

CHAPTER 4

LOADING, UNLOADING, AND DUD-JETTISONING

The preceding course of this series and the preceding chapter of this course gave you an overview of guided missile launching systems. The control panels operated by GMMs were described. The functioning cycles in three types of operation-automatic, step, and emergency were explained, and crew stations were illustrated.

LOADING is the process of bringing the round from the magazine, attaching any additional parts necessary (wings, fins, power supply, arming plug), and placing the complete missile on the launcher, ready for firing.

UNLOADING the missile consists of returning the round to the magazine or to a container for off-loading. Wings and fins have to be folded or removed, the arming plug and the thermal batteries removed, and the round stowed in the magazine, in the cell or tray designated for it (or packed in its container for shipment).

Since most of the work is done automatically by launching system, and lower rated men do most of the assembling and disassembling, what does the GMM 1 or C do? He may operate a control panel, supervise the work of the assembly team, act as a safety observer, troubleshoot the equipment, and make the more difficult repairs, including overhaul and adjustment of equipments.

You need to become completely familiar with the system or systems you have on board, but you also need to know about other types of systems.

This chapter emphasizes the role of the GMM 1 and C in loading and unloading missiles, and goes into detail on the operation of the dud-jettisoning methods for the different missiles in

use on Navy ships. The quals relating to dud jettisoning are listed for lower grades, but you have the responsibility for supervising the activity. The decision to jettison a missile is made by higher authority.

TERRIER MISSILE SYSTEM

Each side of the Terrier launcher is serviced by a complete and independent loading system, and each of these systems is serviced by a corresponding handling system. Except for some minor differences, the operation of the two sides is identical. The installation on different ships accounts for other variations; the mark differences account for the greatest variations; mod changes may be simple ones. The changes required to accommodate the Asroc missile in the Mk 10 Mods 7 and 8, however, are more than minor although the principles of operation remain the same.

LOADING

The location of the loader in the Terrier launching system is pointed out in figure 2-8. Figure 3-8 points out the location of the loader power drive, and the loader rail view port. Table 3-1 shows that the Mk 8 loader has been used on Mk 9 and Mk 10 Terrier launching systems, with modifications. Ready service rings are identified in both of the above illustrations for the Mk 10 system. The comparable component in the Mk 9 system, the magazine cell rack, is shown in figure 3-5. The three ready service rings of the Mod 7 and Mod 8 were shown in the preceding course, *Gunner's Mate M (Missiles) 3, & 2*, NAVTRA 10199.

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The feeder includes the loader, the magazine and/or ready service rings, and the assembler, each with its components.

The sequence of steps in moving a round from the magazine to the launcher was given in chapter 3 for Mk 9 and Mk 10 launching systems. If you have had duty on a ship with Terrier capability these steps are familiar to you. If your experience has been with other missile systems, you will recognize the similarities. Now you need to know the launching system so well that you can explain it to lower rated men, and can direct and supervise their work in the loading process. The only manual work involved (if everything is working OK) is the assembling of the wings and fins in the assembly room. If any part of the system fails to act automatically on signal, you need to know how to find the trouble and correct it. The multiplicity of parts in the launching system makes this a real challenge. If you look at the whole complex, it might seem too intricate to master, but if you remember it is made up of applications of simple machines, operated by hydraulic or pneumatic power, electricity, and electronics, you can understand it and unravel its problems.

Warn trainees and other nonoperating personnel in the launching system compartments not to touch controls. Only authorized personnel are permitted in the launching system compartments. NO ONE is permitted in the magazine area when the system is being operated. New and inexperienced personnel must not be permitted to work alone, but must be under direct and continued supervision of skilled, and experienced personnel. All persons whose duties involve the operation of, or stationing on or near power-operated missile equipment, must be thoroughly familiar with the safety orders and precautions and operating instructions for that equipment. As a supervising petty officer, you must remind your men frequently of the safety rules and regulations and enforce them. Violation of safety precautions, willful or accidental, should be reported at once to the immediate superior. Safety devices should always be kept in good order and operative at all times.

The launcher captain monitors the launching system functions by watching the indicating lights on his panel during automatic operation. (The step control lights and switches on the EP2

panel are covered and are not in operation during automatic procedure.) He reports any maloperation of the equipment, by telephone, to the feeder system captain and the operator of Guided Missile Status Indicator Mk 81 Mod 0 in weapons control. Under emergency conditions, or during any maloperation, the launcher captain stops the launcher movement with the train and elevation operation selector switch or with the train and elevation motor switches.

Grounds are a major cause of casualties, responsible for damage both to personnel and ordnance equipment. Particular attention should be given to watertight integrity of watertight packing, stuffing tubes, covers on junction boxes, switches, and all types of exposed equipment, as well as equipment in areas where condensation can take place. Damage from moisture is a severe problem in tropical climates; frequent inspections are necessary to detect mildew or other signs of moisture. Other unintentional grounds may be due to abrasion of insulating material on wires, contact of exposed wires, or poorly made connections.

Grounding of explosive components, handling equipment, and containers during handling was described in chapter 2.

When acting as assembly captain, do not allow the assemblers to remove wings and fins from the racks until the missile has stopped in position in the assembly area. Wait until all the assemblymen have completed their wing and fin assembly, have stepped back to the clear area, and have pressed their safety switches. Then signal the launcher captain that the assembly area is ready. If a safety switch is inoperative, or malfunctions in any way, check to see that all the assemblymen are in the clear area after completing assembly; then signal the launcher captain "CLEAR BY-PASS." The safety switch used by the assemblymen is a foot switch on some mods, while a hand switch is provided on others; but each man has one at his place in the assembly area.

UNLOADING

With some launching systems, all Unloading must be done in step control (LOCAL or MANUAL), but automatic unloading is possible with the Mk 10 launching system. The unload

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order is sent by WCS and will indicate the side, A or B, or both, causing a blinking light to appear on the launcher captain's panel. The missile may be in the assembly area or on the launcher when the unload order is given. The launcher captain positions the switches on his panel to conform to the unload orders, and this initiates the automatic unloading. The launcher synchronizes to load position and then proceeds through the unloading steps, the reverse of loading.

When the missile reaches the assembly area, the wings and fins must be removed and returned to the racks. During the unload operation, visually inspect to be sure the wings and fins are removed, the booster is unarmed, and the missile sustainer is in the SAFE position before returning the missile to the magazine area. A dud or misfired booster being returned to the magazine must not be removed from the wing and fin assembly area until the feeder system captain is notified that the booster and missile sustainer have been checked and reset to the UNARMED position.

The assembly area is the most dangerous section of the entire launching system during loading and unloading operations. It is the responsibility of the instructor (usually a GMM 1 or C) to ensure that all safety instructions are strictly adhered to. The trainees must not be permitted to, operate the equipment, to position control switches, or to perform any other work on the system without direct and continuous supervision of the instructor. Although each trainee is responsible for his own safety, you, as a petty officer, must give frequent reminders of the safety precautions and be on constant watch to see that they are observed. When the feeder system is in operation, the assemblymen remain on the station with their foot switches depressed, except during actual assembly or disassembly of the wings and fins. The operator of the assembly captain's panel must not give the READY signal until he is completely sure that every man has stepped back to the safe area and has his safety switch depressed. There is an emergency wing and fin assembly bypass switch on the panel, but this must NEVER be used except in case of a malfunctioning foot switch and during equipment checkout when personnel are clear of the assembly area.

