Serial 4,

RESTRICTED ORDNANCE PAMPHLET 1157

(FIRST REVISION)

ROCKET AMMUNITION

3"/5 and 5"/0 Aircraft Rockets (3"/25 Motor)

DESCRIPTION AND INSTRUCTIONS FOR USE

A BUREAU OF ORDNANCE PUBLICATION 23 MARCH 1945

RECORD OF CORRECTIONS

Change or memorandum no.	Date Entered	Signature of person making corrections
Chang: 1 dtd 21 Sept 1945	22 Oct 1945	Irene Shaver

NAVY DEPARTMENT, BUREAU OF ORDNANCE, WASHINGTON, D.C.

To all holders of Ordnance Pamphlet 1157 (Preliminary)

Insert change; write on cover "Change 2 entered"

Approved by The Chief of The Bureau of Ordnance

Acting Chief of Bureau

OP 1157 (Preliminary) CHANGE 2

8 September 1944

1 Page ——— Page 1

ORDNANCE PAMPHLET 1157 (Preliminary) is changed as follows:

FORWARD FIRING OF 3".5 AND 5".0 AIRCRAFT ROCKETS FROM TBF-1, ETC.

Page 25

Change 1 of OP 1157 (Preliminary) changed Part 3, Section 1, first paragraph on page 25.

This paragraph should be deleted and the following paragraph substituted.

Formerly hard-drawn twelve-gage copper wire has been issued for this purpose and the use of 0".064 fuze arming wire has been authorized where hard-drawn twelve-gage copper wire was not available. As the result of tests conducted on launcher installations, another change has been made in the size of the shear wire. Soft or annealed ten-gage copper wire will now be issued in ammunition boxes, two one-foot lengths per box, and to carriers in five hundred foot coils, and should be used for all arrested landings. The use of 0".064 fuze arming wire as an alternate is no longer authorized. The shear wire furnished by the California Institute of Technology (C.I.T.), which has been shipped in the past with lots marked with C.I.T. lot numbers, is to be used only where no arrested landings are contemplated. For ease of installation, it has been reported that instead of installing the shear wire in the conventional way, a piece of the wire with an "eye" made in one end is installed and left straight, a Fahnestock clip being used to keep the wire in place. It is important that no shear wire be subjected to more than one arrested landing.

D I S T R I B U T I O N

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RESTRICTED

NAVY DEPARTMENT
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To all holders of Ordnance Pamphlet 1157 (1st Rev.)
insert change; write on cover 'Change 1 inserted'
Approved by The Chief of The Bureau of Ordnance

Acting Chief of Bureau

OP 1157 (1st Rev.) CHANGE 1
21 September 1945

1 Page ——— Page 1

ORDNANCE PAMPHLET 1157 (1st Rev.)
is changed as follows:

ROCKET AMMUNITION 3.5-INCH AND 5.0-INCH AIRCRAFT ROCKETS (3.25-INCH MOTOR) DESCRIPTION AND INSTRUCTIONS FOR USE

Add after section "f" pages 8 and 9:

g. 3.5-inch Rocket Head Mark 6 Mod 0.

This head is a smoke round filled with approximately 6,0 lbs. of PWP and a steel well pressed into the head. The Head Mk 6 is used with the 3.25-inch Motor Mk 7 Mod 0 or 1, and the Nose Fuze Mark 155 Mod 0 with integral 3/8 inch burster tube. When the rocket is properly assembled and fired, the round may be expected to burst upon striking a target throwing burning pieces of PWP in a 50 yard diameter circle. This round has a range of 9,000 yards. Dispersion at 2,000 yards will be approximately 60 yards. Arming time is 425 feet at 130 degrees F. and 900 feet at 0 degrees F. Velocity at end of burning is 1150 f./s.

Add after section d, column 2, page 15:

e. Nose Fuze Mark 155 Mod 0.

This fuze is similar to the Mark 149 except that it incorporates a 3/8 inch Tetryl burster in lieu of a booster charge. The Fuze Mk 155 Mod 0 will function instantaneously upon striking land or water, and at low impact angles. The buster which contains approximately 1/8 pound of tetryl, ruptures the case throwing globs of PWP over an area approximately 50 yards in diameter. The PWP ignites spontaneously upon contact with the air and the particles burning at the source produce a dense cloud for 2-3 minutes. There is some anti-personnel effect due to the burning particles which will produce a severe burn if they strike personnel.

Delete sections d and e, column 2, page 16 - Add:

d. 3.5-inch Rocket Head Mark 6.

These rocket heads should be stowed separately in a cool magazine below 100 degrees F. If the temperature of the PWP loaded head is raised above 100 degrees F., the ingredients melt and separate, greatly reducing the effect of the round. If 110 degrees F. is reached while the round is stowed on its side, and the temperature is then lowered, the WP portion of the filling will solidify in the lower portion of the head causing inaccurate flight when fired.

Stowage should be in a position so that a leaking round may be readily observed and easily jettisoned.

If stowed below decks in an accessible space, provision should be made for flooding the magazine. No other ammunition of any kind should be stowed in the same magazine.

e. Nose Fuze Mark 148 Mod 0, Mark 149 Mod 0 and Mark 155 Mod 0.

Nose Fuzes should be stowed in regular bomb fuze magazines in the individual containers in which they are shipped.

f. Base Fuzes.

Base Fuzes come staked in placed in the base of the heads and are stowed with the heads. No attempt should be made to remove the base fuze from the rocket head.

DISTRIBUTION

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(FIRST REVISION)

ROCKET AMMUNITION

3".5 and 5".0 Aircraft Rockets (3".25 Motor)

DESCRIPTION AND INSTRUCTIONS FOR USE

23 MARCH 1945

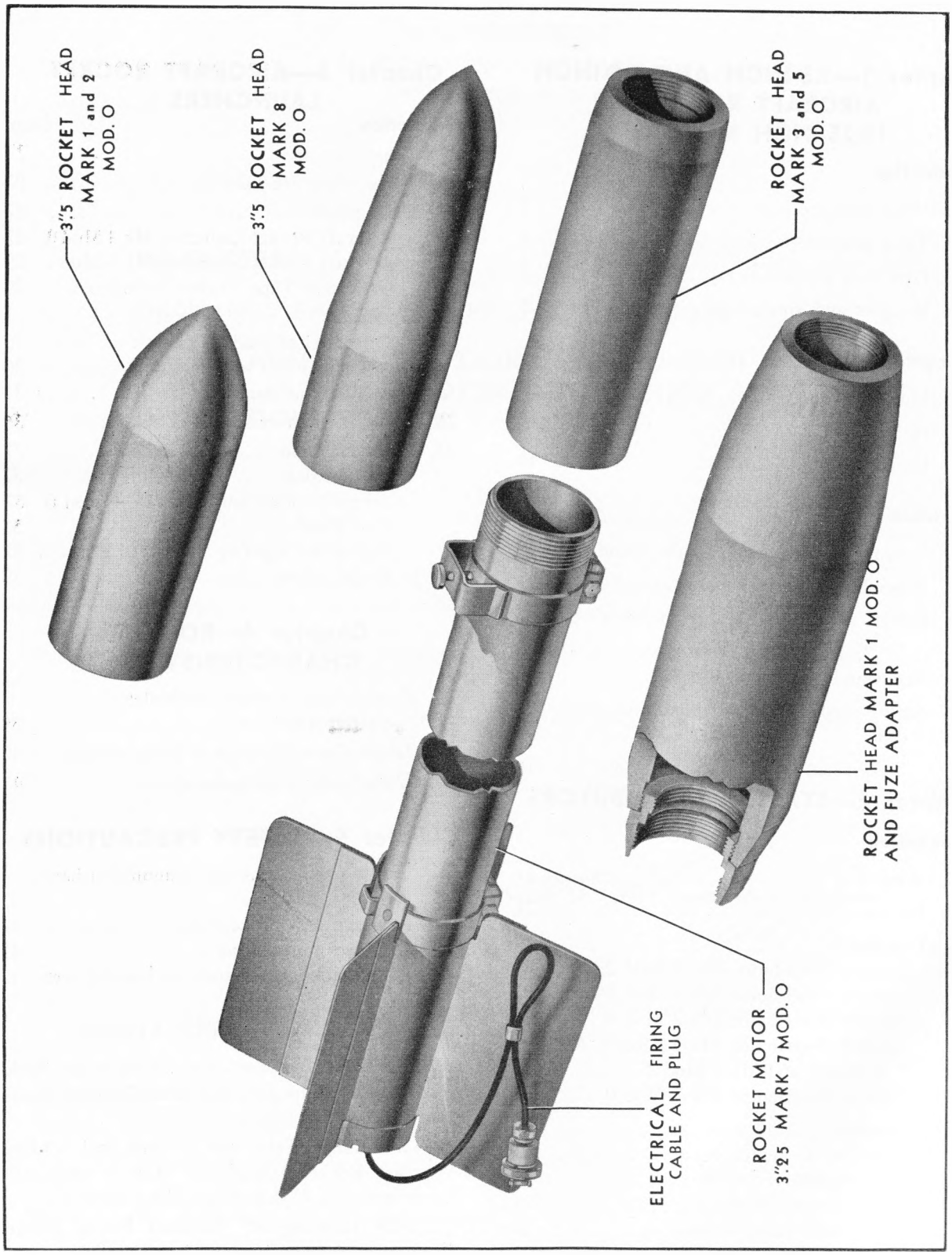

Figure 1.—3.5-inch and 5.0-inch Aircraft Rocket (3.25-inch Motor)

Chapter 1

3.5 INCH AND 5.0 INCH AIRCRAFT ROCKET 3.25 INCH MOTOR

Introduction

1. What They Are

a. The 3.5-inch and the 5.0-inch Aircraft Rockets described in this pamphlet are fin-stabilized rockets using the 3.25-inch Motor Mark 7 Mod 0 as the propulsive unit.

2. Their Purpose

a. The rocket equipped with a 3.5-inch solid steel head is designed for penetrating the hulls of submarines and other lightly armored vessels.

b. The rockets equipped with 3.5-inch or 5.0-inch high explosive heads are intended for use against targets such as shipping, personnel, bivouac areas, and light armor.

3. How They Work

a. A rocket, ready for firing, is in position on a launcher, with connections made to an electric firing device. When the firing button is pressed, an electric impulse passes through a squib in an igniter located in the forward end of the motor tube. The squib sets off a charge of black powder in the igniter, filling the interior of the motor tube with hot burning gas under high pressure, which, in turn, raises to ignition temperature the surface of the propellent grain in the motor tube. As the propellant burns, it generates a large quantity of gas, creating and maintaining high pressure inside the tube. A force is thus exerted in all directions on the interior surface of the tube. The gas rushes out through a nozzle in the rear end of the tube, without exerting any force on the nozzle throat area. The corresponding area of the closed end forward receives the full force of the gas under pressure. Thus is developed a thrust which drives the rocket forward.

b. The propellant burns at almost constant pressure, the value of this pressure being higher if the initial temperature of the propellent grain is higher. The burning time and, therefore, the distance the projectile travels during burning, depends upon the pressure, increasing as the pressure decreases. Thus, a cold round burns for a longer time and at a lower pressure than a hot round.

4. Weights and Dimensions

a. The weights, the various combinations of components that make up a complete round, and shipping box data will be found in the charts of the physical characteristics of 3.5-inch and 5.0-inch Rockets below.

Description

5. Motor

a. **3.25-inch Rocket Motor Mark 7 Mod 0.** The fin-stabilized rockets described in this Ordnance Pamphlet use the 3.25-inch Rocket Motor Mark 7 Mod 0 which is illustrated in Figure 2. The components of the motor are as follows:

(1). Front Shipping Cap. The front shipping cap is screwed onto the front end of the motor tube.

CHART OF SHIPPING WEIGHTS, DIMENSIONS AND SHIPPING BOXES

Item	No. in Box	Box Dimensions (inches)	Vol. (cu. ft.)	Weight (lbs.)
3.5 -inch Head Mk 1 or 2	6	16–12–11 3/8	1.28	150
3.5 -inch Head Mk 3 or 5	6	16 3/8–13 1/2–11	1.4	135.5
5.0 -inch Head Mk 1 Mod 0	2	24 1/8–12 7/8–7 1/8	1.26	106.5
3.25-inch Motor Mk 1 Mod 0	4	52–15 1/16–15 1/16	6.8	189
Nose Fuze Mk 148 *Mod 0	28	9 9/16 Diam.–13 5/8"	0.57	32
Nose Fuze Mk 149 *Mod 0				

* Each Fuze comes in an individual metal can.

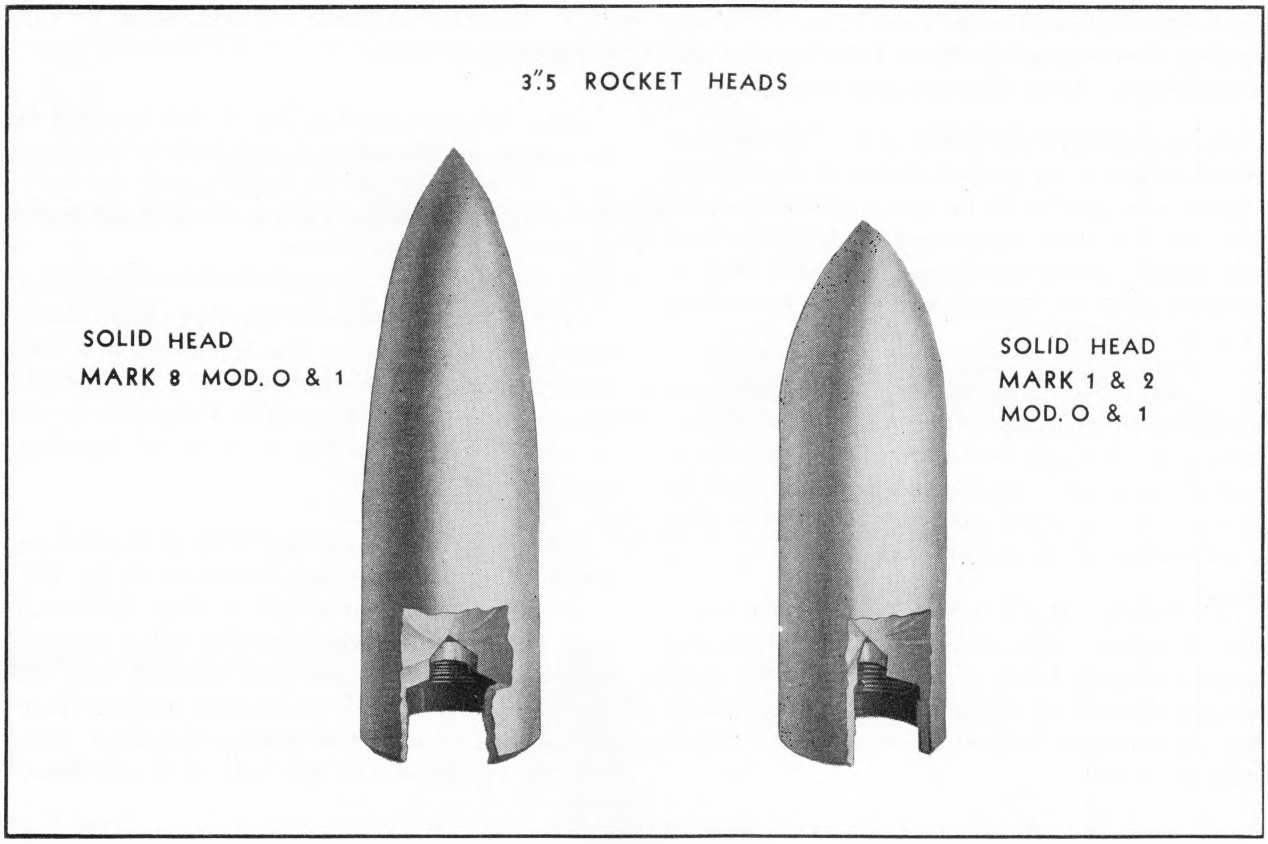

Figure 3.—3.5-inch Rocket Heads—Solid

6. Heads

a. **3.5-inch Rocket Head Mark 1 Mod 0.** This head is a 20-pound solid steel shot with an ogive radius of 5 inches and a total length of 10.35 inches. When attached to the 3.25-inch Rocket Motor Mark 7 Mod 0 this head forms a projectile for firing against submarines and is capable of penetrating up to 1.5 inches of mild steel at normal incidence. The lethal underwater range is approximately 60 feet when the projectile enters the water at an angle of about 20 degrees. The lethal range depends upon the rocket velocity. This velocity is the sum of the plane speed and the velocity imparted to the rocket by the gas jet issuing from the nozzle.

b. **3.5-inch Rocket Head Mark 2 Mod 0.** This head is identical in every respect to the 3.5 Rocket Head Mark 1 Mod 0.

c. **3.5-inch Rocket Head Mark 8 Mod 0.** This head is a 20-pound solid steel shot 11.75 inches long. It differs from the Mark 2 in that a double ogive is incorporated in its design. When fired at entry angles of 20 degrees or less this projectile has a lethal underwater range of about 120 feet.

d. **3.5-inch Rocket Head Mark 3 Mod 0.** This head carries a high explosive charge. When filled with 2.3 lbs. of high explosive and fitted with a nose fuze, the head weighs about 20 lbs. Combined with the 3.25-inch Rocket Motor Mark 7 Mod 0, this head forms a projectile with approximately the same drag coefficients as the rounds equipped with 20-lb. solid steel heads and, hence, has about the same air trajectory. This head may be used with either Nose Fuze Mark 148 Mod 0 or 149 Mod 0. No provision is made for use of a base fuze with this head.

e. **3.5-inch Rocket Head Mark 5 Mod 0.** This head is identical in every respect to the 3.5-inch Rocket Head Mark 3 Mod 0.

f. **5.0-inch Rocket Head Mark 1 Mod O.** This head is a high explosive shell weighing about 46 lbs. when filled with TNT and equipped with both base and nose fuzes. This body may be shipped with a conical nose plug installed, and when thus used will

have the fragmentation and penetration characteristics, at comparable velocities, of the 5″/38 common AA projectile, of which it is a modified design. Future issues of 5.0-inch Head Mark 1 Mod 0 will have mainly flat nose plugs installed for shipping. The flat plug must be removed before use and the Fuze Mark 149 Mod 0 installed.

Until the Nose Fuze Mark 149 Mod 0 replaces completely the Nose Fuze Mark 148 Mod 0 an adapter for accommodating Nose Fuze Mark 148 Mod 0 in the fuze seat liner ring will be included in the shipping box with each head shipped. All 5.0-inch Rocket Heads Mark 1 Mod 0 are shipped with a base fuze installed and staked in place. Under no circumstances should an attempt be made to remove the base fuze from the head.

