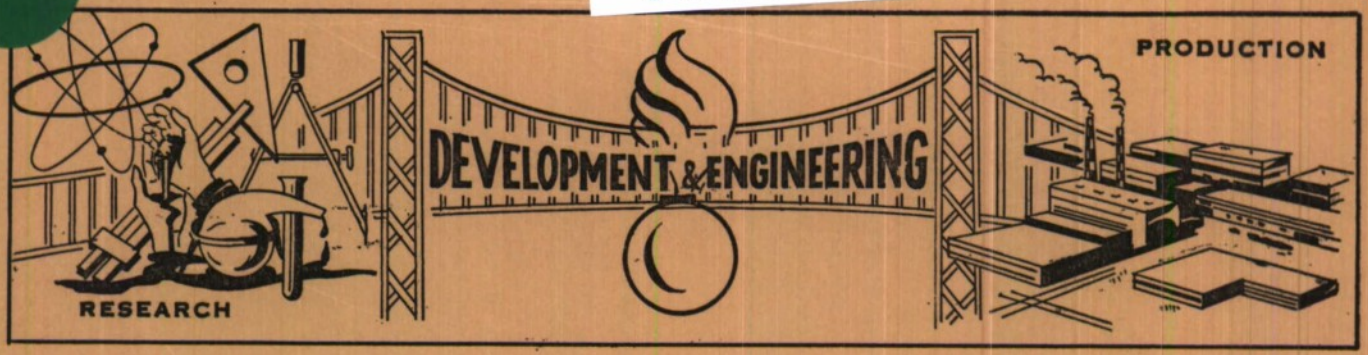

NOTES ON DEVELOPMENT TYPE MATERIEL NO. 284

FUZE, TIME, XM561E1

BY

WILLIAM J. HOLLEY

JOHN P. SKWAREK

AMCMS 5520.12.429K

DA PROJECT 504-04-002

MARCH 1963

AMMUNITION GROUP

PICATINNY ARSENAL - DOVER, NEW JERSEY

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SUBMITTED BY: J.C. HOWELL
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INTRODUCTION

The XM561E1 Time Fuze, Ordnance Part No. 118797 (Figure 1, 2 and 3), was designed for interim use in the T214 Series 81mm Illuminating Cartridge until a mechanical time fuze becomes available.

Characteristics

1. The fuze utilizes a black powder train to provide functioning times ranging from 2 to 39.5 seconds. The fuze is graduated in half-second increments over the functioning range.

2. With the safetywire in place, the fuze is designed to be safe and operable after a jolt test, in accordance with MIL-STD-300, followed by a jumble test, in accordance with MIL-STD-301.

3. With the safetywire in place, the fuze is designed to be 40-foot drop safe when tested in accordance with MIL-STD-302.

4. With the safetywire in place, the fuze is designed to be safe and operable after subjection to transportation-vibration tests in accordance with MIL-STD-303.

5. The fuze will operate over a temperature range of -40°F to 125°F.

6. With the safetywire in place, the fuze is designed to be air deliverable.

7. When the fuze is assembled to the cartridge and the cartridge is packed in a hermetically sealed container, it is considered that the fuze will remain in a safe and operable condition up to 10 years of storage.

