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ADVANCED FUZE & EXPLOSIVE ORDNANCE BULLETIN No. 9

1 OCTOBER 1944

CONFIDENTIAL

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ROCKETS

RESTRICTED

5"0 ROCKET (5"0 MOTOR)

INTRODUCTION:

The 5"0 rocket (5"0 motor) is a fin stabilized rocket for shipboard use or for forward firing from aircraft. It has approximately the same velocity and trajectory as the 3"5 aircraft rocket (with 3"25 motor). It is propelled by a 5"0 rocket motor and can be fired from aircraft rocket launcher Mark 4, Mark 5 Mod 1, or other launchers designed for firing rockets equipped with button type lug bands. The assembled rocket is 69 inches long and weighs approximately 140 pounds. (See Figs. 1, 2 and 3)

5"0 ROCKET BODY MARK 6 MOD 0

This body weighs 52 pounds when filled with TNT and is equipped with a base fuze and nose plug. The body is shipped with a conical nose plug installed and when thus used will have the fragmentation and penetration characteristics of the comparable velocities of the 5"/38 AA common projectile, of which it is a modified design. All 5"0 rocket bodies Mark 6 Mod 0 are shipped with a base fuze installed and staked in place. No attempt shall be made to remove the base fuze from the body. A metal cup shaped thread protector protects the external threads on the tail of the body and the base fuze.

NOTE: The 5"0 body Mark 5 Mod 0 is the initial production of the 5"0 Mark 6 Mod 0; the two bodies are identical.

5"0 ROCKET MOTOR MARK 2 MOD 0

The 5"0 rocket motor consists of a seamless steel tube with internal threads on both ends. Into the rear end is screwed the nozzle plate having 8 nozzles arranged in a circle, and a central blow-out nozzle. The central nozzle is closed by a disc of 0"024 thick copper insulated against the heat of the motor by asbestos and hard fiber plugs. The thickness of the disc is such that it shears and blows out at a pressure of approximately 2400 pounds per square inch, which is the normal maximum motor pressure when the propellant grain is at a temperature of 100° F. If the pressure rises above this, the disc and the plug are ejected; this increases the usable temperature range of the rocket by approximately 40° F.

Seven of the eight nozzles are sealed individually by a light steel cup and sealing compound. The eighth nozzle accommodates the electrical connector cable which is crimped into a steel nozzle closure. In shipment, a dome-shaped steel shipping cap fits into the sleeve of the fin assembly, acting as an auxiliary seal and at the same time serving to enclose and protect the electrical pig tail in shipment.

Lugs for attaching the fins are mounted on the nozzle end of the motor. The fins are shipped with the motor and are attached when the round is assembled. The fins are held in place by spring loaded latches within the fin itself. The fin lugs and rear suspension lug are welded to the bands of the fin assembly, which is slipped on over the nozzle end of the motor. The front lug band is strapped to the motor.

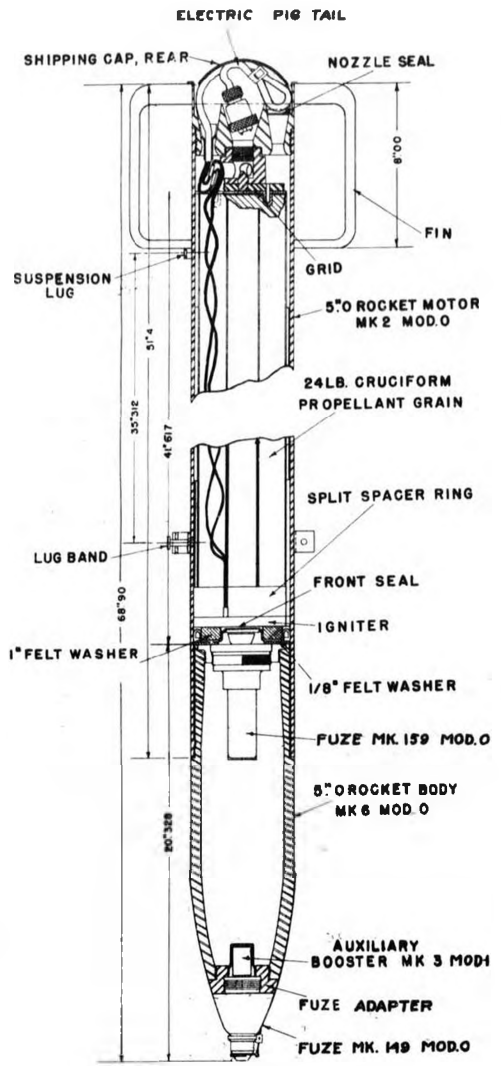

FIG.1 5"O ROCKET
(5"O MOTOR)

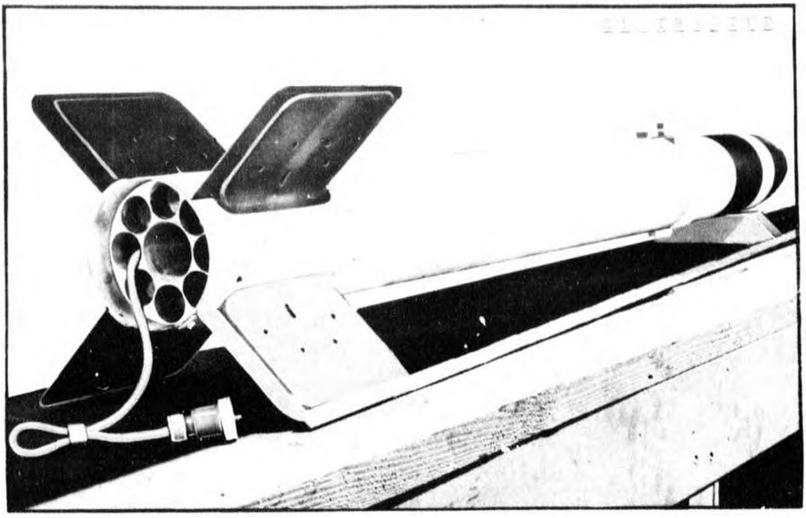

FIG. 2 5"O ROCKET (5"O MOTOR) SHOWING DETAILS OF AFT END

The motor is shipped with lug attachments on the motor tube for use with aircraft launcher Mark 5 Mod 1. An extra rail type lug band is provided in the shipping box to adapt the rocket for use on the Aircraft Rocket Launcher Mark 4.

The front end of the motor is sealed by a steel diaphragm equipped with a blow-out disc in the center to allow easy passage of the motor gases to the pressure arming fuze in the base of the body. In shipment, a cylindrical metal thread protector extends into the motor the same depth as the body and seats on a felt rim glued to the diaphragm seal.

The propellant is a grain of cruciform shaped ballistite weighing 24 pounds. The grain is inhibited on the outer web surface and

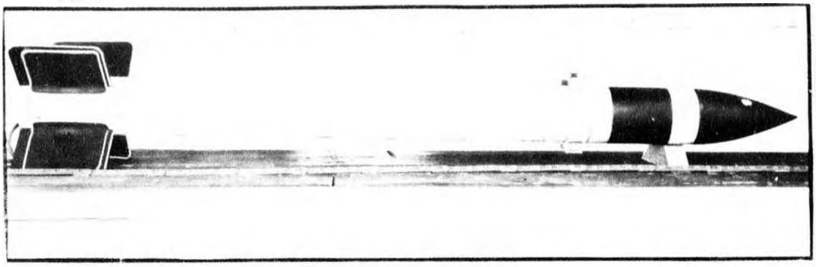

FIG. 3 5"O ROCKET (5"O MOTOR) OVER-ALL VIEW

is supported by a spacer and steel grid at the nozzle end. The propellant is ignited by a metal case igniter containing 35 grams of black powder.

NOTE: The 5"0 rocket motor Mark 1 Mod 0 is the initial production of the 5"0 motor Mark 2 Mod 0. The two motors vary only in that suspension lugs of the former are welded directly to the motor tube.

FUZES:

Rocket Body Mark 6 Mod 0 is shipped with the base fuze and conical nose plug installed. When a nose fuze Mark 149 Mod 0 is to be used, the nose plug is removed and the fuze installed in its place.

Nose Fuze Mark 149 Mod 0

Briefly, the Mk 149 Mod 0 Nose Fuze is an air arming, impact firing fuze used in both the 3"5 and 5"0 rockets (3"25 motor), and the 5"0 rocket (5"0 motor).

For a description of this fuze, "U. S. Bombs and Fuzes", page 45, or AFEO Bulletin No. 2, page 16, may be consulted.

Base Fuze Mark 159 Mod 0

The base fuze Mark 159 Mod 0 is similar in fuze action to Base Fuze Mark 157 (see AFEO Bulletin No. 7, page 10). The essential difference is in the impact firing delay. The Mark 159 Mod 0 has a fixed pyrotechnic delay of approximately 0.015 seconds while the Mark 157 has a delay of .02 seconds.

The Mark 159 Mod 0 also differs in minor design details as follows:

1. The shear wire holding the arming plunger is made with slightly heavier construction.

2. The inlet screen and inlet washer have been replaced by a brass washer having one flat side and the other radially serrated. The radially serrated side faces the fuze head so that motor gases can enter the fuse diaphragm chamber.

3. The number of external threads on the body have been increased and "run out" just below the flange to afford a snug fit for the sealing washer.

4. The fuze is completely waterproofed.

ASSEMBLY OF ROCKET

1. Attach 4 fins to the fin lugs at the nozzle end of the motor. This is accomplished by pressing the fin downward onto the fin lug until it seats, and then pushing it aft until the rear edge of the fin is flush with the rear end of the motor and the spring latch, visible through the slots in the center of the fin, drops into place.

   If the fins are to be removed, insert a screw driver into the slot in the center of the fin, raise and hold up the latch while the fin is pressed off forward.

2. Remove the thread protector from the front end of the motor.

3. Remove the thread protector from the base of the body.

4. Screw the body tightly into the motor using a strap wrench.

5. Remove the rear shipping cap of the motor which protects the electrical pig tail and the nozzles. This cap can be removed with a screw driver. CAUTION: Leave the shorting clip on the electrical pig tail plug pins until it is removed during the loading operation. Removing it before that time might result in accidental ignition of motor.