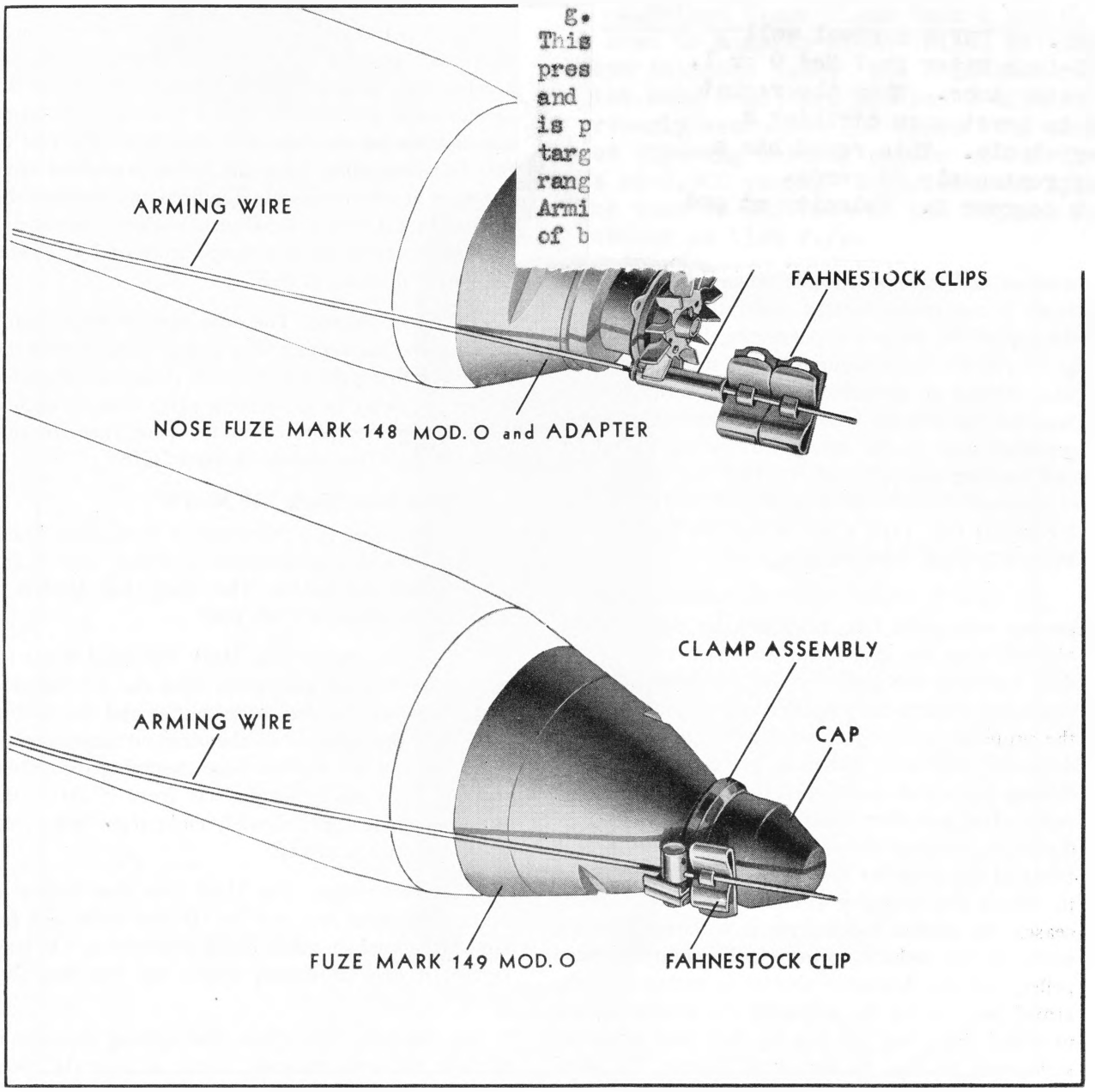

Figure 4.—3.5-inch Rocket Heads with Fuzes, HE

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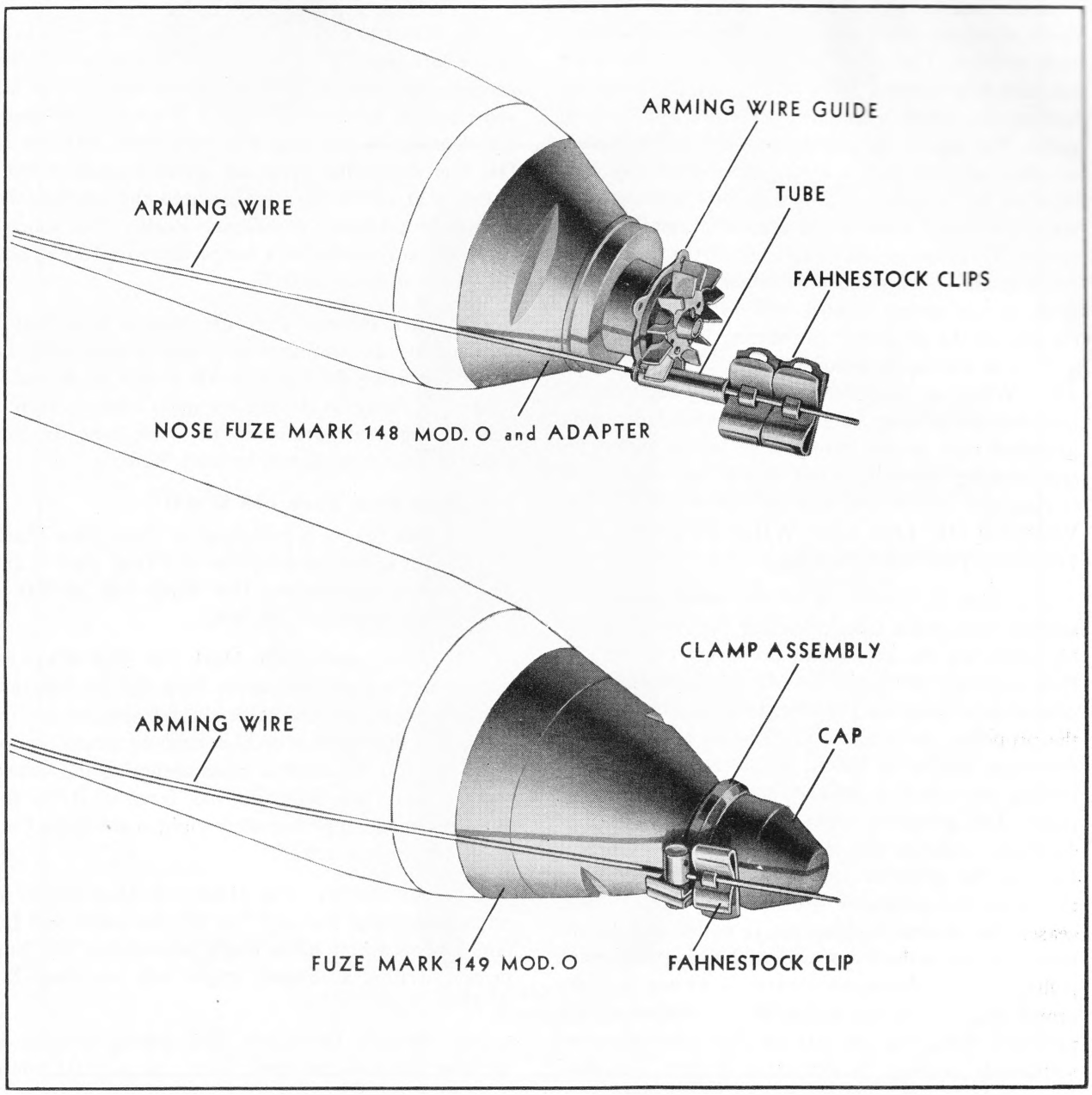


Figure 4.—3.5-inch Rocket Heads with Fuzes, HE

7. Fuzes

a. Nose Fuze Mark 149 Mod 0

(1). If available, O.P. 1017 should be studied for a more complete description of this fuze.

(2). DESCRIPTION. This fuze is an air arming, impact firing fuze designed for use with 3.5-inch and 5.0-inch Forward Firing Aircraft Rockets. The fuze body fits directly into the fuze seat liner ring in the nose of the rocket without requiring an adapter.

In the unarmed position, the firing pin is screwed down alongside the detonator shutter holding it in a safe position. The propeller is attached to the firing pin and is prevented from turning by the propeller locking pin, which is attached to the propeller locking pellet. The cap on the nose of the fuze is held tightly in place on the gasket by a clamp assembly held together by a safety wire, or a fuze arming wire when the round is loaded on a launcher, and is ready to fire. This cap prevents exposure of the fuze to the weather and is removed only when the projectile is fired. A cap spring located under the cap bears on the top of the propeller, preventing it from turning as long as the cap is secured by the safety or arming wire. When an assembled round is loaded on the launcher the arming wire is first inserted in a hole provided next to the safety wire in the clamp pin and bushing assembly, after which the safety wire is removed. THIS ORDER MUST NOT BE REVERSED OR THE CAP WILL FLY OFF EXPOSING THE PROPELLER.

(3). How IT WORKS. When the round is fired, the arming wire pulls free, releasing the clamp assembly, allowing the cap spring to throw off the cap, thus exposing the propeller. At the same time, acceleration retracts the propeller locking pin, releasing the propeller. As long as acceleration continues, the detonator shutter is locked in place by the shutter locking pin which is attached to the shutter locking pellet. The propeller turns outward in a clockwise direction, clearing the detonator shutter. About 8 turns of the propeller are required for the firing pin to release the detonator shutter. When acceleration ceases, the shutter locking pin is withdrawn by the action of the setback spring on the shutter locking pellet, and the detonator shutter is swung into the armed position by the action of the shutter spring, provided the firing pin has by this time advanced sufficiently to clear the detonator shutter. The shutter is locked in the armed position by the detent engaging in a hole in the firing pin guide. The firing pin jams and stops turning when the end of the threads reach the nose plate. Upon impact, the firing pin shears the threads in the nose plate and is driven into the detonator, thus setting off the explosive train.

(4). SENSITIVITY. The Nose Fuze Mark 149 Mod 0 fires at impact angles as low as 5° to 10° for water and for land targets which allow slight penetration. On hard targets it fires at impact angles not less than 20° to 25°.

(5). ARMING DISTANCE. Since the shutter is held in the safe position by the shutter locking pin during acceleration, arming will not occur until about 0.1 second after acceleration ceases. Therefore the arming distance of the fuze will vary from 200 feet to 800 feet depending upon the initial propellant temperature at which the round is fired and whether the fuze is in a 3.5-inch or 5.0-inch Rocket. The shorter distances correspond to a temperature of 130°F. and the longer distance to 0°F.

(6). SAFE FIRING. The fuze may be fired "safe" by releasing the arming wire so that it stays with the round. In firing the 5.0-inch AR it may be desirable to have a delay in detonation upon impact, such a delay being incorporated in the base fuze. In this case the nose fuze should be fired "safe."

b. Nose Fuze Mark 148 Mod 0

(1). This fuze is a prototype of Nose Fuze Mark 149 Mod 0 and is an adaption of a fuze used in another rocket application. The Mark 148 Mod 0 is described in detail in O.P. 1017.

(2). DESCRIPTION. The Mark 148 Mod 0 has no shutter locking pin and, aside from the friction that exists between the detonator shutter and the lead-in disc while the round is accelerating, no means is provided to stop the shutter from assuming the armed position once the firing pin has freed it. After the fuze has made approximately eight right turns outward, the fuze is armed.

(3). SENSITIVITY. The Mark 148 Mod 0 fires at impact angles as low as 5° to 10° for water and for land targets which allow slight penetration. On land targets it fires at impact angles not less than 20° to 25°.

(4). ARMING DISTANCE. The arming distance is variable for two reasons: First, as aircraft speed increases, the torque on the propeller is increased, thus reducing the time required for the firing pin to

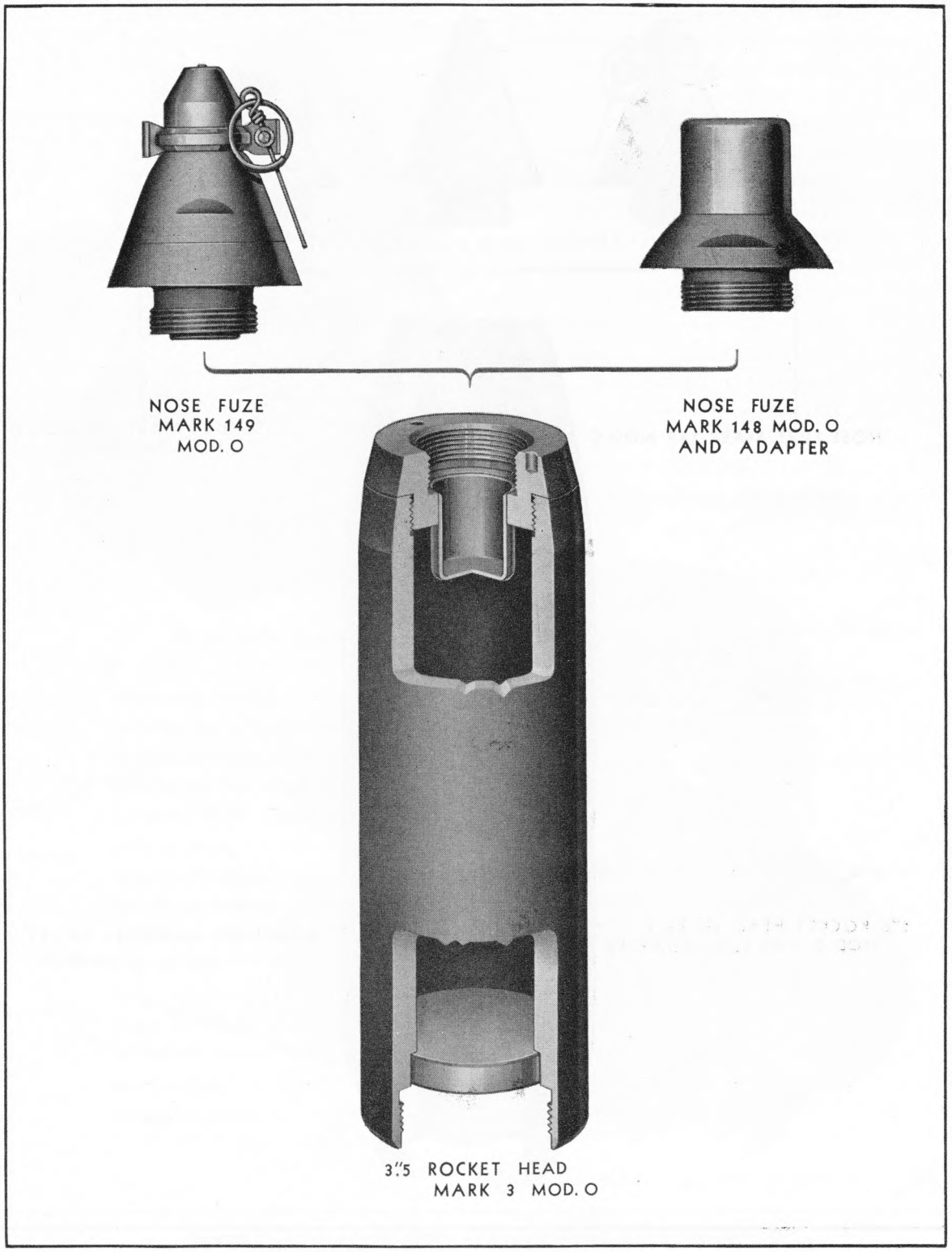


Figure 5.—3.5-inch Rocket Head Mark 3 Mod 0 and Fuzes

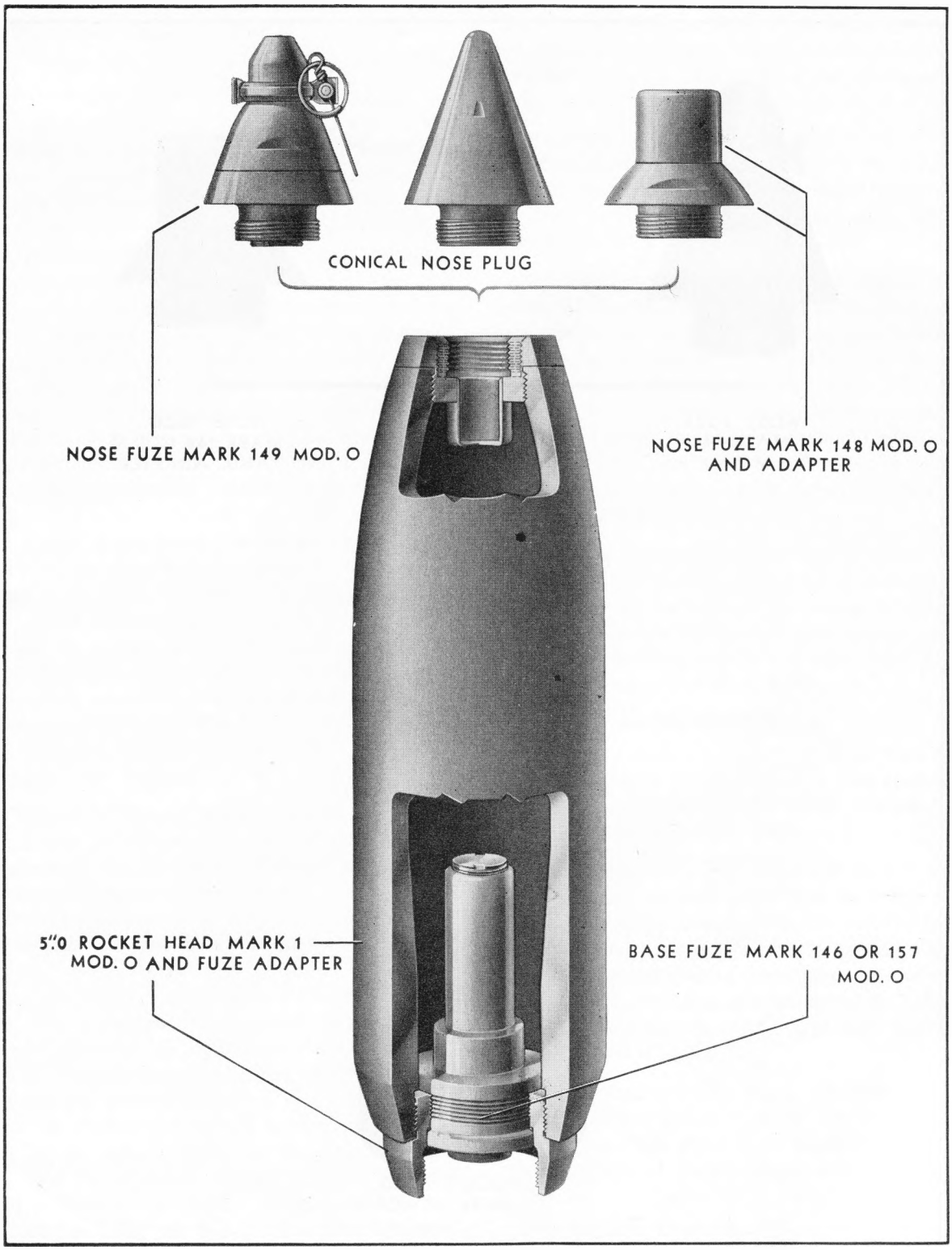


Figure 6.—5.0-inch Rocket Head Mark 1 Mod 0 and Fuzes

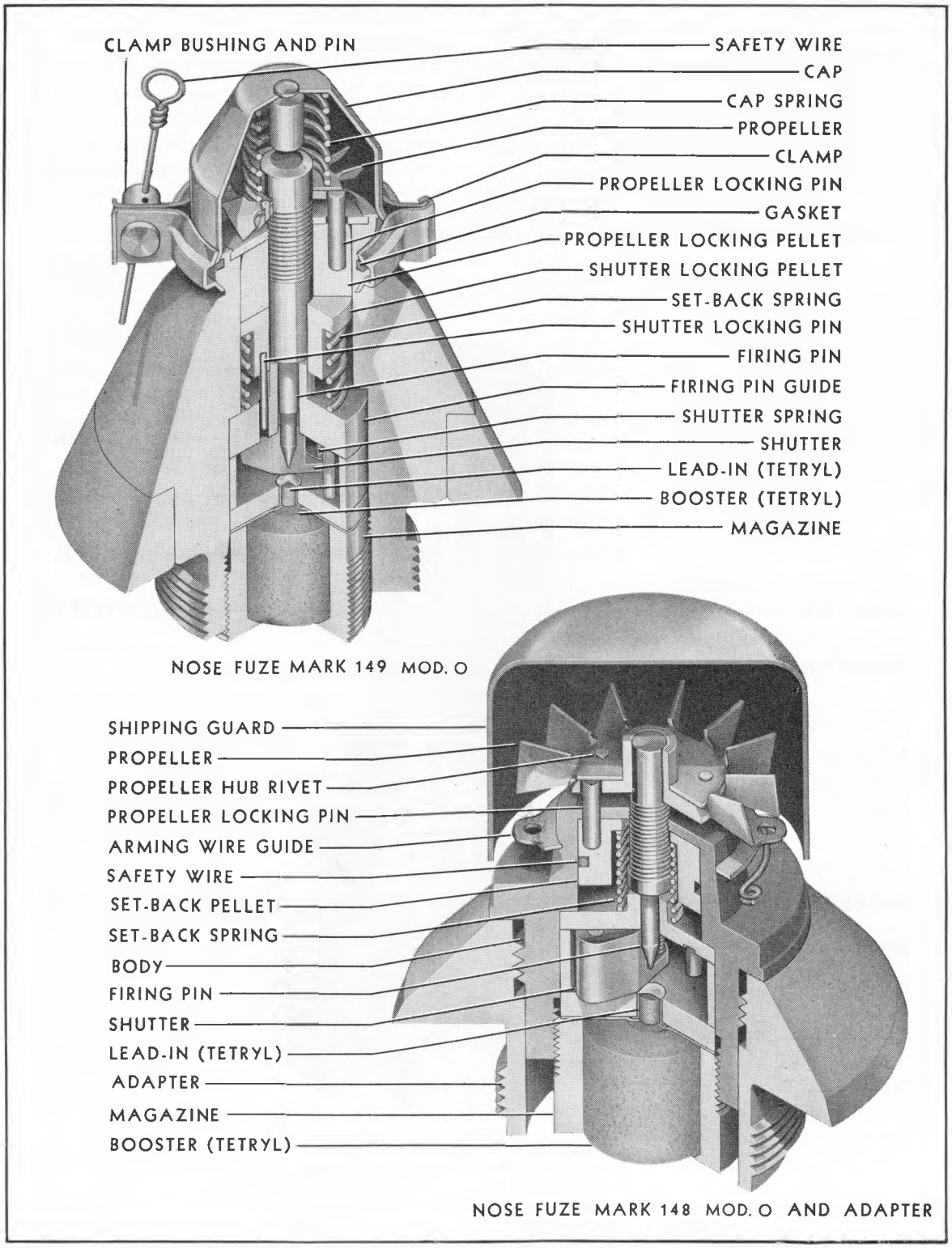


Figure 7.—Nose Fuze Mark 149 Mod 0 and Mark 148 Mod 0

free the detonator shutter; Seccnd, as mentioned above, as the acceleration increases (with increasing initial firing temperature), the friction between the shutter and the lead-in disc increases, and arming is often not completed until propellant burning ceases. Neglecting this friction effect, the minimum arming distance due to the propeller torque can be summarized as follows:

