700 g, the setback weight (19) in the setback detent is pressed backward and the block-up spring (17), which otherwise prevents the arming fork (8) from moving forward, swings to the side freeing the arming fork. All this takes place while the mortar projectile is in the weapon.

(U) Design Details and Functioning (Continued)

When the projectile leaves the barrel, the turbine begins to rotate, driving the arming shaft (5) which rotates at 1/312 of the generator speed. When the arming shaft rotates, it screws itself down into the detonator housing (3) at 0.5 mm (0.197 in)/rev. At the same time the arming shaft also screws itself into the arming fork at 1 mm/rev. Thus the arming fork is withdrawn from the shutter (6) at a rate of 0.5 mm (0.197 in)/rev. After approximately 3 revolutions of the arming shaft, the fork disengages from the shutter. The shutter is now free to rotate by the action of the shutter spring (7). In the safe condition the locking pin (10) rests on the shutter and prevents the detonator contact spring (14) from touching the contact pin (22) which carries the triggering pulse from the L.F. In this way the locking pin (10) also short-circuits the detonator in the safe condition.

When the shutter has been rotated 180° by the shutter spring, the lead-in (16) is in line with the electric detonator (12), and the shutter is now locked in the armed position (by the locking pin [10] dropping into an appropriate hole). This movement also allows the contact spring (14) from the detonator to swing against the pin on the top of the arming fork.

The arming shaft (5) continues to rotate until it has screwed itself out of the threaded part of the fork housing. The fork spring (9) now presses the arming fork (8) into the armed shutter with the splined coupling between the generator and the arming shaft disengaging. As the arming fork is pressed into the armed shutter the pin on top releases the detonator spring (14) which thus finally makes contact with the contact pin (22) from the L.F.

The S&A mechanism is now in the armed condition and to achieve this the arming shaft has had to rotate through 5 revolutions and the turbine through 1560 revolutions. Since the turbine (i.e., generator speed) increases at a rate proportional to the muzzle velocity of the projectile, it follows that the safe distance is approximately constant (130 meters) and independent of muzzle velocity within certain limits.

After assembly of the S&A mechanism, the position of the shutter can be checked by looking into inspection hole (21) and the position of the block-up spring via hole (20).

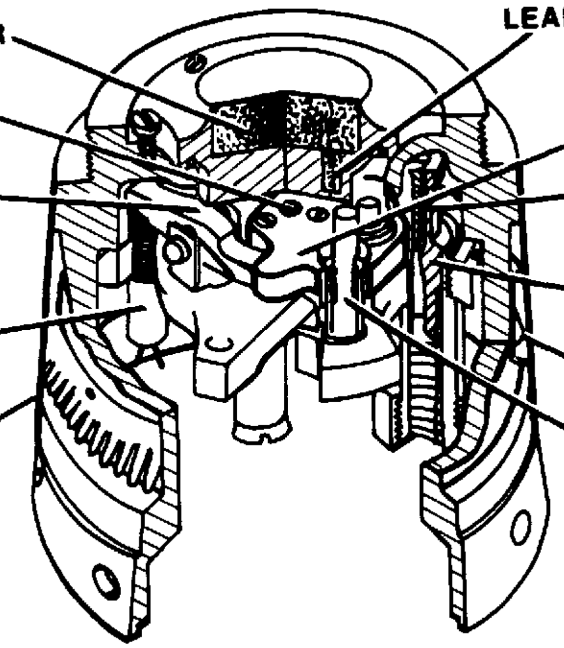

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Figure 8-23. Rapier S&A device, Model K40A1 (U).

(C) Description

The K40A1 S&A device (fig 8-23) is mounted at the base of the Rapier surface-to-air guided missile warhead. The S&A device is in a sense an impact fuze designed to function when the missile penetrates the target. An electrical delay switch (see fig 8-24) is attached to the forward bulkhead of the motor. The rocket motor is used as one environment. Motor burning ignites a delay pellet in front of the switch. Consumption of the pellet allows motor pressure to act on a diaphragm, closing the switch. Switch closure allows electrical power to ignite a squib. Expanding gases (see fig 8-25) cause the piston to be propelled forward.

(C) Description (Continued)

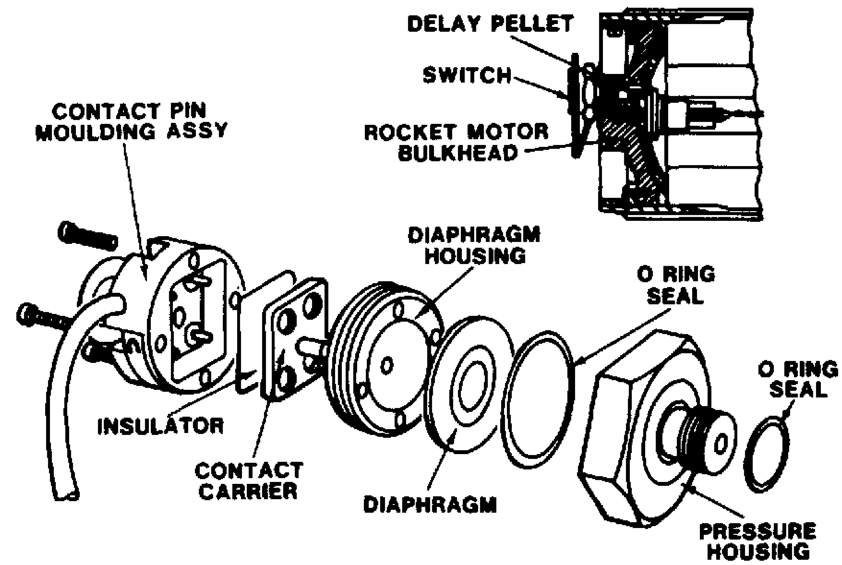

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Figure 8-24. Electrical delay switch for Rapier S&A device (U).

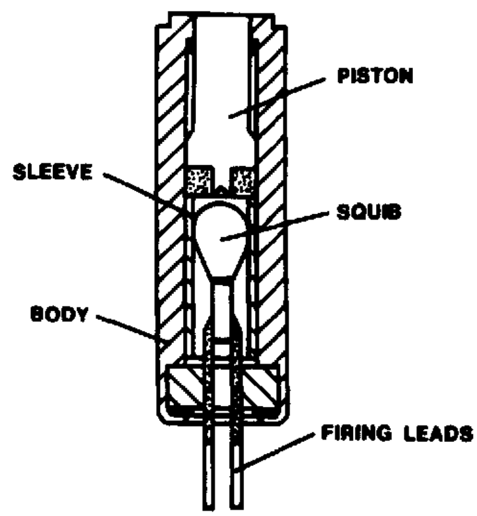

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Figure 8-25. Expansive motor for Rapier S&A device (U).

(C) Description (Continued)

The fuze has another safety which locks the detonator housing directly. This is a variable orifice dashpot which is a "G" latch, spring-loaded, air-damped device. An impact switch mounted on the periphery of the fuze body (i.e., missile skin) will function only when the missile penetrates the target. A window in the missile warhead section is provided for determining whether the fuze is safe or armed.

(C) Operation

At launch, rocket motor propellant gases ignite the pyrotechnic delay in the delay switch. The "G" latch starts to retract at a 16.5-"g" level and is fully retracted after 0.4 second. The pyrotechnic delay burns out any where from 0.77 to 1.33 seconds. This allows enough time for the rocket motor gas pressure buildup to activate the switch diaphragm. The pressure switch closes, igniting the expansive motor and removing the latch from the detonator shutter. The firing capacitor now begins to charge itself. The detonator shutter is driven in line by a spring. A micro-switch then disconnects the expansive motor from the circuit and completes the circuit to the command relay (i.e., self-destruct). As soon as the missile penetrates the target, the impact switch closes, firing the detonator.

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Section IX.

ELECTRIC FUZES, INITIATORS, IGNITERS

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Section IX.

ELECTRIC FUZES, INITIATORS, IGNITERS

GENERAL

(U) An electric fuze normally is a fuze that depends for its arming and functioning upon events of an electronic nature. Such a fuze does not have to be entirely electric; it may contain mechanical components.

(U) An electric initiator or igniter (designated as electric fuzes in UK terminology) functions by means of a current passing through electric leads connected to a battery. The instant of activation is therefore controlled, often at a distance. The ends of the connecting wires are usually bared, and they may or may not be fitted with connectors. This type of initiator is often used, either singly or in a series, as a primary ignition component in another subassembly—e.g., as an initiator for a booster of a fuze. In this section, UK terminology has been followed for items of UK origin.

(U) The fuzes described in this section are well within the state-of-the-art; a few types incorporate unique features.

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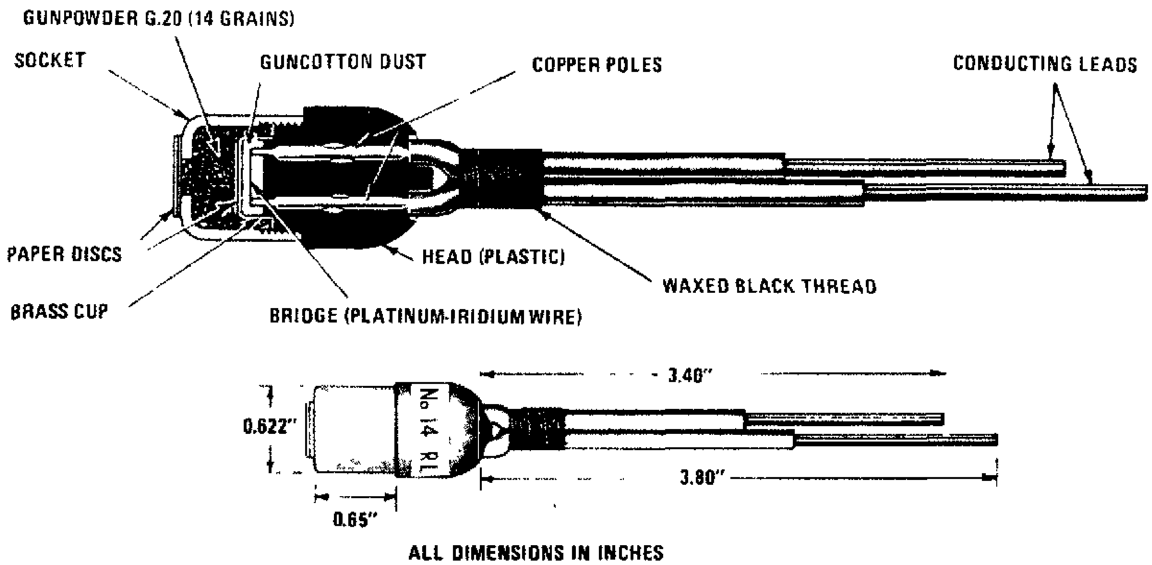
INDEX

*All fuze nomenclatures are UNCLASSIFIED.