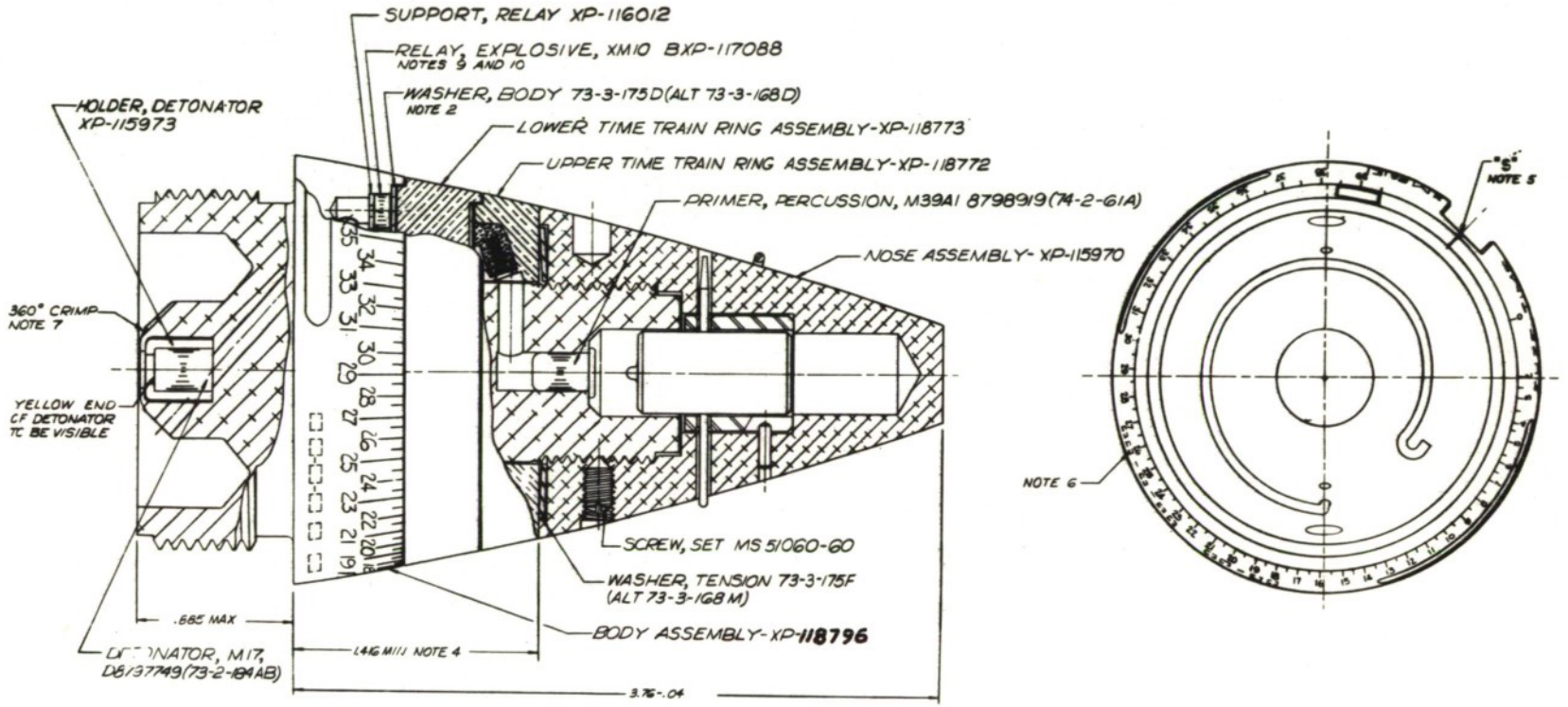
8. The contour conforms with ABC-Army Std. 101 dated 4 October 1961, Types A and D, except that the booster is omitted and the setter slot in the lower time-train ring is slightly modified.

9. The weight is approximately 1.35 pounds.

Construction

The XM561E1 Time Fuze (Figure 1) has a maximum exposed length of 3.76 inches and a maximum diameter of 2.415 inches. Its intrusion is 0.885-0.010 inches with a 2.0-12 UNS-1A thread for attachment to the cartridge. The fuze consists of a nose assembly, two time-train ring assemblies and a body assembly. The nose assembly comprises an aluminum nose, having a central cavity containing a steel plunger, constrained by two shear pins in a steel plunger guide. A removable safety-wire extends through the nose, the plunger guide and the plunger to keep the plunger from moving until the safetywire is removed prior to firing. The bottom of the nose cavity is enlarged and threaded on the inside to receive the male thread at the top of the aluminum body. A cylindrical portion of the body receives the two brass time-train ring assemblies which contain a black powder train. An M39A1 Percussion Primer is situated in the body, immediately below the plunger, and fires into a flash hole leading into the beginning of the time train. An XM10 Explosive Relay is located directly below the output end of the time train and is connected by a flash hole to an M17 Detonator in the rear of the body. The body is inscribed with non-linear divisions, numbered 2-39, which represent seconds. These divisions are further subdivided into half-seconds. The lower time-train ring is rotatable and has a line for setting the time on the scale of the body. When this line is set at "S" on the scale, the time-train is interrupted in two places, isolating the

lower time-train from both the upper time-train and the relay. At "O" setting, the lower time-train is still isolated from the upper time-train to prevent functioning inside the mortar tube. At any setting above "2" however, the flash from the primer will initiate the time-train, and a portion of the time-train will be burned before the relay is initiated. The burned length increases as the setting is increased. The entire time-train will be burned through before the relay is initiated in the full 39.5 seconds of burning time.