During continuous firing, there will be missiles in the assembly area as well as on the launchers. Before the missile to be unloaded from the launcher can be moved, the missile in the assembly area of that side has to be returned to the magazine. The launcher captain must be VERY SURE that there is no missile in the assembly area before he starts the unloading procedure. In automatic unloading, the launcher captain positions his unload assembly switch, the assemblymen remove the wings and fins, the assembly captain positions the assembly-ready switch on his panel to REMOVED, and the weapon is moved by the system mechanisms back to the magazine or ready service ring.

At the end of the firing, all missiles must be returned to the magazine before the system is deactivated.

An unloading cycle is necessary after every firing of an Asroc missile from a Terrier system because the adapter must be returned to the magazine tray.

Step Control Unloading

For checking or maintenance purposes, or in an emergency, the unloading operation may be carried out in step control. Step control is always used when moving the missile-booster combination from the ready service ring to the checkout area for routine care and maintenance or for repairing missiles previously struck down as duds. Step control must also be used for exercise and strikedown. The steps are initiated one at a time by use of the push buttons on the launcher captain's panel. The launching equipment is always started in step control. Use the OP for your launching system, the drawings, and the checklist for the procedural steps and the designations of the switches to be activated. The lights and switches on the control panels are plainly numbered and labeled, but it smoothes operation if you familiarize yourself with the panels so there is no long delay while you search the panel face for the right button or switch to operate next.

The indicating lights on the launcher captain's panel show switch actuation. Each pushbutton contains two light bulbs, separated by a center divider. One bulb (or one-half of the pushbutton) corresponds to the A side and the other

to the B side of the launcher. When using the Step Control switches, depress the pushbutton and do not release it until the indicating light appears. To check for a faulty bulb, push the "Press to Test" pushbutton (fig. 4-1) at the bottom of the EP2 step control panel. If the bulb tests "good," but still no light shows, investigate for the source of trouble.

Before beginning the unloading procedure, the launcher must be latched in the load position. The launcher contractor (which warms the missile while it is on the launcher), and the arming tool must be retracted before the blast

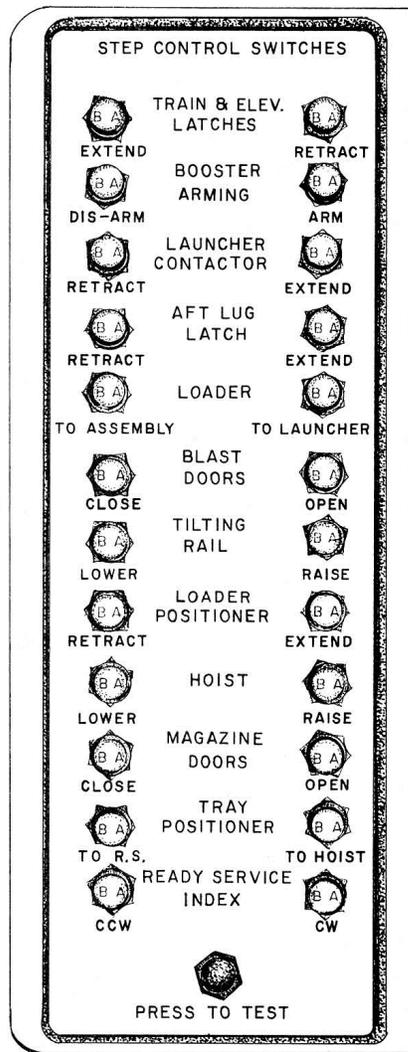
doors are opened. Sound the loader warning horn to warn everyone away from the loader area. After the loader has moved the missile from the launcher back to the assembly area, close the blast doors. The men in the assembly area quickly remove the booster or motor fins and stow them in the racks provided for them. Other assemblers fold the fins on the missile. Before the magazine door can be opened, fm removal must be completed. The assembler captain must check that the missile has been safed.

If only one type of missile is stowed in the ready service ring, any empty tray can be moved to the no. 1 position to receive the missile. If the ready service ring has more than one type of missile, the designated tray must be indexed to the no. 1 position. The designation of particular trays to specified missiles at replenishment was described in chapter 2. It is possible to change the assignment of trays if necessary; consult the OP for the procedure.

MALFUNCTIONS AND THEIR CORRECTION

The most common causes of malfunction (casualties), listed in the order they most frequently occur, are:

1. Personnel errors.
2. Improper switching conditions.
3. Power failure due to malfunctioning interlocks-switch not properly adjusted mechanically, fuse blown (short circuit), loose connection, dirty connection, improper grounding, broken lead (open circuit), faulty contacts.
4. Power failure due to malfunction of relays-loose connection, broken lead (open circuit), faulty contacts, coil failure, overload on system.
5. Mechanical failure-improper lubrication (rust or corrosion), working surfaces burred or scored, improper adjustments, equipment out of alignment (frequently caused by extreme shock or heavy weather conditions).
6. Hydraulic failure-oil supply insufficient, air in oil supply system, foreign matter in oil supply system, improper valve adjustment, scored valve or valve sleeve (foreign matter in system).



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Figure 4-1.—Step control switches, EP2 panel, Mk 10 Mod 7 Terrier launching system.

It is hoped to eliminate (or greatly reduce) many common failures by conscientious application of the 3-M System. No hydraulic system, for example, should be without sufficient oil if a daily check is made. The greatest cause of trouble will probably continue to be no. 1, "Personnel errors."

Troubleshooting

In spite of the best preventive maintenance, there will be some operational failures. The cause of the trouble may be hard to locate, so you have to trace it down. The ability to use schematics and wiring diagrams is essential.

Troubleshooting (casualty analysis) is a very important part of maintenance. Before starting any repairs of a system, determine which of the components is (are) faulty. It frequently happens that the person doing the troubleshooting finds the faulty component, replaces it, but fails to locate the origin of the trouble. The origin of the casualty must be located before replacing a component, otherwise the trouble will recur and the new component will be damaged.

Before performing any casualty analysis or repair work, you should be thoroughly familiar with the equipment, the sequence of operations, the control panels, manual and interlock switches, indicating lights, mechanical and hydraulic functions, and the relation of the control system to the weapons control station. Troubleshooting is discussed in several chapters in connection with different types of components. It may require considerable persistence and patience or it may be quick and easy, but it should always be methodical and thorough.

DUD-JETTISONING

Jettisoning of missiles may be necessary in an extreme emergency or if hazardous conditions exist, such as fire on deck in the vicinity of the launcher, or if the weapon is damaged by enemy action, or if it failed to fire and circumstances do not permit returning it to the magazine or the checkout area. **DO NOT JETTISON A MISSILE WITH A NUCLEAR WARHEAD.** The

decision to jettison comes from the commanding officer via the weapons control station.

The dud-jettisoning unit (fig. 4-2) is associated with each launcher to permit the ejection of missile rounds from the launcher. Each unit consists of two ejectors and a control panel (fig. 4-3). The dud-jettison units are mounted in such a way that ejection can be performed at approximately 95° or 275° of train and at 34° of elevation. (The train and elevation are different on each ship.) The launcher automatically trains and elevates to bring the after end of the round in line with the dud-jettisoning ejector, and a pneumatic mechanism in the ejector elevates a piston in line with the round. The piston extends slowly, under low pressure air, until its mushroom-headed piston mates with the after end of the round, then extends rapidly with a short, powerful pneumatic stroke (3500psi), forcing the round off the launcher and over the side.