Aircraft Speed (knots)	Minimum Arming Distance from Aircraft (feet)
0	300
150	150
200	125
350	40 (estimated)

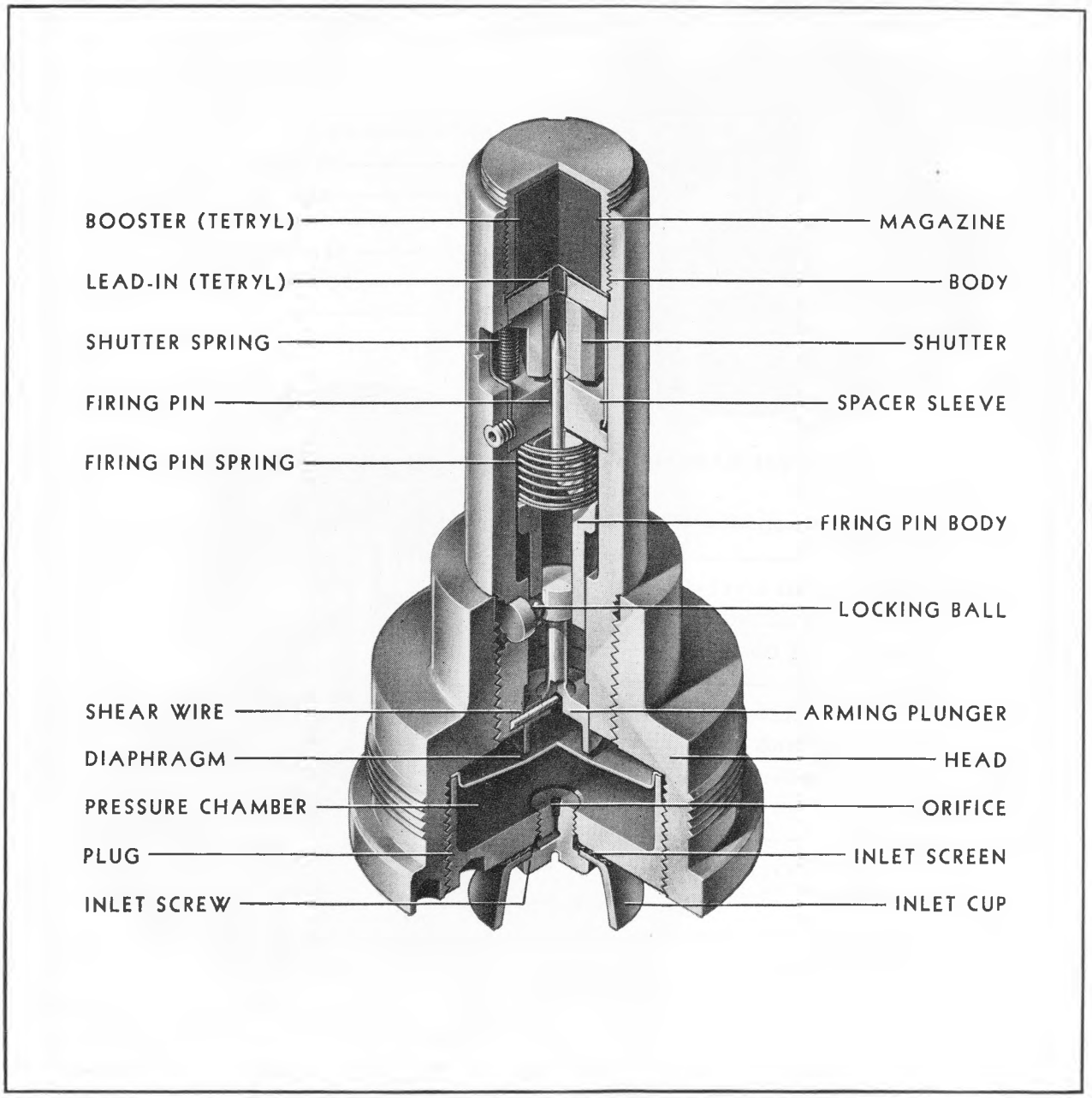


Figure 8.—Base Fuze Mark 146 Mod 0

If frictional forces are large enough to hold the detonator shutter, arming will be delayed until burning ceases. At propellant temperature of 0°F. the burning distances are about 800 feet and 530 feet for the 3.5-inch and 5.0-inch AR respectively. At propellant temperature of 130°F. burning distances are about 320 feet and 195 feet for the 3.5-inch and 5.0-inch AR respectively.

(5). Safe Firing. The Nose Fuze Mark 148 Mod 0 is fired "safe" in the same manner as the Nose Fuze Mark 149 Mod 0.

c. **Base Fuze Mark 146 Mod 0**

(1). Description. The 5.0-inch Aircraft Rocket is equipped with a base fuze. The fuze is shipped installed in the head and no attempt should be made to remove it therefrom. The fuze screws into an adapter in the base of the 5.0-inch Rocket Head Mark 1 Mod 0. The gasket and luting on the threads make a gas-tight seal between the motor and the interior of the head. The exterior surface of the diaphragm of the fuze is exposed to the front end of the rocket motor. The fuze body extends into a cavity of the TNT filler of the rocket head.

(2). How It Works. Gases from the rocket motor enter the pressure chamber through a small orifice in the inlet screw. Debris from the rocket motor is filtered out by the inlet screw. When the pressure in the chamber reaches a value of 300 #/in^2 (when burning is about half completed) the diaphragm collapses, forcing the arming plunger down, and shearing the wire, which holds the arming plunger in place. Movement of the plunger releases the locking ball, which, in the unarmed condition, holds the firing pin body in place, and allows the latter to move toward the rear under the force of its own inertia and action of the firing pin spring. The firing pin is thus withdrawn from the shutter which, in the unarmed condition, is locked in the safe position. During acceleration, the inertia of the shutter forces it back against the firing pin guide, compressing the shutter spring and engaging the shutter locking pin in a hold in the firing pin guide. About midway during acceleration, the firing pin is withdrawn from the shutter, but the latter, held by the shutter locking pin, remains in the safe position. When acceleration ceases, the shutter spring forces the shutter forward, disengaging the shutter locking pin from the hole in the firing pin guide. The shutter spring then forces the shutter to swing into the armed position where it is locked by the detent. Upon impact, inertia of the firing pin body drives the firing pin into the detonator, setting off the explosive train.

(3). The arming plunger and the 0.057-inch phosphor bronze shear wire make the fuze in a fully loaded 5.0-inch AR safe from arming when dropped from any height up to 40 feet. The fuze fires with a slight inherent delay. A minimum deceleration of 10g is sufficient to fire the fuze.

(4). Arming Distance. Since arming of the fuze is not initiated until half the burning is over, the Fuze Mark 146 should not arm if the rocket motor blows up on the launcher. The burning distance and, therefore, the arming distance relative to the aircraft will vary with the initial propellent temperature, arming occurring about 0.1 second after acceleration has ceased:

Initial Propellent Temperature	0°F.	70°F.	135°F.
Arming Distance (Feet).....	575	350	250

Caution:

There is no means of determining by visual inspection if a base fuze is armed. If, for any reason, a base fuze is thought to be armed, the body must be disposed of by lowering it gently, tailfirst, into deep water.

d. **Base Fuze Mark 157 Mod 0**

(1). This fuze is identical to the Mark 146 Mod 0 in every respect except that the Mark 157 Mod 0 has a delay detonator which results in a .020 seconds delay in firing after the explosive train is initiated.

(2). Read carefully the Special Fuze Precautions on page 34 before handling these fuzes.

containers are not waterproof and are considered to be a fire hazard when stowed in magazines, they do afford protection for the rocket motors. Stowage of rocket motors in the wood containers is mandatory unless the regulations for unboxed stowage are satisfied.

If frictional forces are large enough to hold the detonator shutter, arming will be delayed until burning ceases. At propellant temperature of 0°F. the burning distances are about 800 feet and 530 feet for the 3.5-inch and 5.0-inch AR respectively. At propellant temperature of 130°F. burning distances are about 320 feet and 195 feet for the 3.5-inch and 5.0-inch AR respectively.

(5). Safe Firing. The Nose Fuze Mark 148 Mod 0 is fired "safe" in the same manner as the Nose Fuze Mark 149 Mod 0.

c. **Base Fuze Mark 146 Mod 0**

(1). Description. The 5.0-inch Aircraft Rocket is equipped with a base fuze. The fuze is shipped installed in the head and no attempt should be made to remove it therefrom. The fuze screws into an adapter in the base of the 5.0-inch Rocket Head Mark 1 Mod 0. The gasket and luting on the threads make a gas-tight seal between the motor and the interior of the head. The exterior surface of the diaphragm of the fuze is exposed to the front end of the rocket motor. The fuze body extends into a cavity of the TNT filler of the rocket head.

(2). How It Works. Gases from the rocket motor enter the pressure chamber through a small orifice in the inlet screw. Debris from the rocket motor is filtered out by the inlet screw. When the pressure in the chamber reaches a value of 300 #/in² (when burning is about half completed) the diaphragm collapses, forcing the arming plunger down, and shearing the wire, which holds the arming plunger in place. Movement of the plunger releases the locking ball, which, in the unarmed condition, holds the firing pin body in place, and allows the latter to move toward the rear under the force of its own inertia and action of the firing pin spring. The firing pin is thus withdrawn from the shutter which, in the unarmed condition, is locked in the safe position. During acceleration, the inertia of the shutter forces it back against the firing pin guide, compressing the shutter spring and engaging the shutter locking pin in a hold in the firing pin guide. About midway during acceleration, the firing pin is withdrawn from the shutter, but the latter, held by the shutter locking pin, remains in the safe position. When acceleration ceases, the shutter spring forces the shutter forward, disengaging the shutter locking pin from the hole in the firing pin guide. The shutter spring then forces the shutter to swing into the armed position where it is locked by the detent. Upon impact, inertia of the firing pin body drives the firing pin into the detonator, setting off the explosive train.

(3). The arming plunger and the 0.057-inch phosphor bronze shear wire make the fuze in a fully loaded 5.0-inch AR safe from arming when dropped from any height up to 40 feet. The fuze fires with a slight inherent delay. A minimum deceleration of 10g is sufficient to fire the fuze.

(4). Arming Distance. Since arming of the fuze is not initiated until half the burning is over, the Fuze Mark 146 should not arm if the rocket motor blows up on the launcher. The burning distance and, therefore, the arming distance relative to the aircraft will vary with the initial propellent temperature, arming occurring about 0.1 second after acceleration has ceased:

Initial Propellent Temperature	0°F.	70°F.	135°F.
Arming Distance (Feet)	575	350	250

Caution:

There is no means of determining by visual inspection if a base fuze is armed. If, for any reason,

8. Stowage of Components of the Round

a. **3.25-inch Rocket Motor Mark 7 Mod 0.** The regulations applicable to the stowage of smokeless powder apply also to the stowage of rocket motors. In addition, rocket motors are not to be stowed in or near the same compartment with radio apparatus or antenna leads.

(1). Rocket motors are currently being issued in wood shipping containers. Although these shipping containers are not waterproof and are considered to be a fire hazard when stowed in magazines, they do afford protection for the rocket motors. Stowage of rocket motors in the wood containers is mandatory unless the regulations for unboxed stowage are satisfied.

bout 320 feet and 195 feet for the 3.5 inch and
ch AR respectively.

). Safe Firing. The Nose Fuze Mark 148 Mod
fired "safe" in the same manner as the Nose
Mark 149 Mod 0.

Base Fuze Mark 146 Mod 0

). Description. The 5.0-inch Aircraft Rocket is
pped with a base fuze. The fuze is shipped in-
d in the head and no attempt should be made
move it therefrom. The fuze screws into an
ter in the base of the 5.0-inch Rocket Head
k 1 Mod 0. The gasket and luting on the threads
a gas-tight seal between the motor and the
ior of the head. The exterior surface of the dia-
gm of the fuze is exposed to the front end of
rocket motor. The fuze body extends into a
y of the TNT filler of the rocket head.

). How It Works. Gases from the rocket mo-
nter the pressure chamber through a small ori-
n the inlet screw. Debris from the rocket motor
ered out by the inlet screw. When the pressure
e chamber reaches a value of 300 #/in² (when
ing is about half completed) the diaphragm col-
s, forcing the arming plunger down, and shear-
the wire, which holds the arming plunger in
. Movement of the plunger releases the locking
which, in the unarmed condition, holds the fir-
in body in place, and allows the latter to move
rd the rear under the force of its own inertia
ction of the firing pin spring. The firing pin is
withdrawn from the shutter which, in the un-
d condition, is locked in the safe position. Dur-
cceleration, the inertia of the shutter forces it
against the firing pin guide, compressing the
er spring and engaging the shutter locking pin
hold in the firing pin guide. About midway dur-
cceleration, the firing pin is withdrawn from
hutter, but the latter, held by the shutter lock-
in, remains in the safe position. When accel-
n ceases, the shutter spring forces the shutter
rd, disengaging the shutter locking pin from
ole in the firing pin guide. The shutter spring
forces the shutter to swing into the armed posi-

loaded 5.0 inch AR safe from arming when dropped from any height up to 40 feet. The fuze fires with a slight inherent delay. A minimum deceleration of 10g is sufficient to fire the fuze.

(4). Arming Distance. Since arming of the fuze is not initiated until half the burning is over, the Fuze Mark 146 should not arm if the rocket motor blows up on the launcher. The burning distance and, therefore, the arming distance relative to the aircraft will vary with the initial propellent temperature, arming occurring about 0.1 second after acceleration has ceased:

Initial Propellent Temperature	0°F.	70°F.	135°F.
Arming Distance (Feet).....	575	350	250

Caution:

There is no means of determining by visual inspection if a base fuze is armed. If, for any reason, a base fuze is thought to be armed, the body must be disposed of by lowering it gently, tailfirst, into deep water.

d. **Base Fuze Mark 157 Mod 0**

(1). This fuze is identical to the Mark 146 Mod 0 in every respect except that the Mark 157 Mod 0 has a delay detonator which results in a .020 seconds delay in firing after the explosive train is initiated.

(2). Read carefully the Special Fuze Precautions on page 34 before handling these fuzes.

e. Nose Fuze Mark 155 Mod 0.

This fuse is similar to the Mark 149 except that it incorporates a 3/8 inch Tetryl burster in lieu of a booster charge. The Fuze Mk 155 Mod 0 will function instantaneously upon striking land or water, and at low impact angles. The buster which contains approximately 1/8 pound of tetryl, ruptures the case throwing globs of PWP over an area approximately 50 yards in diameter. The PWP ignites spontaneously upon contact with the air and the particles burning at the source produce a dense cloud for 2-3 minutes. There is some anti-personnel effect due to the burning particles which will produce a severe burn if they strike personnel.

wood [illegible]
containers are not waterproof and are considered to be a fire hazard when stowed in magazines, they do afford protection for the rocket motors. Stowage of rocket motors in the wood containers is mandatory unless the regulations for unboxed stowage are satisfied.

(2). Rocket motors which have been issued in wood containers may be stowed unboxed, provided the motors are: (a) suitably supported at two points, (b) adequately protected against any motion or shifting, (c) not stacked barrel fashion or in any manner wherein the motors would rest upon each other, (d) stowed in a horizontal position, (e) given adequate protection to the electric system so that no breaks or short circuits will result from the unboxed stowage, (f) protected sufficiently so that external fittings, such as lugs, lug bands, etc., may not be damaged, and (g) suitably protected against deformation of metal parts so as to avoid damage or dislocation of the propellent grain.

(3) The issue of rocket motors in wood containers is an interim measure. It is planned eventually to issue the motors in metal containers. These containers will (a) be air tight and moisture proof, (b) adequately protect the electrical system, (c) prevent damage to metal parts, (d) be suitable for stowing motors on shipboard for long periods of time if the magazines are fitted out to conform with the requirements specified in the Bureau of Ordnance Manual for stowage of smokeless powder and (e) furnish adequate protection in all respects for rocket motors. When rockets are received in the metal containers it will be mandatory to stow the rockets in the magazines in these containers. The metal containers will be designed so that they can be stacked barrel fashion and it will be feasible to remove the cover from any container and withdraw the rocket motor without disturbing the pile.