6. If a nose fuze is to be installed, remove the conical nose plug from the body and install the nose fuze Mark 149 Mod 0, being careful the auxiliary booster Mark 3 Mod 1, does not fall out. DO NOT remove the fuze safety wire or ready the fuze until the round is loaded on the launcher. (NOTE: The Auxiliary Booster Mk 3 Mod 1 consists of approximately 36 grams of granular TNT)

7. Place the assembled rounds horizontally on the deck or on racks. Do not stand the round on its tail, as this may damage the electrical connector cable.

PERFORMANCE DATA

The temperature limits of the present ammunition vary according to round performance in proof firing tests. Therefore, it is important that round firing temperatures be kept within the limits marked on each motor. No definite temperature limits are now available to cover on 5"0 rocket motors.

The dispersion of the 5"0 rocket (5"0 motor) is about 4 mils laterally and vertically at an aircraft speed of 250 knots and 1000 yard range. When firing against reinforced concrete, the base fuze Mark 159 Mod 0 must be used in order to inflict other than superficial damage. With this fuze it has been calculated that the rocket should penetrate slabs of reinforced (6000 p.s.i.) concrete at normal incidence of 3.75 feet. At an angle of 30° obliquity it should penetrate 2.75 feet.

When fired from a plane traveling at 300 knots, the following performance may be expected from this round. Theoretically, when fuzed with Nose Fuze Mark 149 Mod 0, the rocket is expected to detonate on the surface of the plate and cause "serious damage" to armor up to 1-5/8" in thickness. By "serious damage" is implied that the minimum dimension of the hole through the plate is at least as great as the diameter of the rocket body. With the base fuze Mark 159 Mod 0 and a steel nose plug, this rocket is estimated to be capable of penetrating armor 1"0 thick before detonation.

AMMUNITION SHIPPING AND STOWAGE

Motors will be shipped individually with fins and an extra lug band (for use with Mk 4 launcher) included in each motor shipping box.

In stowage, it must be borne in mind that the motor can be accidentally ignited by any of the following:

1. By feeding electric current to the igniter. About 1/2 amp. at 1/2 volts is required to set it off.

2. By exposing the motor to fire or temperatures above 325°F.

3. By subjecting the motor tube to small arms fire or high velocity bomb or shell fragments.

5"0 Rocket Body

The body must be stored in high explosive magazines and handled as such. Body may be removed from the shipping boxes. However, the thread protector shall not be removed from the body until the ammunition is to be assembled. Body may be stowed in existing 5"/38 projectile bins.

Fuzes

The Nose Fuze Mark 149 Mod 0 is packed in an individual sealed metal container and is to be stowed in existing fuze magazines.

Base fuze Mark 159 Mod 0 is shipped installed and staked in place in the base of the 5"0 rocket body. The fuze is not to be removed from the rocket body.

ROCKET LAUNCHERS

The following launchers are used for launching the 5"0 rocket (5"0 motor).

Aircraft Rocket Launcher Mark 4

This is a single non-jettisonable dural rail, details of which may be found in AFEO Bulletin No. 2, page 8. This launcher is being replaced by the Zero Length Type Launcher on all except certain VPB type aircraft.

Special Zero Length Launcher

These are streamlined steel Zero Length posts which were developed for the SB2C and F4U airplanes prior to the advent of the Mark 5 Launcher. The aft and forward posts are mounted in pairs on forward and aft base plates which may be attached to the under surface of the airplane wings. The bomb arming controls are mounted beside the forward post in the base plates. The rocket pig tail plug-in receptacle is recessed in the base plate on which the aft posts are mounted. A shear plate is provided to shear the pig tail when it is blown aft during launching. A button type stud near the forward end of the round assembles in the slot on the forward post. A loop type lug is employed to assemble the round to the aft post which contains a shear wire retaining latch.

Grumman Type Zero Length Launcher

This launcher now in use on F6F series airplanes comprises forward and aft steel posts which attach to internal provisions built into the airplane. The forward post contains a shear wire retained latch, and the aft post is of the fin suspension type. A button type stud near the forward end of the round assembles in the slot on the forward post. The assembly to the aft post is by fin suspension, and the aft lug is therefore not utilized. Since this launcher was developed for the 3"5 and 5"0 rockets (3"25 motor), the fin suspension on the aft post must be modified by an adapter before the 5"0 rocket (5"0 motor) may be assembled to it.

Universal Zero Length Launcher Mark 5 and Mods.

This launcher has been selected as the standard launcher for all carrier based aircraft, and it will replace all other types. This launcher comprises 4 dural aft posts mounted on a base plate, and 4 dural forward posts mounted on a base plate. (These may be mounted integral or cut in sections as required to accommodate aircraft structure). These base plates are attached at suitable points on the under surface of each wing. The round is assembled to the forward posts with a button type stud, and attachment to the aft post is by means of a loop type lug. The rocket arming control is built into the forward post, and a latch and pig tail receptacle are built into the aft post.

The launcher Mark 5 was never issued to the service. The launcher Mark 5 Mod 1 (See AFEO Bulletin No. 5, page 38), has been used successfully for launching the 3"5 and 5"0 rockets (3"25 motors) and the 5"0 rocket (5"0 motor). The launcher Mark 5 Mod 2, incorporating improvements, is not in production. The major changes in this launcher are an increase in the wall thickness of the posts from .064 to .081 inches, and taper of the latch tongue on which the lug loop is suspended. The launcher Mark 5 Mod 3, still undergoing final tests, contains a spring operated latch which is activated by a lanyard attached to the rocket motor pig tail. (See Figs. 4 and 5). This latch will soon be available for installation in all previously issued Mark 5 launchers. This latch eliminates the necessity for a shear wire. It will permit emergency arrested landing with

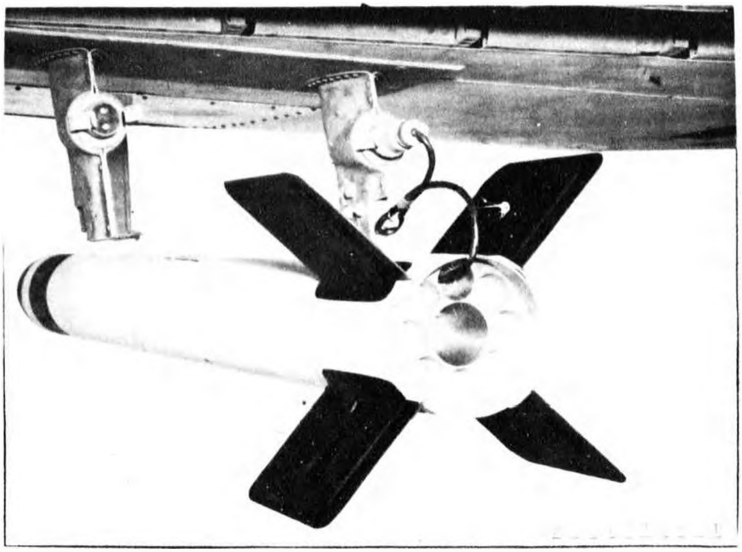

FIG. 4 5"O ROCKET (5"O Motor) INSTALLED IN MK 5 MOD 3 LAUNCHER. NOTE HOW ELECTRICAL PIG TAIL ACTS AS LANYARD TO TRIGGER RELEASE IN AFT STUD. (NOTE: AT FIRST GLANCE THE LAUNCHER STUD ON LEFT MIGHT BE MISTAKEN FOR THE FORWARD STUD. THIS IS NOT THE CASE; THE PICTURE WAS INADVERTENTLY TAKEN AT A PERSPECTIVE WHICH BLOCKS OUT THE FORWARD STUD.)

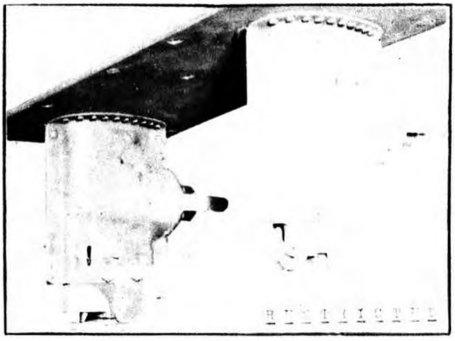

FIG. 5 ON LEFT IS AFT LAUNCHER STUD, Mk 5 MOD 3. NOTE DIFFERENCE IN RELEASE MECHANISM FROM THAT OF MK 5 MOD 1 ON RIGHT. WHILE THE MK 5 MOD 1 REQUIRES USE OF A SHEAR WIRE TO RETAIN ROCKET, THE MK 5 MOD 3 HAS A TRIGGER RELEASE MECHANISM WHICH DOES NOT REQUIRE A SHEAR WIRE. THE MK 5 MOD 3 WILL PERMIT EMERGENCY ARRESTED CARRIER LANDINGS WITH 5"O ROCKET (5"O MOTOR).

5"O rockets (5"O motor). Nevertheless, it is to be pointed out that every effort should be made to fire all rockets before returning the plane to the carrier. In case of emergency landing because of misfire, the deck should be properly cleared to prevent injury to personnel.

Shear Wire

The standard shear wire furnished with the ammunition is the only shear wire authorized for use. At present it is a No. 12 model hard (Spec. ASTM-B-2-39) copper wire. No. 10 soft or annealed (Spec. 22W-9) copper wire will replace the above as soon as it is available. Either shear wire is satisfactory for use with the 5"0 rocket (5"0 motor). These shear wires should be employed in all type launchers. The Grumman type launcher employs a 3/32 inch stainless steel welding wire. This should be employed for 3"5 and 5"0 rockets (3"25 motor) but only when arrested landing is contemplated. The standard shear wire should be employed at all other times. Unauthorized shear wires should never be employed with 5"0 rockets (5"0 motor) since these rockets cannot be retained safe during arrested landings even with stronger shear wires. Use of such shear wires will result in over-stressing the launcher installation and airplane structure.

CIRCUIT TEST PROCEDURE

Circuit test devices now in service include the Circuit Test Kits Models 1 and 2, and the Circuit Test Plug Model 1, Figs. 6 and 7.