The control panel for the dud-jettison unit is mounted in the deckhouse, and is operated by the launcher captain (or the port side assembler captain) upon orders from the WCS by sound-powered telephone. In the Mk 10 Mod 8 system, the control panel is adjacent to the A-side blast doors, within the aft compartment. When the ship's roll exceeds 20°, jettisoning must be performed only on the downroll. A standard bubble type inclinometer with a 45° index scale is mounted next to the dud-jettison control panel to indicate ship's roll.

The launcher captain initiates jettisoning by positioning the DUD-JETTISON switch at the EP-2 panel, which causes the launcher to synchronize automatically to the dud-jettison position.

The dud-jettisoning procedure may be applied to a dud missile, a misfired booster, or any other condition which necessitates a decision to jettison a weapon.

Operation

Whenever the firing key is depressed, the DUD and MISFIRE lamps light momentarily, until the missile has cleared the rails. However, if the missile is a dud, the DUD lamp continues to be lighted. The contractor fails to retract. The operator may try to fire the missile by placing

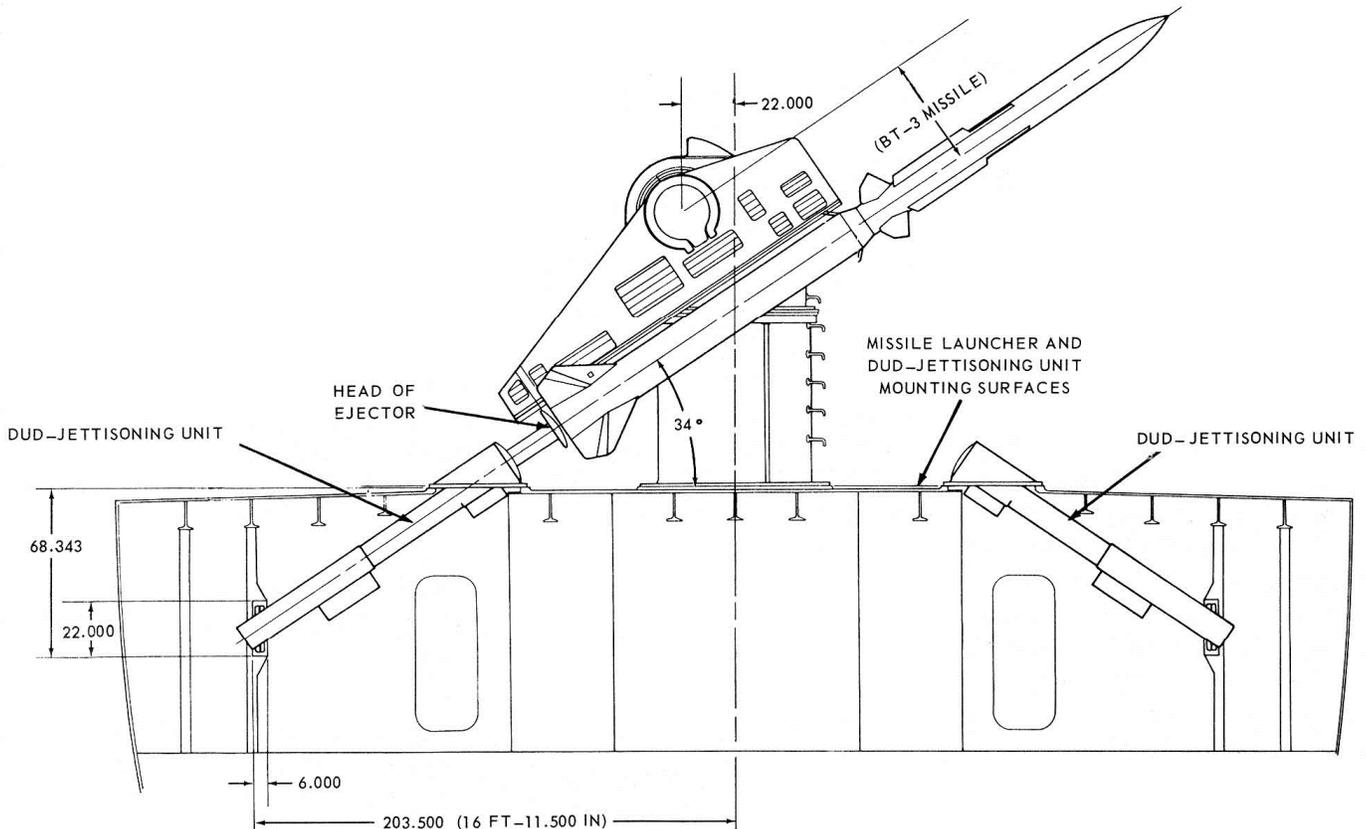


Figure 4-2.—Dud-jettisoning unit Mk 108; cross section view. DLG Terrier installation.

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the dud switch in the ON position. If this succeeds, the contactor retracts and the DUD lamp, the RAIL lamp, the WARMUP TIMER RAIL lamp, and the READY TO FIRE lamp all go out. When the arming tool unwinds, the READY lamp also goes out.

If attempts to fire the missile are unsuccessful, it may be returned to the magazine for later inspection and possible repair; its location is marked on the control panels. In some situations (emergency or combat), it may be necessary to jettison a dud missile; wait for the order to do so.

A DUD indication will also occur if the firing key is released too quickly (before 1.5 seconds have elapsed). The booster firing relay will not be energized and as a result a dud missile is left on the launcher.