(4). 3.25-inch Rocket Motors Mark 7 Mod 0 are shipped without fins attached. The fins are packed in the space between the four motors. Various combinations of lug bands will be encountered for some time, but eventually a button lug band will be installed on the front end of the motor and a tunnel lug band on the rear end.

b. **3.5-inch Rocket Heads Mark 1, Mark 2, and Mark 8 and Mods.** These heads are solid steel and contain no fuze or explosives of any kind. Stowage should be provided for 3.5-inch Heads Mks. 1, 2, and 8 and Mods. aboard ship in accordance with the requirements specified by article 14C24 of the Bureau of Ordnance Manual (1943 edition) for inert ammunition components.

c. **3.5-inch Rocket Heads Mark 3 Mod 0 (or Mark 5) and 5.0-inch Rocket Head Mark 1.** These heads must be stowed in high explosive magazines. The 5.0-inch HE heads are to be removed from their shipping boxes and stowed in magazines in racks or bins similar to those provided for 5-inch-/38 AA Common projectiles. The 3.5-inch HE heads are to be stowed in the same manner in the same or similar magazines in bins of proper dimensions. In shipment, the front end of the high explosive head is equipped with a dummy nose plug. When it is desired to use a nose fuze, either the Nose Fuze Mark 148 Mod 0 or Mark 149 Mod 0 may be inserted after removal of the nose plug.

d. 3.5-inch Rocket Head Mark 6.
These rocket heads should be stowed separately in a
If the temperature of the PWP loaded head is raised
melt and separate, greatly reducing the effect of t
reached while the round is stowed on its side, and
WP portion of the filling will solidify in the lowe
flight when fired.
Stowage should be in a position so that a leaking
easily jettisoned.
If stowed below decks in an accessible space, pr
magazine. No other amm. of any kind should be stow

e. Nose Fuze Mark 148 Mod 0, Mark 149 Mod 0 and
Nose Fuzes should be stowed in regular bomb fuze mag
in which they are shipped.

f. Base Fuzes.
Base Fuzes come staked in placed in the base of the
No attempt should be made to remove the base fuze fr

The [illegible]nds of the rocket motor fit into the slots of the support arms and prevent the motor from turning or moving fore or aft.

(3). Assembly Vise Mk 1 Mod 0—The Rocket Motor is clamped to the assembly vise which holds it in a secure, rigid position.

b. **Assembly**

(1). 3.5-Inch Aircraft Rocket with Solid Steel Head

(a). Unscrew the tail ring and remove the rear shipping cap which protects the electrical connector in the rear of the motor. CAUTION: Leave the shorting clip on the plug pins, as accidental ignition will fire the round at full velocity. Be careful not to break the nozzle closure or damage the electrical connector cable and plug during subsequent operations.

(b). See that the lug bands fit the type of launcher installed on the aircraft. A boss on the inside of the rear lug band should drop into a depression on the motor tube when it is lined up properly with the front lug band. If the motors, as issued, have button lug bands fore and aft, they will fit only Aircraft Launcher Mark 4 Mod 0. If they are to be used with Aircraft Launcher Mark 5, Mods 1, 2, or 3, it will be necessary to remove button after lug band and replace it with a tunnel lug band. If the rocket is to be fired from a Grumman Type Launcher, either lug band may be used on the after end, but if a button

pparately in a cool magazine below 100 degrees F.
ead is raised above 100 degrees F., the ingredients
e effect of the round. If 110 degrees F. is
its side, and the temperature is then lowered, the
y in the lower portion of the head causing inaccurate

hat a leaking round may be readily observed and

ble space, provision should be made for flooding the
hould be stowed in the same magazine.

9 Mod 0 and Mark 155 Mod 0.
bomb fuze magazines in the individual containers

base of the heads and are stowed with the heads.
base fuze from the rocket head.

(g). Do not stand the round on its tail, as this may damage the electrical connector.

(2). 3.5-Inch and 5.0-Inch Aircraft Rocket with High Explosive Head and Nose Fuse Mark 148 Mod 0.

(a). Unscrew the tail ring and remove the shipping cap which protects the electrical connector in the rear of the motor. CAUTION: Leave the shorting clip on the electrical connector plug pins, as accidental ignition will fire the round at full velocity.

Be careful not to break the nozzle closure or damage the electrical connector cable and plug during subsequent operations.

(b). See that the lug bands fit the type of launcher installed on the aircraft. A button lug band is shipped with each 3.25-inch Motor Mark 7 Mod 0 in case a change of the rear lug band is necessary. A boss on the inside of the rear lug band should drop into a depression on the motor tube when it is lined up properly with the front lug band.

(c). Push the fin assembly onto the rear end of the motor until it is positioned against the rear lug band with the lug band centered between two fins.

(d). Screw the tail ring onto the rear of the motor locking the fin assembly in place.

(e). Unscrew the thread protector from the front end of the motor and base plug from the head.

(f). Screw the head onto the front end of the motor. See paragraph (f) of Section 9 b, 1 above.

). Remove the nose plug from the head and in the Fuze Adapter Mark 148 Mod 0 furd for each head.

). Screw the Nose Fuze Mark 148 Mod 0 into uze adapter.

. Do not stand the round on its tail, as this damage the electrical cable.

). High Explosive Heads Using the Nose Mark 149 Mod 0 and Base Fuze Mark 146 0 or Mark 157 Mod 0.

). The Nose Fuze Mark 149 Mod 0 is assemin the body in the same manner as the Nose Mark 148 Mod 0 but does not require a fuze ter.

). The Base Fuze Mark 146 Mod 0 or Mark Mod 0 is shipped installed in the base of the nch Head Mark 1 Mod 0. No preparations are ired to ready the fuze for use.

). A shipping plug is screwed into the head to protect the exposed end of the fuze. The shipping plug must be kept in place until the head is assembled to the motor and must be replaced if the round is disassembled. WARNING: Before assembling the 5.0-inch Head Mark 1 Mod 0 make certain that a base fuze is securely installed. The head will explode when the motor is fired if the round has been assembled without the base fuze.

10. Effects of High and Low Temperatures on Rocket Motors

a. Each rocket motor is marked with two temperatures defining the range within which it is safe to fire the rocket. An attempt to fire a rocket whose temperature is less than the lower temperature indicated will result in spasmodic or partial burning (often called "chuffing" from the noise made by the

(2). Rocket motors which have been wood containers may be stowed unboxed. the motors are: (a) suitably supporte points, (b) adequately protected against a or shifting, (c) not stacked barrel fashior manner wherein the motors would rest other, (d) stowed in a horizontal position, adequate protection to the electric system breaks or short circuits will result from th stowage, (f) protected sufficiently so tha fittings, such as lugs, lug bands, etc., m damaged, and (g) suitably protected against deformation of metal parts so as to avoid damage or dislocation of the propellent grain.

(3) The issue of rocket motors in wood containers is an interim measure. It is planned eventually to issue the motors in metal containers. These containers will (a) be air tight and moisture proof, (b) adequately protect the electrical system, (c) prevent damage to metal parts, (d) be suitable for stowing motors on shipboard for long periods of time if the magazines are fitted out to conform with the requirements specified in the Bureau of Ordnance Manual for stowage of smokeless powder and (e) furnish adequate protection in all respects for rocket motors. When rockets are received in the metal containers it will be mandatory to stow the rockets in the magazines in these containers. The metal containers will be designed so that they can be stacked barrel fashion and it will be feasible to remove the cover from any container and withdraw the rocket motor without disturbing the pile.

(4). 3.25-inch Rocket Motors Mark 7 Mod 0 are shipped without fins attached. The fins are packed in the space between the four motors. Various combinations of lug bands will be encountered for some time, but eventually a button lug band will be installed on the front end of the motor and a tunnel lug band on the rear end.

b. **3.5-inch Rocket Heads Mark 1, Mark 2, and Mark 8 and Mods.** These heads are solid steel and contain no fuze or explosives of any kind. Stowage should be provided for 3.5-inch Heads Mks. 1 2, and 8 and Mods. aboard ship in accordance with the requirements specified by article 14C24 of the Bureau of Ordnance Manual (1943 edition) for inert ammunition components.

c. **3.5-inch Rocket Heads Mark 3 Mod 0 (or Mark 5) and 5.0-inch Rocket Head Mark 1.** These heads must be stowed in high explosive mag-

d. **Nose Fuze Mark 148 Mod 0 and Mark 149 Mod 0.** Nose Fuzes should be stowed in regular bomb fuze magazines in the individual containers in which they are shipped.

e. **Base Fuzes.** Base fuzes come staked in place in the base of the heads and are stowed with the heads. No attempt should be made to remove the base fuze from the rocket head.

9. Assembly of the Rockets

a. **Assembly Equipment.**

(1). The Bomb Skid Adapter Mk 3 Mod 0 or the Rocket Assembly Vise Mark 1 Mod 0 should be used for assembling the rocket. Provided neither of these is available, some alternate method should be used to hold securely the rocket motor without injury to the motor tube.

(2). Bomb Skid Adapter Mk 3 Mod 0—Rocket Motors are placed on the supports of the Adapter, alternating the direction in which they are pointing. The lug bands of the rocket motor fit into the slots of the support arms and prevent the motor from turning or moving fore or aft.

(3). Assembly Vise Mk 1 Mod 0—The Rocket Motor is clamped to the assembly vise which holds it in a secure, rigid position.

b. **Assembly**

(1). 3.5-Inch Aircraft Rocket with Solid Steel Head

(a). Unscrew the tail ring and remove the rear shipping cap which protects the electrical connector in the rear of the motor. CAUTION: Leave the shorting clip on the plug pins, as accidental ignition will fire the round at full velocity. Be careful not to break the nozzle closure or damage the electrical connector cable and plug during subsequent operations.

(b). See that the lug bands fit the type of launcher installed on the aircraft. A boss on the inside of the rear lug band should drop into a depression on the motor tube when it is lined up properly with the front lug band. If the motors, as issued, have button lug bands fore and aft, they will fit only Aircraft Launcher Mark 4 Mod 0. If they are to be used with Aircraft Launcher Mark 5, Mods 1, 2, or 3, it will be necessary to remove button after lug band and replace it with a tunnel lug band. If the rocket is to be fired from a Grumman Type Launcher, either lug band may be used on the after end, but if a button is used, it must be rotated 90 degrees in order not to strike the forward launcher post on firing.

(c). Push the fin assembly onto the rear end of the motor until it is positioned against the rear lug band, with the lug band centered between two fins.

(d). Screw the tail ring onto the motor, locking the fin assembly in place.

(e). Unscrew the front shipping cap from the motor. Do not remove any of the cardboard washers or spacers.

(f). Screw the head onto the front end of the motor, using a suitable wrench. When the head and motor are cross-threaded, separation may be expected to occur on the launcher. With the 3.5-inch Aircraft Rocket, 3.25-inch Motor, cross-threading is easily detected by the one-half inch or more space that separates the head skirt from the forward lug band when improperly assembled. With the 5.0-inch Aircraft Rocket, 3.25-inch Motor, cross-threading may be detected by the exposed motor threads indicating partial assembly.

(g). Do not stand the round on its tail, as this may damage the electrical connector.

(2). 3.5-Inch and 5.0-Inch Aircraft Rocket with High Explosive Head and Nose Fuse Mark 148 Mod 0.

(a). Unscrew the tail ring and remove the shipping cap which protects the electrical connector in the rear of the motor. CAUTION: Leave the shorting clip on the electrical connector plug pins, as accidental ignition will fire the round at full velocity.

Be careful not to break the nozzle closure or damage the electrical connector cable and plug during subsequent operations.

(b). See that the lug bands fit the type of launcher installed on the aircraft. A button lug band is shipped with each 3.25-inch Motor Mark 7 Mod 0 in case a change of the rear lug band is necessary. A boss on the inside of the rear lug band should drop into a depression on the motor tube when it is lined up properly with the front lug band.

(c). Push the fin assembly onto the rear end of the motor until it is positioned against the rear lug band with the lug band centered between two fins.

(d). Screw the tail ring onto the rear of the motor locking the fin assembly in place.

(e). Unscrew the thread protector from the front end of the motor and base plug from the head.

(f). Screw the head onto the front end of the motor. See paragraph (f) of Section 9 b, 1 above. above.

(g). Remove the nose plug from the head and screw in the Fuze Adapter Mark 148 Mod 0 furnished for each head.

(h). Screw the Nose Fuze Mark 148 Mod 0 into the fuze adapter.

(i). Do not stand the round on its tail, as this may damage the electrical cable.

(3). High Explosive Heads Using the Nose Fuze Mark 149 Mod 0 and Base Fuze Mark 146 Mod 0 or Mark 157 Mod 0.

(a). The Nose Fuze Mark 149 Mod 0 is assembled in the body in the same manner as the Nose Fuze Mark 148 Mod 0 but does not require a fuze adapter.

(b). The Base Fuze Mark 146 Mod 0 or Mark 157 Mod 0 is shipped installed in the base of the 5.0-inch Head Mark 1 Mod 0. No preparations are required to ready the fuze for use.

(c). A shipping plug is screwed into the head to protect the exposed end of the fuze. The shipping plug must be kept in place until the head is assembled to the motor and must be replaced if the round is disassembled. WARNING: Before assembling the 5.0-inch Head Mark 1 Mod 0 make certain that a base fuze is securely installed. The head will explode when the motor is fired if the round has been assembled without the base fuze.

10. Effects of High and Low Temperatures on Rocket Motors

a. Each rocket motor is marked with two temperatures defining the range within which it is safe to fire the rocket. An attempt to fire a rocket whose temperature is less than the lower temperature indicated will result in spasmodic or partial burning (often called "chuffing" from the noise made by the

round). When so fired, the rocket will travel a very short distance. An attempt to fire a rocket whose temperature is greater than the upper temperature indicated will cause the interior motor pressure to increase and the generation of gases to become so rapid that the gases cannot escape. As a result, the motor tube may burst.

b. OP 1235 illustrates how rocket temperature can be accurately computed. However, except for very short flights an accurate computation is not necessary. A good general rule in estimating rocket temperature is to consider the rocket the same temperature as the magazine, if the rocket has only recently been removed from the magazine, but is not yet in flight. If the rocket has been out of the magazine for 2 hours or more, but not yet in flight, its temperature can be considered to be the same as the air temperature. If the round has been out of the magazine for ½ to 1½ hours, but is not yet in flight, its temperature can be considered to be the average between the magazine temperature and air temperature. When a rocket is outside its safe firing temperature range, it must be restored to the safe firing temperature range before it can be fired. Change in temperature is dependent upon many factors, but a general rule to follow is to consider that a return to a safe firing temperature will take place after the rocket has been exposed for 6 or more hours to the temperature desired. If any doubt exists as to the rocket temperature after that length of time an accurate temperature computation should be made as illusrated in OP 1235.

11. Accidental Ignition

a. Until the head is secured to it, the motor is non-propulsive. The motor is shipped and stowed with the metal shipping cap on the front end. This cap is of light construction and will blow out at relatively low pressure. The hot gas blast will issue from both ends of the motor and, hence, constitute a fire hazard. If the motors are stowed in contact with one another, it is not probable that one motor will ignite those around it.

b. The motor can be accidentally ignited as follows:

(1). By feeding electric current to the igniter. About ½ ampere at 1 volt is required to set it off.

(2). By exposing the motor to fire or temperature above 325°F.

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

CAUTION: Every precaution shall be taken to guard against exposing the motor to any of the conditions described above.

12. Safety Precautions for Ammunition Handling

a. Rockets, whether completely assembled or disassembled, shall be handled with extreme care to avoid damage to parts.

b. Rocket motors should be stored in the same manner as smokeless powder. Matches and open flames must never be allowed in the storage area.

c. Rockets must be kept in a cool place out of the direct rays of the sun to prevent an increase in temperature.

d. A rocket must never be fired when its temperature is either greater or less than the safe firing temperature indicated on the rocket body. A rocket temperature can be considered to have returned to the safe firing range after the rocket has been exposed for 6 or more hours to a temperature within the safe firing range.

e. Rocket motors must not be stowed in the same compartment with or near radio apparatus or antenna leads.

f. HE heads and fuzes (except base fuzes which are permanently installed in the head) must be stowed separately from each other in the same manner as high explosive projectiles.

g. Except when unavoidable due to battle conditions, motors must not be exposed to small arms fire or high velocity shell fragments.

h. Long pants and long-sleeved shirts, with the sleeves buttoned snugly about the wrists, should be worn by personnel handling ammunition.

ASSEMBLY CHART OF COMMON ROUNDS*

Complete Round Designation	Head	Load	Load Wt. Lb.	Motor	Fuze Nose	Fuze Base	Nominal Total Wt.
3.5-inch SD002	3.5-inch Mk 1 or 2	Solid		3.25-inch Mk 7 Mod 0	None	None	54 lbs.
3.5-inch HE004	3.5-inch Mk 3 or 5	TNT	2.3	3.25-inch Mk 7 Mod 0	None	Mk 148 Mod 0	54 lbs.
3.5-inch HE006	3.5-inch Mk 3 or 5	TNT	2.3	3.25-inch Mk 7 Mod 0	None	Mk 149 Mod 0	54 lbs.
3.5-inch HE014	3.5-inch Mk 8 Mod 0	Solid		3.25-inch Mk 7 Mod 0	None	None	54 lbs.
5.0-inch HE001**	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	None	Mk 148 Mod 0	80 lbs.
5.0-inch HE005	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 146 Mod 0	Plug	83 lbs.
5.0-inch HE007	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 146 Mod 0	Mk 148 Mod 0	82 lbs.
5.0-inch HE009	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 146 Mod 0	Mk 149 Mod 0	83 lbs.
5.0-inch HE022	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 157 Mod 0	Plug	83 lbs.
5.0-inch HE023	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 157 Mod 0	Mk 148 Mod 0	82 lbs.
5.0-inch HE024	5.0-inch Mk 1 Mod 0	TNT	8.6	3.25-inch Mk 7 Mod 0	Mk 157 Mod 0	Mk 149 Mod 0	83 lbs.

* For more complete round designations see O.D. 5368.

** Assembly 5.0-inch HE001 was the first production of 5.0-inch Heads and did not contain a base fuze; no further issue of this round will be made.

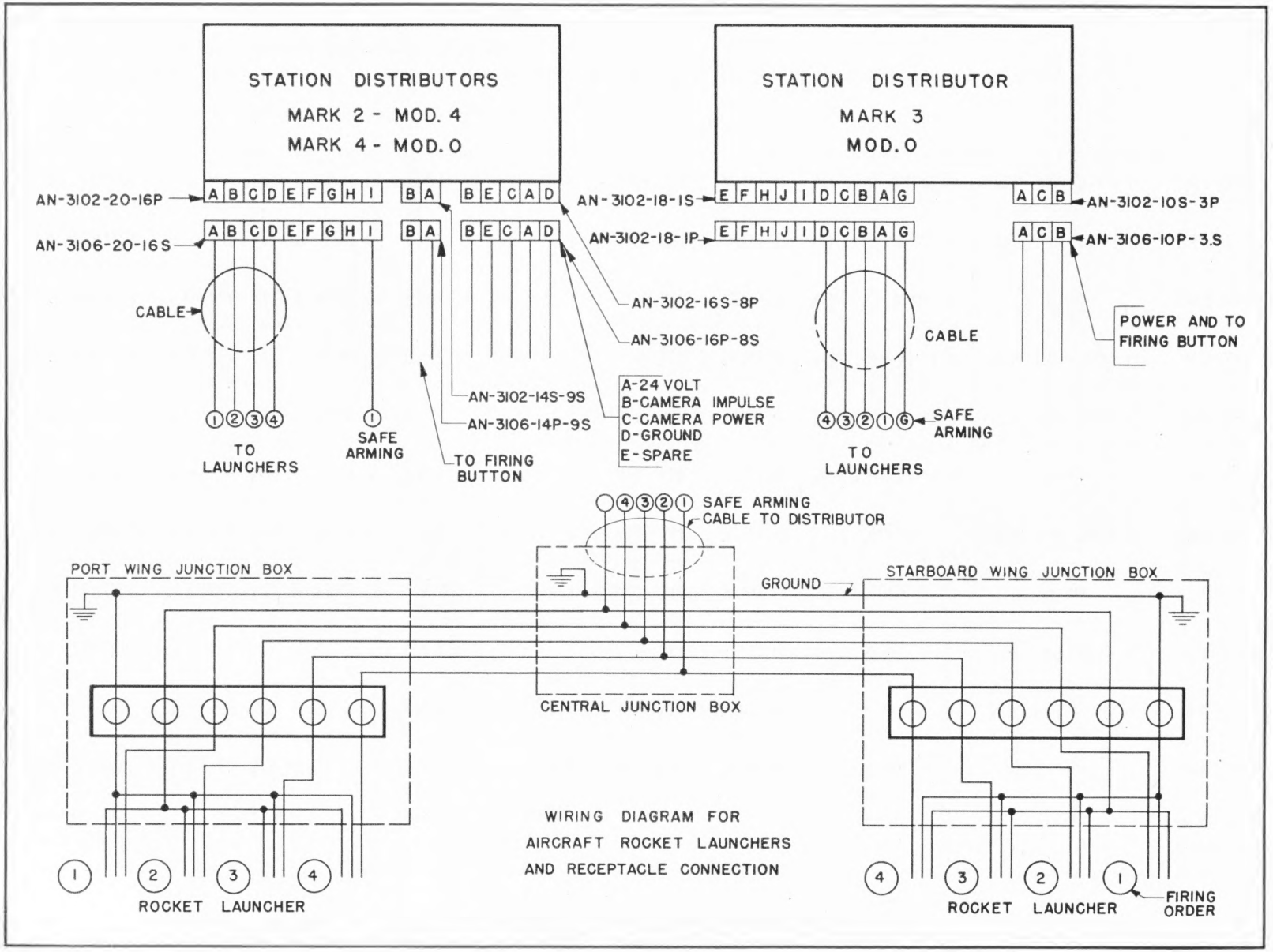


Figure 9.—Wiring Diagram for Aircraft Rocket Launchers and Socket Connection

Chapter 2

STATION DISTRIBUTORS

Introduction

13. What It Is

The station distributor located in the cockpit of the airplane is an electrical control box from which the pilot may fire the aircraft rockets and arm the fuzes.