LIST OF ILLUSTRATIONS

*All figure titles are UNCLASSIFIED

Fuze, Electric, No. 14 Mk 5
FOM No. 1375-35-3-4



Neg. 552524 (CONFIDENTIAL)

Figure 9-1. Fuze, electric, No. 14 Mk 5, external and cutaway views (U).

(U) Description

This device (which would be designated a squib in US terminology) consists of a dome-shaped, molded plastic head, a magazine (booster), and two conducting leads. Two copper electrodes inserted in holes drilled through the top of the head have their lower ends projecting into the magazine portion of the fuze. The ends of the electrodes are flattened and connected together by a platinum-iridium wire to form a bridge. Around the bridge is placed a small amount of guncotton dust, which is retained by a brass cup cemented below the screw threads at the base of the head. The upper ends of the electrodes are connected to wire bases by pure tin.

The magazine portion of the device consists of a metal cup-shaped socket, screw-threaded internally at the mouth and with a hole drilled in the base. The external area around the hole is shellacked and sealed with two paper disks. The socket is filled with 14 gr (0.91 grams) of G20 gunpowder and then screwed onto the head. The threads of the head are coated with a cement.

Fuze, Electric, No. 14 Mk 5
FOM No. 1375-35-3-4

(U) **Description (Continued)**

The conducting leads consists of two wires, each made of three-strand, tin-coated copper wire, then covered with vulcanized rubber. One lead is 3.4 inches (86.36 mm) long, while the other is 3.8 inches (96.5 mm) long. The exposed ends of each wire are bared of their insulation for a length of 1.5 inches (38.1 mm). The wires are also secured together by waxed thread for about 0.25 inch (6.0 mm) from where they emerge from the head. The recess in the head where the leads emerge is made watertight by a rubber solution. The exterior of the head and socket is painted white.

(C) **Other Designs**

The No. 14 Mark 5 electric fuze is similar to the following fuzes with exceptions as noted.

The Mark 3 fuze differs from the No. 14 Mark 5 as follows:

- An ebonite head is used, the sides being longer than those of the plastic head. They extend to the bottom of the brass cup by an ebonite ring.
- The magazine is a brass cup press-fitted to the head.
- Guncotton yarn is used around the bridge in lieu of guncotton dust.
- Filling is 23 gr (1.49 grams) of RP or G.20 black powder.

The Mark 4 fuze differs from the Mark 5 as follows:

- Uses an ebonite head like Mark 3, but not the full length as in Mark 3.
- A paper collar is used as an extension of the head in place of an ebonite ringe as used in the Mark 3.
- Guncotton yarn and filling same as used in Mark 3 above.

The Mark 5 fuze is similar to the No. 14 Mark 5 fuze, except that it uses two 12-inch (304.8-mm) leads instead of two short leads of unequal length.

(C) Application

This fuze is used with exploding charges of gunpowder.

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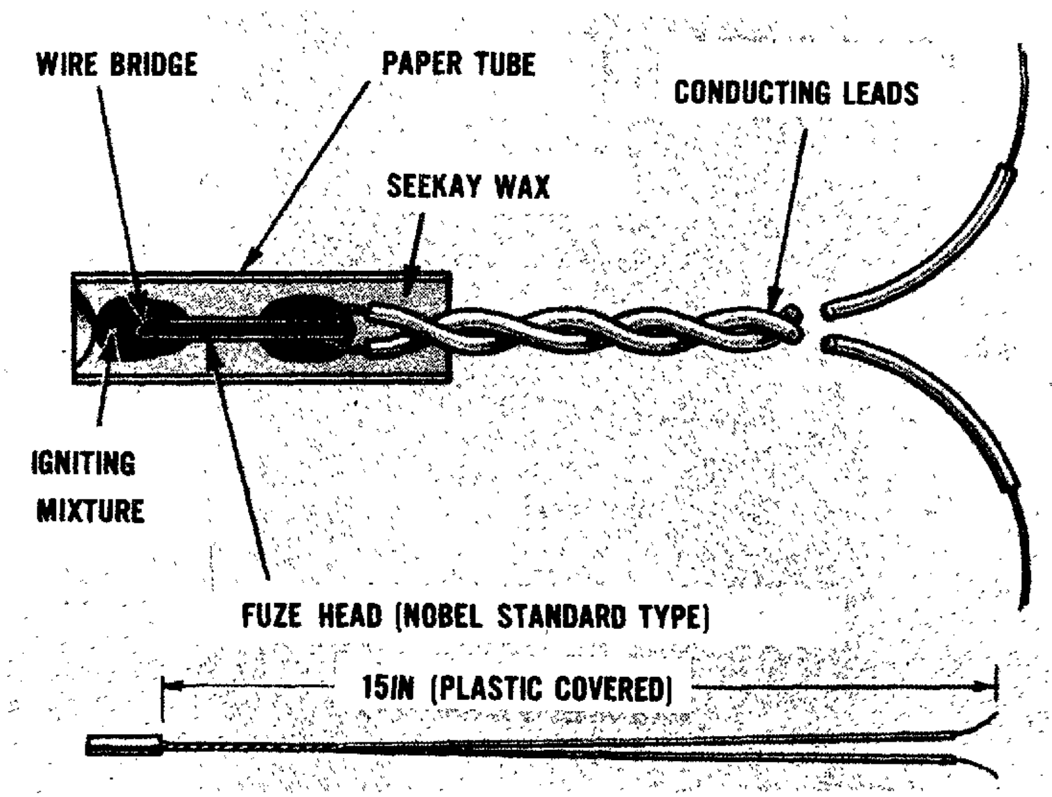

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Figure 9-2. Fuze, electric, 15 inch, No. F-53 Mk 1, general and cutaway views (U).

(C) Description

This initiator (designated a fuze in UK terminology) consists of two insulated conducting leads connected to a fuze head which carries a bridge wire surrounded by an igniting mixture. The fuze head is sealed in the paper tube (i.e., fuze body) by means of Seekay wax or other approved sealing material with the bridge wire toward the opposite end of the paper tube where leads are inserted. The leads are made of 25 SWG (0.02 in) tinned-copper wire covered by plastic insulating material. The bared end of each wire is flattened and soldered to the upper ends of the brass foil contacts affixed to a pressboard

Fuze, Electric, 15 inch, No. F-53 Mk 1
FOM No. 1375-35-3-5

(C) Description (Continued)

tube positioned in the center of the fuze head. The lower ends of the brass foil contacts are connected together by a wire bridge.

The 15-inch (381-mm)-long conducting leads are twisted together for a length of 3 inches (76.2 mm) from the point where they emerge from the paper tube. The ends of each wire are bared of insulation for a length of 1.5 inches (38.1 mm). The paper tube into which the fuze head is sealed is 0.83 inch (21.1 mm) long and 0.22 inch (5.6 mm) in diameter.

(C) Design Differences

The following fuze initiators are similar to the 15-inch No. F-53 Mk 1 electric fuze, with exceptions as noted:

- Fuze, electric, 12 inch, No. F-53 Mk 1 for use with simulator 25-pounder HE shell burst, Model L1A1 (only difference is the use of 12-inch [304.8-mm] leads instead of 15-inch [381-mm] leads).

- Fuze, electric, 21 inch, No. F-53 Mk 1 for use with charge line mine clearing, No. 1 Mk 2 (only difference is that two 21-inch [533.4-mm] cotton-covered leads are used instead of 15-inch [381-mm] leads).

- Fuze, electric, 15 inch, No. F-53 Mk 1/1 for use with igniter, electric, 3.5-inch HEAT rocket, Mk 1/2 (differs from the 15-inch Mk 1 in having two 15-inch [381-mm] 22 SWG [0.028 inch] tinned copper, polythene-covered instead of two plastic-covered 25 SWG leads).

- Fuze, electric, 30 inch, No. F-53 Mk 1 for general use (differs only in having two 30-inch [762-mm] cotton-covered leads).

(C) Application

The No. F-53 Mk 1 fuze is for general use, except in rocket motors.

Fuze, Electric, No. F-85 Mk 2
FOM No. 1375-35-3-6

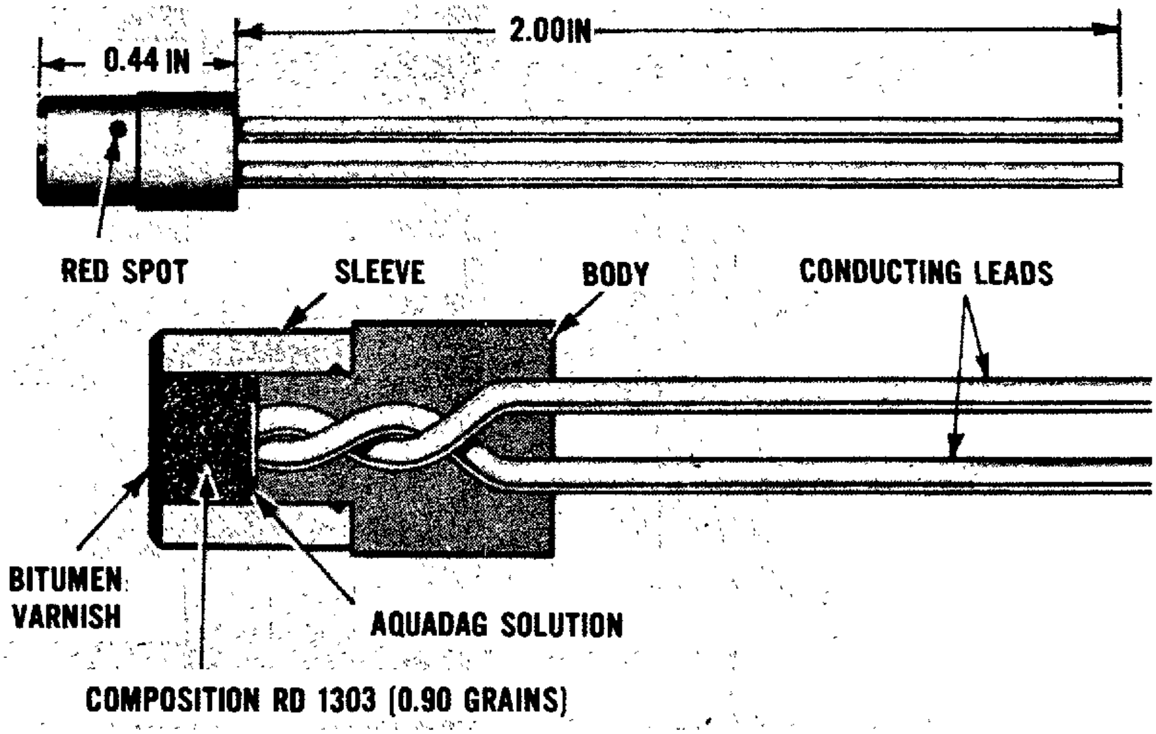

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Figure 9-3. Fuze, electric, No. F-85 Mk 2, general and cutaway views (U).