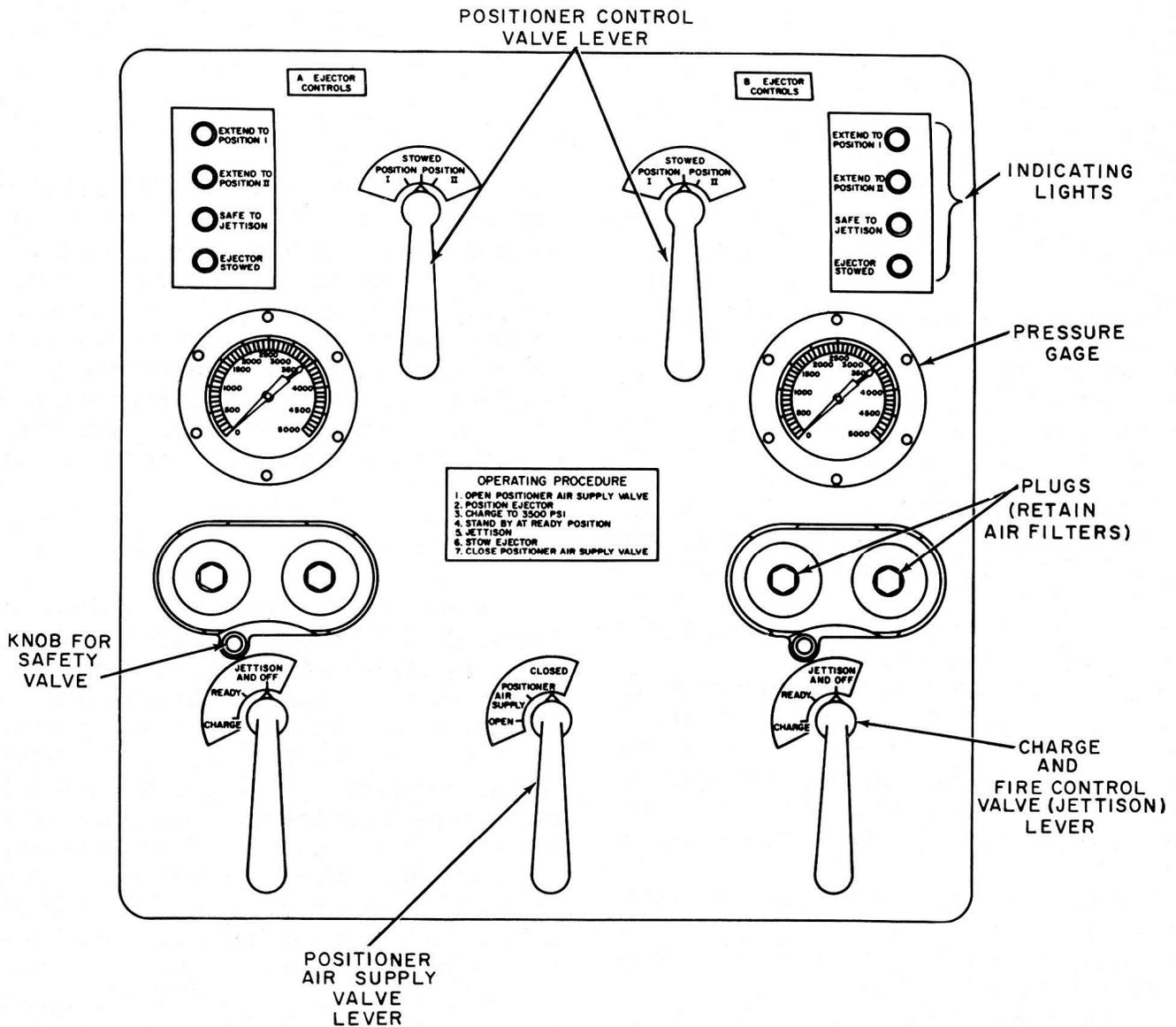
OPERATING THE DUD-JETTISON PANEL. - Suppose jettisoning of a missile has been ordered. On a Mk 10 launching system the port

side assembler captain mans the dud-jettison panel. He must have sound-powered telephone communication established. At the control panel (fig. 4-3) he opens the positioner air supply valve. This connects to low pressure air. Next, he rotates the positioner control lever to POSITION I for a BT-3 missile or POSITION II for a BW-1, for ejector side A or B, whichever side is to be used. When the ejector is in the raised position, rotate the jettison lever to CHARGE and hold the lever in this position until the air pressure meter reads 3500 psi. (Pressure requirements for your installation may be different.) A light ("Safe to Jettison") on the control panel indicates when the ejector is fully raised to "Firing Position."

WARNING: Do not cycle below the designated operating pressure.

Rotate the jettison lever to READY and wait for the command. Upon receiving the command to "Jettison," check that the air pressure meter

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Figure 4-3.—Dud-jettisoning panel, Terrier launching system Mk 10 Mod 0.

reads in excess of 3400 psi and rotate the jettison lever to JETTISON. The head of the ejector is forced against the missile base by the air pressure and spring pressure from the spring side of the firing valve, and the missile is forced overboard from the launcher. Note that the air pressure drops rapidly. Lastly, rotate the positioner control lever to the STOW position. The dud-jettison unit must be lowered ALL the way before the launcher power brake can be released and the launcher trained and elevated for reloading.

There are differences in control panel switches and nomenclature, but the principles of operation are very similar. The steps in operation of the dud-jettison panel on your ship should be posted beside the panel. On some mods, a metal instruction plate is permanently fastened to the dud-jettison panel, directly in front of the operator. After the jettison operations are completed, the dud-jettison panel operator moves the lever of the Positioner Air Supply valve to CLOSED, and the launcher captain returns control to the EP2 panel by

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repositioning the switches to the desired type of operation.

If the round is considered dangerous to the ship, the launcher captain positions his emergency enabling switch to ENABLE upon telephoned order from the WCS operator. The WCS operator then holds down the dud emergency firing switch until the round leaves the rail (RAIL LOADED light goes out). This is dud firing (not jettisoning), and is carried out in WCS without action by the launching system crew. This method of dud firing disables one side of the launching system. It is used only in case of real danger from the missile on the launcher. This method of dud firing disables one side of the launching system. It is used only in case of real danger from the missile on the launcher.

SAFETY RULES FOR DUD JETTISONING. -

Under emergency conditions or during any maloperation, the launcher captain must stop the launcher movement with the train and elevation operation selector switch or with the train and elevation motor switches.

In case of booster misfire, do not permit personnel to approach the launcher for at least 10 minutes after the last attempt to fire, and the firing circuits have been known to be open. The time limit is at the discretion of the commanding officer and is not obligatory in time of action.

The return of a dud or a misfired booster to the magazine, or dud jettisoning, it should not be started until the firing safety plug in the EP-2 control panel has been removed.

During all operations for disposal of misfires or dud, the launcher captain should remain at his control panel to guard the firing safety plug and to observe and make certain the launcher and the guide remain in a SAFE and UNLOAD position.

Do not position the emergency enabling switch to ACTIVATION and ENABLE during firing, unless specifically ordered to do so by weapons control. Use caution as to the proper side and the position ordered.

During unload operations, visually inspect to be sure that wings and fins are removed, booster is unarmed, and the missile sustainer is in the SAFE position before returning the missile to the magazine area.

A dud or a misfired booster being returned to the magazine must not be removed from the wing and fill assembly area until the feeder system captain is notified that the booster and the missile sustainer have been checked and reset to the UNARMED position.

WHAT TO DO WITH ASROC. With the extensive missile tests and circuitry checkout required for Asroc missiles, it is not likely that an Asroc missile will have to be jettisoned, as duds will be discovered before the missile is placed on the launcher. If it is necessary to jettison an Asroc missile, the adapter rail is jettisoned with it. It is jettisoned in the same manner as a Terrier missile. If a dud results from loss of synchronization, it should be handled according to ship's doctrine.

Is It a Dud or a Misfire?

Note the difference between a dud and a misfire. If the DUD lamp lights on the weapons assignment console (WAC) when the firing key is pressed, nothing happens to the missile-it does not transmit the electrical energy to set off any explosive components. Except under certain tactical situations, when the launcher has to be cleared quickly for firing, the dud missile can be returned to the magazine for later examination and repair. In a misfire, some part or parts of the explosive system were actuated when the missile firing key was depressed, but not enough to send the missile off the launcher. A misfire presents a dangerous situation. If the MISFIRE lamp lights at any time during the firing cycle, there are three alternatives: (1) emergency firing procedures may be used; (2) the launcher may be aimed in a safe direction for a waiting period prescribed by ship's doctrine. If nothing happens, the missile may be returned to the magazine for later examination and repair; or (3) the round may be jettisoned.

A missile is considered to have misfired when its booster fails to fire after its electrical and hydraulic systems have been activated and the booster firing relay has been energized. When the firing key is depressed, the DUD lamp lights and the MISFIRE lamp flashes. When the missile fails to clear the rail, the MISFIRE lamp continues to flash and the DUD remains lighted.