The Test Kit Model 1 was designed to test the functioning and continuity of the rocket circuit; a limited quantity was made and it is being supplanted by the Test Plug Model 1. The latter is a compact plastic plug with a 26 volt light plug and an electric plug to match the rocket launcher receptacle.

The Test Kit Model 2 was designed to test for stray low voltage in the aircraft launcher, and to provide an auxiliary means for testing the bulbs in the test plugs. It consists of a case containing a low voltage light bulb, five pencil type flashlight cells, resistance, a receptacle and a switch and a short electric lead with a plug to fit the launcher receptacles. As a safety measure the socket on the case was designed to allow the tester plug to make contact with the battery through the resistance but to prevent the shorting pins of a rocket pigtail plug from reaching the battery circuit in case a rocket is inadvertently plugged into the test kit. The extra long pins of the test plug will reach a switch within the test kit thereby shorting out the resistance and allowing the full 7-1/2 volts of the battery to light the test plug.

The procedure for testing rocket circuits specified in the past, can be appreciably simplified resulting in a saving of time and an increase in safety. The practice of testing circuits for continuity immediately before loading and on the flight line should be discontinued. Continuity tests need be performed on rocket circuits only as often as performed on other armament circuits during normal operation or after unloading rockets when misfires have occurred. Continuity tests should never be made with rockets loaded on the launcher.

To perform a continuity test, insert one test plug into each rocket launcher receptacle. Close all necessary switches. Activate the rocket firing switch and verify that the test plugs light in the proper sequence. Check the test lights with each setting of the station distributor or rocket selector switch. Remove the test plugs.

The following safety test must be performed IMMEDIATELY BEFORE PLUGGING THE ROCKET PIGTAILS INTO THE LAUNCHER RECEPTACLES. Verify that the master armament switch is off and that the safety plug is removed. Plug the launcher test kit Model 2 into each launcher receptacle in turn and observe that the bulb does not glow. Then insert the test kit plug into the test kit receptacle to check the functioning of the test kit bulb. If the bulb fails to glow when plugged into launcher but lights when plugged into the battery circuit (of the test kit), the launchers are free of dangerous voltage. The rocket pigtails may then be plugged into the rocket launchers.

PROCEDURE FOR LOADING AND UNLOADING ON AIRCRAFT LAUNCHER MARK 5 MOD 1

PREPARATION FOR LOADING THE AMMUNITION

Safety Officer and Crew

One member of the loading party designated as the safety officer shall be responsible for inspecting all safety precautions. Loading

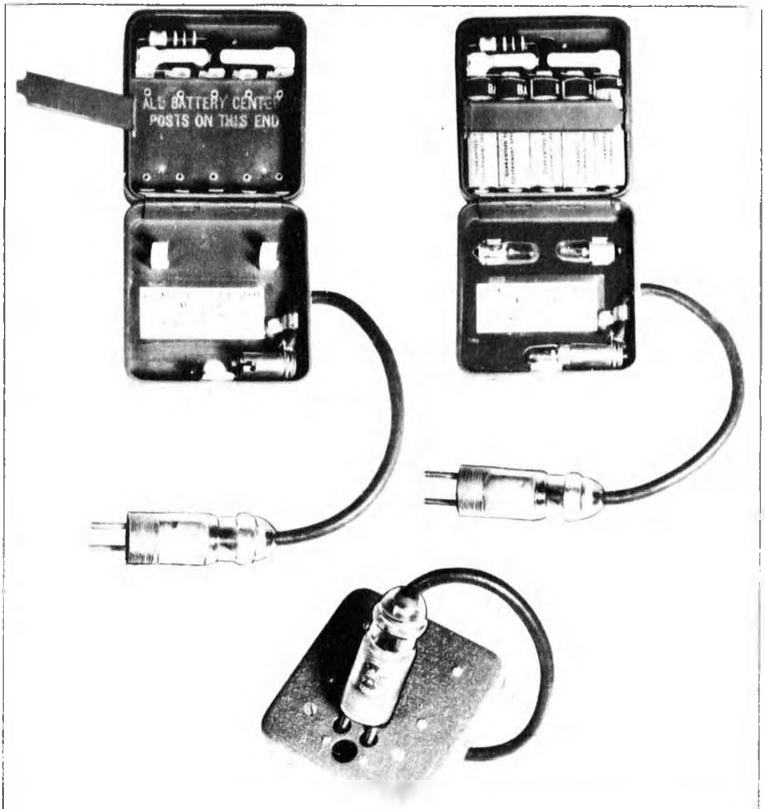

FIG. 6 LAUNCHER CIRCUIT TEST KIT
MODEL 2

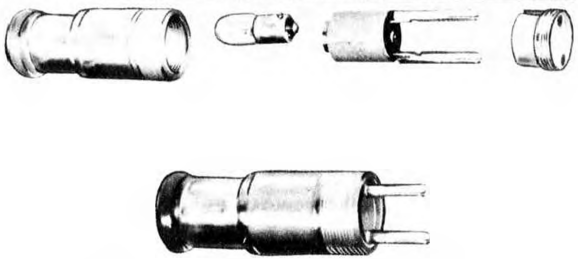

FIG. 7 CIRCUIT TEST PLUG MODEL 1

shall be done by qualified personnel.

Equipment Check-Up

Before the rockets are loaded, the safety officer shall himself turn off the following switches:

1. Main battery switch.
2. Master armament switch.
3. Rocket power switch on the station distributor, and remove safety plug if used.

Inspect all the launchers to insure that:

1. All fittings are secure.
2. Studs and stud parts are not damaged.
3. No obstructions of any kind are in the stud slots or latch mechanisms.
4. All moving parts are in working order.

If the safety officer believes that the launchers are unsafe for use, he must notify the pilot and obtain instructions before allowing the loading operations to proceed.

Loading the launcher

After seeing that (in accordance with the general safety rules) the airplane is positioned properly and unauthorized persons are away from the plane, the safety officer shall authorize the loading to begin. The safety officer shall notify the pilot, if he is in the airplane, that loading operations are to begin.

The following steps are then performed:

1. The front lug button and rear lug are fitted into the front slot and rear tongue of the launcher. The latch on the rear launcher stud must be put onto the launcher connections simultaneously. The shear wire must be inserted through the latch on the rear launcher as soon as the round is in place and bent down on both sides to prevent its coming out.

   NOTE: Use only the shear wire supplied.

2. Insure that the round is firmly held by trying to push it forward and rearward. DO NOT PLUG IN THE ELECTRIC PIG TAILS; LET THEM HANG LOOSE. DO NOT REMOVE THE SHORTING CLIPS.

3. The ammunition truck and loaders shall leave the loading area.

Loading Rockets Using Nose Fuze Mark 149

After loading the rocket firmly into place but before plugging in the electric pig tail, perform the following additional steps if the round uses a Nose Fuze Mark 149.

1. Inspect cap and clamp assembly on nose of fuze for corrosion. If the cap and clamp are badly corroded, it is best not to use the fuze. If corrosion is slight, grasp the clamp and rotate it around the fuze body until it slides freely. To prevent corrosion and icing, cover the clamp assembly with a light coat of vaseline.

2. Turn clamp so that clamp pin and bushing are on the same side of fuze as the arming wire. Insert arming wire in

the hole which is provided next to the safety wire, and then remove safety wire. DO NOT REVERSE THIS ORDER. Save safety wire for reinsertion if the round is returned to storage.

3. Insert the arming wire plate into the arming solenoid.

4. Put one Fahnestock Clip on the end of the arming wire and slip it down against the clamp bushing. Adjust the clamp so that there is just enough slack in the arming wire between the solenoid release and the fuze to insure that the plate is not pulled part way out of the catch in the arming wire release.

5. Cut off excess arming wire, leaving three or four inches sticking out in front of the fuze, and dress for burrs.

Final Steps After Loading

The pig tails of the rockets are not plugged in until after the launcher circuit has been checked as follows:

1. The Launcher Test Kit Model 2 shall be checked to see that it is not burned out.

2. The Test Kit Model 2 shall then be inserted successively in all launcher receptacles. It must not light in any of these tests.

3. The lamp shall then be checked to make sure that it has not been burned out or damaged in the above operation.

4. The ordnance man shall then remove the shorting clip from the electrical pig tails and plug in the pig tails of each round consecutively from inboard out. While plugging in the electrical pig tails, he must not stand to the rear of any of the rockets being plugged in or already plugged in. Shorting clips should be saved for use in case the round is not fired.

5. When the load is complete, the master armament switch and rocket power switch on the station distributors are still OFF. The camera switch may be set in the ON position and the station distributors selector set on "1".

Unloading

The safety officer shall observe the same safety precautions as in loading the launcher. The loading crew shall unload the rockets having Mark 149 Mod 0 fuzes, as follows:

1. Remove the electrical pig tail and replace the shorting clip.

2. Reinsert the fuze safety wire.

3. Inspect the fuze to see that it is dry. Dampness will corrode the working parts of the fuze.

4. Remove the arming wire. DO NOT REMOVE THE ARMING WIRE BEFORE INSERTING THE SAFETY WIRE.

5. Remove the launcher shear wire.

6. Slide the rocket out forward, one man supporting the body and one the motor.

7. Disassemble rocket or put assembled round in ready stowage.

If the rockets are left on the airplane, perform only Step 1 above. Under these circumstances, inspect the fuze frequently and if possible protect the fuze and pig tail from exposure.

Loading or unloading rockets equipped with conical nose plug is to be performed in the same manner outlined above, with the exception of those parts dealing with the nose fuze.

NOTE: Loading or unloading rockets on the aircraft Launcher Mark 4 is the same as for the aircraft Launcher Mark 5 Mod 1 except that the button type attachment must be secured to the rear lug on the motor to make loading possible.

GENERAL SAFETY PRECAUTIONS

It is advisable to appoint one man to be in charge of safety precautions. He should be familiar with all safety rules regarding the handling and loading of rockets onto planes. He should also know the nature and construction of rockets and the equipment used to fire them from planes -- the circuits, switches, launchers, etc. The following instructions summarize the duties of the safety officer:

1. See that loading area is safe for entry of planes.

2. If there are any misfires, obtain safety plug at once and supervise immediate removal of round or rounds.

3. Proceed with a thorough inspection of all rocket gear on the plane.

4. Give permission to camera man or others to do all testing which must be done with safety plug in place.

5. Obtain safety plug from cockpit and check to see that all switches are open and that rail selector switch is on "1". Keep safety plug in plain sight during loading operation.