(C) Description

The No. F-85 Mk 2 electric fuze (an initiator in US terminology) consists of a spigot-type fuze body filled with an explosive compound and two conducting leads. The spigot of the body is fitted with a brass sleeve.

The fuze body is made of polystyrene plastic in the form of a cylinder with a round spigot protruding from one end. The ends of the insulated leads are twisted together and placed within the pressed explosive composition. An application of colloidal graphite is applied over the cut ends of the wires in the center of the spigot to form a conducting path.

Fuze, Electric, No. F-85 Mk 2
FOM No. 1375-35-3-6

(C) **Description (Continued)**

The brass sleeve has internal annular grooves and a small slot across one end for securing it to the fuze body. An application of adhesive-type destrene varnish is placed over the spigot prior to securing the sleeve. The end of the spigot with sleeve is then coated with a bitumen varnish sealant. The leads of 2-inch (50.8-mm) free length are bared of insulation for the last 1.5 inches (38.1 mm). The fuze head is approximately 0.5 inch (12.7 mm) in length and 0.25 inch (6.35 mm) in diameter. The fuze is identified by two red spots placed diametrically opposite on the sleeve.

(C) **Application**

The No. F-85 Mk 2 fuze is used in Gaine (i.e., booster), No. 17 Mk 1.

(C) **Remarks**

An Mk 1 fuze in the naval service differs from the army Mk 2 fuze in its explosive filler.

Fuze, Electric, No. F-92 Mk 1
FOM No. 1375-35-3-7

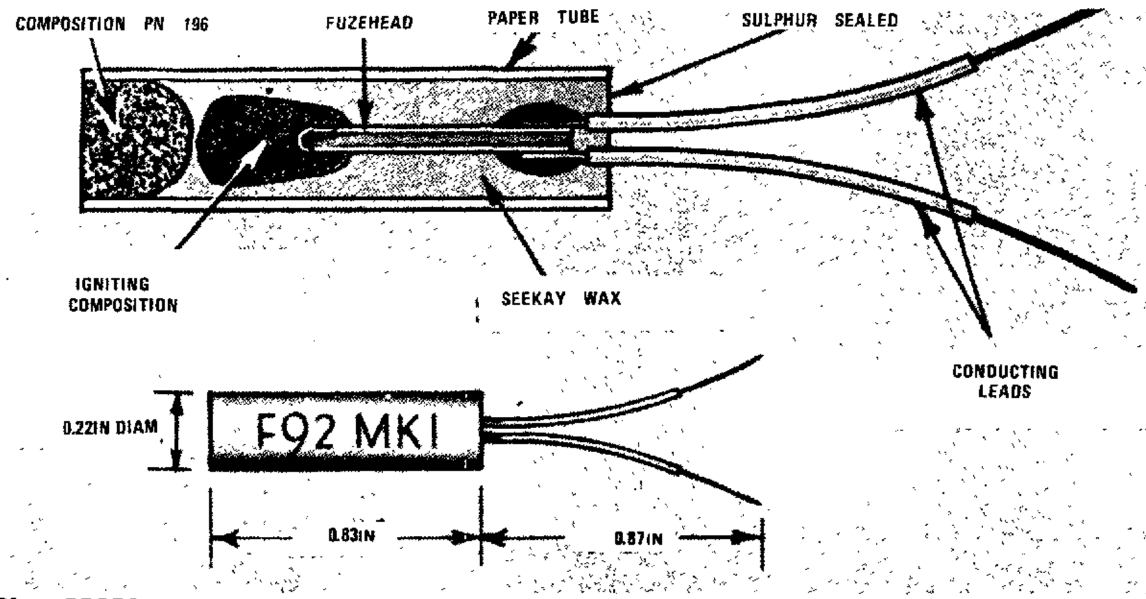

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Figure 9-4. Fuze, electric, No. F-92 Mk 1, general and cutaway views (U).

(C) Description

The No. F-92 Mk 1 electric fuze (a squib, in US terminology) consists of a paper tube (i.e., fuze body) and a Nobel-type fuze head (i.e., match head) with two conducting leads. The fuze head is sealed in the paper tube by means of a Seekay wax or other approved sealing material. The wire bridge is positioned toward the opposite end of the tube to where the conducting leads are inserted. A cavity formed at the base end of the tube contains a small charge of igniting composition. The forward end of the tube from which the conducting leads emerge is sulphur sealed. The two conducting leads are plastic covered; each is approximately 0.87 inch (22.1 mm) long. The exposed ends are bared for approximately 0.25 inch (16.35 mm). A strip of blue paper printed with the number and mark of the fuze is placed around the paper-tube body.

(C) Applications

This fuze is used with the Mk 2 igniter in smoke generator, No. 8 Mk 6.

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Fuze, Electric, No. F-101 Mk 1
FOM No. 1375-35-3-8

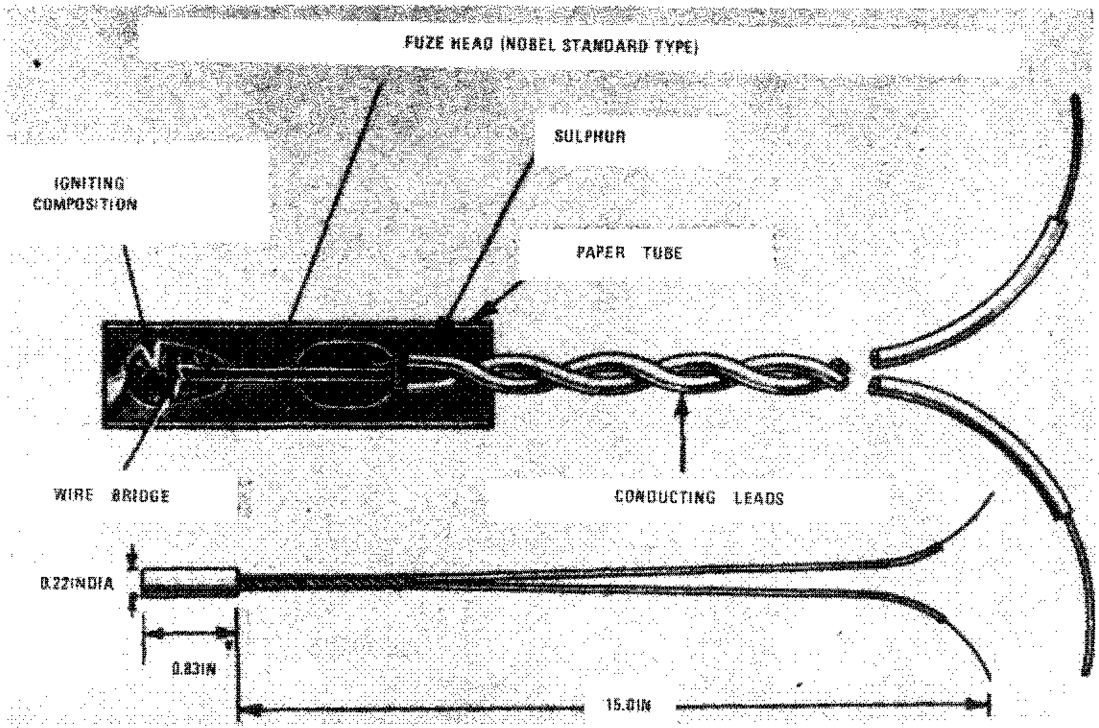

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Figure 9-5. Fuze, electric, No. F-101 Mk 1, general and cutaway views (U).

(C) Description

The No. F-101 Mk 1 electric fuze (an igniter, in US terminology) consists of a paper tube (i.e., fuze body), a fuze head (i.e., match head), and two conducting leads for electrical ignition. The fuze head is a standard Nobel type. It is positioned in the paper tube so that the wire bridge, which is surrounded by an igniting composition, is at the extreme end of the tube. The fuze head is surrounded by sulphur. The ends of the insulated conducting wires are bared and are soldered to the fuze head. The conducting leads consist of two tinned-copper, plastic-covered wires 15 inches (381 mm) long; the exposed ends of the leads are bared for approximately 1.5 inches (38.1 mm). Where they emerge from the paper tube (i.e., body), the leads are twisted for a length of 3 inches (76.2 mm), after which they are left untwisted.

Fuze, Electric, No. F-101 Mk 1
FOM No. 1375-35-3-8

(C) Application

The F-101 Mk 1 is used in electric igniter No. 84 Mk 1/1, for smoke generator, No. 24 Mk 5.