NOTES

1 – SEC MIL-F-2550 APPLIES.

2 – SECURE BODY WASHER TO BODY ASSEMBLY WITH GLUE COMPOSITION (NOTE 3) AND ALLOW TO DRY UNDER PRESSURE. HOLE IN BODY WASHER MUST BE CENTERED OVER THE XM10 RELAY. PRESS BODY WASHER AT APPROXIMATELY 10,000 PSI PRIOR TO ASSEMBLY.

3 – GLUE COMPOSITION: 35.0 PARTS (APPROX) BY WEIGHT OF BOILING WATER
20.0 PARTS BY WEIGHT OF 28% ACETIC ACID, SPEC JAN-A-465.
50.0 PARTS BY WEIGHT OF GLUE, GRADE I SPEC MIL-G-20469.
30.0 PARTS BY WEIGHT OF BURGUNDY PITCH, SPEC MIL-P-3826.
QUANTITY OF WATER TO BE ADJUSTED UNTIL 5ML OF GLUE COMPOSITION, AT A TEMPERATURE OF 50° ± 1° C. IS DELIVERED FROM THE ORIFICE OF AN ASTM CONSISTENCY CUP IN 16 ± 2 SECONDS. THE APPARATUS AND PROCEDURE TO BE USED IS DESCRIBED IN FEDERAL SPEC TT-P-141, METHOD 428.4. THE APPLICATION TEMPERATURE OF THE GLUE COMPOSITION SHALL BE 175°F TO 190°F.

4 – THICKNESS OF LOWER TIME TRAIN RING MAY BE .505 MIN OR THICKNESS OF UPPER TIME TRAIN RING MAY BE .370 MIN PROVIDED 1.416 MIN DIMENSION ON ASSEMBLY IS MAINTAINED.

5 – SET FUZE SAFE, ADJUST NOSE ASSEMBLY SO THAT THE TORQUE NECESSARY TO TURN THE LOWER TIME TRAIN RING AFTER ASSEMBLY EQUALS 35. INCH-POUNDS MIN, 65. INCH-POUNDS MAX. INSERT SET SCREW FIRMLY AND STAKE.

6 – STAMP LOADER'S LOT NUMBER, DATE (MONTH AND YEAR) IN CHARACTERS .093 HIGH x .500 ± .005 DEEP

7 – CRIMP MUST WITHSTAND 10,000 G'S (35. LB) SET BACK FORCE.

8 – ALL SOURCES MUST SUPPLY AN ITEM EQUIVALENT TO THE MANUFACTURER'S ITEM INDICATED. ORDNANCE CORPS ENGINEERING APPROVAL REQUIRED.

9 – OPEN END OF RELAY TO BE VISIBLE IN ASSEMBLY PRIOR TO ASSEMBLY OF TIME RINGS.

10 – RELAY XM10 MUST BE FLUSH OR BELOW FLUSH WITH METAL SURFACE OF BODY IN ASSEMBLY.

11 – LOAD TIME TRAIN RING WITH POWDER, FUZE, TYPE I, SPEC X-PA-PD-623 AND POWDER, BLACK, SLOW BURNING, TYPE II, SPEC X-PA-PD-623, BLENDED TO PRODUCE MEAN BURNING TIMES IN SECONDS, WHEN CORRECTED TO THE EQUIVALENT TIME AT 30 INCHES OF Hg (NOTE 11A), WITHIN PLUS OR MINUS 3% OF THE SET TIMES AND A MAXIMUM DISPERSION OF $2\sigma = 5.5\%$ OF THE SET TIME (NOTE 11B) WHEN ASSEMBLED WITH CARTRIDGE, ILLUMINATING T24E3 AND FIRED UNDER THE FOLLOWING CONDITIONS AT AN AMBIENT TEMPERATURE OF 60° ± 30° F:

NO. OF INCREMENTS	ELEVATION OF MORTAR	FUZE SETTING
3	70°	18
9	70°	36

11A – FORMULA FOR BAROMETRIC CORRECTION:

$$T_c = T_o - .22(30 - B_o)$$

WHERE T_c = CORRECTED BURNING TIME
T_o = OBSERVED BURNING TIME
B_o = OBSERVED BAROMETRIC READING

11B – FORMULA FOR DISPERSION.