6. See that rockets are delivered safely to loading area, removed from conveyance and loaded on the launcher. See that the loading crew remains out of line with the rockets fore and aft as much as possible.

7. See that pig tails are not plugged into the launcher until all other necessary operations, such as insertion of fuze arming wires and shear wires, are completed.

8. Inspect shear wire to see that it is through the shear lever and that the lever hook is down in front of the lug band button. Also inspect fuzes to see if arming wire is properly secured and if safety wires are removed.

9. A new wire must be used after each arrested landing.

10. If two or more planes are to be loaded and fuzed at once, there should be a safety officer for each plane. If this is not possible, the safety officer should obtain all safety plugs and stand where all operations on airplanes are plainly visible.

11. In case of trouble in launcher or camera circuits, all rounds should be removed from the launchers on both sides before any testing is done.

12. Circuits should be tested with launcher test kit each day before operations begin. If nose fuzes are to be used, arming solenoids should be checked.

13. In warm weather care should be taken so that rockets are not used if temperatures exceed the safe limits marked on the motors or boxes. Cooling for several hours, depending upon prevailing conditions, should return them to within safe limits.

14. Smoking should not be permitted in the loading area within 200 ft. of any ammunition.

15. Planes should not be fueled while the rockets are present or on the launchers.

16. The loading area should be inspected to determine in what direction planes should be pointed while loading. This should be the direction in which least damage to persons or property would be caused by a premature firing.

17. Parking of armed planes on the flight deck for an extended period is not permitted except for planes which are to be used the same day or which are for ready use. Electrical pig tails are to be left disconnected, and shorting clips left on the plug.

18. Stowage of assembled rockets other than in the ready service compartment is prohibited. Do not stand assembled rounds on their tails, since this may damage the electrical cable.

19. Arming planes on the hangar deck is not recommended. Loading of the planes on the hangar deck is permitted at the discretion of the commanding officer when necessitated by operational requirements. IN ANY OPERATION INVOLVING FUZING, UNFUZING, ASSEMBLY, DISASSEMBLY, CLEANING, PAINTING, ETC. OF ALL TYPES OF MUNITIONS, THE WORK SHALL BE ACCOMPLISHED IN THE MOST SUITABLE LOCATION, TAKING INTO ACCOUNT SAFE REMOVAL FROM OTHER EXPLOSIVES AND POSSIBLE DAMAGE TO VITAL INSTALLATIONS, AND SHALL INVOLVE EXPOSING THE SMALLEST NUMBER OF ROUNDS PRACTICABLE. Only those persons actually essential for the work shall be in the vicinity. The ideal situation would be that where work would be performed on only one round at a time, in a location on deck remote from magazines, from ready stowages, from other supplies of ammunition or explosives, and from vital installations.

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REFERENCE: O. P. No. 1239 (Preliminary)

C O N F I D E N T I A L

CLUSTER, FRAGMENTATION T4E3 (M26)

DESCRIPTION:

The fragmentation bomb cluster T4E3, Fig. 8 and 9, tentatively to be standardized as the M26, consists of a cluster adapter to which are secured twenty 20-lb. fragmentation bombs, M41, in two groups of ten each. The cluster weighs approximately 500 lbs. and measures 53-9/16" long by 14-11/16" wide, and 13-3/4" high. It was designed to fit a 500-lb. bomb station.

The M41 fragmentation bombs in the cluster are not provided with individual suspension lugs, thus providing means for securely packing the bombs in the cluster without the interference of these suspension lugs.

The cluster adapter is a steel framework consisting of a tubular suspension bar to which the suspension lugs are fitted, steel separator plates, and two metal straps secured by release buckles. The cluster can be adapted to both quick opening as well as delayed opening.

The separator plates located forward of each group of M41 fragmentation bombs are built with arming vane stops for the M110A1 Nose Fuzes used in the individual bombs.

DELAYED OPENING:

Delayed opening is accomplished by means of the Mechanical Time Nose Fuze, M111A2, screwed to the fuze adapter in the forward end of the tubular suspension bar. A steel slug for cutting the shear wires of the release mechanism is wired in place inside the tubular bar just inside the fuze adapter. In this case the release buckles are held closed by a shear wire which is fed through a hole in the release buckle and vertically through the tubular suspension bar. When the fuze detonates at the pre-set time delay, the explosion of the booster drives the steel slug rearward, cutting the shear wires in both the forward and aft release buckles, thereby permitting the cluster to open.

QUICK OPENING:

Quick or immediate opening of the cluster is accomplished by the arming wires which are fed through the release buckles and are withdrawn upon release of the cluster from the airplane. For quick opening it is necessary first to cut the shear wires which secure the buckles for delayed opening.

SHIPPING AND PACKING:

The T4E3 (M26) cluster is packed in a hermetically sealed container and boxed in a strong wooden crate. The cluster is carefully packed and should arrive in good condition.

SAFETY PRECAUTIONS:

According to Memorandum No. 3-77 issued by Headquarters, United States Strategic Air Forces in Europe, the following safety precautions are called to attention:

> When the cluster is removed from the box and each time before it is loaded in an aircraft, the following inspection should be made:

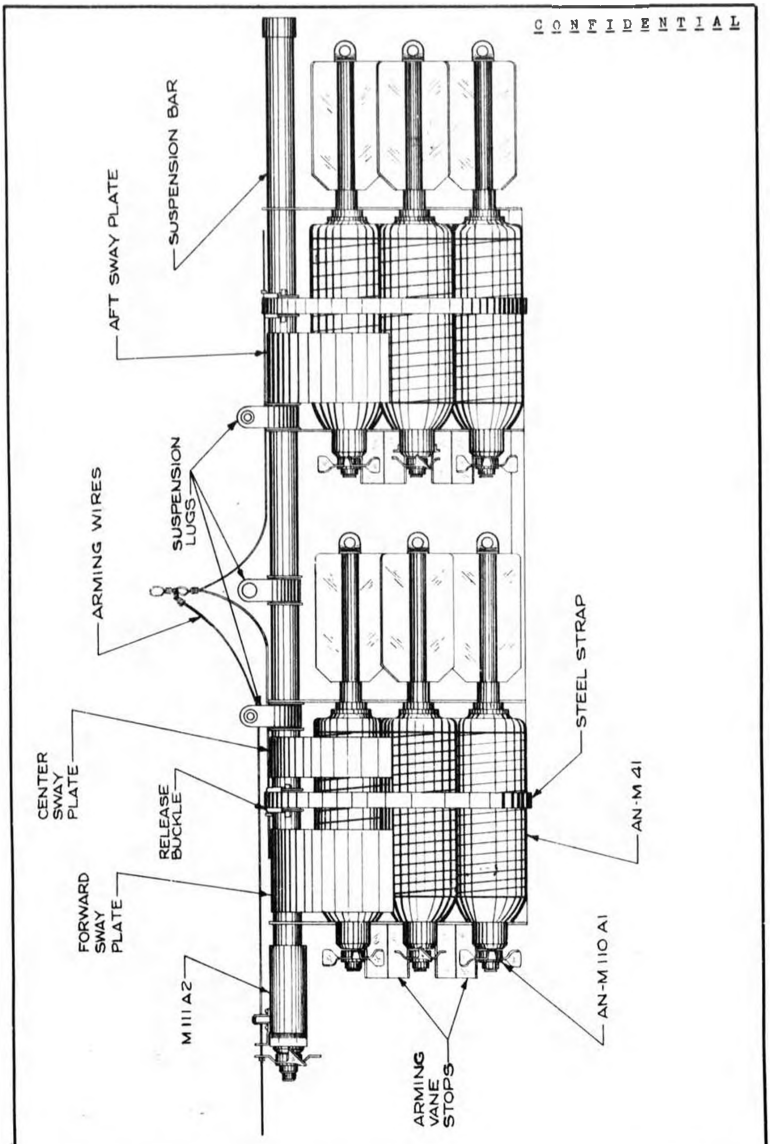

FIG. 8 CLUSTER BOMB, FRAGMENTATION T4E3 (M 26)
CONSISTING OF 20 - 20 LB. FRAG. BOMBS AN-M41

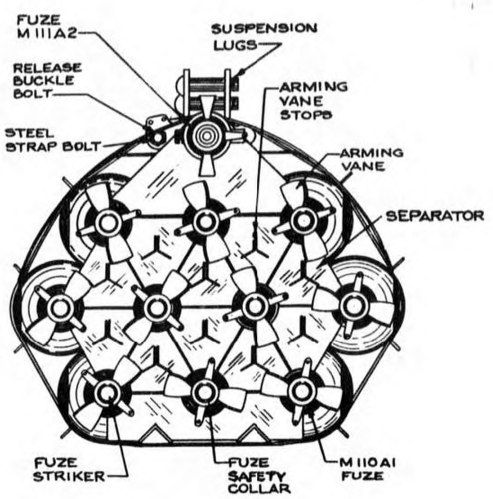

FIG. 9
NOSE VIEW - CLUSTER T4E3 (M26)

1. Check to see that metal straps securing the M41 Fragmentation Bombs to the cluster are not loose.

2. Check to see that the bolts hinging the release buckles are not loose or missing.

3. Be sure that none of the arming vanes (on M41 Fragmentation Bombs) are free to rotate.

4. Check to see that arming vane stops are not bent, loose, or missing.

5. Be sure that separator plates are not loose and do not overlap so that they are out of position.

6. Check to see that the M110A1 fuzes are not partially armed.

7. Be sure that none of the safety collars on the M110A1 fuzes are missing.

8. Be sure that none of the striker heads of the M110A1 fuzes are broken or missing.

The memorandum states further that if any of the above defects are present, the cluster is hazardous and no attempt should be made to repair damage at combat stations. A safety wire should be placed in arming vanes of all fuses in defective clusters.

The T4E3 (M26) cluster is very sensitive to impact upon

the nose. Extreme care should be taken to prevent accidental dropping of the cluster in loading or unloading operations.