Fuze, Electric, No. F-103 Mk 3
FOM No. 1375-35-3-9

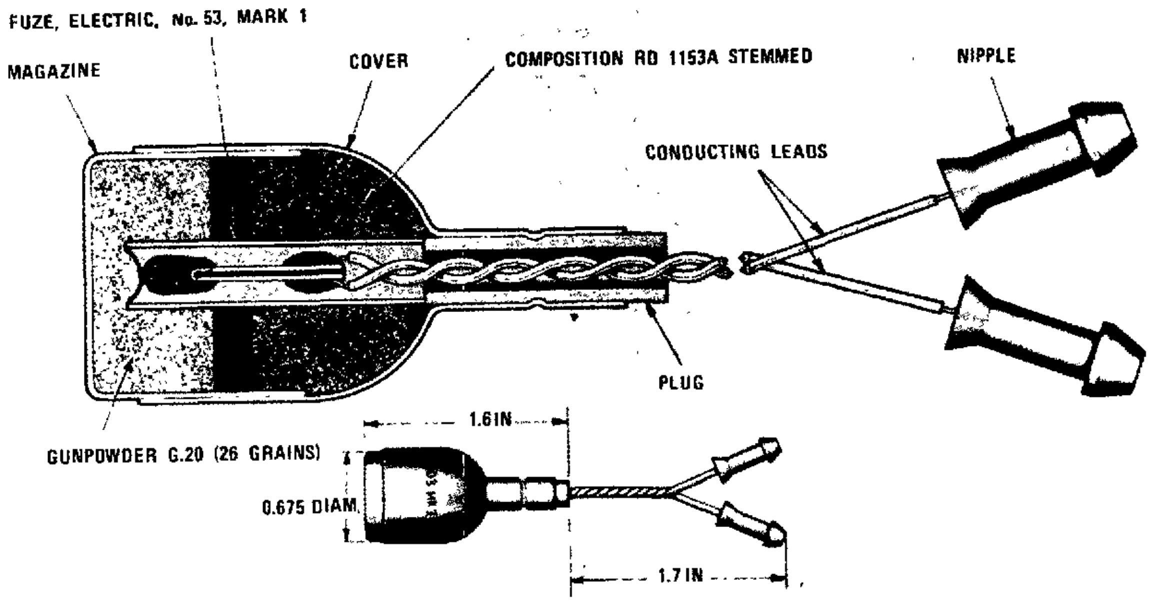

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Figure 9-6. Fuze, electric, No. F-103 Mk 3, general and cutaway views (U).

(C) Description

The Mk 3 No. F-103 electric fuze (an igniter in US terminology) consists of a brass cup-shaped magazine, brass cover, neoprene plug, and electric fuze, No. F-53 Mk 1. The two insulated conducting leads pass through the center of the neoprene plug, which is positioned in the tube-shaped portion of the cover. The ends of the leads are bared and soldered to the upper ends of the copper poles in the fuze head. The leads are secured together by twisting the wires and soldering the exposed ends to two standard connectors.

(C) Application

The No. F-103 Mk 3 is used as a means to eject grenade, No. 80 (WP), when fired from a smoke discharger.

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Fuze, Electric, No. F-111 Mk 1
FOM No. 1375-35-3-10

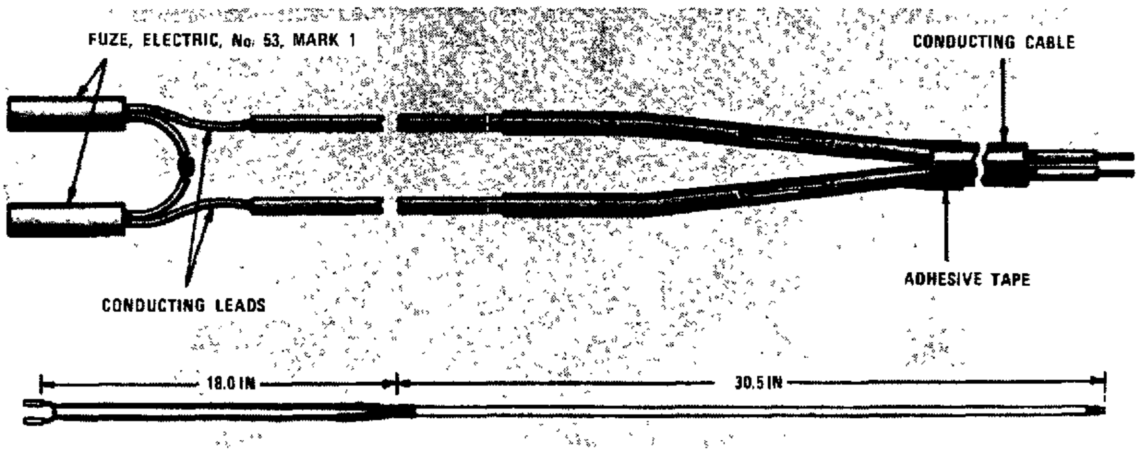

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Figure 9-7. Fuze, electric, No. F-111 Mk 1, general view (U).

(C) Description

This fuze (an igniter in US terminology) consists principally of two F-53 Mk 1 electric fuzes connected in series and joined to a conducting cable. One conducting lead of each fuze is cut about 2.5 inches (63.5 mm) from where is emerges from the fuze. Part of the insulating material is removed, and the two short wires are soldered and insulated. The two remaining cotton-covered leads, each 16 inches (406.4 mm) long, remain uncut and are shellacked up to a point where they are soldered to the rubber-covered conducting cable.

Before being soldered, an insulating sleeve 14.5 inches (368.3 mm) long is slipped over each lead. A larger insulating sleeve 3 inches (76.2 mm) long is affixed over the junction where the ends of the leads are soldered to the cable. These larger sleeves are retained in position by adhesive tape wrapped around the junction of the sleeve and cable. The end of the cable has the outer insulating cover removed for a length of 0.75 inch (19.1 mm), and the inner wires are bared of insulating covering for 0.25 inch (6.35 mm). The bared ends are then tinned.

(C) Application

The No. F-111 Mk 1 fuze is used with the 5-inch rocket motor, No. Mk 3.

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Figure 9-8. Fuze, electric, Model F-1, general view (U).

(U) Description

This general-purpose electric fuze (fig 9-8) is designed to initiate antitank or antipersonnel mines and booby traps. With the addition of simple supplemental elements, this fuze can be used as a pressure fuze for tank track mines, as a fuze for tank belly mines, or with a trip wire for antipersonnel or antivehicle mines. The metal barrel is moistureproof and is protected against corrosion; it withstands shock and vibration, and functions at temperatures from -40° to +80°C. Electrical connections consist of two flexible leads with connectors. This fuze delivers a powerful electrical impulse (10 V for 30 ms with 5-ohm output impedance) that enables the simultaneous detonation of several explosive devices from a distance. Weight is 230 grams (0.51 lb), diameter is 40 mm (1.57 inches), and overall length is 72 mm (2.83 inches). This fuze has been adopted by the French Army and is in quantity production. It is manufactured by the Centre de Recherches Industrilles et de Fabrications, in Pierrelage, France.

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Fuze, Electric, Mk F-1, Type ZB
FOM No. 1390-17-5-8

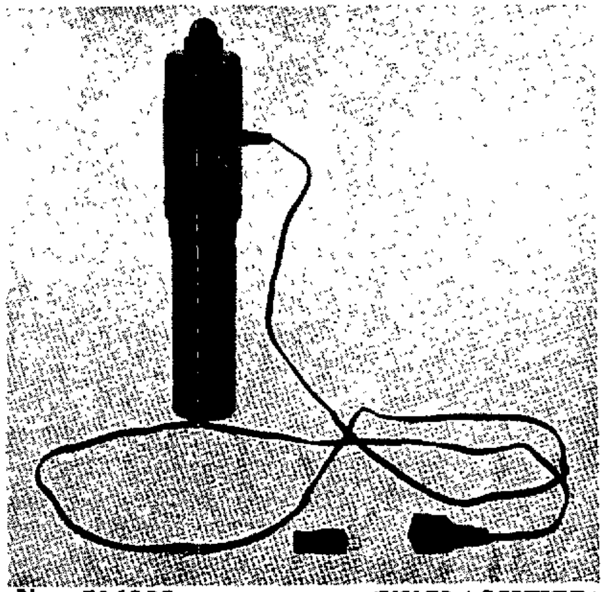

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Figure 9-9. Fuze, electric, Mk F-1, Type ZB, general view (U).

(U) **Description**

The fuze (fig 9-9) consists of a completely waterproof casing, 240 mm (9.45 in) long, 48 mm (1.88 in) diameter, weighing 150 grams (0.33 lb). Its self-contained power supply consists of two 1.5-V dry cell batteries, which provide power for continuous operation from 1 to 1.5 years at operating temperatures of -40° to +70°C. Two electric leads permit use of this fuze with either a Type A antivehicle circuit 80 meters long or a Type B antipersonnel circuit 200 meters long. Safety is provided by a short-circuiting jumper on the firing circuit. The fuze is armed by removing the jumper. This fuze can be used with various types of antitank, antipersonnel, and illuminating mines. The fuze, produced by Societe E. Lacroix of Muret, France, has been adopted by the French Army.

(U) **Functioning**

The fuze functions when the two-wire trapping circuit is cut.

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ELAR

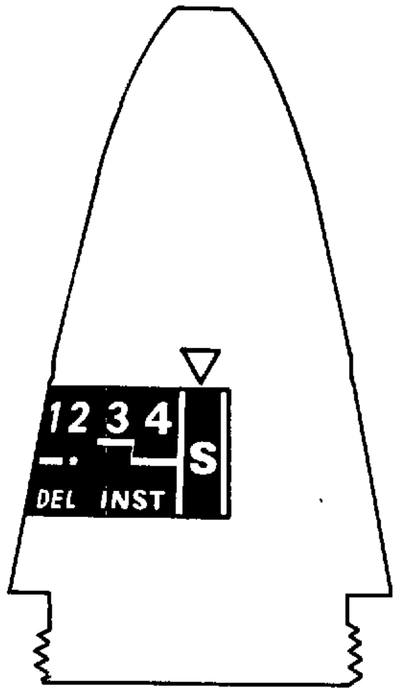

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Figure 9-10. Fuze, electric, impact Model ELAR (U).

(U) Description

The ELAR fuze (fig 9-10) is a delayed-arming electric fuze that functions upon impact. It is similar in design to the Swedish proximity fuze, ZELAR, except that it does not contain the electronic part for proximity functioning. The ELAR has four different settings for functioning upon impact: short delay, long delay, instantaneous high-sensitivity action, and an instantaneous low-sensitivity action.