$$2\sigma = 2\left(\frac{\Sigma x^2}{N-1}\right)^{\frac{1}{2}}$$

WHERE σ = STANDARD DEVIATION
x = THE DIFFERENCE BETWEEN THE AVERAGE BURNING TIME AND THE INDIVIDUAL BURNING TIME AFTER APPLYING THE BAROMETRIC CORRECTION.
N = THE NUMBER OF FUZES TESTED

11C – EXPERIENCE HAS INDICATED THAT STATIC BURNING TIMES AT THE ABOVE SETTINGS, WHEN CORRECTED TO THE EQUIVALENT BURNING TIME AT 30 INCHES OF Hg (NOTE 11A), ARE AS FOLLOWS

FUZE SETTING	STATIC BURNING TIME
18	17.04 SEC
36	34.60 SEC

P-118797

Figure 1. Fuze, Time, XM561E1

PRECAUTIONS IN USE, HANDLING AND STORAGE

Use and Handling

The XM561E1 Time Fuze is designed to withstand normal rough handling and the usual care in handling of all pyrotechnic time fuzes should be exercised. The fuze should be properly packed in accordance with prescribed drawings for protection against moisture, shock and rough handling. The fuze should not be disassembled except under the proper technical supervision.

This fuze will be shipped assembled to the T214 Series 81mm Illuminating Cartridge and packed in a hermetically sealed container. When the cartridge is unpacked, preparatory to firing, the fuze should be examined to determine that the safetywire is in place. If the safety-wire is missing, or if it is loose and cannot be reinserted, the cartridge should be disposed of in accordance with instructions for disposal of unsafe illuminating cartridges. After ascertaining that the safetywire is in place, set the fuze for the desired functioning time. The XM31E1 Universal Fuze Setter should be used if the appropriate socket assembly is available, however, in its absence, either the M14 or the M27 Fuze Setter may be used. If either of the latter fuze setters are used, the setting should be made by turning in a clockwise direction to avoid errors in fuze setting. If the fuze should be inadvertently set for a time greater than desired, the clockwise rotation should be continued until the desired setting is reached. No harm will be done in rotating the lower time-train