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REFERENCES: 1. USSTAF Armament and Ordnance Memorandum No. 3-77.
2. Ordnance Department Drawing No. 82-0-111.

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UNCLASSIFIED

BOMB, PRACTICE, 100LB. M 85

While the current standard practice bomb used by the Army Air Forces is the 100-lb. M38A2, which is a thin walled steel bomb that is filled with sand when ready for use, the Army recently deemed it necessary to provide a substitute for the M38A2 because of a temporary shortage of these bombs.

The resulting substitute practice bomb is the new M85. The M85 has the same contour, weight and center of gravity as the 100-lb. G. P. bomb AN-M30A1 but is made of reinforced concrete. It is the same weight when shipped as the M38A2 is when filled with sand.

The M85 has been tested and found to be just about as good as the M38A2 for all practical purposes. However, only a relatively small quantity will be made until such time as manufacturing facilities can once again be utilized to turn out the standard M38A2.

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REFERENCE: Ordnance Committee Item #24749

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RESTRICTED

SMOKE BOMB (HC) 10LB. M 77

INTRODUCTION:

The M77 HC Smoke Bomb, Figure 10, is clustered in the 100-lb. quick opening cluster M25 which accommodates 14 bombs. The M77 was designed to screen airborne operations, amphibious landings, or to blanket large areas of enemy positions with a continuous smoke cover, and is to be used over land only.

When dropped from an altitude of 500 ft. the cluster disperses its bombs over a semi-elliptical area about 50 yards across its smallest diameter. The bombs require 2 to 4 minutes after impact to build up an effective screen and are capable of producing smoke for 12 to 20 minutes. Ten clusters dropped 150 ft. apart across the wind will screen a front about 1500 ft. in length. Six clusters dropped in salvo in a ten-knot wind should produce a screen 6000 to 8000 feet long. The screen thus produced will be about 300 ft. high and 150-200 ft. wide. Longer screens can be produced with more favorable wind conditions. The M25 cluster will function satisfactorily from altitudes of 50 to 5000 ft. A small percentage of duds (10%) may be expected from all altitudes.

DESCRIPTION OF M77 BOMB:

The 10-lb. M77 consists of a hexagonal steel case 2⅜72 in diameter across the flats, and 19⅝5 long. The bomb weighs approximately 13 lbs. when filled. This bomb has no device for stabilization in flight and therefore uses the all-ways action type fuse, M4, Fig. 11. Components of the bomb are as follows:

1. The body is a sheet steel leak-proof casing extending the entire length of the bomb.

2. A tail cup fits into the aft end of the casing, having a dome housing the M4 fuze.

3. Filling is Type E HC Smoke Mixture (carbon-tetrachloride-zinc oxide-aluminum mixture) weighing 9.8 pounds.

4. The M4 fuze, Fig. 11, is an all-ways action type fuze. The fuze incorporates a spring loaded arming pin and a spring loaded safety pin. The head and body are zinc alloy castings. A retaining wire holds the arming pin in place and is removed when the fused bombs are assembled in the cluster. The fuze is comparatively small, being only 1"0 in diameter and 2"625 overall in length.

The M77 is painted blue-gray overall, with a 1/2" yellow band around the approximate center. On one flat surface the symbol of filling, designation, etc., are stencilled in yellow marking ink.

OPERATION OF M77 BOMB

While the bombs are in the cluster, their proximity holds a release clip to the head of the fuze, depressing the arming pin. When the bombs are released, the arming pin, together with the release clip, is forced out by the arming pin spring permitting the safety pin to enter the cavity in the striker. Impact forces the striker and sleeve together, piercing the primer which in turn ignites the first fire mixture and subsequently the HC Smoke Mixture. The heat generated by the burning of the first fire mixture and the HC Smoke Mixture melts the zinc alloy fuze body. The smoke is then emitted through the fuze hole in the tail cup.

CAUTION: ONCE THE ARMING PIN JUMPS OUT, THE FUZE IS ARMED AND ANY ATTEMPT TO REINSERT IT MAY CAUSE THE FUZE TO FIRE.

100-lb. SMOKE BOMB CLUSTER M25

The smoke bomb cluster is made up of an M4 cluster adapter to which 14 smoke bombs, M77, are secured. The complete cluster weighing 193 lbs. is issued fully assembled and ready for installation in the airplane. The cluster adapter consists primarily of two parallel channelized bars, one forming the base of the adapter while the other is used as the suspension bar, affording a means for attaching the cluster to a rack or shackle. It is the quick-opening type, the bombs being held together in two bundles of 7 each by two steel bands circumscribing the cluster. When packed for shipping, the release buckles are held closed by both the arming wire and a safety wire. Upon installation, the safety wire is withdrawn and the swivel loop of the four-wire arming wire is attached to the arming mechanism of the rack or shackle.

Three suspension lugs are set in the upper suspension bar. The two outside lugs are used when the cluster is to be suspended from a double loop rack or shackle, while the center lug is used for single suspension.

The M25 cluster is packed in a water-tight cylindrical steel container and is painted olive drab with a 1/2" yellow band painted around the container.

SAFETY PRECAUTIONS:

Although the smoke mixture in the M77 will not ignite from the effects of moisture or water, these bombs should nevertheless be handled with care and the water-tight integrity preserved.

In general, stowage conditions of the M77 are essentially the same as that for other HC Smoke munitions such as smoke pots, floats, etc.

NOTE: While HC Smoke is harmless to breathe for short periods in low concentrations in the open air, it is toxic in high concentrations and all persons fighting HC fires should wear rescue breathing apparatus or gas masks.

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REF: C.W. Dwgs: M4, #B14-15-56; M77, #C14-5-473

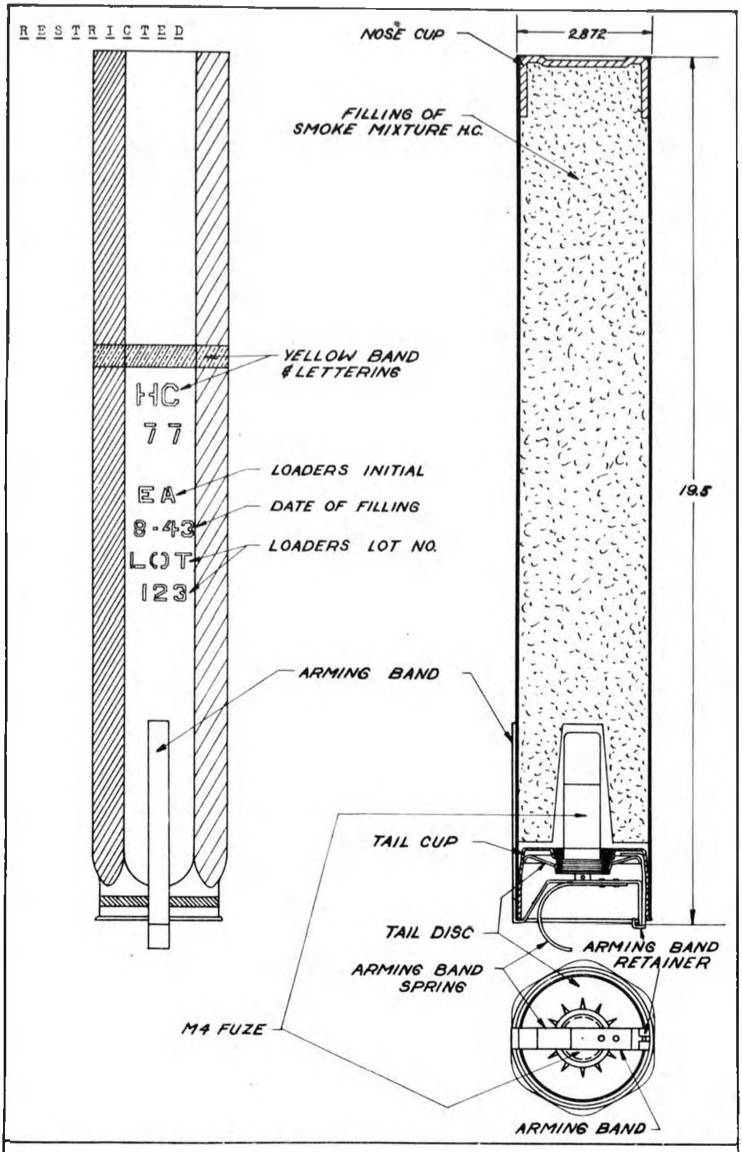

FIG.10 10 LB. SMOKE BOMB(HC) M 77

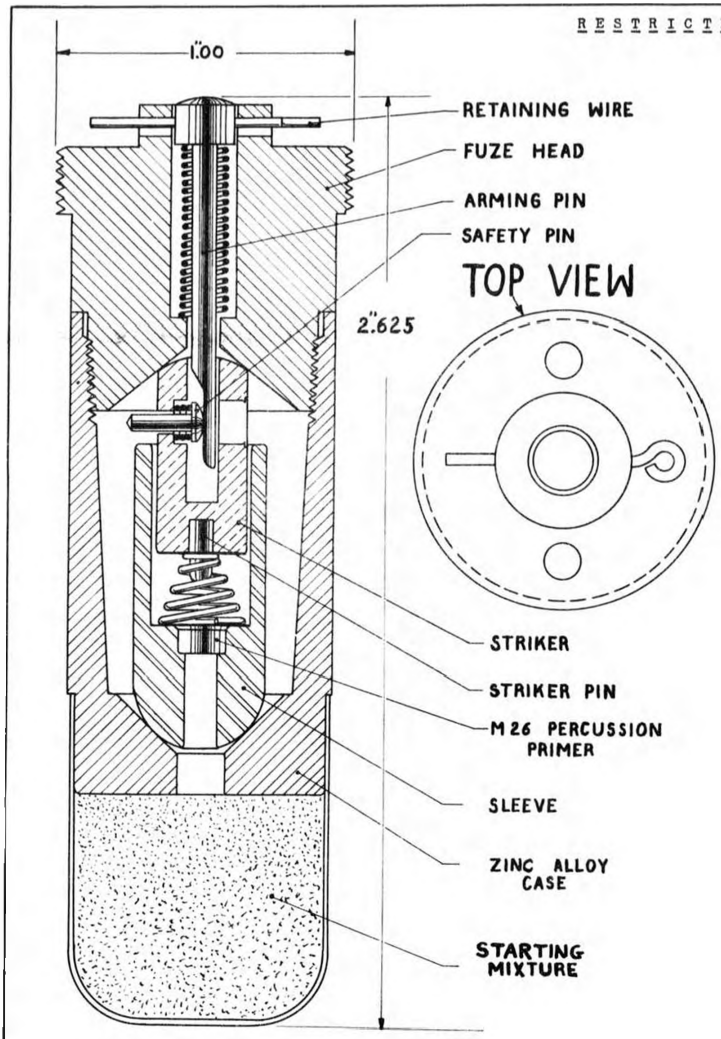

FIG. 11 FUZE, M4 (ALL-WAYS ACTION) FOR BOMB SMOKE (HC) M 77

RESTRICTED

BOMB NOSE FUZE T29E2

INTRODUCTION:

The T29E2, Figs. 12 and 13, is a vane arming, detonator-safe nose fuze for use in any G. P. bomb which can accommodate the AN-M103 nose fuze. The fuze is designed for both instantaneous action on impact and for air-burst a short distance above the target as a result of blast pressure from the first bomb of a stick. The first bomb will detonate on impact while its blast, if of sufficient intensity, will detonate the second bomb, etc., in the air over the target.