14. Its Use

The principal function of the station distributor is to fire rockets when the pilot presses the firing switch on the throttle lever or on the control column. All station distributors are equipped with a launcher selector which may be preset to any desired position by turning the selector dial or by pushing the presetting button.

15. Description

a. **Station Distributor Mark 2 Mod 2.** This distributor does not have a fuze-arming control or camera switch. The firing button must be pressed each time a pair of rockets is fired, after which the rail selector automatically advances.

b. **Station Distributor Mark 4 Mod 0.** This distributor differs from the Mark 2 Mod 2 in that it is of the three wire fuze arming type and is

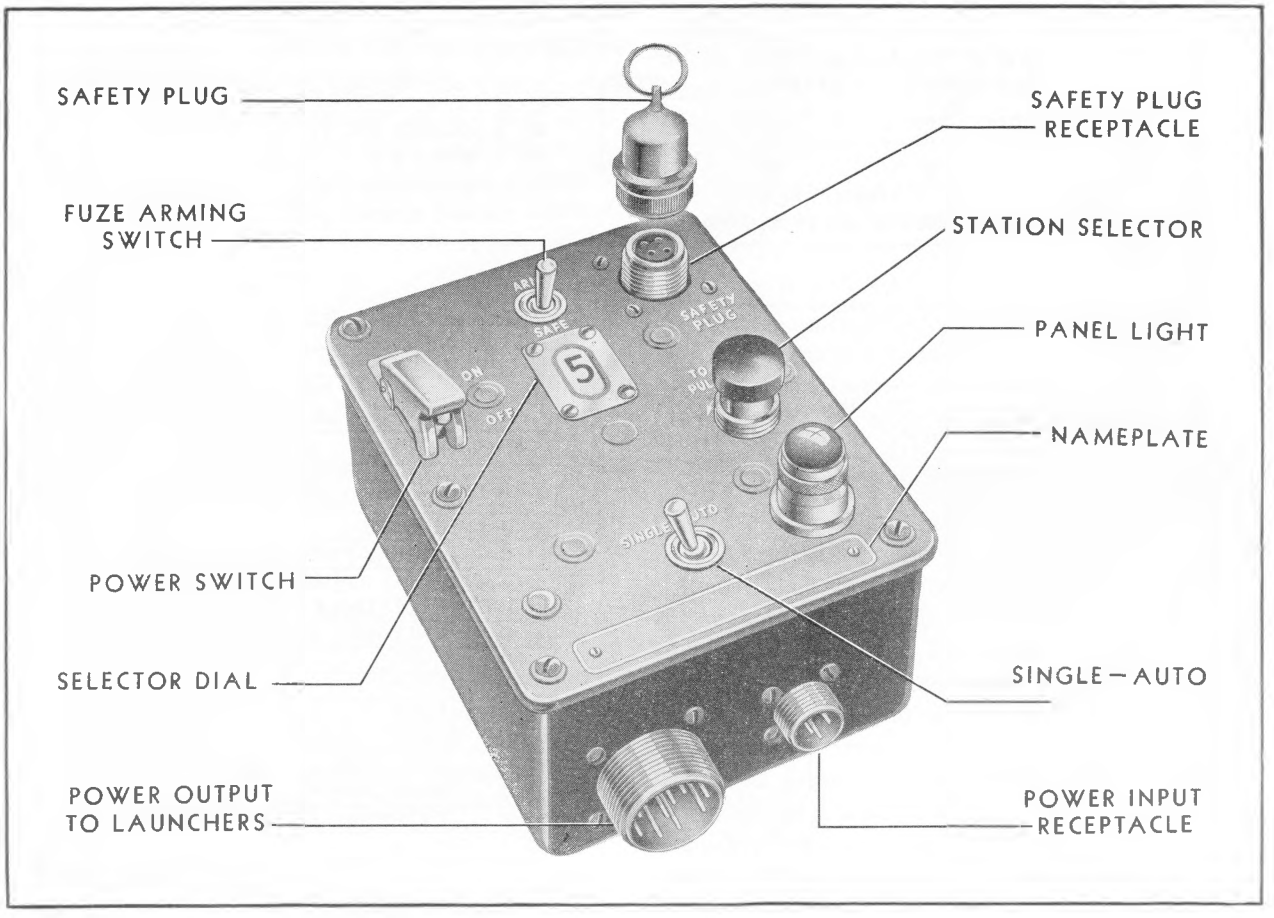
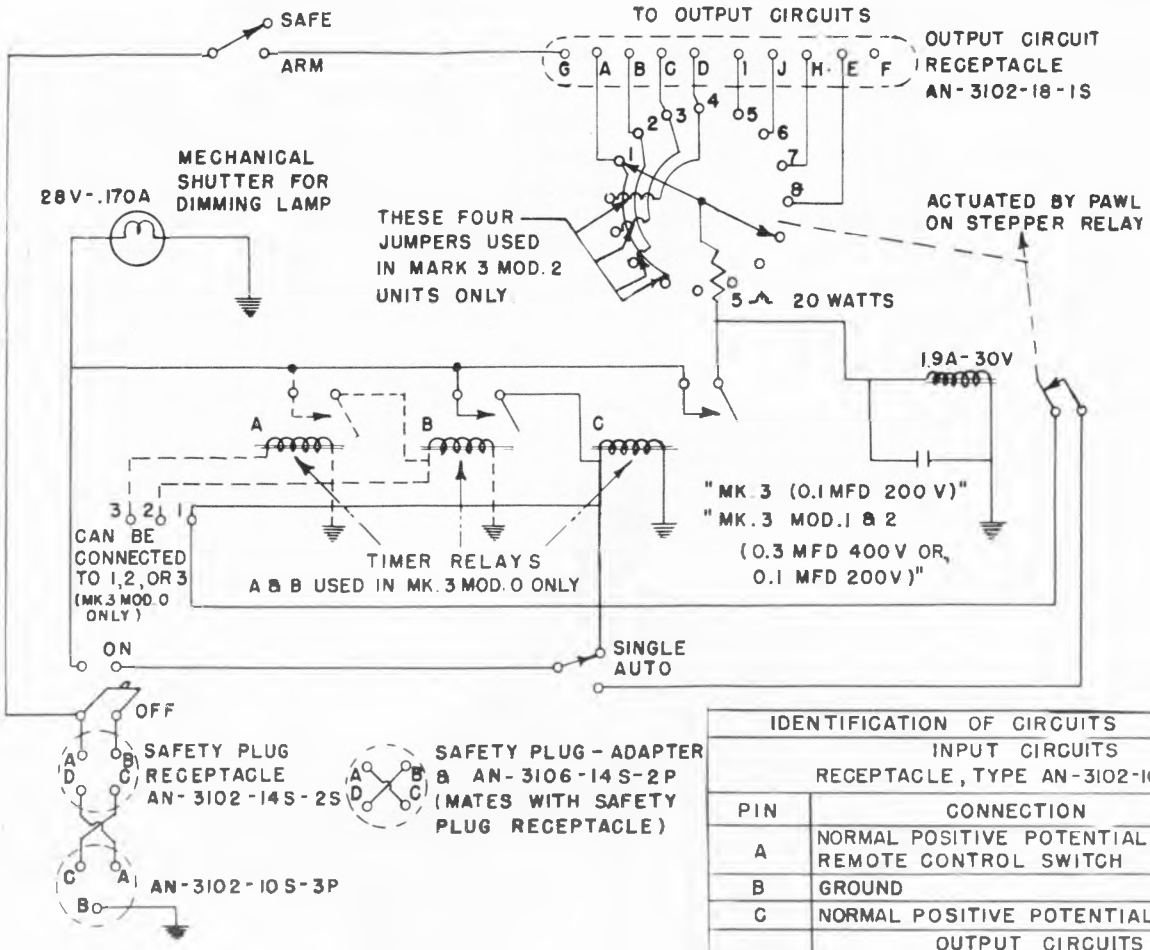


Figure 10.—Station Distributor Mark 3 Mod 0 and Mod 1

equipped with a camera circuit. The firing button must be pressed each time a pair of rockets is fired, the rail selector of British design advancing automatically after each firing.

c. **Station Distributor Mark 2 Mod 4.** This distributor closely resembles the Mark 4 Mod 0, the principal difference being that it will fire pairs of rockets either singly or in automatic sequence, depending upon the setting of the selector swith on the lower edge of the panel. When on AUTO the distributor will fire pairs of rockets in ⅓ second intervals if the firing button is pressed only momentarily. When on SINGLE, one pair of rockets will be fired each time the firing button is pressed. A half-second interval is necessary after the firing button is released before the next pair of rockets can be fired.



IDENTIFICATION OF CIRCUITS	
INPUT CIRCUITS RECEPTACLE, TYPE AN-3102-10S-3P	
PIN	CONNECTION
A	NORMAL POSITIVE POTENTIAL FROM REMOTE CONTROL SWITCH
B	GROUND
C	NORMAL POSITIVE POTENTIAL
OUTPUT CIRCUITS RECEPTACLE, TYPE AN-3102-18-1S	
SOCKET	
A	EXTERNAL CIRCUIT NUMBER 1
B	" " " 2
C	" " " 3
D	" " " 4
E	" " " 8 & 4*
F	NOT USED
G	BOMB ARMING CONTROLS
H	EXTERNAL CIRCUIT NUMBER 7 & 3*
I	" " " 5 & 1*
J	" " " 6 & 2*

* MOD 2 ONLY

Figure 11.—Schematic Wiring Diagram for Station Distributor Mark 3 Mod 0, Mod 1 and Mod 2

d. **Station Distributor Mark 3 Mod 0, Mark 3 Mod 1 and Mark 3 Mod 2.** These distributors are a later design, intended to replace all other station distributors described previously herein. They are similar to the Mark 2 Mod 4 in that they can fire pairs of rockets singularly or automatically. They have eight stations, but the number of stations used depends upon the number of pairs of rocket launchers in the particular installation. A camera switch and circuit are not included in these units. The only difference between the Mark 3 Mod 0 and Mark 3 Mod 1 units is that the Mark 3 Mod 0 units have three (3) selections of automatic impulse speed (i. e., 0.1, 0.2, 0.3 seconds between impulses), while the Mark 3 Mod 1 has one (1) fixed automatic impulse speed (0.1 second between impulses).

(1). The Station Distributor Mark 3 Mod 2 differs from Mod 0 and 1 in the internal wiring. The Mod 2 when energized and actuated in either "Single" or "Auto" operation will send out one impulse, in turn from station one (1) to four (4) inclusive, and two simultaneous impulses from station five (5) to eight (8) inclusive (i. e., stations one and five, two and six, three and seven, four and eight).

(2). The external appearance of the Mod 2 differs slightly from the Mod 0 and 1. The Station Distributor Mark 3 Mod 2 units incorporate a combination instruction and name plate with the following instructions inscribed just below the indicator dial:

Set to #1 for "Single" fire.

Set to #5 for "Pair" fire, if launcher is wired per BuAer Armament Bulletin #26.

e. **Station Distributor Mark 5 Mod 0.** These distributors are an improved design of the Station Distributor Mark 3 Mod 2 and can be used to fire rockets or effect release of bomb racks and shackles. The only difference between the Mark 5 Mod 0 and the Mark 3 Mod 2 units is the addition of an output relay with CONTACTS CAPABLE OF HANDLING INDUCTIVE LOADS UP TO AND INCLUDING 15 AMPERES, a condenser connected across these contacts and a selector switch labeled "Rocket-Bomb." This selector switch shorts out the five (5) ohm resistors in the output circuit when it is in the "Bomb" position. The schematic wiring diagram for the Station Distributor Mark 5 Mod 0 is shown in Figure 14.

16. Operation

a. **The ON-OFF Switch.** Power is fed to the rail selector switch through the rocket armament ON-OFF switch and the safety plug. Removal of the safety plug cuts off all power to the station distributor and launchers. The ON-OFF switch is equipped with a safety cover to prevent accidental closing of the switch.

b. **The ARM-SAFE Switch.** On station distributors equipped with fuze arming circuits, the ARM-SAFE switch controls the fuze arming solenoids. When rockets are fired with the switch in the ARM position, the solenoids retain the arming wires as the rockets leave the launchers, allowing the fuzes to arm. With the switch in the SAFE position the solenoids release the arming wire plate and allow the arming wire to go with the rocket, preventing the fuze from arming.

c. **The Camera Switch.** The camera relay and switch are used when a camera is employed in rocket firing. The circuit allows the camera to be actuated when the firing button is pressed. Essentially, the camera relay is a safety feature, as it isolates the camera from the firing circuit except when the firing button is pressed.

d. **The Single-Auto Switch.** The station distributor may be used for either "Single" or "Automatic" fire. When the station distributor is set for "Single" fire, only one impulse is provided by the station distributor each time the remote firing switch is closed. When set for "Automatic" fire, the station distributor will produce impulses as long as the remove firing switch is closed.

(1). Launchers are installed three or more on each wing and are numbered 1 to 3, etc., outboard-in. Launchers of the corresponding number on each wing are connected together on combat airplanes so that they are always fired in pairs, one from each wing. Certain training installations may be wired to fire single rounds.

e. **Rocket Selector Switch Mark 1 Mod 0.** The Rocket Selector Switch Mark 1 Mod 0 was designed by the Bureau of Aeronautics to take the place of the Station Distributor Mark 3 in production installations. The unit is smaller and lighter than the latter and it has provisions for a firing sequence of "pairs," "2-2-4," "2-6" and "salvo" in 8 aircraft rocket installations and "pairs," "2-4" and "salvo" in 6 aircraft rocket installations. It can be quickly reset to "salvo" when preset at any other station. The "safety" plug is omitted, and necessary switches are conveniently placed in the airplane armament switch panel.