You cannot tell whether the explosive train inside the missile will sputter and go out, or if it will burn and explode on the launcher, or if it will fire in a short time. All factors of the situation - known, calculated, and surmised - have to be considered in deciding whether to wait and see what happens or jettison the missile. In a battle situation, it may be necessary to fire a missile from the other side of the launcher while leaving the misfire on the first side. Several attempts may be made to fire the missile, by means of the emergency firing key. When the emergency enabling switch is at NORMAL, the emergency firing key can be held down as long as desired in an attempt to activate and fire the missile. If it is placed at ACTIVATION AND ENABLE, the booster firing transformer is energized through an alternate circuit and many of the normal firing relay contacts are bypassed. If the firing is successful, it shows the relays were at fault on the first try. If the missile cannot be fired by this method, most likely it will have to be jettisoned. Decision must be made in WCS.

The two emergency firing circuits in the Mk 10 Mod 7 launching system, EMERGENCY ACTIVATION AND ENABLE, and EMERGENCY ENABLE, are used only in the Terrier mode.

Malfunctioning of Dud-Jettisoning Units

The dud-jettisoning unit has been designed to provide maximum service with a minimum of maintenance. A major difficulty that may be experienced with dud-jettisoning units is that of ice forming in the valve passages. This is caused by rapid expansion of moist, compressed air. Any moisture traps in air lines should be drained regularly. Deicing lines port heated fluid to the cover door sections to prevent formation of ice during cold weather, permitting operation of the jettisoning unit in the most adverse weather conditions. The anti-icing system which also protects the launcher from icing.

MAINTENANCE.-Since the dud-jettisoning unit is intended for emergency use, it must be kept in operating condition, ready for instant use when needed. Check out the equipment at:

regular intervals by exercising each dud ejector (no missiles on launcher rails). Replace indicator lamp bulbs on the control panels when necessary. The outside of the panel should be cleaned periodically. Usually wiping with a dry cloth is enough; a damp, soapy cloth may be needed to remove grease spots or fingerprints. Wipe dry. The dud jettison unit does not require lubrication. In particular, take care NOT to lubricate the firing piston head or stem.

WARNING: If it is necessary to disassemble any of the air lines, be sure the valve in the ship's high pressure line (4500 psi) is closed, and also the nearest shutoff valve in the 100-psi ship supply line. Bleeder valves in the ejector unit accumulators should be open. Tag all valves while working. Protect any open ends of pressure lines with suitable caps or plugs to prevent entry of dirt, moisture, or other foreign matter.

It may be necessary to replace a gasket on an ejector unit, or a defective limit switch. The need for a new gasket may be discovered when checking the air-charging chamber of the ejector for hydraulic fluid or moisture. To make the check, remove the drain plug from the lower end of the ejector assembly. If there is any drainage, wipe the drain port clean, check the gasket and plug for signs of deterioration, and replace if necessary. Wait at least 2 hours after a unit has been cycled before making the drainage check. Further disassembly of ejector units is not contemplated, short of battle damage.

Air filters and air breathers, of which there are six: each in the Terrier jettisoning equipment, require regular inspection to see if they need cleaning. Cleaning is done by washing the filter or breather in solvent, rinsing in clear water, and drying with a stream of compressed air. Never direct compressed air at yourself or others; it can be fatal.

Before unscrewing a plug that holds a filter, be sure the manual shutoff valve on the jettison panel is closed and that the pneumatic lines leading to the ejector are vented (JETTISON AND OFF on panel). (See figure 4-3.) There are four of these plugs (and filters) on the face of the panel.

The sensitive switch assemblies, solenoid assembly, and dud-jettison synchro-transformer all need periodic inspection, and adjustment or replacement as required. The adjustment is

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determined at installation and is not changed later, but units are brought back into adjustment if they vary from it. Two sensitive switch assemblies are located on each ejector. The four solenoid assemblies are all located in the jettison control panel. Any malfunctioning parts are replaced. The synchros are located within the EP2 panel. The synchro control transformers are adjusted or replaced. Instructions for this are given in OP2350.

Manual switches are not repaired but are replaced if they do not function. (The foot-operated safety switches in the assembly area are an exception.) These include indicating pushbutton switch assemblies, pushbutton switch assemblies, toggle switch assemblies, and rotary switch assemblies used on control panels.

Maintenance of the electrical cables includes periodic checking of the cables, connectors, or other associated components: Measure the insulation resistance of power supply cables with a megger. A ground-detection indicator on the EPI panel continuously monitors the control supply circuit. Disconnect this indicator before making a megger test of a cable in the system. If an insulation breakdown is indicated, trace it down and correct it, then test again. If a cable is damaged so it requires replacement, get a spare cable of the same kind from spare parts stock and install it. Umbilical cables are always replaced, not repaired. Do not splice a cable except in an emergency. Attach identification markers to all cables. All terminal lugs should be crimped to their connectors.

TESTS.-Maintenance tests are conducted in cooperation with other ratings and all components of the missile system are tested. System readiness tests are performed every day; system maintenance tests are performed weekly or monthly. Use the OP for your weapons system when each test is performed. OP 2629, Volume 3, *CLG (Terrier) Guided Missile and Anti-aircraft Weapon System, Maintenance Test Procedures (U;C)*, consists almost entirely of tables that list the tests to be made. The equipment to be used, the settings to make on the control panels, directors, computers, etc., and the response expected are all given in the tables. Step No. 29 is a test of the dud-firing circuits. Steps Nos. 27 and 28 are for misfire circuit testing. Referring to table 3.2, you find that steps 26,

27, 28, 29 and 30 must be performed weekly and must be conducted together and in sequence. Turning to step No. 27 in the table of test procedures, you find that the EP-3 panel on the launcher and the weapon assignment console in the weapons control station must be manned. The actions to take (buttons to push) and the desired response for each are listed. Sample log sheets are shown for recording performance of tests. If any failure is indicated on the EP-3 panel, obtain the circuit diagrams of the system, schematics, and the maintenance instructions for your equipment, trace the trouble to its source, and correct it. It may be only a burned-out signal light, or it may be some trouble very hard to locate; Check out the simplest or most obvious cause first. Work in cooperation with the men from the weapons control room to locate and correct the trouble.

Operation of the dud-jettisoning equipment is part of the regular training schedule. If any part fails to function as it should, it is up to you to locate and remedy the trouble with the aid of your men. If the air pressure does not build up enough to eject the missile, check the air lines and valves of the system. The publications custodian of your division has all the drawings, OPs, and other publications needed for the care and repair of the equipment aboard.

TALOS MISSILE SYSTEM

Talos, the largest of the Navy surface-to-air missiles, is stowed as a complete round in the magazine. The missile and booster are mated before stowing in the ready service compartment, but the wings and fins are added in the wing and fin assembly area when the missile is being moved to the launcher.