Tests conducted with 500 lb. G. P. bombs using the T29E2 have shown air bursts can be expected after detonation of the first bomb of a stick on impact, as follows:

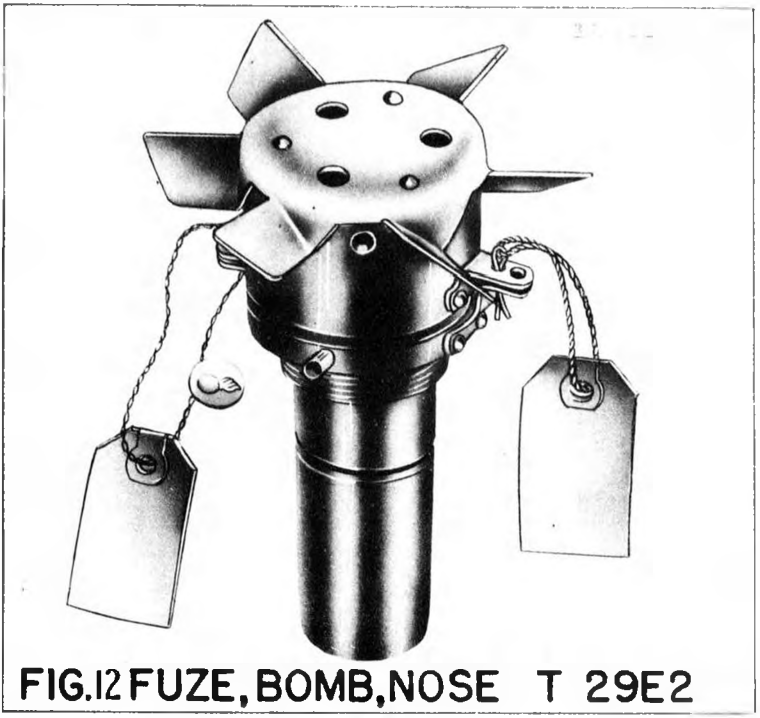

FIG.12 FUZE, BOMB, NOSE T 29E2

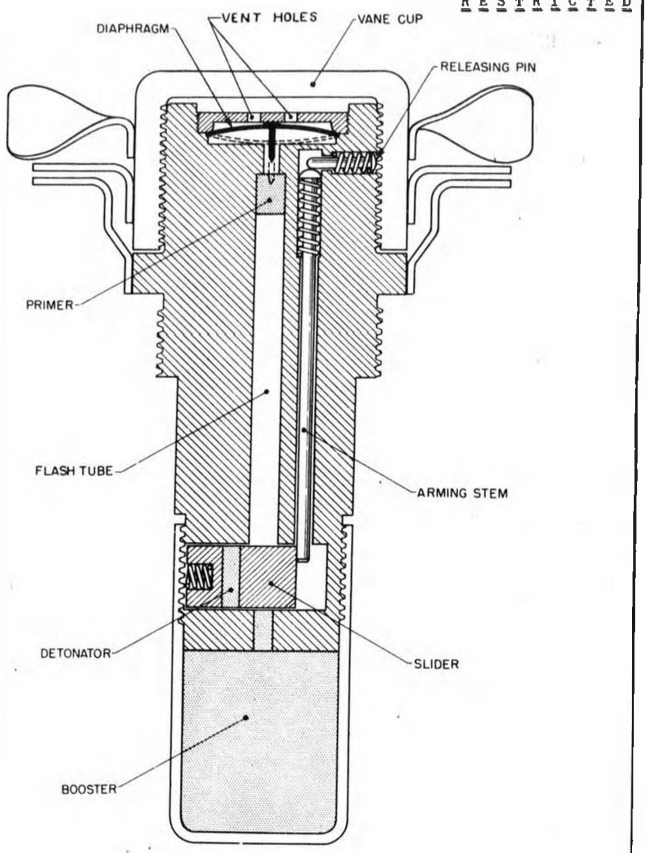

FIG. 13 FUZE, BOMB, NOSE T 29E2
CROSS SECTIONAL VIEW

Spacing (Ft.)	Expected Functioning
15	100%
25	50%

Bombs that for some reason do not give air burst can still function on impact.

DESCRIPTION:

The T29E2 is 7.5 long overall and when fitted to a bomb, it will extend 2.5 beyond the nose of the bomb.

A sturdy vane cup fits over the nose of the fuse to which is attached a 6-bladed vane assembly. The fuse is armed as the vane cup unscrews. It requires only about 12 or 13 revolutions of the vane cup to completely unscrew from the fuse and fall away.

Inside the fuze head is a thin brass pre-stressed diaphragm with a firing pin fitted to its center. This diaphragm functions like the base of an ordinary oil can; that is, it is in a convex position before being subjected to air pressure and concave after being "popped" over. The diaphragm is held in place by a threaded disc perforated with vent holes.

The diaphragm principle used on this fuze is similar to that of the British #44 and #45 pistols.

The fuze is detonator-safe in a manner similar to the AN-M103. The release pins hold the arming stem down keeping the detonator slider out of line with the flash tube. The booster portion also resembles that of the AN-M103.

OPERATION:

As the arming wire is withdrawn, the vane cup rotates. After approximately 8 or 9 turns of the vane cup the release pin is ejected by its spring. The arming stem rises under pressure of its spring, permitting the detonator slider to align itself below the flash tube. After 12-13 turns of the vanes the cap falls off and the fuze is now fully armed. Bombs fused with the T29E2 should be released in close train to take advantage of the air burst feature of the fuze. The first bomb of a stick will detonate on impact with the ground; impact simply "pops" the diaphragm to its reversed position (see dotted position in Fig. 13) causing the firing pin to strike the primer.

The second bomb of the stick will be detonated by the pressure blast of the first bomb. The blast of the first bomb will cause the diaphragm in the fuze of the second bomb to "pop" over while the bomb is still in the air a relatively short distance above the target and thus cause detonation. The third bomb, will then function as the second, etc.

Should the diaphragm fail to function for air burst, the fuze can still fire from impact action.

PRECAUTION: When installing the T29E2, the vane cup should be checked to see that it is free to turn. However, DO NOT unscrew the vane cup as only a few turns are required to arm the fuse. In the armed condition the fuze must of necessity be very sensitive. Handle it accordingly.

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FUZE MARK 154 MOD 2

DESCRIPTION:

The Fuze Mark 154 Mod 2, Fig. 14, is designed for use in the 4.5 Rocket (WP) Smoke filled. It consists simply of a Fuze, Mark 137 Mod 2* to which is fitted a tetryl burster tube.**

The burster tube is 14.06 long. A steel collar is brazed to the upper end of the tube. A rubber gasket is inserted between the burster tube collar and the burster retaining disc. Between the wall of the burster tube and the inside wall of the burster retaining disc a clearance of approximately 0.03 exists. This clearance, together with the rubber gasket allows the burster tube a certain degree of flexibility with respect to this fuze itself, which is desirable when installing the complete fuze assembly in the fuze adapter of the rocket body. If the burster tube were secured to the fuse by a metal-to-metal flush fit, it would not be sufficiently flexible and might tend to bind or jam, providing the burster tube is not perfectly concentric, when attempting to screw the long fuze assembly into the rocket body.

OPERATION:

Operation of the Mark 154 Mod 2 is the same as that for the Mark 137. Briefly, the operation is as follows:

When the fuze is inserted in the rocket, the locking wire is withdrawn and the rocket placed on the projector. At the instant the rocket is projected, setback causes the setback block to move against its spring. This movement of the setback block withdraws the propeller locking pin from the propeller. The propeller is then free to rotate. The setback block spring will return the setback block to its original position at the end of the acceleration while the firing pin will have unscrewed sufficiently to prevent re-engagement of the propeller locking pin with the propeller.

Rotation of the propeller will cause the firing pin to thread up against the top of the fuze body. As the firing pin rises, it withdraws itself from alongside the detonator shutter allowing the shutter to align the detonator directly under the firing pin and over the burster lead-in. Approximately 8 to 10 rotations of the propeller are required to arm the fuse.

On impact with the beach or water, the striker shears the threads in the top of the fuze body, piercing the detonator and initiating the explosive train.

The minimum angle of elevation at which the fuze may still give consistent functioning is 15° .

SAFETY FEATURES:

1. The fuze is detonator safe.
2. When the fuze is installed in the rocket, it is locked in the unarmed position by the propeller locking pin. It cannot arm until the set-back force withdraws the propeller locking pin allowing the propeller to rotate and withdraw the firing pin to release the detonator shutter.

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* The Fuze Mark 137 Mod 2 is similar to the Fuze Mark 137. Several improvements have been made in design but essentially the functioning is the same.

** See AFEO Bulletin No. 8, page 13, for a similar assembly using the Fuze Mark 137 Mod 1 together with the same burster as used in a 4.2 chemical mortar shell.