Fuze, Electric, Impact, Model ELAR
FOM No. 1390-19-1-6

(U) **Characteristics**

Weight	900 grams (1.98 lb)
Thread size	1.5-inch diam; 20 TPI
Operating temperature	-40° to +60°C
Min acceleration	1,500 g
Min rotation	2,400 r/min
Min delayed arming	75 m

Fuze, Electric, SSQ, Mk 669
FOM No. 1390-37-3-1

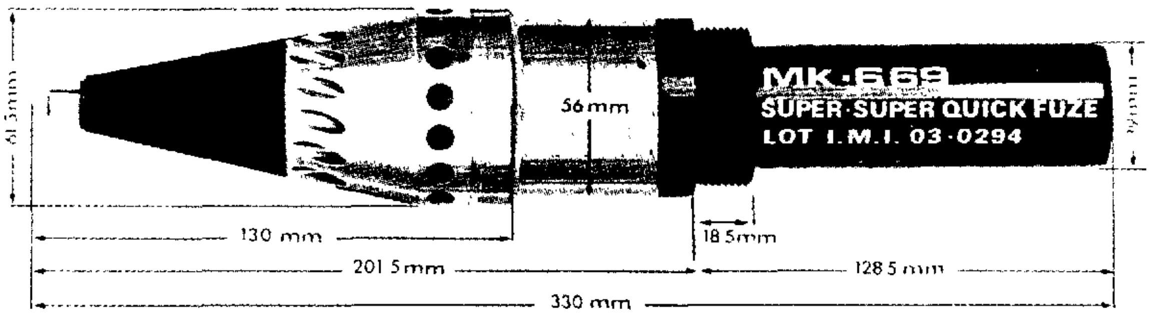

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Figure 9-11. Fuze, electric, SSQ, Mk 669, general view (U).

(U) Description

The Mk 669 fuze (fig 9-11) is a standard delayed-arming, self-charging, electro-mechanical fuze designed for an SSQ action of 50 μs upon impact. It was developed by IMI of Israel for use with bombs; however, it can be modified for use with mortar projectiles or rocket warheads.

(U) Unique Features

- Turbo-generator power source.
- Self-charging firing capacitor.
- Triple delay arming process.

(U) Characteristics

Fuze assembly:

Body material	?
Weight	0.97 kg (2.13 lb)
Markings	Mk 669
Length	330 mm (12.99 in)
Max diam	61.5 mm (2.42 in)
Thread size	2 in-12 UNS (50.8 mm)

Fuze, Electric, SSQ, Mk 669
FOM No. 1390-37-3-1

(U) Characteristics (Continued)

Booster:

Body material	?
Body length	128.5 mm (5.06 in)
Explosive	?
Explosive weight	?

Functional data:

Arming method	Electrical & acceleration
Firing method	Electromechanical
Safety devices	See safety paragraph
Arming distance	?
Arming time	3.2 to 4 s

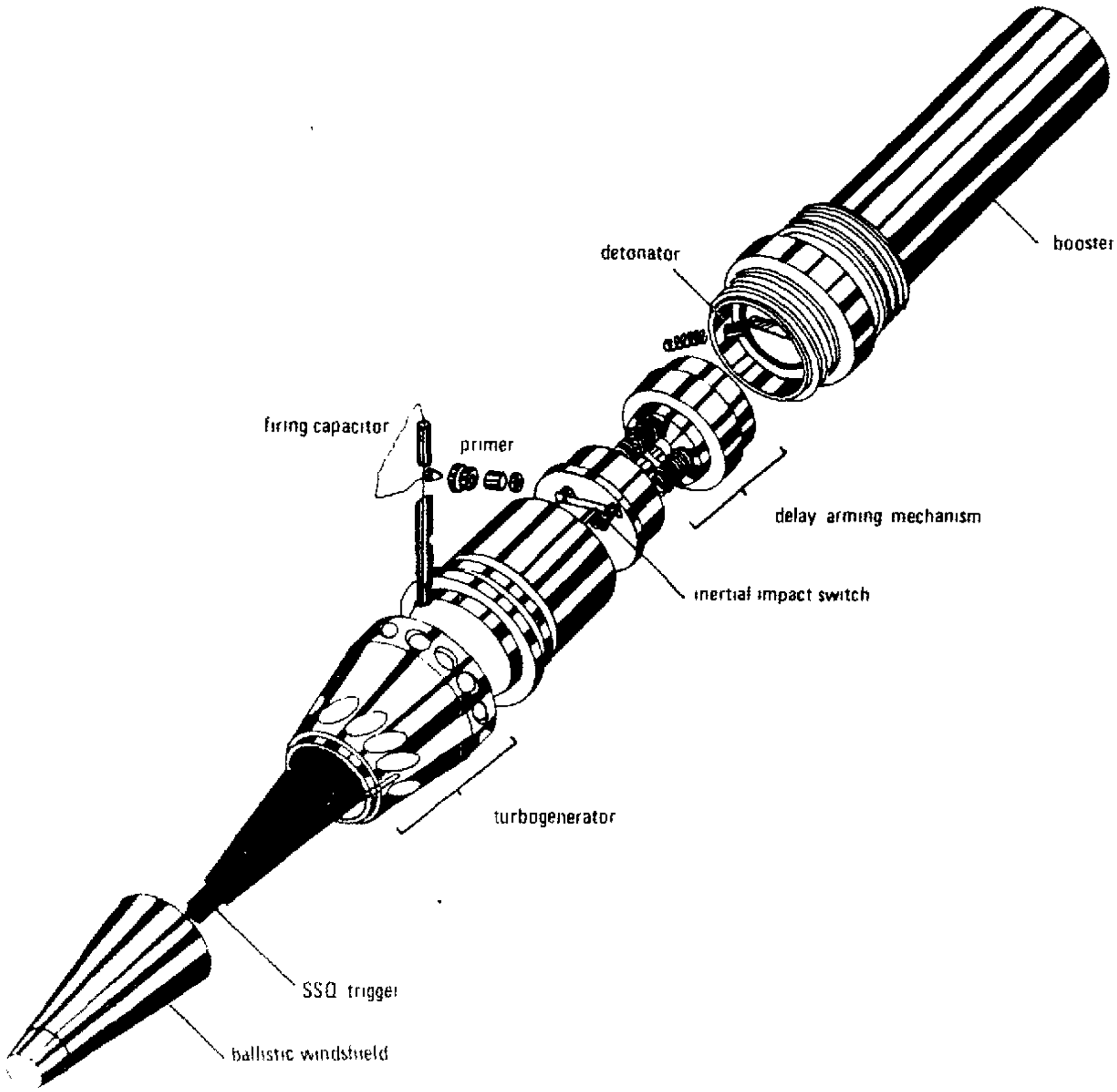

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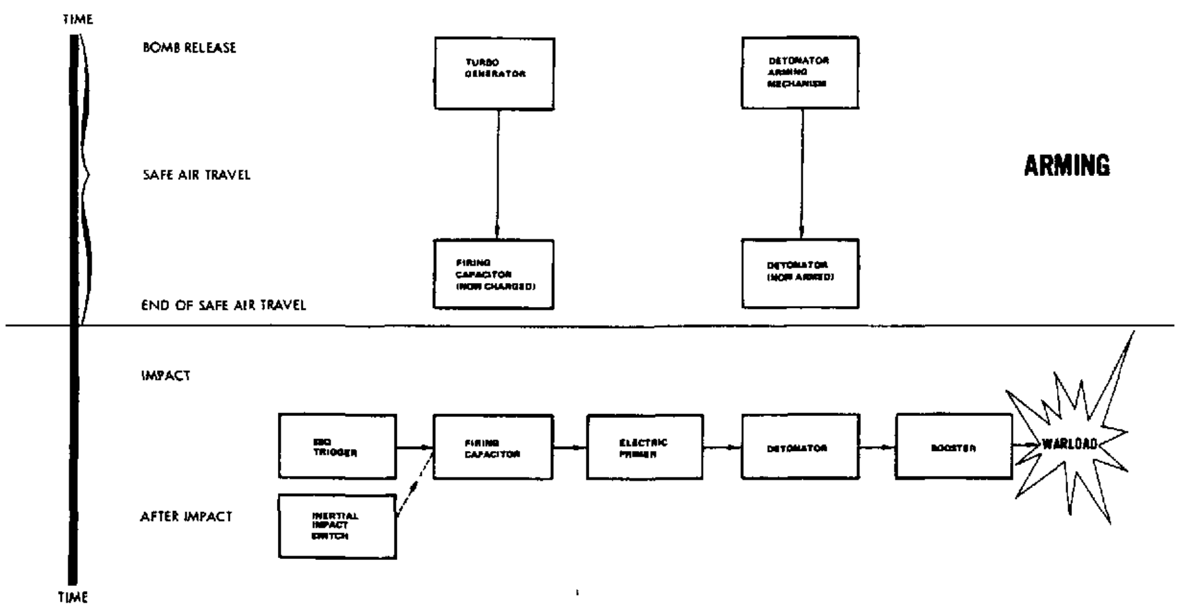
Figure 9-12. Fuze, electric, SSQ, Mk 669, exploded view (U).

Fuze, Electric, SSQ, Mk 669
FOM No. 1390-37-3-1

(U) Design Details

The Mk 669 fuze (fig 9-12) consists primarily of a turbo-generator, firing capacitor, electric primer, SSQ trigger and inertial impact switch, delayed-arming mechanism, detonator, and booster.



DETONATION

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Figure 9-13. Fuze, electric, SSQ, Mk 669, functioning sequence (U).

(U) Safety Factors

The following safety factors have been built into the design of the Mk 669.

- **Detonator Safety.** The components of the firing train remain unaligned until after bomb release. Mishandling on the ground will not result in premature detonation.

(U) Safety Factors (Continued)

- **Arming wire safety.** When the Mk 669 is housed in the bomb nose, the aircraft arming wire prevents any stage of arming–including the flow of electric current–until after release.

- **Shear safety.** The fuze will not arm in the event of damage to (or even the complete shearing of) fuze components. This has particular relevance for bomb loads carried externally.

- **Electrical safety.** As the fuze's electricity supply is not drawn from the aircraft, no charge is supplied before the bomb is dropped; the fuze's generator begins functioning only after release.

- **Arming delay.** No part of the arming sequence commences before the bomb has been dropped. On release, 3.2 to 4 seconds of air travel–at a minimum velocity of 100 m/s–are required before arming is complete. At the end of the safe air travel, the following three delayed-arming processes have taken place:

  1. The firing train components have been aligned.

  2. The firing capacitor has been charged.

  3. The backup inertial impact switch may be considered armed once the capacitor has been charged.

(U) **Packing**

The Mk 669 fuze is packed in individual hermetically-sealed containers and are packed 12 per wooden case.

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Section X.

DEVELOPMENTAL TRENDS

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(a)

Section X.

DEVELOPMENTAL TRENDS

1. (U) General

Several free world countries—e.g., France, Switzerland, Sweden, Israel, Norway, United Kingdom, Belgium, Italy, Spain, and the Netherlands—are actively engaged in fuze development efforts. These developments, primarily undertaken to meet the specific military requirements of the nations involved, are directed toward improving the safety, reliability, and maintainability of fuzing. Fuze standardization is also a major consideration; fuze cost and inventory are being reduced by using common parts and/or by incorporating multipurpose roles into a single fuze.