AUTOMATIC LOADING OPERATION

Normally the launcher rails are loaded simultaneously. This provides maximum fire power as well as backup in the event of a dud, misfire, failure to capture the missile in flight, or any other contingency rendering the fired missile useless. The load order comes from the Launcher Direction Console (LDC) in the

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Weapons Control Station (WCS). It is an order to transfer missiles, selected according to type ordered, to the launcher rails. Initiation of the load orders on the LDC causes the center hoist mechanisms (Mk 7 system) to automatically lift the desired weapons to the load position. The missiles are raised by the magazine hoist (Mk 12 system), which rides on vertical rails, up to the main deck level, where the missile is received by the loader. The empty tray is returned to the magazine by the hoist. The magazine door closes after the hoist and tray have been returned. The magazine doors are operated by a hydraulic accumulator power drive. Power for the hoist operation is supplied by the hoist power drive, located on the machinery deck of the magazine. In both Mk 7 and Mk 12 systems, shoes on the booster engage the loader rail by which the missile is moved onward to the wing and fill assembly area.

In the wing and fill assembly area, warmup power is applied, the missile arming plug (W missile) is installed, and the wings and fins are attached. When the assembly operations are completed, the blast doors open and the missiles are rammed onto the launcher rails. Then the blast doors close and the launcher is ready for assignment to its first target. As missiles are used during combat, the initial setup of missiles in the ready service ring may become changed considerably. A tray that held a missile round at the beginning of operations may now be empty, or the reverse may be true. Monitoring of the ready service missile distribution by the operators of the ready service panels (EP-6 and EP-7) is of special importance. To prevent delay in loading, the operators need to index rounds to the hoist position, ready for the next load order without loss of time, indexing past one or more empty trays (or wrong type rounds) to get to the desired round. If there is a delay, the DELAY lamp lights on the LDC panel, indicating to the panel operator that the loading delay is not caused by a malfunction of any of the equipment. It also indicates whether the delay is on Rail A or B, and whether an S or a W missile is to be loaded.

As the missile passes through the launching system, lights on the LDC panel in the weapons control station, and on the launcher control

panels, indicate to the panel operators the location of the missile and the stage of operation at all times.

While wings and fins are being assembled to weapons, the assembly captain checks the TWO SAFE lamps on the safing plug on a W missile. If ONE of them lights, he removes the safing plug and inserts the arming plug. If none of the SAFE lamps light he must obtain further instructions from the weapons officer.

As in Terrier systems, each assemblyman has a safety switch which he depresses when he has finished his part of the wing and fin assembly. All assembly switches must be depressed before the missile is loaded on the launcher rail. The Mk 7 launching system has foot switches in the assembly area; the Mk 12 system has hand switches.

The normal mode of loading is automatic. Only two manual operations are involved - attaching the wings and fins, and installing the arming plug in W missiles. As long as everything is operating normally, the panel operators merely monitor their panels. If anything goes wrong, however, you have to locate the trouble and correct it as quickly as possible. The OP for the launching system, for example, OP 3590 Guided Missile Launching System Mark 12 Mods 0 and 1, contains schematics for the circuits. The sequence of action is described in the accompanying text. These aids will help you pinpoint the area of failure. If the fault is in the hydraulic system, or in pneumatic components, refer to the OP.

Unloading

In the Mk 12 launching system, missiles may be moved automatically from the launcher to Area 2, above the magazines, or from Area I (wing and fin assembly area) to Area 2. The operations for bringing the missiles from Area 2 to the magazine are not automatic. Step control switches at EP-6 and EP-7 magazine panels are used to bring the missiles to the magazine and stow them. The missiles must be halted in Area I so the wings and fins can be removed and stowed in their racks. If a W missile is being returned to the magazine, the (magenta) arming plug must be removed and locked in its locked storage space, and a safing plug installed in its

CHAPTER 4 - LOADING, UNLOADING, AND DUD-JETTISONING

place. The weapons officer has charge of the plugs; removal and insertion of the plug must be done according to the checkoff list for this procedure. The antiloading devices, sometimes called handcuffs, are put back on the W missile booster shoes. These devices lock the booster shoes preventing the transfer from the magazine to the loader.

The safety switches in the assembly area, are used in the same manner as in the loading operation. Each assembler steps behind his safety screen and actuates his safety switch as soon as he has finished removing the wing or fin. When all 12 switches are actuated, the next step in unloading can be initiated, that is, to return the missile to the ready service compartment. The man at the EP 6 (or EP 7) panel operates the push buttons for unloading. The man at the EP3 panel monitors the operation.

In the Mk 7 launching system, unloading cannot be done automatically, but is done in step mode. This is relatively slow.

Step Control

Step control is used for training, practice, and checkout. All or part of the loading cycle may be in step control. Talos missiles are not fired in step control. The sequence of actions of the launching system are the same as in automatic loading, but each step must be initiated by turning a switch or pushing a button on a control panel. The step control switches on the EP-2 panel are covered when not in use. Each switch has a light or a pair of lights to indicate the position of the component. The pairs of lights indicate the position of similar components on A and B sides of the launcher. The fourth letter in the light designation indicates the side. For example, amber indicator light DSAB1 indicates that the booster arming device on the B side is extended.

The launching system captain operates the -step control switches on the EP-2 panel. He maintains telephone contact with the weapons control station and the officer in charge of the launching system. The operators of the magazine control panels, EP-6 (A-side) and EP-7 (B side) operate the equipment in compliance with phone orders from the officer in charge of the launching system or indicator light orders from

the launching system captain. They sound the warning horn when activating magazine equipment, operate the magazine equipment, and, when unloading, strike down the booster-missile combinations.

TALOS DUD JETTISONING

The Talos launching system does not have dud-jettisoning equipment. The launcher is used if a dud must be ejected. The procedure with the Mk 7 and Mk 12 launching systems is essentially the same. If, after the firing key has been depressed at the console in the weapons control station, the missile does not fire and the DUD indicator lamp lights on the launcher control panel, the missile is considered a dud. Ordinarily, the wings and fins are removed and the missile is returned to stowage as a dud for subsequent repair. In a tactical situation, it may be necessary to clear the launcher quickly so as not to lose half the fire power of the launcher. In that case, the dud-firing switch (for A or B side, as appropriate) is closed until the DUD lamp goes out. The closing of the dud-firing switch bypasses the missile activation circuits in firing the booster squibs. Only single-rail firing is possible from a dud-firing key. Although there are no interlocks to prevent dud firing simultaneously by using both dud-firing keys, this should be avoided because an inactivated missile is aerodynamically unstable, and its flight path is highly unpredictable. Two missiles fired simultaneously might collide near the ship.

Misfire

If the MISFIRE light goes on, it indicates that firing was initiated and the missile internal power switchover circuits were completed; the booster firing relay energized, but the weapon did not clear the rail. This light is always on momentarily after the firing key is pressed (in the WCS), but if the weapon does not clear the rail in the time limit prescribed by the delayed misfire relay, the MISFIRE light remains on. If firing circuit troubles are suspected, emergency firing can be attempted after the guidance circuits have been reset and the missile gyros have been recaged. If a misfire is indicated again, the

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missile should be treated as a potential "hangfire." It is kept on the launcher rail for 30 minutes with both blast doors closed, and if nothing happens, it is returned to the ready service compartment and stowed as a dud. A missile already on the other rail may safely be fired, but do not reload for 30 minutes.