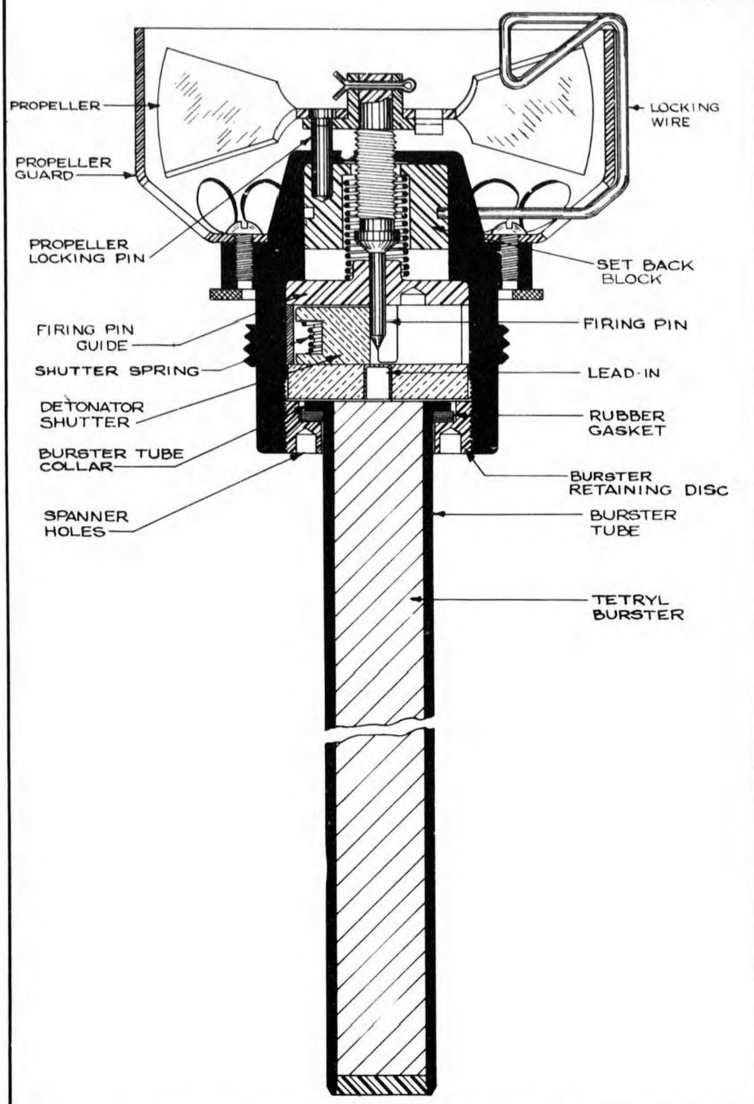

FIG. 14 FUZE MK. 154 MOD. 2
FOR USE IN 4.5 CHEMICAL ROCKET

3. The locking wire passes through a hole in the fuze body locking the set-back block and also the propeller.

4. The propeller guard protects the propeller at all times.

SAFETY PRECAUTIONS:

During installation, check the following points:

1. Fuze seat liner must be clean.

2. Burster well in rocket body must be straight and concentric.

3. Fuze gasket must be in place.

4. Fuze must be seated securely.

5. The locking wire must be pulled out just prior to firing.

6. If rocket is not fired, see that locking wire is correctly reinserted.

GENERAL PRECAUTIONS:

1. No disassembly of this fuze is authorized.

2. Do not alter the setting of the propeller as it has been correctly pre-set to insure proper arming.

3. If propeller, for any reason, is unscrewed beyond rim of propeller guard, the fuze should be considered armed. In this condition taps propeller to guard and dispose of the complete round by lowering into deep water.

4. Do not attempt to unarm a fuze suspected of being armed.

5. Do not fire an armed fuze in launcher.

6. Fuzing and unfuzing operations should be carried out in accordance with prescribed safety rules and conditions.

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REFERENCE: BuOrd Dwg. #42384
O. P. No. 1017

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R E S T R I C T E D

NOSE FUZE MARK 152

GENERAL:

The Fuse Mark 152 is a modified AN-Mk 219 designed for use in 7T2 Demolition Rockets. Essentially, the changes made on the AN-Mk 219 consist of:

1. Pre-arming the fuze 50 revolutions of the vanes. A metal fork is inserted between the vane carrier and the fuze body to take up the space left by the pre-arming process. This fork must be removed before launching a fuzed rocket.

2. The pitch of the vanes has been increased to form an angle of 40° with reference to the vertical axis of the fuze. (Pitch of the vanes on AN-Mk 219 is approximately 18°)

REMARKS:

The fuze body is marked "Mark 152" while a notation stencilled on the fuze packing can states that the fuze is "FOR USE IN 7T2 ROCKETS ONLY." Caution should be observed that AN-Mk 219 and Mark 152

fuzes are not mixed up.

When installing the Mk 152 in demolition rockets, a regular adapter ring for the AN-Mk 219 fuze (same as that used when installing an AN-Mk 219 in the nose of a depth bomb) must be used.

The fuze cavity in the rocket body is deep enough to necessitate the addition of the following with the Mk 152:

1 Mk 2 Auxiliary Booster (2.70 inches long)

1 Mk 1 Auxiliary Booster (3.70 inches long)

1 cardboard spacer (improvised) approximately 1/2" thick placed <u>below</u> the auxiliary boosters.

(<u>NOTE</u>: Tests have indicated that a high order detonation can still be expected if the Auxiliary Booster Mk 2 is omitted and its space taken up by additional cardboard spacer. Nevertheless, it is preferable to use both.)

When the rocket is placed in the launcher, an arming wire is required in place of the safety pin. There is an attachment for the other end of the arming wire on the launcher. The arming wire is necessary to prevent fuzes of other rockets in the launcher from becoming armed as a result of the blast given off by the first rocket leaving the launcher.

If the rocket is not fired, both the safety pin and the safety fork must be replaced.

Demolition Rockets, fused with the Mark 152, are effective for beach barrage purposes in amphibious landing operations.

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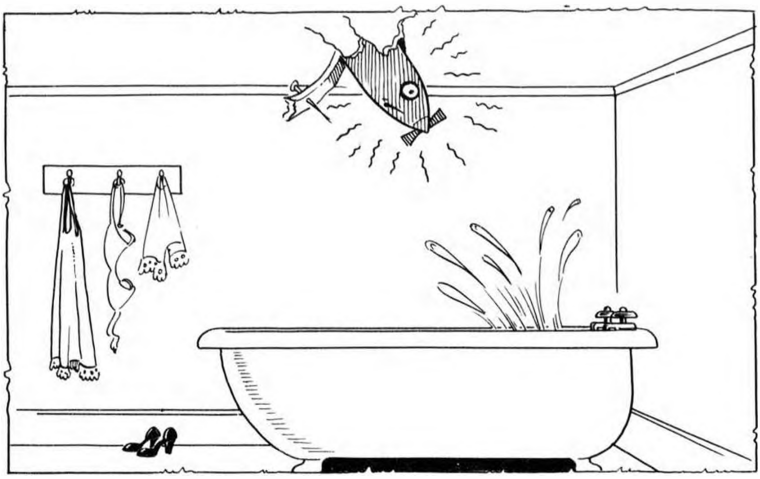

MISCELLANEOUS

CONFIDENTIAL

TECHNIQUE OF TARGET ANALYSIS AS APPLIED TO TRUK

Bombs destroy, but how many and what kinds of bombs are needed to destroy particular installations or to neutralize a particular base are the difficult questions with which the professional target analyst is faced. Working to the solution of these problems, the analyst, following a logical process, begins with consideration of the functions served by a prospective target and of the economic and military significance thereof; he progresses to a study of the facilities and installations by means of which these functions are performed and, next, to the selection of the particular installations most vital to the enemy and most vulnerable to attack; and arrives finally at a conclusion concerning the forces necessary to inflict the necessary damage and the method bombs, and fuzes best calculated to effect that damage.

Target analysis has been furthest developed in connection with the bombing of industrial objectives. A paper has been received recently from the Air Intelligence Group, Division of Naval Intelligence, Office of the Chief of Naval Operations, which illustrates the application of target analysis to the continued neutralization of Truk as an enemy base.

The paper is based on available target data of Truk but does not consider the effects of our recent carrier and heavy bomber strikes, nor is it concerned with the effect of these and other strikes in the Central Pacific upon the strategic disposition of Japanese air and naval forces. It is assumed that Truk is still serving three important functions in the Japanese war effort: as an air base, as a naval base and trans-shipping center, and as a radio warning and communication point.

In considering Truk as an airbase, seven different target systems are designated for attack, the destruction of which will result in its most efficient neutralization for that purpose. It is considered that bombing extraneous targets only detracts from the effectiveness of any attack. For this reason and because only neutralization and not pill boxes, barracks, etc., are not considered primary bombing targets.

The seven installations necessary to the maintenance of Truk as an airbase are: aircraft, airstrips, seaplane ramps and service aprons, dispersal areas and revetments, repair and maintenance facilities, aviation fuel, and ammunition storage. Each of these targets is first considered from the viewpoint of vulnerability to bombing. Those which are vulnerable to this type of attack are analyzed to determine the proper bombs to use against them. Finally, the targets are considered with relation to the total bombs necessary to score the number of hits required for neutralization. The last step in the analysis covers the relative probability of hitting by dive bombing, glide bombing, and level bombing from 10,000 and 25,000 feet.

Seaplane ramps and service aprons, and dispersal areas and revetments (except when occupied by aircraft) are poor targets and little is to be gained by bombing them. No concentration of aviation fuel or ammunition storage have been found on Truk.

Of the seven target categories mentioned above, therefore, only aircraft, airstrips, and repair and maintenance facilities are vulnerable to aerial bombs. The analysis of these three targets is carried through the next two steps in an attempt to determine the number and type of bombs required for each.