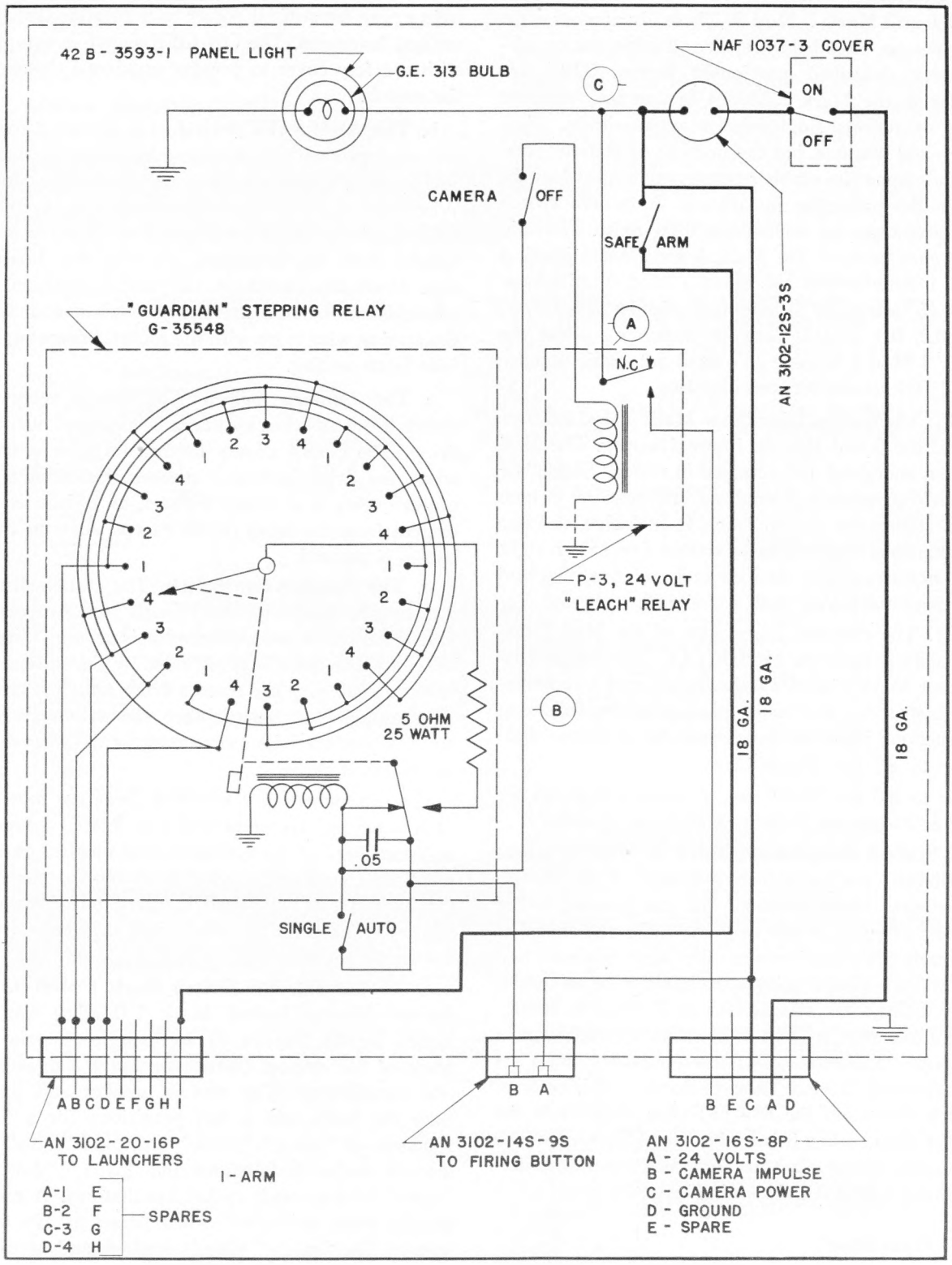


Figure 12.—Wiring Diagram for Station Distributor Mark 2 Mod 4

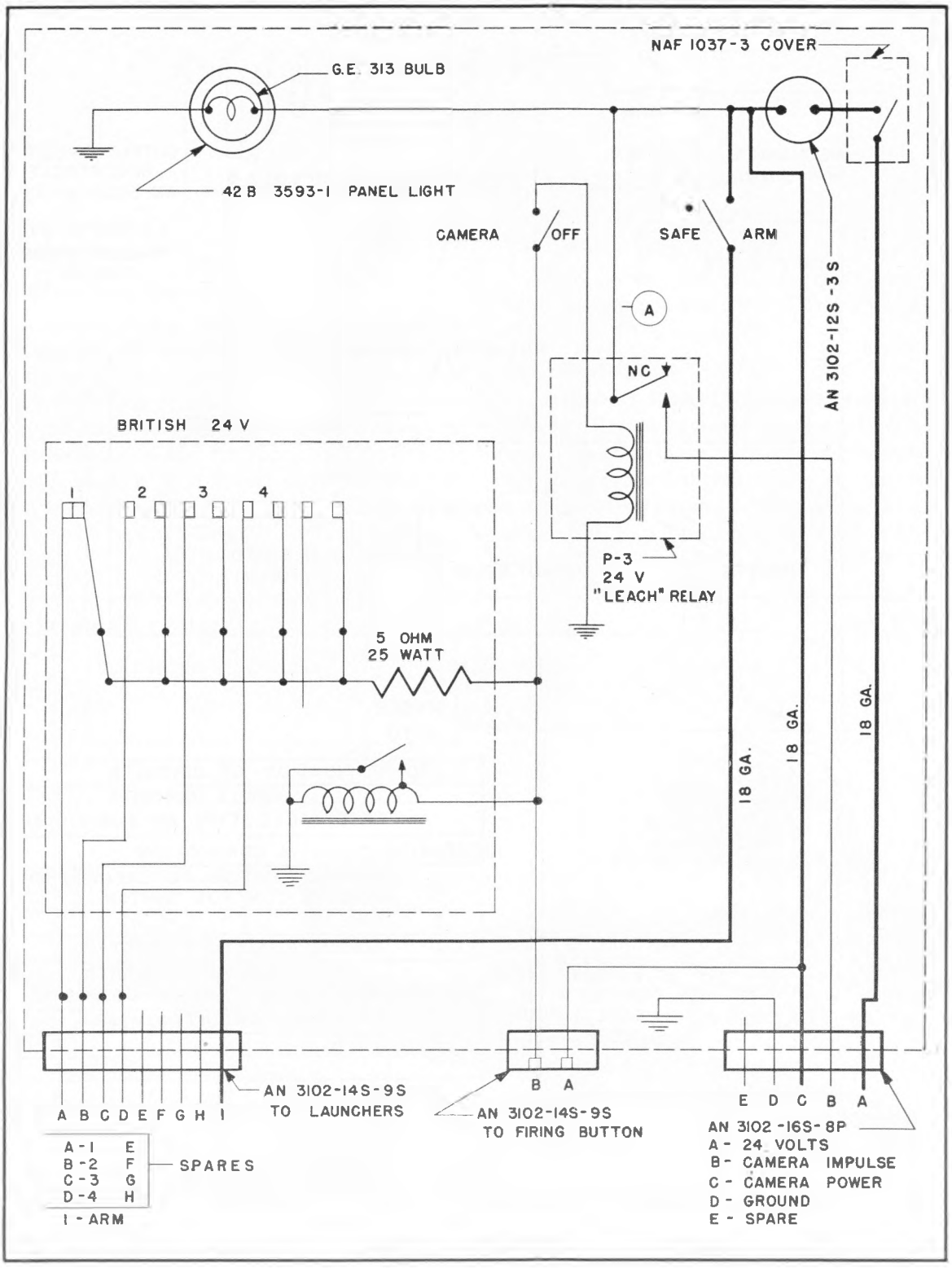
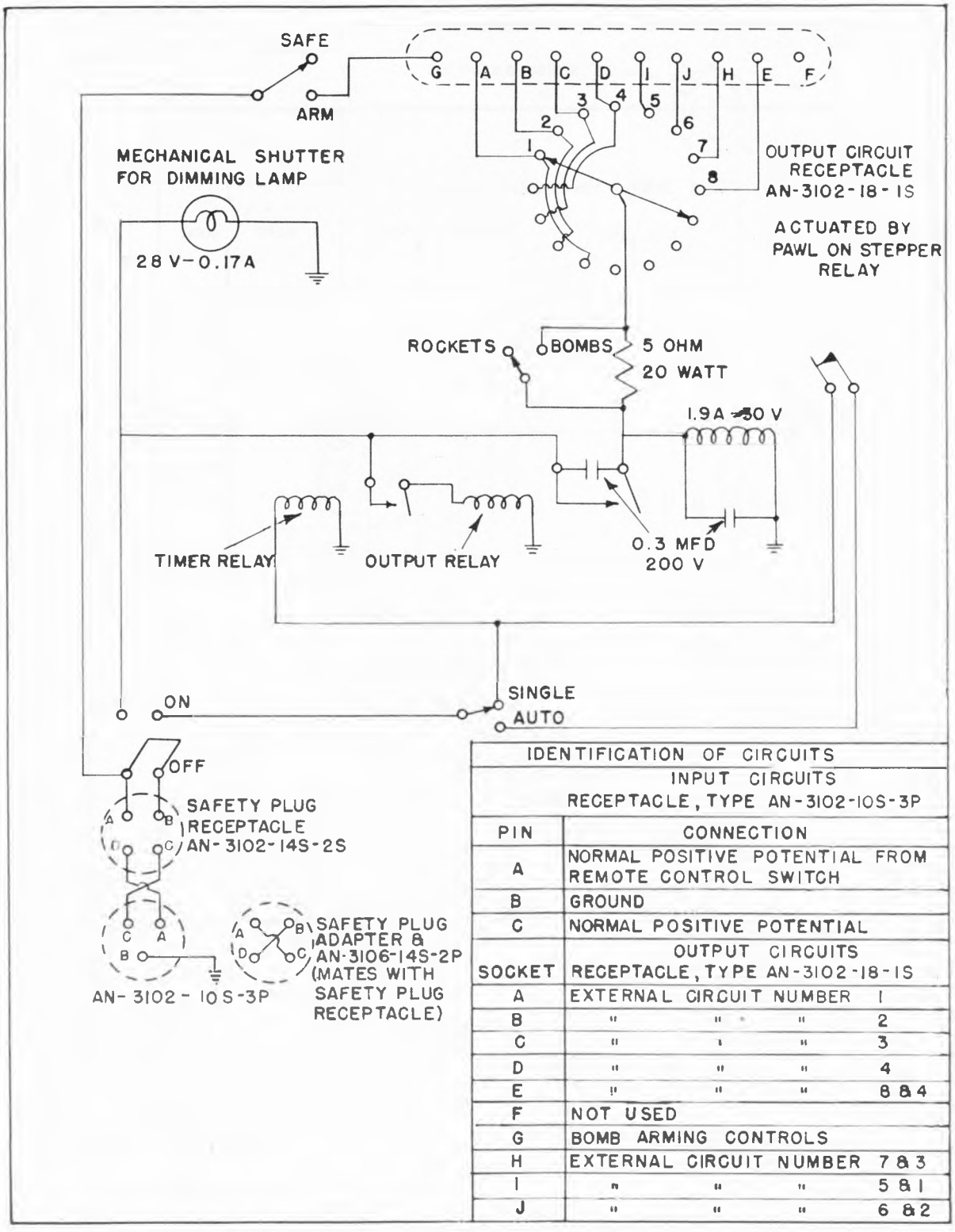


Figure 13.—Wiring Diagram for Station Distributor Mark 4 Mod 0



IDENTIFICATION OF CIRCUITS	
INPUT CIRCUITS RECEPTACLE, TYPE AN-3102-10S-3P	
PIN	CONNECTION
A	NORMAL POSITIVE POTENTIAL FROM REMOTE CONTROL SWITCH
B	GROUND
C	NORMAL POSITIVE POTENTIAL
OUTPUT CIRCUITS SOCKET	RECEPTACLE, TYPE AN-3102-18-1S
A	EXTERNAL CIRCUIT NUMBER 1
B	" " " 2
C	" " " 3
D	" " " 4
E	" " " 8 & 4
F	NOT USED
G	BOMB ARMING CONTROLS
H	EXTERNAL CIRCUIT NUMBER 7 & 3
I	" " " 5 & 1
J	" " " 6 & 2

Figure 14.—Wiring Diagram for Station Distributor Mark 5 Mod 0

Chapter 3

AIRCRAFT ROCKET LAUNCHERS

Introduction

17. What They Are

The aircraft rocket launchers are the means by which the aircraft rockets are hung and launched from the under side of the airplane wings. They hold the aircraft rocket securely and are wired electrically to the station distributors to provide energy to fire the rockets and arm the fuzes. Aircraft Rocket Launcher Mark 4 Mod 0 and the "Zero-Length" Rocket Launcher Mark 5 Mod 1 and later Mods and the Grumman type are discussed in this pamphlet.

18. Where They Are Used

At the present time aircraft rocket launchers are being installed on the TBF, TBM, PV, PBJ, F6F, F4U, FM, SB2C and SBD.

19. Description

a. **Aircraft Rocket Launcher Mark 4 Mod 0.** Aircraft Rocket Launcher Mark 4 Mod 0 is a single non-jettisonable dural rail. The rail is fastened under the aircraft wing by means of two steel studs threaded to screw into a fitting in the wing. At the other end is a transverse threaded hole through

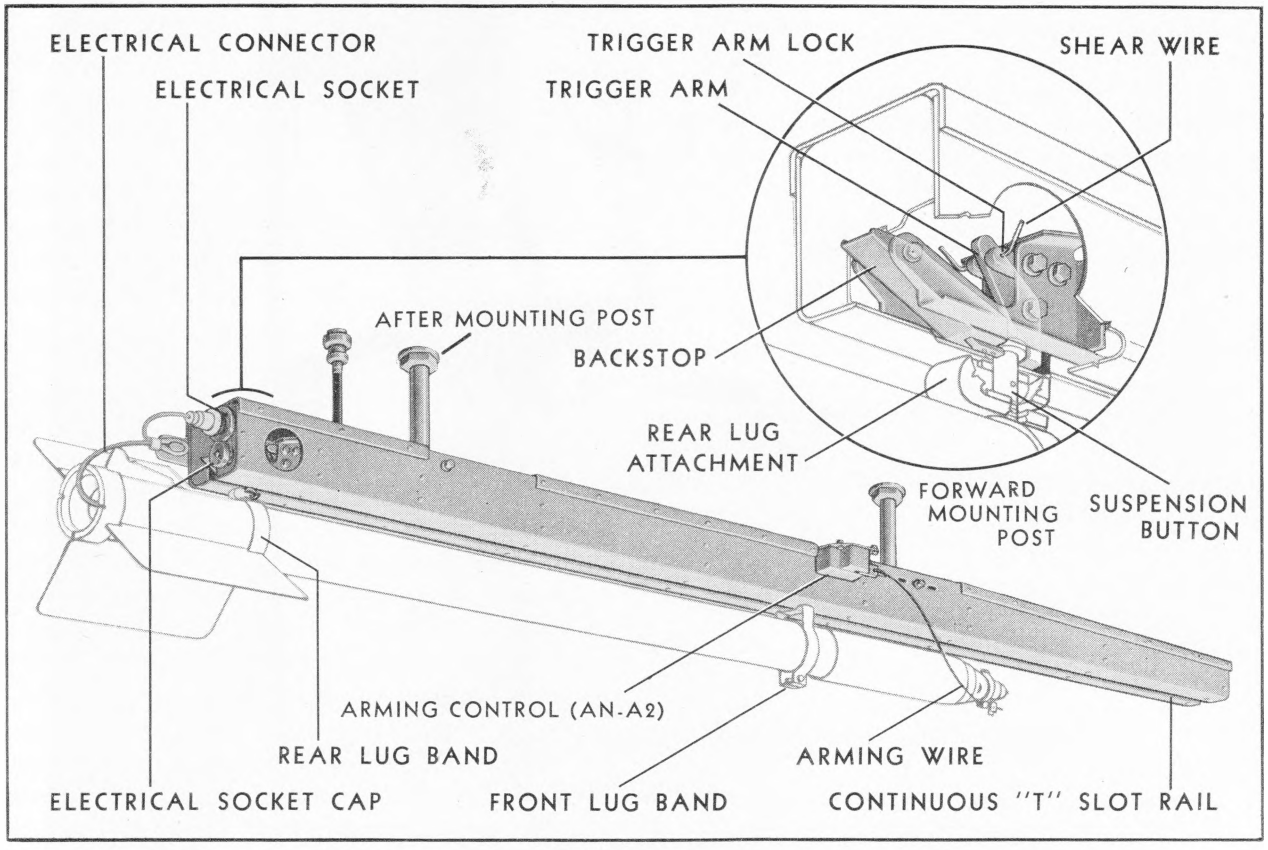


Figure 16.—Aircraft Rocket Launcher Mark 4 Mod 0

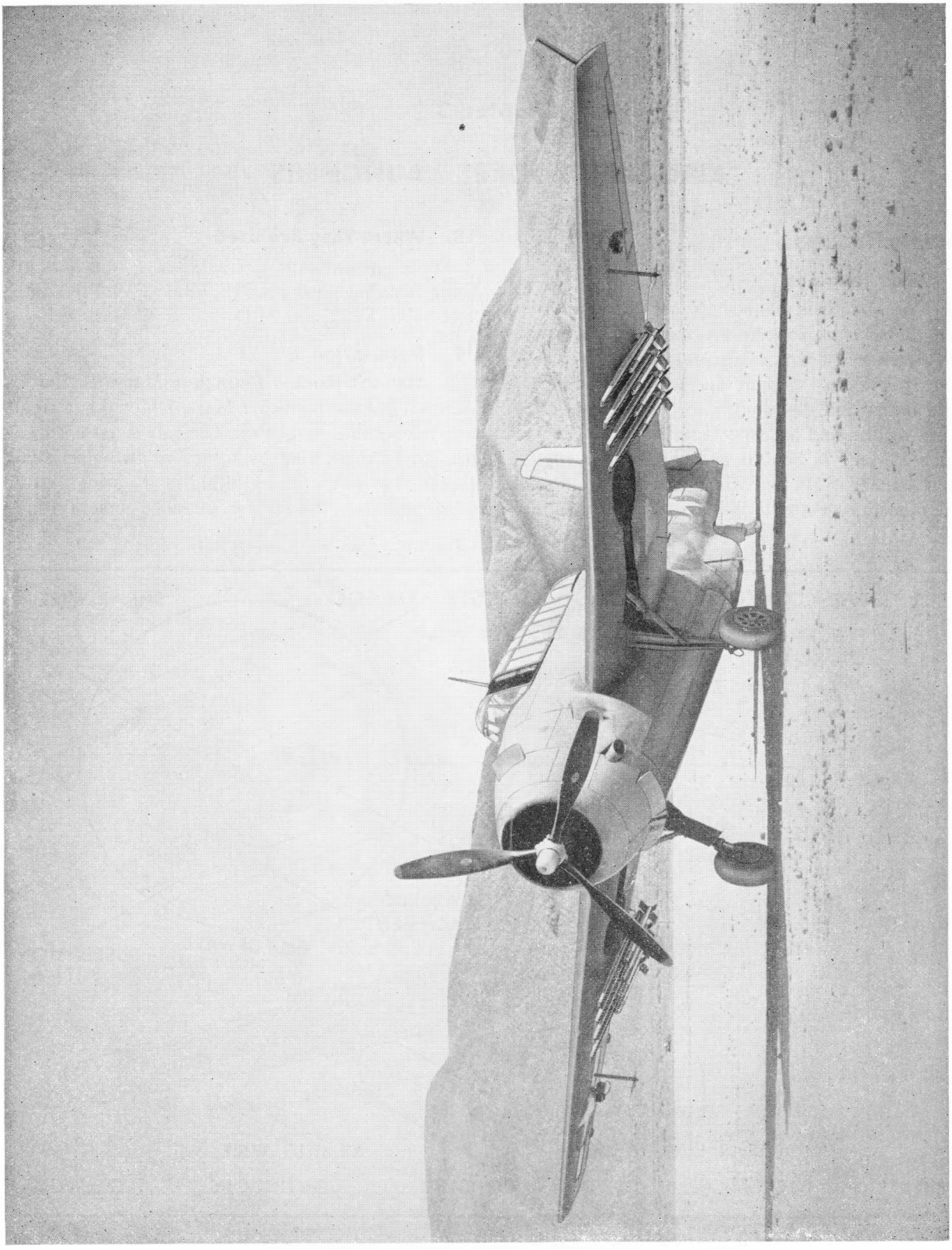


Figure 15.—Typical Installation of Aircraft Rocket Launcher Mark 4 Mod 0 on a TBF-1C

which is screwed a hollow rod used to make lateral adjustment of the launcher. A bolt fits into the hollow rod and passes through holes in the rail. The rail is attached to the stud by passing a bolt through a hole in one side of the rail, through the hollow rod and out a hole in the opposite side of the rail, where the bolt is secured by a lockwasher and nut. Each stud has a locking nut which must be "backed off" the stud in order to allow vertical adjustment of the launcher.

(1). A slot along the centerline of the bottom of the rail holds a round on the launcher when the launcher is loaded. At the rear end of the rail is a spring-loaded backstop which snaps under the lug band button of a round, preventing the round from sliding rearward out of the rail after it is placed on the launcher. Forward of the backstop is located the trigger arm, which is positioned so that when the round is loaded on the launcher one end of the trigger arm is in front of the lug band button, securing the round in place on the launcher.

(2). With a rocket in place on the launcher and the trigger arm down in front of the rear lug band button, the drilled (upper) end of the trigger arm is engaged by a slot in the trigger arm lock. The trigger arm lock is also drilled so that a shear wire can be inserted through the trigger arm lock and the trigger arm, locking them together. The shear wire is sufficiently strong to prevent the trigger arm from rotating when subjected to the decelerations encountered in arrested landings.

(3). At the rear end of the rail is located a socket into which the electrical connector plug is inserted. In some early models the socket is equipped with a cap for protecting the socket from the weather when no ammunition is loaded on the launcher. This cap, when not protecting the socket, is screwed onto the cap retainer below the socket to prevent it from hanging free, when the rocket is loaded on the launcher. A knob at the rear of the launcher holds the loop of the electric connector and prevents it from damaging the plane by being thrown rearward when the round is fired.

(4). An AN-A1 or AN-A2 Bomb Arming Control is mounted on one side of the launcher near the center. When a fuze on a round is readied, the fuze arming wire plate is inserted in the arming control, wherein it is retained when the round is fired.

(5). NOTE: Early models of Aircraft Rocket Launcher Mark 4 Mod 0 were 90 inches long, and would not clear the deck when folding the wings of certain aircraft if the aircraft shock absorbers were short of fluid. Fleet activities have therefore been authorized to cut 20 inches from the front of the longer launcher.

b. **Aircraft Rocket Launcher Mk 5 Mod 1.** Aircraft Rocket Launcher Mk 5 Mod 1 consists of two posts mounted on the aircraft wing and separated by a distance equal to that between the front and rear lug bands of the rocket. The forward post contains an AN-A2 bomb arming control. When a fuze on a round is readied, the fuze arming wire plate is inserted in the arming control, wherein it is retained when the round is fired. A "T-slot" extends from the front of the lower end of the post and accommodates the forward rocket lug band button. The rear post is equipped with a spade which hooks into the rear "tunnel" lug band loop. A trigger arm is mounted on the rear post and is drilled to take a standard shear wire. It engages a trigger arm lock in a manner similar to that of the Aircraft Rocket Launcher Mark 4 Mod 0.