EMERGENCY FIRING.-Under emergency conditions, missile firing can take place from the emergency firing panel in WCS. Firing from this panel bypasses all system safety interlocks except those involving the blast doors, firing cutout cams, and the firing safety switch. Unlike dud firing, the emergency firing sequence energizes the missile activation circuits, making the launched missile capable of normal flight. Determination of when to use emergency firing procedures should be based upon established ship doctrine and the tactical situation. When emergency firing is authorized, WCS notifies the EP-2 panel operator by sound-powered telephone to set the EMERG. FIRING, ENABLE switches. WCS closes the emergency firing key when the EMERGENCY READY TO FIRE light goes on. The launcher may be damaged if the emergency firing key is pressed before this light is on. It goes out when the rail has been cleared by the missile and the firing key can be released. Only single-rail firing is possible in emergency firing.

EMERGENCY IGNITER.-If the missile is not fired by emergency firing, the use of an emergency igniter injector may be ordered. It was designed for combat use to dispose of a misfired missile and booster, and to fire a missile tactically with the hope that it might be a successful shot. The emergency igniter injector has been placed on all Mk 12 Mods 0 and 1 launching systems; later mods will have them installed with the launchers. Mk 7 launching systems have been modified to include them; figure 4-4 A shows the igniter injector installed on each launcher arm, and figure 4-4B indicates the parts of the igniter injector. It is hydraulically operated and is remotely controlled through the launching system firing circuits. In its normally stowed position (fig. 4-4A), the injector is locked to the guide arm by a hydraulically operated latch (fig. 4-4B), out of the path

of the missile blast. The emergency igniter cartridge (fig. 4-4B) contains an igniter which is a plastic cylinder about 4 inches in diameter and 8 inches long, filled with 1500 grams of boron-potassium nitrate pellets. This explosive provides sufficient ignition to the booster to develop full normal booster thrust. The cartridges containing the igniters are carried by the ship as ammunition components and are loaded into the injectors when their use is anticipated.

A test unit that simulates the emergency igniter and cartridge is kept in the injector at all times except when it is desired to use the emergency igniter cartridge. It is used for the periodic cycling of the injector mechanism, for checking the firing circuit, and for sealing the cartridge housing in the injector unit against the weather. When the use of the emergency igniter injector is ordered, the launcher captain places the EMERG. FIRING ENABLE switch at EMERG. IGNITER position. The launcher then automatically positions at 30° elevation with respect to the deck (fig. 4-5A), the hydraulic latch on the guide arm is released, and the injector unit is rotated to LOAD position in line with the longitudinal axis of the booster. The hydraulic piston of the unit then extends and carries the igniter cartridge and igniter to the booster closure disc. The cartridge travel is stopped as its forward flange contacts the Styrofoam closure disc of the booster. The piston, continuing its travel, pushes the igniter out of the cartridge, punctures the center disc, and catapults the igniter inside the booster cavity aft of the booster grain (fig. 4-5B). The piston then retracts, carrying the empty igniter cartridge back into the ejector housing, and uncoils the umbilical ignition wire from the igniter in the booster (fig. 4-5C). The injector rotates back into its stowed position, and the igniter is then fired through the fire control panel (fig. 4-5D). The total cycle is completed in about 6 seconds.

WARNING: Do not operate launcher in local control with the emergency igniter extended.

WARNING: Do not operate upper blast door in local or manual control when the igniter is extended.

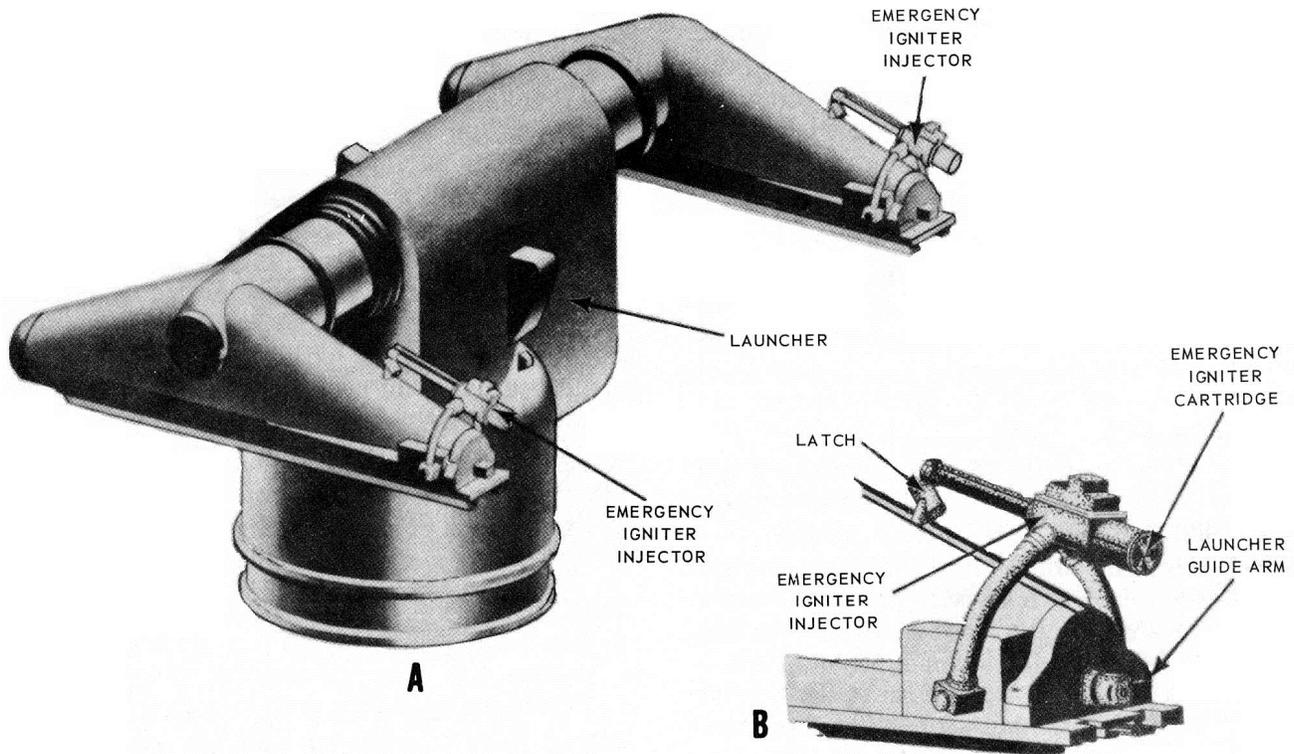


Figure 4-4.—Talos emergency igniter injector: A. Installed on launcher arm of Mk 7 system; B. Parts of the emergency igniter injector.

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In addition to the systems indicating circuits, telephone communications should be used between WCS, the launcher captain's panel, and the safety observer.

If a Talos W Missile is a dud or misfire, notify the nuclear weapons officer at once and follow his instructions.

Once the missile battery is activated, its power is rapidly dissipated. If the missile cannot be fired within 5 minutes, it will be unstable and cannot be used for target intercept. The launcher must be trained into a safe area to fire the missile after depletion of its internal power.

The emergency igniter injector is reloaded manually by inserting a new cartridge. This should be done as soon as possible after firing, so the equipment is ready.

Remember that the emergency igniter injector is to be used only in a real emergency, such as imminent danger of the missile exploding on the

launcher. Its use must be authorized, and authorization is given only if it appears that it is not possible to save the missile, to be repaired later.