2. (C) Point Detonating Fuzes

(U) With the several fuze developments undertaken for bombs, artillery, rockets, mortars, small arms (20 thru 30 mm), and recoilless high-explosive and smoke ammunition applications, the preponderance of developments are for mortar and antiaircraft ammunition.

a. (U) **PDSD Fuzes for Antiaircraft Weapons.**

(1) (U) French PDSD fuzes developed for antiaircraft munitions reflect such current state-of-the-art features as mechanical self-destruction through spin decay by means of arming balls. Bore and muzzle safety are achieved by way of an arming coil and an out-of-line detonator rotor. Using these tested and proven elements, French developmental work is directed toward design refinement to provide increased arming distance, improved safety and reliability, and reduced cost through parts commonalty and automated production. No radical departures in design or concept are involved; the French apparently consider their goals in fuze design achievable within the current state-of-the-art. (See app I for current characteristics of French PDSD fuzes.) Some improvements, such as a double-ended, dual-detonator rotor with a high-quality surface finish to reduce friction, are worth noting.

(2) (U) The Diehl firm has been notably prolific in developing PDSD fuze design variations to meet specific requirements. The more recent designs incorporate an arming coil and detonator rotor to provide detonator, bore, and muzzle safety, but continue to use a shutter-type mechanical self-destruct mechanism instead of arming balls. Also of interest is the joint US-West German production of the Diehl-designed M594 fuze for 20x139-mm cartridges. German fuzes are well within the current state-of-the-art and do not incorporate any novel features.

(3) (U) With the competition that existed between the Oerlikon and Hispano-Suiza firms until their merger, a wide variety of improved fuze designs were developed that influenced foreign fuze design, notably in France and Israel, and to some degree in the United Kingdom. Several countries have made Oerlikon and Hispano-Suiza fuzes under license. Since 1973, Oerlikon has had underway a development program intended to replace some 20 conventional fuzes with two basic types, involving parts commonalty, which will serve all calibers from 20 mm to 35 mm. The proposed schedule is given below:

Time Schedule for OERLIKON Standard Fuze Program

Mechanical Standard Fuzes	1973	1974	1975	1976	1977	1978	1979	1980
35-mm nose fuze for KDA/353MK system	xxxo	ooo -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
35-mm base fuze for KDA/353MK system	xxxx	xooo	o - - -	- - - -	- - - -	- - - -	- - - -	- - - -
30-mm nose and base fuze for KCA/HS831/ RARDEN system	xxxx	xooo	oo - -	- - - -	- - - -	- - - -	- - - -	- - - -
30-mm nose and base fuze for DEFA/ ADEN systems	xxxx	xxxo	oooo	- - - -	- - - -	- - - -	- - - -	- - - -
25-mm nose fuze for KBA system	xxoo	ooo -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
25-mm base fuze	xxxx	xooo	o - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20-mm nose fuze for 693 system,	oo - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
for HS820 system,	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
for 5TG/ 203GK system	oooo	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20-mm base fuze for 5TG/ 204GK system	xxoo	oo - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -

Key:

xxxx Development
oooo Pilot lot
- - - - Serial production

o or x = 1st quarter
oo or xx = 2d quarter
ooo or xxx = 3d quarter
oooo or xxxx = 4th quarter

As part of a new program, Oerlikon in 1973 started developing a new family of fuzes whose functioning—arming, muzzle safety, sensitivity and delay on impact, and self-destruction—would be controlled by electronic elements. These PDSD fuzes are designed for use in projectiles for 27 mm through 35 mm. A follow-on second-generation series of fuzes utilizes electronics to program fuze functioning upon exit from the muzzle of the gun. Electronic circuitry is expected to provide increased safety in storage and handling, more accurate timing, and adjustable sensitivity regardless of environmental conditions.

(4) (U) The Netherlands fuze effort in the 20- to 30-mm range has hitherto been limited to production of Hispano-Suiza fuzed ammunition at that firm's branch at Breda. In 1974, however, Eurometaal started development of a medium-caliber (25- to 35-mm) PDSD fuze of novel design that has only two moving parts. The fuze has an out-of-line detonator in a ball rotor; a pyrotechnic self-destruct mechanism initiated by setback; and a pyrotechnic impact delay element to insure penetration of the target before the projectile's HE charge is detonated. The key feature of this fuze is use of fluidics, in this case a liquid to control fuze functioning. Details of construction are of a proprietary nature.

(5) (U) BPD of Italy and Bofors of Sweden have also developed PDSD fuzes which are competitive with Oerlikon. Their developments reflect such current state-of-the-art features as the use of mass in the form of balls instead of springs to displace the striker or firing-pin assembly. The latest Italian and Swedish PDSD developments for the L60 40-mm AA gun are well-engineered designs with excellent delay arming, post-impact delay, obliquity, graze, and self-destruct features. Some of the Swedish developmental effort has been directed toward satisfying customer requirements. (See app II, Evolution of Bofors PDSD fuzes.)

b. (C) PD Fuzes for Mortars.

(1) (U) In the area of PD fuzes designed for mortar projectiles, most of the foreign development efforts have been directed toward providing a graze-sensitivity feature, increasing arming distance (i.e., muzzle safety), assuring safety against double loading, providing positive safety for parachute delivery, improving bore safety, increasing functioning reliability, and improving terminal ammunition effectiveness.

(2) (U) In their latest PD mortar fuze development, Tavaro of Switzerland uses a runaway-type escapement to delay the arming of the fuze, with a considerable increase in arming distance assuring greater muzzle safety. In addition, a unique carrier housing two primers and delay charge, coupled with dualized firing pins for instantaneous or delay action, increases functioning reliability. Bore safety is achieved via a spring-loaded slider housing an out-of-line detonator. The slider's movement is controlled via the escapement.

(3) (U) SNEM of France, Junghans of West Germany, and Oerlikon of Switzerland employ similar fuzing technology with some minor differences. For example, Oerlikon uses a double detent system to assure positive safety for parachute delivery, whereas Junghans uses a pull wire that locks the delay-arming mechanism and firing-pin assembly.

(4) (C) Spain, Italy, the United Kingdom, and Israel have also been prolific in their PD mortar fuzes, which reflect current state-of-the-art with some unusual features. Israel, for example, in order to increase the effectiveness of their 120-mm mortar ammunition, went to the use of a telescopic metal probe stand-off to give an airburst similar to that of proximity fuzing which is more costly to manufacture. Other features incorporated are concrete-piercing and delay-functioning modes, which provide a multipurpose fuze and eliminate the need for other PD fuze developments.

(5) (U) For graze-sensitivity action, Junghans of West Germany uses a protruding striker/head whereas France employs a conical "V"-shaped block for camming the striker and inertial-type primer holder assembly when the projectile impacts at a grazing angle.

(6) (U) A unique feature developed by Spain for their PD mortar fuze is a sharp needle that protrudes above the striker's closure cap. This needle, which is both visible and can be felt by the hand in the dark, warns that the fuze is armed.

c. (U) **Fuzes for Artillery Projectiles, Rocket Warheads, and Bombs.**

(1) (U) With the exception of Switzerland, the United Kingdom, Israel, and Italy, very little effort is being expended on PD fuzes for artillery projectiles, rocket warheads, and bombs. Most countries have relied on current US fuzing and/or modified existing US fuzing.

(2) (U) In the area of developments to meet new requirements for rockets, Fratelli and Borletti of Italy have developed a setback-armed PD fuze with a delayed-arming mechanism and a graze-sensitivity feature to replace existing fuzes used with the US XM151 2.75-inch aircraft rocket. In addition, Borletti has modified this fuze design for Spain. The modification involves centrifugal force and reportedly improves the accuracy of the US-designed 2.75-inch rocket by rotating the rocket in flight.

3. (C) Point Initiating, Base Detonating Fuzes

a. (C) Sweden, France, West Germany, the United Kingdom, Japan, and Belgium have been the most active of the free world countries in developing PIBD fuzes to meet their military requirements, with the preponderance of the developmental effort directed toward shaped-charge (HEAT) munitions for shoulder-fired weapons and/or ATGM. Except for Belgium, with their HEAT grenades, most fuzing designs undertaken utilize the principles of electro-mechanics, incorporate S&A devices, employ redundancy in design for greater reliability, and use bleeder-resistor piezoids coupled with hot-wire bridge detonator technology for quicker reaction time, resulting in better shaped-charge efficiency.

b. (U) Belgian efforts to date, most likely because of cost considerations, have been improvements in the older spitback PIBD fuzing technology. Included are anti-richochet features with fuze arming by setback and inertia during acceleration of the warhead. Techniques to enhance safety include the use of detent balls and an arming sleeve.

c. (C) France perhaps has been the most prolific free world country in their development efforts; in fact, their fuze technology surpasses all known foreign state-of-the-art. Their design objectives have been directed toward increased reliability, safety, and minimization of costs. The use of a piezo-generator function precludes the need for a graze mechanism and arming delay timer, thereby reducing the cost and complexity of the base portion of the fuze. The use of rocket motor pressure as an arming sensor coupled with a bore-rider technique enhance safety. Increased reliability is obtained by the use of an impedance matching transformer that effectively couples a high-impedance piezoid with a low-impedance detonator. A lead zirconate-titanium crystal silverplated on both sides results in a high-energy crystal that is self-rectifying. In addition, their hot-wire bridge technology, which includes a twin pin in an ungrounded case with an excellent explosive output, results in reliable initiation of a booster without the need for a lead charge. In their ATGM PIBD fuzing, the French utilize a unique delay-arming technique based on gas pressure generated during firing and a mechanical timer. A self-destruct feature has been added for increased safety.

d. (C) Swedish, UK, and Japanese efforts in PIBD fuzing systems reflect current state-of-the-art similar to US technology. FFV of Sweden, in their latest fuzing development efforts for their Carl Gustav recoilless HEAT munitions, are using a series of piezo-electric crystals and a diode in the flat of the projectile. The use of a diode is an inexpensive technique to provide a brush or graze-sensitivity feature without adding complexity to the design, whereas the use of a series of crystals in the flat of the projectile enhances reliability in that the fuzing cannot be defeated by unconventional or bar armor.