Considering Truk as an air base, the study concludes that each of the three vulnerable targets has a very high rate of . operability and that any neutralization of air facilities at Truk will be only

temporary. Aircraft on the ground are best attacked by fighters. When only bombers are present, 20 pound fragmentation bombs are most effective. The airstrips are best attacked by a combination of cratering bombs (500# G. P., 0.01 second tail and 0.1 second nose fuses), varying long-delay G. P. bombs, butterfly bombs fused with various long delays or anti-disturbance devices, and spikes. Repair and maintenance facilities are best attacked by 500# G. P. bombs with 0.01 second tail fuses and 0.1 second nose fuzes. In a carrier attack, fighters should be used to attack aircraft and bombers to attack repair and maintenance facilities.

In a medium or high level attack, because of the possibility of finding few enemy aircraft on the ground, it would appear preferable to omit the fragmentation bombs and to attack airfields and repair and maintenance facilities. As an estimate of the total weight of attack necessary to render the three airfields at Truk temporarily inoperative, 150 to 300 PB4Y from high altitude and slightly fewer from medium altitude may be utilized. For the repair and maintenance facilities about 250 attacking PB4Y sorties from medium altitude or about 1200 from high altitude would yield a reasonably high probability (80%-90%) of destroying the main buildings. It is stated that attacks will have to be repeated after a short time, the length of which can be determined only after subsequent detailed target analysis.

By a similar system of analysis, it is concluded that the best way to neutralize Truk as a naval base is to attack ships rather than fuel oil storage, warehouses, and other facilities. It was found impossible to estimate the force necessary for this task as the number of ships found at Truk would be subject to variation, but graphs are presented showing the force required for a given probability of obtaining a given number of hits on particular types of ships. Finally, it is concluded that radio installations on Truk should not be considered as targets because of the relative unimportance of the R.D.F. stations on Truk alone, the unlikelihood of being able to locate all of the radio stations on the islands, and the inherent difficulty of then destroying them.

Any study such as the target analysis of Truk is to some extent unrealistic insofar as it does not consider the difficulties which are inherent in the geographical position of the target, the surprise which our carrier task forces have been able to achieve when attacking Japanese bases, the attrition in planes and ships which has already been inflicted on the enemy, the greater production capacity of the United States as compared to Japan, and the forces which we have available to hit the enemy. When considered with these factors, however, such studies will help us to determine the force required to neutralize or wipe out particular targets, and to select targets which destroy the most valuable functions of the objective. Their principal value should be in preventing us from sending a force to accomplish a task for which it is not equipped, or, conversely, from dissipating our strength on targets which could be destroyed or neutralized by relatively small numbers of planes.

Personnel are considered poor primary targets. Troops are almost certain to be dispersed, well concealed, and well protected during attack. Buildings designed for the maintenance of personnel are a convenience rather than a necessity in a tropical environment. If barracks or mess-halls are destroyed, troops can be quartered and fed in tents or in the open with no loss other than a few personal belongings.

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REFERENCE: Air Operations Memorandum No. 30

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EFFECTIVENESS OF FORWARD FIRING AIRCRAFT ROCKETS

The table below gives data on forward firing aircraft rockets (chemical and practice assemblies excepted):

BODY Diam.	BODY Mark	BODY Filler	Fuze	Motor** (3"25)	Wt. of Body Loaded & Fused Lbs.	Wt. of Complete Round Lbs.
3"5	1, 2	Solid	None	Mk. 6,7	20	53
"	"	"	"	Br.UP-3	"	54
"	8*	"	"	Mk. 7	20	53
"	"	"	"	Br.UP-3	"	54
"	3, 5	2.3 lb. TNT	NF Mk. 148	Mk. 7	20	53
"	"	" "	NF Mk. 149	"	21½	54½
"	"	" "	NF Mk. 148	Br.UP-3	20	54
"	"	" "	NF Mk. 149	"	21½	55½
5"0	1	8.4 lb. TNT	NF Mk. 148	Mk. 7	44½	77½
"	"	" "	NF Mk. 149	"	46	79
"	"	" "	NF Mk. 148	Br.UP-3	44½	78½
"	"	" "	NF Mk. 149	"	46	80
"	"	7.9 lb. TNT	NF Mk. 148 BF Mk. 148, 157	Mk. 7	49½	82½
"	"	" "	NF Mk. 149 BP Mk. 146, 157	"	50½	83½
"	"	" "	Nose Plug BP Mk. 146, 157	"	50½	83½

* Body developed to give improved underwater performance.

** Performance of Motors Mk. 6, Mk. 7, and British UP-3 are considered as identical for the purpose of this letter.

EFFECTIVENESS AGAINST ARMOR:

The H. E. nose fuzed rockets are particularly effective when used against exposed personnel and materiel. They are not adapted to the penetration of armor, but, given sufficient velocity, are capable of holing light plates. In the description below the term "serious damage" indicates that the minimum dimension of the hole through the plate is equal to, or greater than, the diameter of the rocket body.

(a) 3"5 H. E. rockets may be expected to inflict "serious damage" to plates from 3/4" to 1" in thickness, depending on the speed of the firing aircraft and the range. Slight damage will be done by fragments behind the plate. In thinner plates the rockets will tear large holes with correspondingly greater fragment damage behind the plate. The performance will probably not differ materially for striking obliquities between normal and 45°.

(b) The 3"5 solid rocket bodies are made of non-heat-treated steel and tend to deform badly or shatter upon impact with heavy armor.

However, at obliquities near normal they may penetrate class B armor as thick as 1-1/2". The limiting thickness of mild steel is estimated at about 2".

(c) The performance of 5"0 rockets[1] fired with the nose fuze free to arm will be essentially the same as that of the 3"5 H. E. rocket described above. Although the 5"0 rocket has a larger explosive charge, its velocity is such that "serious damage" is not to be expected in plates much thicker than 1".

(d) Maximum penetration with the 5"0 rocket is obtained by using the steel nose plug (or nose fuze inoperative) and the delay base fuze Mk. 157. With this combination the rocket will penetrate approximately 1" of class B armor at normal obliquity and 3/4" at 45° obliquity, detonation occurring a few feet behind the plate. Against thicker plates the body is likely to break up before the delay element functions. With the non-delay base fuze Mk. 146 the inherent delay is such as to allow slightly more penetration than when the nose fuze is permitted to function. (Approximately the same damage will be done to the plate but more fragments will be projected through.)

EFFECTIVENESS AGAINST SUBMARINES:

In order for a H. E. rocket to cause lethal (sinking) damage to a submarine, the rocket must be detonated in contact with the pressure hull. This is unlikely to occur with nose fuzed or non-delay base fuzed rockets since intervening structures such as an upper deck or saddle tanks will initiate fuze action before the pressure hull is reached. The 5"0 rocket with a nose plug (or with nose fuze inoperative) and with a delay base fuze may penetrate these structures and breach the pressure hull. In any case a direct (above water) hit will be required since both nose and base fuzes will function upon water impact.

The 3"5 solid body rockets have been developed primarily for anti-submarine use and are capable of penetrating a submarine's pressure hull even after considerable underwater travel. Tests have been conducted to investigate the underwater trajectories of these rockets. Firings were from aircraft - speed about 220 Kts., dive angles 5° to 30°. Range to target was such that burning had nearly always been completed before the round had struck the water. It was found that the rockets usually have stable underwater travel. Upon striking the water the rocket path tends to curve toward the surface and, if the entrance angle is not too great, the round may reappear after an underwater run. Due to the blunter nose, rockets with bodies Mk. 1 and 2 reappeared after runs of 100 to 200 feet, whereas the Mk. 8 body reappeared after runs of 150 to 550 feet. As the entrance angles increase the length of the underwater run increases but fewer of the rounds reappear. The rocket employing the Mk. 8 body maintains its underwater velocity much better than do those with bodies Mk. 1 and 2, and has an estimated lethal range underwater of about 130 feet against a submarine pressure hull while bodies Mk. 1 and 2 have a lethal range of about 70 feet.

EFFECTIVENESS AGAINST REINFORCED CONCRETE:

The 3"5 and 5"0 rockets with explosive bodies fused with nose fuzes and/or non-delay base fuzes are not expected to cause more than superficial surface damage to concrete slabs of appreciable thickness.

The 3"5 solid body rockets and the 5"0 rocket with the delay base fuze and steel nose plug (or nose fuze set "safe") are effective against reinforced concrete. Penetration capabilities of these 3"5 and 5"0 rockets are about the same. The thickness of slab which will be completely penetrated varies to a certain extent with the conditions of firing but on the average may be taken as approximately 2 feet at normal obliquity, and 1-1/2 feet at 30° obliquity. The depth of penetration in massive slabs will be about one-half of the above values.

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1 When reference herein is made to the 5"0 rocket, use of the 3"25 motor, Mk 7, is implied and should not be confused with the 5"0 rocket with 5"0 motor.

The data contained in "Effectiveness Against Armor" and "Effectiveness Against Reinforced Concrete" are to be considered as preliminary since most of the information has been derived from tests with projectiles other than rockets. More complete data will be published when available.

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REFERENCE: NavOrd OCL AV21-44

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SUGGESTED READING

(Restricted)

1. Ordnance Pamphlet #1223, "Range Table for 3.5 and 5.0 Aircraft Rockets, British 3.25 Motor No. 1 Mark II (11 lb. Cruciform Grain) used with Launchers Mark 4 and Mark 5", dated 17 July 1944.

   For personnel interested, this O. P. gives data on subject rockets for use in determining the proper sight settings for firing the rockets under various sets of conditions.

(Restricted)

2. Ordnance Pamphlet #1017 (First Revision), "Special Fuses for Rockets, Projector Charges, and Miscellaneous Munitions", dated 13 June 1944.

   This O. P. contains the description, operation, installation, care and maintenance of fuses from the Mark 131 through Mark 149. The O. P. is well illustrated and ample written material is provided for complete coverage of the subject fuses.

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CORRECTIONS

The following corrections should be made in AFEO Bulletin No. 8:

1. Page 19. The fuze indicated as "AN-Mk 239" is actually not Army-Navy (AN-M) Standard. Corrections should be made by simply crossing out the "AN", so that the fuse will be shown as "Mark 239".

2. Page 15. The bombs referred to in this article on the Cluster Fragmentation T8 are called the "M81, 90 lb. Fragmentation Bombs". The designation of the bomb is in error and should be corrected wherever mentioned to read, "M82". It will be recalled that the "M81" is the 260 lb. fragmentation bomb.

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