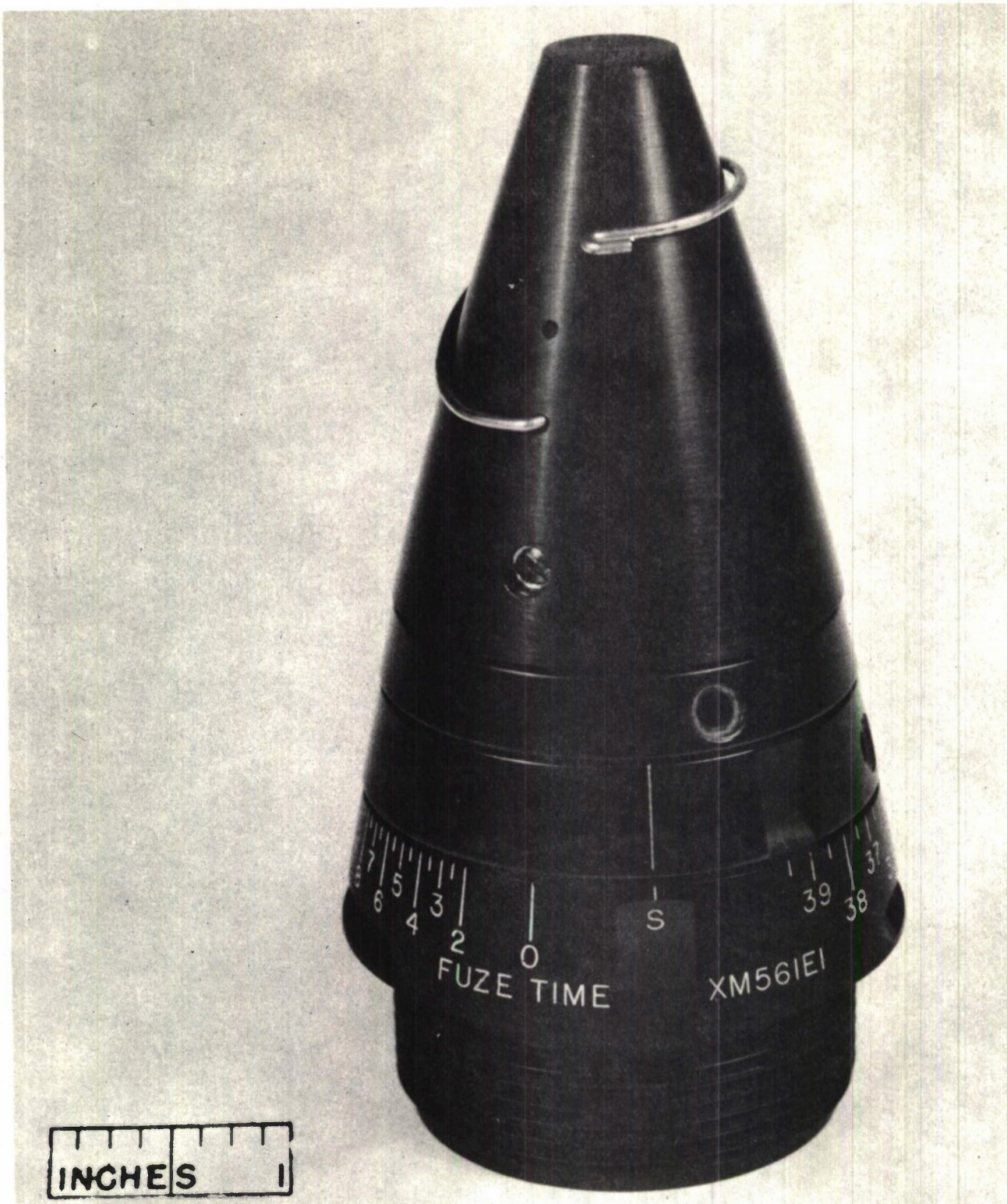
ring more than 360° in a clockwise direction. During setting of the fuze, it is desirable to leave the safetywire in place; although, when the M27 Fuze Setter is used, removal of the safetywire may become necessary due to interference between the wire and fuze setter. Should it be decided not to fire a cartridge, after the fuze has been prepared for firing, the lower time-train ring should be returned to the "S" setting and if the safetywire was removed it must be replaced.

If the safetywire is inadvertently removed prior to rotating the lower time-train ring assembly from the "S" setting, and the cartridge is dropped from a height sufficient to sever the shear pins and in such a manner that it impacts tail first, the primer and upper time-train ring assembly will be initiated but not the remainder of the time-train, the relay and detonator. The fuze will be safe but inoperable and the cartridge should be discarded in accordance with disposal instructions. Any attempt to fire the cartridge will result in a dud.

If the cartridge is accidently dropped from a sufficient height to sever the shear pins, and in such a manner that it impacts tail first after the safetywire has been removed, and the fuze is set at two seconds or above, burning of the time train will be complete and the relay, detonator and cartridge will subsequently be initiated. To assure maximum safety to the handler, either the XM31E1 or the M14 Fuze Setter should be used and the safetywire should not be removed except immediately prior to inserting the cartridge into a mortar.

Storage

The black powder time-train is hygroscopic and since the fuze is not waterproof, it must be protected from moisture. Consequently, the cartridge is packed in a hermetically sealed container. The container should not be opened until immediately prior to preparing the cartridge for firing. Follow the storage instructions provided for the cartridge,



28-017-200/Ord-63

Figure 2. Fuze, Time, XM561E1

PREPARATION FOR USE AND FUNCTION

The fuze is initiated by the setback force generated on firing the cartridge. When the setback force exerted on the plunger reaches approximately 570 Gs, the two shear pins are severed and the plunger moves rearward striking the primer. Functioning of the primer at any setting will result in initiation of the upper time train. When the fuze is set for functioning at a time of two seconds or over, the lower time-train will be initiated after a portion of the upper time-train has burned, and the relay will be initiated after a portion of the lower time-train has burned. Increasing the time setting increases the portion of each train which must be burned before the relay is initiated, the entire length of both trains being consumed at the 39.5 setting. Functioning of the relay results in a flash that fires the detonator which, in turn, ignites the candle and the separation charge in the cartridge.