4. (C) Base Detonating Fuzes

a. (U) The United Kingdom, Switzerland, and Sweden have been the most active of the free world countries in developing BD fuzes to meet their military objectives as well as various customer requirements. Most fuzing designs reflect current state-of-the-art and use the principles of mechanics or electro-mechanics, incorporate pyrotechnic delay functioning, self-destruct functioning, graze-sensitivity functioning, instantaneous functioning, and brush discrimination. Most development efforts have been directed toward enhancing safety and increasing functioning reliability and terminal effectiveness.

b. (U) UK efforts to date have been directed toward providing adequate delay functioning to assure that their tank-fired HESH projectile spreads effectively on the armor surface prior to detonation for efficient spalling action.

c. (U) Swedish and Swiss efforts have been directed toward providing adequate delay of the fuze to insure proper penetration of the armor prior to detonation of the aluminized RDX high explosive. These fuze developments have been undertaken for use with APHEI projectiles fired from AA guns. Developmental efforts include adequate safety and arming techniques, proper bore and detonator safety, and adequate self-destruct times for increasing safety to ground crews.

d. (C) Sweden's BD fuze design for shaped-charge munitions surpasses that of other known foreign state-of-the-art. Current designs incorporate unique features and utilize electro-mechanical principles. Unique features include a ball-metering technique considered comparable in accuracy to a runaway escapement employed for delayed arming. In addition, a piezoid with a bleeder resistor mounted in the base of the projectile and excited upon impact with the target is also unique. The use of a diode is an excellent technique to provide for brush discrimination.

5. (U) Time Fuzes

a. Sweden, France, Switzerland, the United Kingdom, and West Germany have been the most active of the free world countries in the development of time fuzes for controlled-fragmentation munitions, for improved conventional munitions (ICM), and for high-explosive munitions and illumination munitions. Efforts have been directed toward developing an accurate timer and a fuze that can be readily set. Other areas being worked on are increased safety and reliability as well as an efficient backup impact function.

b. Dixi and Tavaro of Switzerland have been more prolific in their developments than other designers such as Thiel of Sweden and Junghans of West Germany.

c. Although Japan has relied on current US fuzing, they are working on an electric time fuze with a quartz oscillator for use with their ICM-type rocket development. To date, there has been no evidence of any concentrated effort to replace mechanical timers with electronic timers. Electronic timers offer better accuracy up to 0.1-second standard deviation over a 200-second time of flight compared to 0.2-second for mechanical timers over a 75-second time of flight.

6. (C) **Proximity (VT) Fuzes**

a. (U) The United Kingdom, Sweden, Norway, Israel, France, and the Netherlands have been the most active of the free world countries in developing doppler, infrared, and capacitance-type proximity fuzing. In the area of doppler-type VT fuzing, Kongsberg of Norway has been the most prolific in their developments, whereas in infrared-type fuzing France has developed a unique active infrared technique. As regards capacitance-type fuzing, Sweden has successfully developed a low-airburst type.

b. (U) Current efforts in proximity fuze developments have been directed toward improved antennas, improved infrared techniques, and improved electronics with a trend toward converting tube types to transistorized versions using integrated circuit chips and encapsulation technology. The net effect of this trend is to reduce fuze cost and physical size.

c. (C) As regards improvements in chemical battery technology, the Netherlands is considering liquid ammonia in a glass ampoule to replace zinc-carbon energizers that are known to deteriorate in storage. To increase fuze shelf life, Kongsberg has developed a mechanical means of powering VT fuzes by utilizing a turbine-generator concept. This concept allows the conversion of kinetic energy into mechanical and electrical energy needed for arming and functioning of the fuze's electronic package.

d. (C) In infrared fuzing, the British have solved the problem of sun and target discrimination by the use of interference filters and dual-channel operation, one for target identification and the other for sun interference. In addition, the temperature change problem affecting detection sensitivity was solved by using a Thompson Cryostat for cooling to a fixed value. Currently, France has developed a unique active infrared technique for their Crotale SAM.

e. (U) Other areas of development for increased safety and reliability are redundancy in design and the use of dualized electric squibs and S&A devices, as well as improved backup functions such as using an electric switch in the nose to replace an inertial-type switch which has a slower SQ function.

f. (C) For indirect fire roles, most countries are relying on electronics functioning in the downward trajectory of the projectile or warhead's flight, making detection unwieldly because of the required costly, sophisticated, high-powered countermeasure equipment that would be used on the battlefield. Work on an accurate timer is being pursued which would allow turning on the electronics as late as possible in the downward trajectory.

g. (C) To date, no electronic counter countermeasure (ECCM) techniques have been included in VT fuzes. The Netherlands, however, is conducting research for ECCM for their Nina fuze, while Sweden is doing the same for the Zelar.

7. (C) **Mine and Grenade Fuzes**

a. (U) Except for West Germany, the United Kingdom, and France, not much development effort has been expended by free world countries on mine and grenade fuzing. Most countries are apparently content with the current state-of-the-art contact sensing for pressure-active mine fuzing and pyrotechnic-delay time for grenade fuzing.

b. (C) In the area of mine fuzing for ICM-type minelets, several years ago West Germany in conjunction with France experienced problems with self-sterilization minelet fuzing for their MARS ICM rocket program. To date, there has been no evidence to indicate any concerted effort to develop self-sterilization or influence fuzing for ICM-type minelets used for seeding a minefield.

c. (U) As regards most land mine fuzing for either antipersonnel or antitank application, efforts have been directed toward increased safety, increased reliability, and elimination of all metallic components to preclude detection.

d. (U) As with mine fuzing, very little effort has been expended on grenade fuzing developments. UK efforts have included improvements in safety via modification to the fly-out lever, striker mechanism and fuze body, whereas West Germany and, in particular, Diehl, is currently developing fuzing with more efficient or accurate pyrotechnic delay time as well as incorporating a detonator safety for greater protection to the infantry man throwing or launching the grenade.

8. (C) **Electric Fuzes**

a. (C) Israel and Sweden are the only countries currently working on electric fuzes. Israel has developed an electric fuze, Model MK 669, for an SSQ action, bridging the gap between the SQ PD fuze and the VT or proximity fuze.

b. (C) The MK 669 fuze uses a turbine generator for charging a firing capacitor, eliminating external arming vanes or battery power onboard the projectile or bomb.

c. (U) Swedish efforts have been as a result of their Zelar multipurpose VT fuze development, wherein the electronic package is removed and the fuze, designated ELAR, becomes an electric fuze.

d. (C) Israel claims tenfold increase in effectiveness of their ammunition on SQ action of 50 μs upon impact, resulting in a semiairburst of the projectile, bomb, or warhead.

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APPENDIX I.

CURRENT CHARACTERISTICS OF FRENCH PDSD FUZES, 20 TO 30 MM

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APPENDIX I.

CURRENT CHARACTERISTICS OF FRENCH PDSD FUZES, 20 TO 30 MM

1. (U) General

a. French fuze development in the 20-mm to 30-mm field is directed toward commonalty of design and components, adjusted to the specific weapon environment by minor variations in components, and produced and assembled by automated procedures.

b. The French claim that when the ball rotor is given a very fine surface finish, the arming time is increased significantly.

c. Current French production identification of fuzes is as follows:

Example – FUPIA-F3

FU	P	I	A	F3
Fuze	Percussion	Instantaneous	Self-destruct	Consecutive modification in fuze design

2. (U) 20-mm Fuzes

a. **Fuze, PDSD, Model 711 (20 FUA 711).** Designed for 20x102-mm cartridges (M50 type), this is a conventional fuze that incorporates an out-of-line detonator in a ball rotor, an arming ball self-destruct mechanism, and an arming coil to provide delayed arming. The fuze functions instantaneously against target material corresponding to or greater than 0.5-mm (0.019-in) aluminum or paperboard weighing 1000 g/m^2 (0.0014 lb/in^2). It will not function against paperboard weighing 200 g/m^2 (0.00028 lb/in^2), which corresponds to water drops of about 2-mm (0.079-in) diameter. Delayed arming provides muzzle safety to a minimum of 5 meters. The fuze is reported to function reliably at angles of obliquity as great as 85°. Self-destruction occurs after a time of flight of about 6 seconds. This fuze was reported to be in production in 1974.

b. **Fuze, PDSD, Model 732 (20 FUA 732).** Designed for 20x139-mm cartridges of the HS 820 pattern, to be fired from gun tubes with 7° rifling (French M693 [F-1] automatic gun), this fuze is adaptable to guns with 5° or 6° rifled tubes such as the West

German Rh-202 and the US M139 guns. The 732 fuze is similar in design to the 711 fuze, except that the ball rotor contains two detonators. In the unarmed state, the rotor is held in a horizontal position, 90° out of line with the fuze axis. Either end of the rotor may act as the initiator, while the other detonator propagates the explosive train into the booster. The 732 fuze has a muzzle safety distance of 15 meters.

c. **Fuze, PDSD, Model 723 (20 FUA 723).** This fuze is under development as a common fuze for 20x102-mm and 20x139-mm cartridges, fired from gun tubes with 7° rifling; it is also adaptable to 5° or 6° gun tubes. The 723 fuze has been designed to simplify manufacture and reduce production costs; the two detent weights that retain the rotors of the 711 and 732 fuzes in the unarmed position have been replaced in the 723 fuze by a simple split ring.

3. (U) **30-mm Fuzes**

Fuzes for 30-mm automatic guns are similar in design to the 20-mm fuzes, but differ in details due to the wide variation in gun environments between the 30x170-mm AA gun and the 30x113B DEFA aircraft gun. Both fuzes resemble the 711 fuze in design in that the ball rotor contains just one detonator and is secured in its out-of-line position by two detent weights; both 30-mm fuzes also retain the excellent muzzle safety characteristics of the 20-mm fuzes.

a. **Fuze, PDSD, Model 691 (30 FUA 691).** This fuze, designed for the high-performance 30x170-mm ammunition of the HS 831 gun, is now in production. No data on functioning or self-destruct time are available.

b. **Fuze, PDSD, Model 694 (30 FUA 694).** This fuze is designed for use in air-to-air HEI cartridges for the 30x113B DEFA aircraft gun, 30/550 series. Work is underway to modify this fuze design to provide a delay element of 50 to 60 μs delay after impact, to permit penetration of aircraft skin before detonation.

APPENDIX II.