The socket for the electrical connector does not have threads for retaining the plug. The latter is held by spring clips during normal flight but is blown to the rear along with the rocket pigtail when the round is fired. Present launcher production consists of Launchers Mark 5 Mods 1, 2 and 3. The Launcher Mark 5 Mod 2 has been reinforced to carry the 5.0-inch HVAR rocket, and its latch mechanism has been modified to provide more lug band clearance, so that failures will not occur due to wing flexing on arrested or rough field landings. The Mark 5 Mod 3 launcher contains a latch which operates on a new principle. A spring-loaded locking pin retains the round during flight and arrested landing loads, the pin being held in position by a second spring-loaded pin, which acts as a trigger. The trigger is connected to the rocket pigtail by a safety wire and, as the round is fired, the rocket pigtail releases the trigger, allowing the locking pin to spring up out of position and the round to go forward. The Launchers Mark 5 and Mods have replaced the Launchers Mark 4 on all airplanes except the PB4Y, PBY and PBM types.

c. **"Grumman Type" Rocket Launchers.** A number of "Grumman Type" post rocket launchers have been installed on F6F's by the Bureau of Aeronautics. Eventually they will be replaced by the Mark 5

Mod 1, Mod 2 or Mod 3. The "Grumman Type" launcher suspends the rear of the rocket by means of a rear post provided with slots, into which two of the fins are inserted; at the same time, the regular front suspension button is inserted in the forward post. The forward post is equipped with a trigger arm and trigger arm lock, which are secured by a shear wire in a manner similar to that of the other launchers. The arming control for the fuze arming wire plate is installed on the forward post.

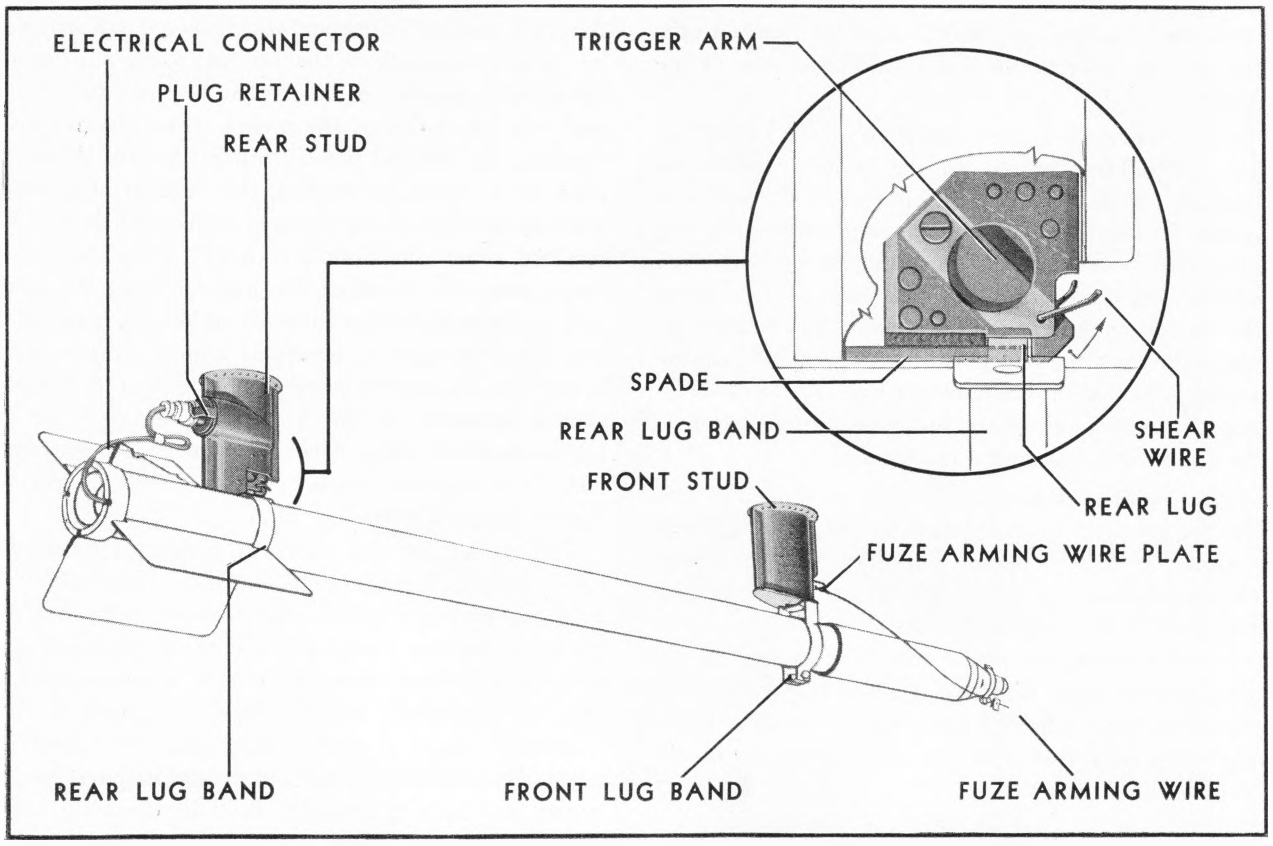


Figure 17.—Aircraft Rocket Launcher Mark 5 Mod 1

20. Operation

a. **Personnel of Loading Party**

(1). A "Safety Officer" must be in charge of every loading and unloading operation and will have a loading crew of trained and responsible men under his command. It is his duty to see that all safety rules and precautions pertaining to the loading operations are enforced.

(2). When a number of airplanes are being loaded at the same time, the "Safety Officer" may be unable to supervise personally all steps in each loading operation. In this case he will delegate a member of each loading crew to see that all safety rules and precautions are observed by his crew.

b. **Inspection and Tests**

(1). Testing the Firing Circuit. Once each day of firing, before any rockets are loaded, the rocket firing circuit on each plane should be checked for continuity. Checking is best done with Rocket Launcher Test Plugs, Model 1, which are inserted in each launcher. When no test kit is available, a single 24-28 volt lamp can be wired to a connector plug and used to test each rail.

After making certain that there are no rockets on the launcher under either wing of the aircraft, a member of the loading crew enters the cockpit and energizes the firing circuit as follows:

Inserts the safety plug.

Turns on master armament switch.

Turns "bomb-rocket" transfer switch to "rockets."

Turns on rocket armament power switch (under red cover). Panel light should now glow.

Sets the rail selector dial to "1" or "pairs."

Presses the firing button.

NOTE: 1 and 4 are omitted when the Rocket Selector Switch Mark 1 is used. A man at the launcher watches the test plugs to determine that they light up at the proper time. Following this test, all switches shall be turned off and the safety plug, if used, hung in a conspicuous place in the cockpit.

(2). CHECKING THE LAUNCHERS

(a). When cameras are to be used, the cameraman shall load the cameras and wind the film into position for the first picture before ammunition is brought up to the airplane.

(b). Before the rockets are loaded, the safety officer shall assure himself that the safety plug is out and that it remains out during loading. He shall then inspect the rails to insure that:

All fittings are secure.

Rails and rail parts are not damaged.

No obstructions foul the rail slot.

All moving parts are in working order.

In the case of Aircraft Rocket Launcher Mark 4, the trigger arm is open so that it does not foul the forward suspension button.

NOTE: If the safety officer believes that any of the rails are unsafe for use, he is authorized and required to stop the use of such rails.

(c). The safety officer shall notify the pilot, if he is in the airplane, that loading operations are to begin.

(d). The safety officer shall check the electrical installation as follows:

See that the master armament switch is off and, if a station distributor is used, that the rocket armament power switch is off, and the safety plug is removed.

See that the safety plug is kept in plain sight of the loading crew during the loading operation, if practicable.

(e). After seeing that the aircraft is pointed in a direction in which the least damage to persons or property would be caused by the accidental firing of a rocket, and that all unnecessary persons are away from the airplane, the safety officer, with the safety plug in plain sight, shall authorize the loading to begin.

c. **Loading the Launcher**

Loading of rockets on planes may be done in the same areas used for loading bombs on planes or for loading machine guns. Rocket electrical plugs, however, are not to be inserted until after the null voltage test has been made. On aircraft carriers, the plugs are not to be inserted until the plane is on the flight deck. At Naval Air Stations planes are to be pointed in the most safe direction when inserting the plugs. The safest direction is that direction in which the least damage to persons or property would be caused by the accidental firing of a rocket. The ranges of the present aircraft rockets at an angle of elevation of 17 degrees, which is the maximum angle of the aircraft launcher, when the plane is in a 3-point position are:

ROCKET	RANGE YARDS	RANGE MILES
3.5-inch Rocket (3.25-inch Motor)	5,430	3.1
5.0-inch Rocket (3.25-inch Motor)	2,100	1.2
5.0-inch Rocket (5-inch Motor)	5,550	3.2
2.25-inch Subcaliber Rocket	5,650	3.2

The above may be considered to be the length of the danger zone when loading the above type rockets on a plane.

(1). AIRCRAFT ROCKET LAUNCHER MARK 4 MOD 0. The loading crews shall load the rails from the rear end as follows:

(a). Raise the completely assembled round, holding it parallel to the rail, and engage the front suspension button in the "T-slot" in the rear end of the launcher and slide the round forward. The backstop will spring out of the way.

(b). Engage the rear suspension button and slide the round forward until the backstop drops into place.

(c). Slide the round to the rear until it seats firmly against the backstop.

(d). Close the trigger arm and secure it in place with a 10 GA. soft copper shear wire. Shear wires must not be re-used after arrested landings.

(e). Insure that the round is properly held in place by trying to push it forward and rearward.

wire to insure that the plate is not pulled part way out of the arming wire release.

Cut off excess arming wire, leaving 3 or 5 inches sticking out in front of the fuze. Remove any burrs on the end of the wire.

Remove the safety wire and save for reinsertion in case the round is not fired.

NOTE: Do not remove the safety wire unless the arming wire has first been inserted, or the cap will fly off, exposing the propeller.

(c). Base Fuze Mark 146 Mod 0. The Base Fuze Mark 146 Mod 0 is shipped installed in the base of the 5.0-inch AR head. No safety wire is provided, and no preparations are required to ready the fuze.

(d). Base Fuze Mark 157 Mod 0. Readying instructions applying to the Base Fuze Mark 146 Mod 0 apply also to the Base Fuze Mark 157 Mod 0.

(5). Special Fuze Precautions

(a). Nose Fuze Mark 148 Mod 0

The safety wire and shipping guard should be in place at all times except when the arming wire is inserted. The fuze is safe as long as the propeller assembly is engaged by the propeller locking pin. If the propeller is advanced far enough to clear the propeller locking pin, the fuze should be considered armed and should be disposed of by bomb disposal personnel. If bomb disposal personnel are not available, dispose of the fuze by first taping the propeller so it can not move and then lower gently into deep water. Do not allow the propeller to turn in either direction. A counterclockwise turning will screw the firing pin into the detonator and will fire the fuze.

If parts of the fuze, normally protected by the shipping cap, show evidence of corrosion, carefully inspect the fuze with the safety wire in place to determine that the propeller is free to move within the limits allowed by the propeller locking pin. Also, with the safety wire removed, determine that the setback pellet retracts freely and easily by pushing on the locking pin with a small piece of wire, making sure that the propeller is not allowed to turn. If these tests are not satisfactory the fuze must be considered defective and not used.

(b). Nose Fuze Mark 149 Mod 0. This fuze is safe as long as the cap and clamp assembly on the nose is held in place by the safety wire, or by the arming wire after loading. If the cap and clamp assembly comes off by accident, the fuze is still safe as long as the propeller is locked by the locking pin. This can be determined by visual inspection. The fuze shall be considered armed if the propeller is out of engagement with the propeller locking pin so that the propeller is free to rotate. DO NOT ATTEMPT TO SCREW THE PROPELLER BACK IN: THIS MAY FIRE THE FUZE.

(c). Armed fuzes MUST NOT be fired from the rocket launchers. If the fuze in an assembled round is armed inadvertently, the propeller should be carefully taped to prevent further rotation and the fuze carefully unscrewed from the rocket, taking care not to drop the round or fuze on its nose or strike the fuze in any way. This work should be done by a Bomb Disposal Officer, if available. Dispose of the armed fuze in deep water or by the most feasible means under the circumstances. Since no safety wire to lock the setback pellet is provided, a fuze which has lost its cap should be carefully handled, even though the propeller is locked by the locking pin. A fuze in this condition should be disposed of by first taping the propeller to the nose so that it cannot turn and then lowering gently into deep water.

(d). Base Fuze Mark 146 Mod 0. Normal safety precautions in handling base-fuzed heads should be observed at all times. In the case of a motor failure, or accidental fire which does not result in a detonation, dispose of the head with care. DO NOT attempt to remove the fuze from the base of the head. There is no way to determine by examination whether the fuze is armed. If it is armed the fuze may fire if the head is dropped on its nose.

(e). Base Fuze Mark 157 Mod 0. The safety precautions applying to Base Fuze Mark 146 Mod 0 apply to Base Fuze Mark 157 Mod 0.

(6). Completing the Electrical Connections

(a). When the airplane is readied for take-off, the electrical connectors should be plugged in by the loading crew under the direct supervision of the safety officer as follows:

The safety officer shall insure that unauthorized persons are clear of the plane, that the plane is pointing in a safe direction, the crew members are in the plane, and that the safety plug is still hanging in plain sight. In combat areas on carriers, aircraft electrical connectors may be plugged in on the flight

deck, when planes are to be in a ready condition, with one man in the plane. The airplane may then be left in a ready condition as required. The ordnanceman shall then test each rail from inboard out with a Null-Voltage test lamp to make sure that the circuit is dead. After each test of each launcher the Null-Voltage test light should be tested to insure that it is no burned out. The electrical connector plug on each round should then be plugged into the socket on the aircraft launcher. This may be done by one ordnanceman working on first one wing and then the other or by two ordnancemen working simultaneously on each wing. The preferable procedure is to plug the rounds in consecutively from inboard out.

CAUTION: The ordnanceman must stand to one side of the round being connected and to one side of rounds already connected when connecting the plugs, to avoid the rocket blast in case of accidental ignition.

Shorting clips, which are to be removed before plugging in, should be saved for future use in case the round is not fired.

(b). When all rounds are plugged in, the ordnanceman shall notify the safety officer and then leave the loading area.

(7). PREPARATION FOR TAKE-OFF

(a). The Safety Officer shall now:

Notify the pilot that the loading is completed.

Note that the master armament switch and rocket armament switch are still OFF.

See that the launcher selector switch is set on "1."

Check to see that the safety plug is in the possession of the pilot.

(b). The rockets are now properly loaded and the plane is ready to take off.

(8). PILOTS' FIRING PROCEDURE

(a). When the plane is over the target area the pilot shall carry out the following steps in firing the rockets:

See that the rail selector dial is set to "1."

Be sure that the safety plug is in its receptacle in the station distributor.

Turn on the master armament switch.

Turn on the rocket armament power switch. The panel light should now glow.

Check sight setting.

Press the firing button on throttle, on control wheel, or stick.

(b). After firing has been concluded, or when preparing to land, the pilot shall turn off the master armament switches, and the power switches, if a station distributor is used, and remove the safety plug from the circuit.

(9). UNFIRED ROUNDS

When a plane returns with an unfired round on a launcher, the same safety precautions used in loading the launchers shall be observed and the crew shall proceed as follows:

SEE THAT THE MASTER ARMAMENT SWITCH IS OFF AND THAT THE SAFETY PLUG, IF USED, HAS BEEN REMOVED FROM THE CIRCUIT AND IS KEPT IN PLAIN SIGHT.

Notify the pilot that rounds are to be removed.

See that the airplane is properly oriented with respect to structures, etc.

See that no one stands in front of or to the rear of the launchers.

Keep unauthorized personnel away.

(10). REMOVING ROUNDS

(a). The safety officer shall have an ordnanceman remove the electrical connector plugs. The loading crew shall remove the rounds from the launchers as follows:

Unhook the electrical connector loop and remove plug from receptacle. Replace plug shorting clip.

Reinsert fuze safety wire.

Inspect fuze to see that it is dry and not corroded so as to impair its functioning and remove fuze arming wire.

Replace fuze shipping guard. (This does not apply to the Mark 149 Mod 0.)

Remove nose fuze from the round and place in the fuze ready-locker.

Remove launcher shear wire.

Open trigger arm.

Lift the backstop and slide the round out to the rear, one man supporting the head and one the tail. The foregoing applies to the Launcher Mark 4 Mod 0. In the Launcher Mark 5 Mod 0 the round need only be pushed forward slightly and it will drop out.

Disassemble the rockets and stow the components in their respective stowage lockers.

(b). If the rounds are to remain on the airplanes, as may be necessary on a carrier, perform only step (1) above. Under these circumstances inspect the

fuze frequently, and, if possible, protect the fuze and igniter cable assembly from exposure.

(11). Misfired Rounds

In case a plane returns with a misfire, the following procedure is to be followed:

The safety plug must be out of the station distributor and hanging in plain sight and the master armament and rocket armament power switches must be OFF.

Caution: A ten-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher.

The plane must be pointed in a safe direction away from groups of personnel and structures.

If the nozzle closure is in place the round may be unloaded in the same manner as an unfired round. The rocket is then labeled as a misfire and, if desirable in the opinion of the safety officer, it may be used again. If the rocket is a misfire for a second time, after removal from the launcher, the head is to be removed and the motor tagged to show the nature of the trouble or any other information which may aid in determining the cause of the misfire.

If the nozzle closure has been blown out, a hangfire may exist. If practicable, the head should be removed while the rocket is on the rails. Extra precautions should be taken in handling these rounds. The motor shall be unloaded from the rails and tagged to show the nature of the trouble and any other information which may aid in determining the cause of the misfire. The motor should then be delivered to the nearest ammunition depot. If this is not practicable, the motor may be disposed of by lowering gently into deep water or in a manner designated by the officer in charge.

Note: It is possible for a rocket motor to burst or blow up while still on the launcher due to some mechanical defect or to firing above the safe propellent temperature limit specified. The effect of a burst is not closely predictable but numerous intentional test bursts indicate that the Launcher Mark 4 Mod 0 assemblies will absorb most of the explosive force of the rocket and damage to the aircraft will be relatively minor. A burst on a Launcher Mark 5 Mod 1 will cause more damage than when the Launcher Mark 4 Mod 0 is being used, but it appears that the destruction to the wing surface will not be severe enough to prevent the aircraft from returning to its base.

21. Safety Precautions

a. **Loading Area Precautions**

(1). A "safe" direction in which to position the plane must be designated by the safety officer. The safe direction is the direction toward that area in which the least damage to personnel or property would result from premature firing.

(2). If two or more planes are to be loaded and fuzed at once, there should be a separate safety officer for each plane. If this is not possible the safety officer should delegate a member of each loading crew to see that all safety rules and precautions are observed by his crew.

(3). 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 connectors are to be left disconnected, except in combat areas where the condition of readiness in effect may require that they be loaded.

(4). Arming of planes on the hanger deck shall not be permitted except when ordered by the commanding officer to meet operational requirements.

(5). When the planes land after operation they shall be inspected for rocket misfires. If misfires are present the safety plug shall be obtained by the safety officer and the removal of such round or rounds supervised by him.

b. **Launcher Precautions**

(1). Circuits should be tested for continuity with the Launcher Test Plugs, Model 1, each day before operations begin, but UNDER NO CONDITIONS SHOULD CONTINUITY TESTS BE MADE WITH ROCKETS LOADED ON LAUNCHERS. If fuzes are to be used, arming solenoids should be checked.

(2). A thorough inspection shall be made of all rocket gear on the plane.

(3). Cameramen or others authorized to make various tests which must be done with switches on shall obtain permission from the safety officer before initiating tests.

(4). Safety plug must be obtained from cockpit and kept in plain sight during loading operations. The master armament switch shall be open and the station distributor on "1" setting.

(5). Rounds shall not be plugged into the launcher until all other necessary operations, such as insertion of fuze arming wires and shear wires, are completed.

(6). Shear wire must be inspected to see that it is through the shear lever and that the lever hook is down in front of the lug band button. Fuzes shall be inspected to ascertain that the arming wire is properly secured and the safety wires removed.

(7). A new wire must be used after each arrested landing. No. 10 gauge soft copper wire must be used, except for specific case described under Grumman launchers.

22. Harmonization

a. Introduction

(1). Before an aircraft equipped with rocket launching gear can be used for accurate firing, launcher and sight must be adjusted so they point in the direction parallel to the flight line of the airplane.