The principle safety feature of the fuze is the safetywire, which is inserted during the fabrication process, to prevent the plunger from accidently striking the primer during shipping and handling. In addition to this feature the fuze is set at "S", which prevents functioning of the fuze, even if the primer should be initiated. After the safetywire is removed, preparatory to inserting the cartridge into a mortar, the plunger is retained by two shear pins that prevent it from striking the primer. The shear pins

are strong enough to hold the plunger under normal handling conditions during this interval; however, the shear pins will not assure the safety of the cartridge if it is dropped from an appreciable height.

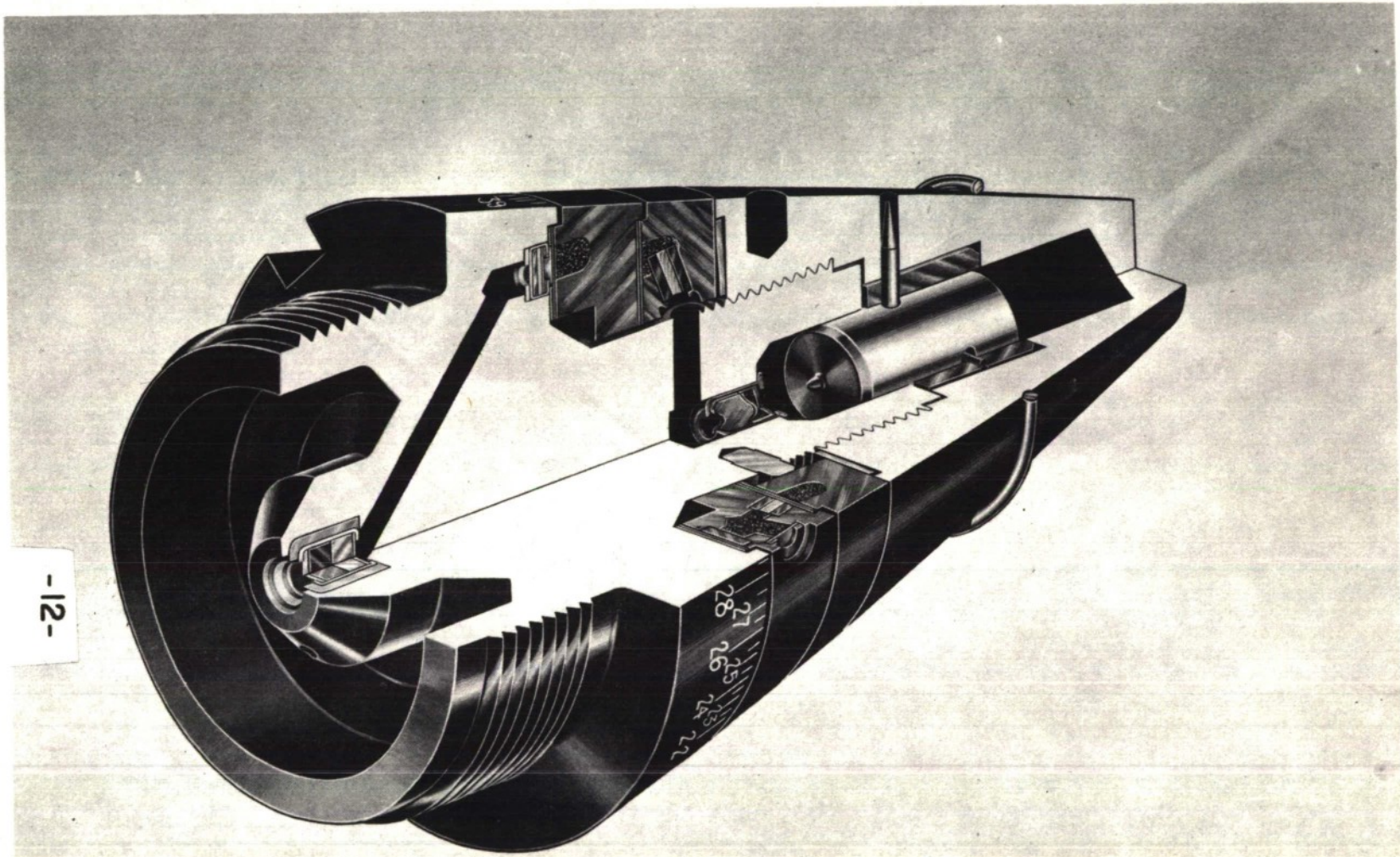


Figure 3. Time, Fuze, XM561E1
(Sectional Drawing)

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