EVOLUTION OF BOFORS PDSD FUZES

NO FOREIGN DISSEM

CLASSIFIED BY CDR, USAFSTC
SUBJECT TO GDS OF EO 11652
AUTOMATICALLY DOWNGRADED AT
TWO YEAR INTERVALS
DECLASSIFY ON. 31 DEC 80

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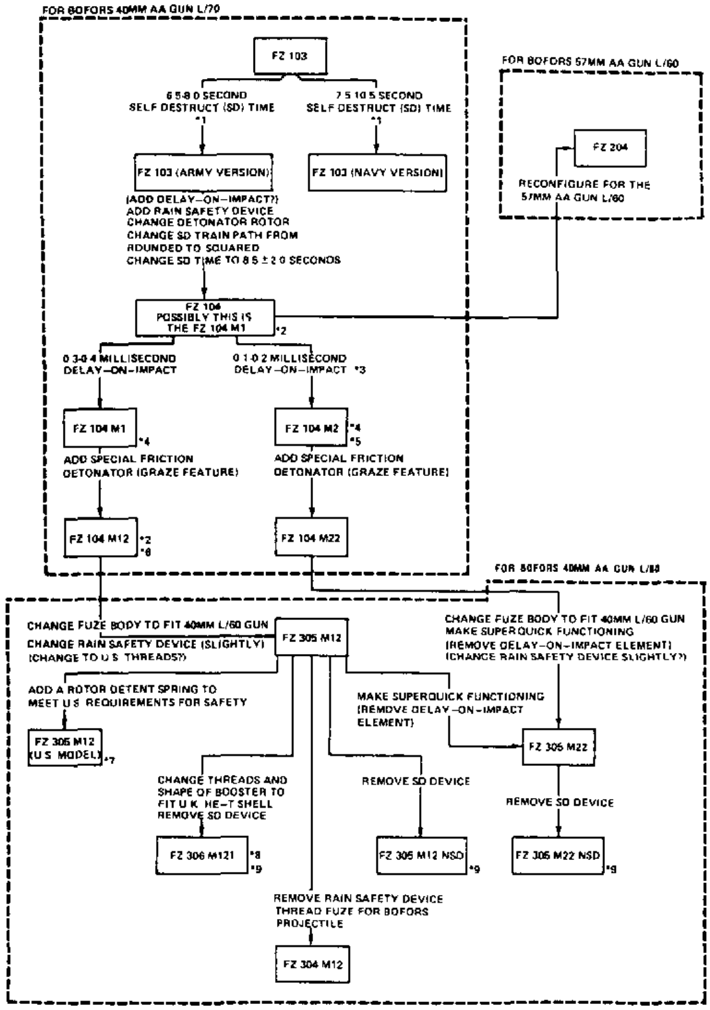
APPENDIX II.

EVOLUTION OF BOFORS PDSD FUZES



SOURCE COMPILATION OF DATA EXTRACTED FROM APPROXIMATELY 20 DOCUMENTS AVAILABLE TO US SCIENTIFIC AND TECHNICAL INTELLIGENCE ELEMENTS

NOTES

1 THE ARMY AND NAVY VERSIONS OF THE FZ 103 MAY USE DIFFERENT BOOSTERS. BOTH APPARENTLY FUNCTION SQ.

2. GIVEN NATO "SYMBOL OF INTERCHANGEABILITY" IN 1960. IN ORDER TO MAINTAIN THIS SYMBOL, PERIODIC PRODUCTION AND USER TESTS MUST BE CONDUCTED FUZES FZ 104 AND FZ 104 M12 HAVE MAINTAINED THEIR APPROVED STATUS CONTINUOUSLY AT LEAST INTO 1974 (LATEST INFORMATION AVAILABLE TO THIS OFFICE)

3 POSSIBLY THIS IS AN SQ FUZE, WITH 0.1-0.2 MS BEING FUNCTIONING TIME.

4. FZ 104 M1 AND FZ 104 M2 DIFFER ONLY IN DELAY-ON-IMPACT TIMES

5 WEST GERMAN DESIGNATION IS AZZ DM 91

6 UK STANDARD FUZE DESIGNATION L 41 A1

7. EXTENSIVELY TESTED BY PICATINNY ARSENAL AND RECOMMENDED FOR US ADOPTION (NOVEMBER 1973) NOT ADOPTED AS YET (2 APRIL 1975)

8. MAY BE UK STANDARD FOR USE IN THE 40MM AA GUN L/60

9. PD FUZE, NOT PDSD

(CONFIDENTIAL-NFD)

NO FOREIGN DISSEM

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APPENDIX III.

EVOLUTION FROM NVT-2 PROTOTYPE

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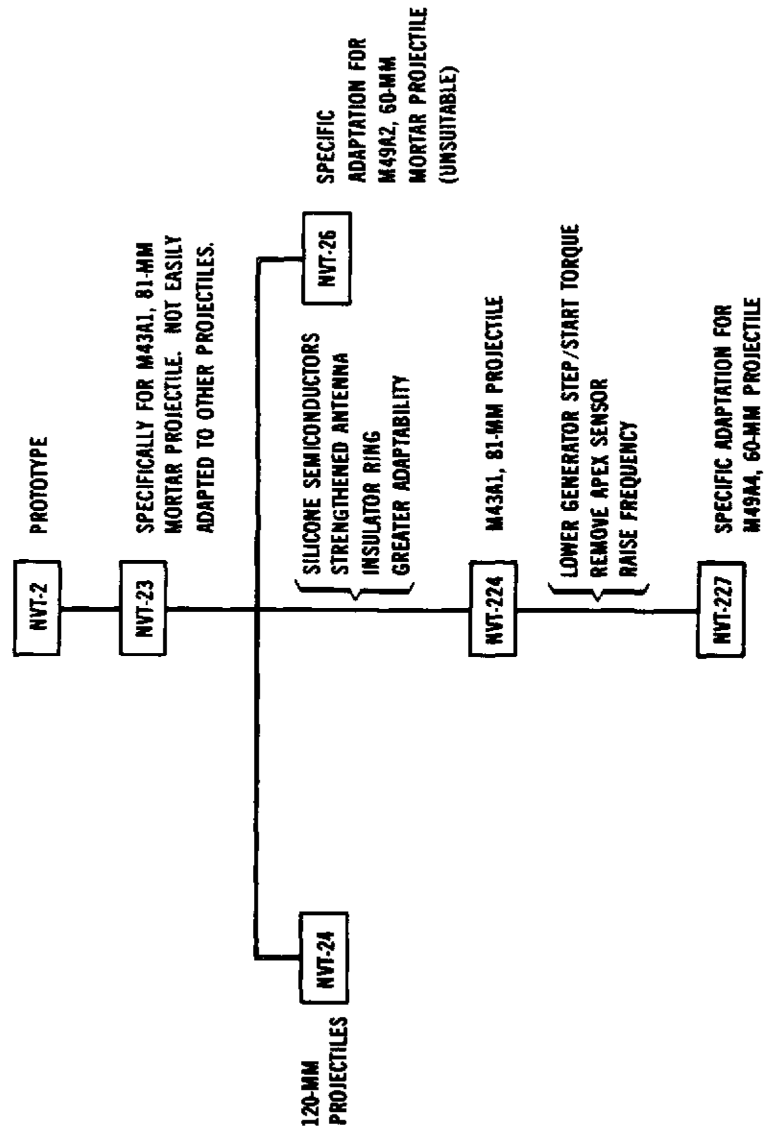
APPENDIX III.

EVOLUTION FROM NVT-2 PROTOTYPE



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APPENDIX IV.

CONVERSION TABLES: METRIC AND US UNITS

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APPENDIX IV.

CONVERSION TABLES: METRIC AND US UNITS

	Metric Units				US Units				Metric Units
LENGTH									
			0.03937	=	inches	x	25.40005		
	mm	x	0.00328	=	feet	x	304.8006	=	mm
			0.00109	=	yards	x	914.4018		
			0.3937	=	inches	x	2.54000		
	cm	x	0.03281	=	feet	x	30.48006	=	mm
			0.01094	=	yards	x	91.44018		
			39.37	=	inches	x	0.02540		
	meters	x	3.28083	=	feet	x	0.30480	=	meters
			1.09361	=	yards	x	0.91440		
			0.00062	=	miles	x	1609.34		
			3280.833	=	feet	x	0.00030		
	km	x	1093.6111	=	yards	x	0.00091	=	km
			0.62137	=	miles	x	1.60934		
AREA									
	mm^2	x	0.00155	=	in^2	x	645.1626	=	mm^2
	cm^2	x	0.15499	=	in^2	x	6.45163	=	cm^2
			1549.9969	=	in	x	0.00065		
	m^2	x	10.76387	=	ft^2	x	0.09290	=	m^2
			1.19599	=	yd^2	x	0.83613		
	km^2	x	0.386	=	$miles^2$	x	2.59	=	km^2
VOLUME			1000 mm = 1 cm^3						
	cm^3	x	0.06102	=	in^3	x	16.38716	=	cm^3
	m^3	x	35.31445	=	ft^3	x	0.02832	=	m^3
			1.30794	=	yd^3	x	0.76456		
	liter	x	61.0250	=	in^3	x	0.01639	=	liter
			0.03532	=	ft^3	x	28.316		
WEIGHT			(US units in avoirdupois measure)						
	mg	x	0.01543	=	grains	x	64.79892	=	mg
			15.43236	=	grains	x	0.06480		
	g	x	0.03527	=	oz	x	28.34953	=	g (grams)
	(grams)		0.00220	=	lb	x	453.59243		
			2.20462	=	lb	x	0.45359		
	kg	x	0.00110	=	tons*	x	907.18486	=	kg
	metric	x	2204.62234	=	lb	x	0.00045	=	metric
	tons		1.10231	=	tons*	x	0.09718	=	tons
			*short ton of 2000 lb						
VELOCITY					US Units				
	cm/s	x	0.33	=	ft/s	x	30.48	=	cm/s
	m/s	x	3.281	=	ft/s	x	0.305	=	m/s
	m/s	x	196.85	=	ft/min	x	0.0051	=	m/s
	km/h	x	0.6214	=	mi/h	x	1.6093	=	km/h

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DOD AND JOINT AGENCIES

A115 OASD ISA
A117 OASD PA&E
A125 OSD (DDR&E) (2)

DIA

B138 DIA/DE-4 (2)
B150 DIA/DT
B162 DIA/DT-1A2
B169 DIA/DT-2D
B624 DIA/DI-5A1
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