(2). All Launchers Mark 4 Mod 0, with the exception of those on one airplane, the PV-1, are to be boresighted parallel to the boresight datum line which is the line parallel to the flight line at Vmax, less ½ gas load and full armament load. It is actually ½° to 1½° above the flight path for most airplanes under rocket attack conditions. Even though this deviation exists, it has been found that dispersion is not appreciably increased when the angle between the flight line and the boresight datum line is as high as 3° or 4°.

(3). For all practical purposes parallel boresighting is satisfactory because:

(a). A launcher setting other than zero would be desirable if it is permitted use of the same sight setting for both rockets and guns. However, it is impossible to find such a launcher setting because of the wide variety of rocket attack conditions and consequent variations.

(b). Convenience of harmonization aboard carriers and land.

(c). Similarity of procedure with boresighting guns.

b. Aircraft Launcher Mark 4 Mod 0

(1) Boresighting Using a Distant Object. It is quite convenient to boresight Rocket Launcher Mark 4 Mod 0 accurately, when a boresight screen is not available, if a target a mile or more away can be seen from the airplane. To boresight the launchers parallel to the datum line follow these steps:

(a). Elevate the tail until the line of sight through the boresight fixtures is directly on the target. For a target any well-defined landmark will be satisfactory.

(b). Check the sight to make sure that in the zero setting the pip is directly on the same target. If the pip is off, align the sight until the pip is on.

(c). Stand two or three feet behind each launcher rail and sight down the longitudinal slot. No boresighting tool is necessary. Adjust the launcher in azimuth and elevation until the line of sight is on the target. Repeat with other rails.

(2). Boresighting Using a Boresighting Screen. Under certain conditions the distant object method is not practicable on land nor is it practicable aboard ship. It is suggested that a boresighting screen be laid out on the forward bulkhead, and suitable positioning lines be laid out on the hanger deck to aid in spotting the plane.

(a). The wings of the plane are leveled by jacking them up sufficiently on two wing jacks to prevent any motion in the "oleo struts."

(b). Elevate the tail until the plane is both parallel to the deck and perpendicular to the boresighting screen. A height gage is used for the purpose of determining the perpendicular distance from the wing to the deck.

(c). Align the boresight fittings to bear upon the intersection of the horizontal and vertical boresight lines and adjust the launchers parallel to the boresight datum line.

(d). Detailed instructions for boresighting launchers installed on specific planes are given in OP 1296.

c. Post Launchers

The Mark 5 Mod 1 and "Grumman Type" Launchers require no boresighting after the original installation is made.

d. Sights and Sighting Tables

(1). Sights. Aircraft rockets are aimed in much the same way as fixed machine guns and the methods of sighting are similar. However, the rocket has a much larger gravity drop which is dependent upon dive angle, range, aircraft speed, temperature and type of ammunition. The gravity drop under extreme conditions is as great as 90 mils.

(2). The sights in use at the present time are the Torpedo Directors Mark 8 Mod 0, the Mark 9 Mod

0 and the Mark 30 Mod 0. The adjustable reflector sight when adjusted parallel to the boresight datum line is to be preferred, for it allows the sight to be adjusted to a wide variation of attack conditions. If a fixed sight is used the new ladder type with rungs at 10 mil intervals should prove effective.

e. **Range Tables**

(1). Sight Settings for the 3.5-inch and 5.0-inch AR (with 3.25-inch Motors) used with Launcher Mark 4 Mod 0 may be computed from the gravity drop data given in OP 1176 together with the angle of attack data given in OP 1296.

(2). Sight Settings for 2.25-inch AR (Subcaliber), 3.5-inch and 5.0-inch AR (with 3.25-inch Motors), and 5.0-inch HVAR, used with Launcher Mark 5 Mod 1 ("Zero-length"), have been computed for various aircraft and have been issued as the following Ordnance Pamphlets:

Aircraft	OP
FM-2	1353
F4U-1, F4U-1D, and FG-1	1354
F6F-3 and F6F-5	1355
SB2C Type	1358

OP 1356 and OP 1357 contain corresponding information for TBF-1, TBF-1C, TBM-1, and TBM-1C aircraft.

Chapter 4

ROCKET CHARACTERISTICS

23. Comparison of Rocket and Bullet Trajectories

(a). The 3.5-inch AR has a velocity of 1150 ft./sec. at the end of burning for a propellent temperature of 70°F., which is considerably less than that of a machine gun bullet. Also, a rocket takes from 0.6 to 1.3 seconds, depending upon the propellent grain temperature, to reach its maximum velocity, whereas the bullet has its maximum velocity when it leaves the muzzle. Since the rocket takes longer to reach the target it has a larger gravity drop. The 5.0-inch AR has a velocity of 720 ft./sec. and the end of burning for a propellent temperature of 70°F. and therefore a larger gravity drop than the 3.5-inch AR. With firing conditions of a 20° Dive Angle, 70°F. temperature and 240 knot aircraft speed, the gravity drops in feet of machine gun bullets and of rockets from the Post Launcher Mark 5 are as follows:

Range (yds.)	Gravity Drop (in feet) 30 Cal.	50 Cal.	AR 3.5-inch	5.0-inch
600	3	5	58	76
800	10	10	89	120
1000	20	18	126	171
1200	32	28	166	234

(b). Rockets tend to follow the direction of flight of the aircraft rather than the direction in which the launcher is pointing. As the rocket leaves the rail the forces acting on its fins tend to point the rocket into the wind. Consider the case of an aircraft traveling at 400 ft./sec. As the rocket leaves the Launcher Mark 4, its velocity will be only 100 ft./sec. Here the velocity of the apparent wind is 400 ft./sec. A vector diagram shows that the projectile will line up with the resultant velocity in a direction nearer to the flight line than the direction of the launcher.

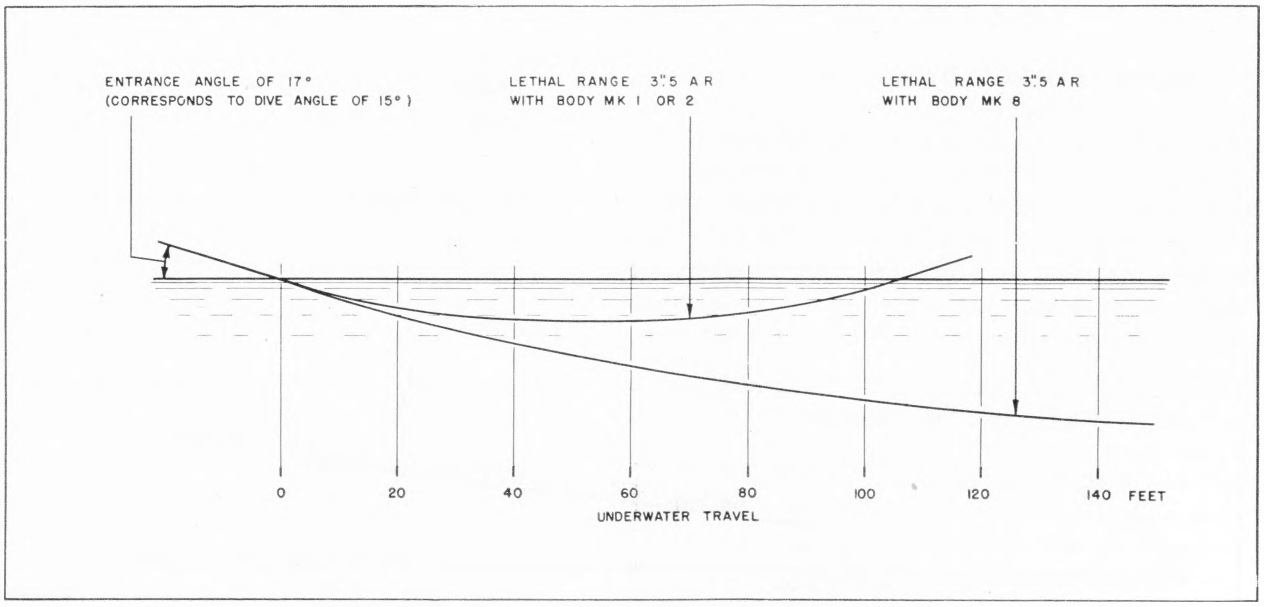


Figure 19.—Underwater Trajectories of 3.5-inch AR

(c). Since the angles θ and ϕ are small an approximate value for θ is 0.2ϕ. Thus, if the launcher, in the example illustrated below, is raised 1°, the trajectory rises approximately 0°.2, assuming that the rocket lines up instantly with the wind. A more accurate analysis indicates that in this example the trajectory rises 0°.27.

(d). The propulsion force on a rocket does not necessarily continue in the direction of the launcher. As shown above, the rocket tends to point in the direction of flight. Also, after the rocket has left the launcher it begins to fall, due to the effect of gravity. The fins align the rocket with its trajectory so that it actually points downward tangent to the trajectory. Since a component of the jet force is, therefore, downward, there is an increase in drop due to this factor.

24. Dispersion and Errors in Firing

a. **Ammunition Dispersion.** The inherent dispersion of rockets arises from the fact that a large fraction of the burning of the propellant takes place after the rocket has left the launcher. While thus unconstrained, the rocket is caused to deviate from a straight line of flight by off-axis forces arising in the jet. The fins oppose yawing and deviations from the line of flight, these forces increasing as the launching velocity increases. The greater the aircraft speed (and thus the launching velocity), the smaller will be these deviations.

b. **Sighting Errors.** Sighting errors are, of course, the same as in gun sighting and depend upon the pilot's ability as well as upon the type of sight used. Sighting accuracy will be enhanced if the sight is held on the target for a few seconds before firing without allowing the plane to deviate from the intended glide angle. It is also necessary to maintain steady flight before firing to avoid throwing the rocket and destroying the aim. A lag of the order of 0.1 second occurs between the time the firing key is pressed and the rocket leaves the launcher, and the plane should be held steady for that instant.

c. **Wind or Target Motion.** Allowances for wind or target motion should be made in the same way as for bullets (or bombs). However, since the time of flight of a rocket is several times that of a machine gun bullet, the drift is proportionately greater. For the 5.0-inch AR the time of flight to 1000 yd. is about 3.0 sec. Hence, for a cross-wind (or target motion) of 10 knots it is necessary to aim 17 yd. upwind. The effect of wind along range is very much less than the above, the ratio of effects of range wind to cross wind varying roughly as the sine of the dive angle. There is also the fact that wind or target motion causes the aircraft to fly on a curve of approach, thus altering the angle of attack. This effect, however, is rather small.

d. **Faulty Estimation of Range.** Because of the curvature of the rocket trajectory a vertical error will occur if the rocket is released at a range other than that for which the sight is set. For 10% error in range estimation the resulting vertical errors for aircraft speeds of from 175 to 275 knots are approximately as follows:

Range (yds)	Vertical Error (mils) Aircraft Vel. 175/275 knots 3.5-inch AR	5.0-inch AR
500	1	2
1000	2.5	4
1500	3.5	6

e. **Aircraft Speed.** Variations in aircraft speed introduce errors for two reasons: (a) The slower the speed, the slower the final velocity of the rocket and the greater the gravity drop. In general, this is a small effect. (b) The attitude of the aircraft varies

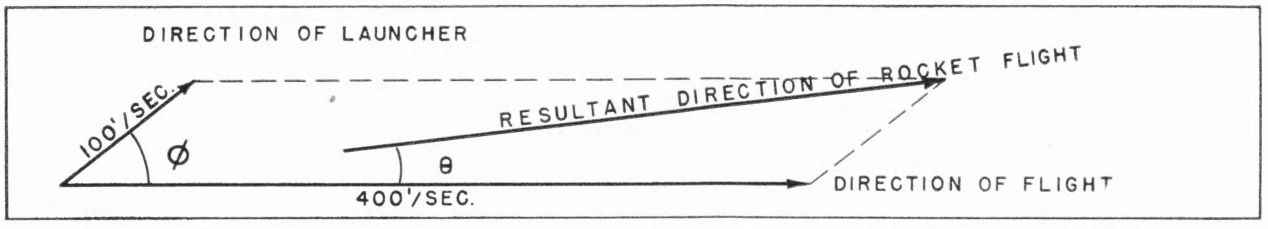


Figure 20.—Vector Diagram of Rocket Trajectory

with its speed. Since the sight is fixed to the aircraft while the rocket heads into the lines of flight, errors can arise from deviations in aircraft speed from the value for which the sight setting is made.

f. **Aircraft Dive Angle.** In general, deviations in dive angle from that for which the sight is set produce only negligible striking errors. Small vertical errors arise with changes in dive angle because of small changes in rocket trajectory and small changes in aircraft attitude.

g. **Temperature.** Trajectories are dependent on propellent temperature because the burning time of the rocket decreases with increasing temperature, and, therefore, the trajectory drop at a given distance becomes smaller as the temperature increases.

h. **Vertical and Lateral Errors.** The errors arising from faulty estimation of wind, range, etc., are summarized in the table below. With firing conditions of a 20° Dive Angle, 70° Temperature and 750 yard Range, the errors (expressed in mils) arising from faulty estimation of these factors, using Aircraft Rocket Launcher Mark 4 Mod 0, are summarized below:

Vertical Errors	3.5-inch AR				5.0-inch AR			
Aircraft Speed	200	225	250	275	200	225	250	275
Ammunition Dispersion	5	4	3	2	6	5	4	3
Aiming	3	3	3	3	3	3	3	3
Wind (10 ft./sec.)	3	3	3	3	4	4	4	4
Range (10%)	2	2	2	2	3	3	3	3
Temperature (10°F.)	2	2	2	2	2	2	2	2
Aircraft Speed (10%)	7	6	6	5	9	8	7	6

Lateral Errors	3.5-inch AR				5.0-inch AR			
Ammunition Dispersion	5	4	3	2	6	4	3	2
Aiming	2	2	2	2	2	2	2	2
Wind (10 ft./sec.)	8	8	8	8	11	11	11	11

Obviously some of these errors will be positive and others negative. By taking the square root of the sum of the squares of the errors listed above, the total mean error to be expected under the given conditions will be found to be approximately as follows:

	3.5-inch AR				5.0-inch AR			
Aircraft Speed	200	225	250	275	200	225	250	275
Vertical Errors	10	9	8	7	12	11	10	9
Lateral Errors	10	9	9	8	13	12	12	11

25. Underwater Trajectories

a. Of the Rocket Heads described in this pamphlet only the 3.5-inch solid heads are designed to have desirable underwater trajectory characteristics. They were designed primarily for use as antisubmarine weapons and the underwater trajectory is therefore of some significance. In the early stages of development of solid heads considerable stress was laid upon their lethal range.

It is now generally agreed, however, that complete penetration of a submarine with consequent possible damage to equipment is much more desirable than mere penetration of the hull. An impact velocity of the order of 1000 ft./sec. is necessary to accomplish complete penetration. A steep glide on the approach contributes to greater accuracy in aiming and stability of the rocket in flight.

b. **The 3.5-inch Head Mark 2 (or Mark 1) Mod 0.** This head has a single ogive nose. Its path underwater is theoretically an arc of a circle. If the underwater travel is not too great to reduce the velocity to the value where gravitational forces become appreciable, the rocket will emerge. At entry angles greater than 20° less than one-half of the rockets emerge. The length of underwater travel at which the head Mark 2 Mod 0 will still have a velocity (600 ft./sec.) sufficient for it to penetrate a submarine hull is approximately 70 feet (lethal range).

c. **The 3.5-inch Head Mark 8 Mod 0.** This head was developed in experiments to increase underwater travel. It has a double ogive head which results in less nose lift and greatly increases the radius of curvature of the underwater trajectory. At the same time, the velocity is not decreased to 600 ft./sec. until the length of the underwater travel has reached about 135 feet.

Chapter 5

SAFETY PRECAUTIONS

26. Safety Precautions for Ammunition Handling

a. Rockets, whether completely assembled or disassembled, shall be handled with extreme care to avoid damage to parts.

b. Rocket motors should be stored in the same manner as smokeless powder. Matches and open flames must never be allowed in the storage area.

c. Rockets must be kept in a cool place out of the direct rays of the sun to prevent an increase in temperature.

d. A rocket must never be fired when its temperature is either greater or less than the safe firing range temperature indicated on the rocket body. A rocket temperature can be considered to have returned to the safe firing range after the rocket has been exposed for 6 or more hours to a temperature within the safe firing range.

e. Rocket motors must not be stowed in the same compartment with or near radio apparatus or antennae leads.

f. HE heads and fuzes (except base fuzes which are permanently installed in the head) must be stowed separately from each other in the same manner as high explosive projectiles.

g. Except when unavoidable due to battle conditions, motors must not be exposed to small arms fire or high velocity shell fragments.

h. Long pants and long-sleeved shirts with the sleeves buttoned snugly about the wrists should be worn by personnel handling ammunition.

NOTE: It is possible for a rocket motor to burst or blow up while still on the launcher due to some mechanical defect or to firing above the safe propellent temperature limit specified. The effect of a burst is not closely predictable but numerous intentional test bursts indicate that the Launcher Mark 4 Mod 0 assemblies will absorb most of the explosive force of the rocket and damage to the aircraft will be relatively minor. A burst on a Launcher Mark 5 Mod 1 will cause more damage than when the Launcher Mark 4 Mod 0 is being used, but it appears that the destruction to the wing surface will not be severe enough to prevent the aircraft from returning to its base.

27. Loading Area Precautions

a. A "safe" direction in which to position the plane must be designated by the safety officer. The safe direction is the direction toward that area in which the least damage to personnel or property would result from premature firing.

b. If two or more planes are to be loaded and fuzed at once, there should be a separate safety officer for each plane. If this is not possible the safety officer should delegate a member of each loading crew to see that all safety rules and precautions are observed by his crew.

c. 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 connectors are to be left disconnected, except in combat areas where the condition of readiness in effect may require that they be loaded.

d. Arming of planes on the hanger deck shall not be permitted except when ordered by the commanding officer to meet operational requirements.

e. When the planes land after operation they shall be inspected for rocket misfires. If misfires are present the safety plug shall be obtained by the safety officer and the removal of such round or rounds supervised by him.

28. Launcher Precautions

a. Circuits should be tested for continuity with the Launcher Test Plugs, Model 1, each day before operations begin, but UNDER NO CONDITIONS SHOULD CONTINUITY TESTS BE MADE WITH ROCKETS LOADED ON LAUNCHERS. If fuzes are to be used, arming solenoids should be checked.

b. A thorough inspection shall be made of all rocket gear on the plane.

c. Cameraman or others authorized to make various tests which must be done with switches on shall obtain permission from the safety officer before initiating tests.

d. Safety plug must be obtained from cockpit and kept in plain sight during loading operations. The master armament switch shall be open and the station distributor on "1" setting.

e. Rounds shall not be plugged into the launcher until all other necessary operations, such as insertion of fuze arming wires and shear wires, are completed.

f. Shear wire must be inspected to see that it is through the shear lever and that the lever hook is down in front of the lug band button. Fuzes shall be inspected to ascertain that the wire is properly secured and safety wires removed.

g. A new wire must be used after each arrested landing. No. 10 gauge soft copper wire must be used except for specific cases described under Grumman Launchers.

29. Ammunition Precautions in Loading Area

a. The loading crew must remain out of line with the rockets fore and aft as much as possible.

b. The rounds must not be plugged into the launcher until all other necessary operations, such as insertion of fuze arming wires and shear wires, are completed.

c. In warm weather, the safety officer should see that thermometers are placed on at least one round of each airplane load ten minutes or more before loading, and should note the temperature limits marked on motors or boxes. Rounds should not be loaded until they are cooled enough to insure their being below this limit. (For AR motors two to three hours are required.)

d. Smoking should not be permitted in the loading area within 200 feet of ANY ammunition.

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

f. Stowage of assembled rounds, other than as required incident to immediate loading operations, is prohibited.

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