ADJUSTMENT OF LAUNCHER TO MISSILES

Although there are some differences in size in Talos missiles Mk 11, Mods 0, 2, 3, and 4, the launching systems in use (Mk 7 and Mk 12) can handle any of the missiles without special adjustments or adapters. All mods of Talos missiles and boosters have been built to the same diameter. The length has been increased from 30 ft 10 in. for the RIM-8A missile to 32 ft. 4 in. for the RIMBE missile. The booster weight has remained the same for all mods, 4425 lb, but the missile weight has been increased from 3145 lb to 3360 lb. A comparison of the components of the launching systems (Table 3-1) will show that many of the components are the same for the

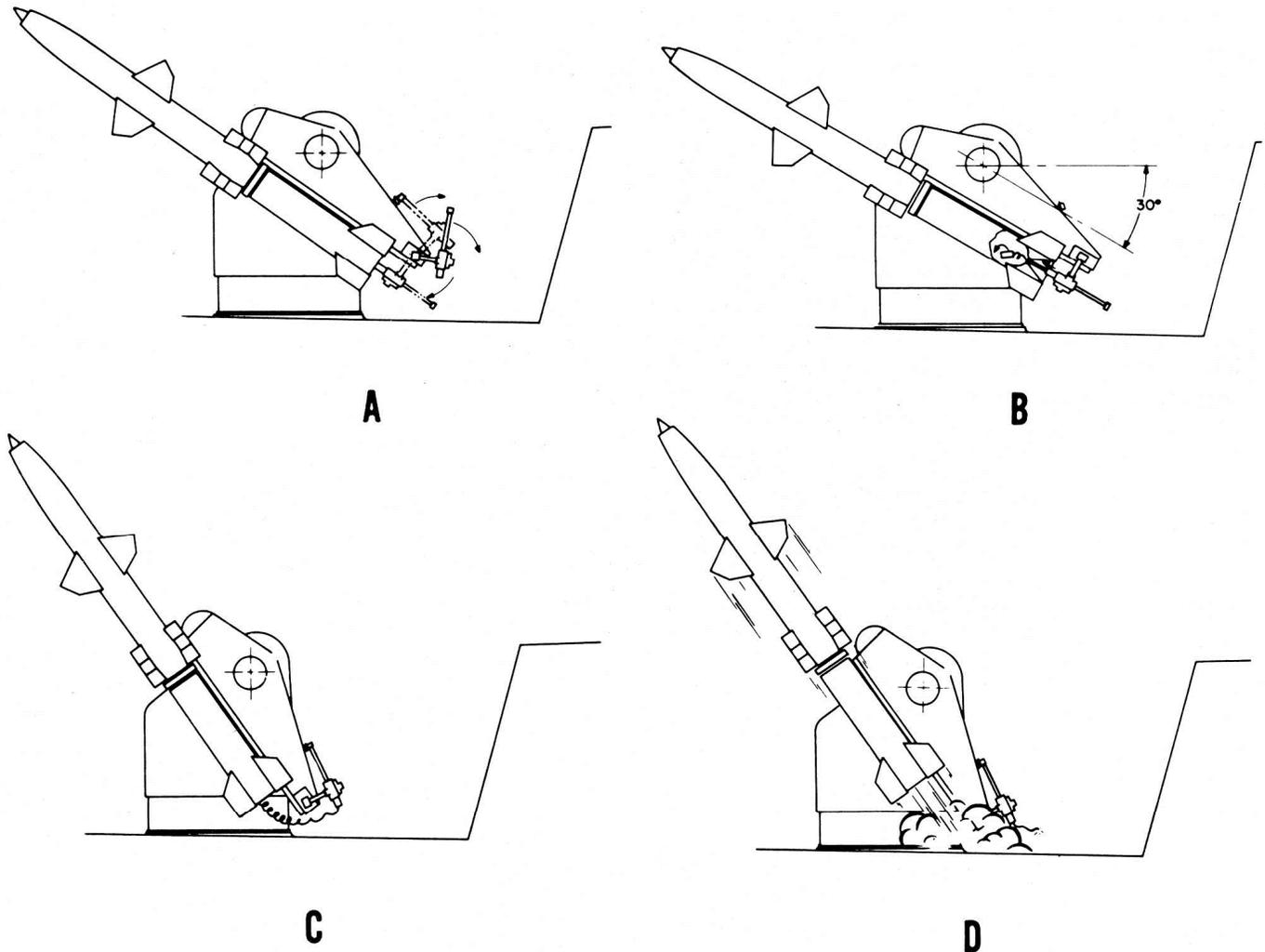


Figure 4-5.—Operation of emergency igniter injector, Talos missile: A. Stowed-to-load position; B. Loaded position; C. Firing position; D. Fired.

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Mk 7 and the Mk 12 launching systems, and some have only a mod change. The fewest changes are in the launcher and its components. The differences in the arrangement and operation of the magazine and ready service compartment has been pointed out. To take care of these differences, the controls also have to be changed, and it is in this area that you find many changes in detail although the principles applied are the same.

A comparison of the control panels listing for the Mk 7 and Mk 12 launching systems (table 3-1) shows that there is at least a mod change in every instance, and many are different mark numbers. That means that the wiring from the

panels to the launching system components is changed from the Mk 7 system.

LOCATION AND DUTIES OF PERSONNEL

Location on shipboard will vary with the installation; we refer here to location in relation to the launching system. Where there are differences between the Mk 7 and the Mk 12 launching system, these will be pointed out. This does not include the men in Fire Control, Weapons Control Station, CIC, or other control rooms.

The officer in charge supervises the operation and testing of the system. His position is on a

platform near the EP2 panel. The launching system captain operates the EP2 panel. On the Mk 7 system, the EP3 panel is adjacent to the EP2 and is a control panel, but on the Mk 12 system, the EP3 is a test panel and is manned only during tests, also by the launcher captain. The test panel on the Mk 7 is the EP9. In both systems, the relay panel is the EP8, and it is not manned. The power panels, EP1A and EP1B, are energized at the beginning of operations, also by the launcher captain. The assembly captains' panels, EP4 and EP5, are operated by the assembly captains, each on his side, in the wing and fm assembly area. The assembly captain is also responsible for arming or disarming a W missile, carefully following the checkoff list from the OP. Each assembly area (A and B) has 12 wing-and-fm assemblymen who attach the wings, missile fins and booster fins.

The EP6 and EP7 panels are called Ready Service Panels on the Mk 7 system, and are monitored by operators during step control. In the Mk 12 system they are called Magazine Control panels and also are used for step control. The Mk 7 system does not have local control panels comparable to EP9, EP10, EP11, and EP12 of the Mk 12 system. They are used to operate the loader and the hoist power drives in local control. By using the local control panels, individual drives can be operated. An additional method of control, also controlled from the Local Control panels, is the Auxiliary Drive System, whose separate power drive is located next to the A side power drive. It is slow and it is used chiefly for maintenance purposes. Exercise control, a form of step control, is used while making tests.

Two feeder technicians should be stationed in the feeder system, ready to perform emergency repairs on the feeder.

TARTAR MISSILE SYSTEM

The steps in the operation of the Tartar launcher in bringing a missile from the magazine to the launcher arm were described in chapter 3. In automatic loading, no one is permitted in the magazine; no manual operations are needed in the magazine. This is true of all Tartar systems. There are no wings nor fins to be assembled; the

TARTAR fins are erected automatically by launcher equipment. Figure 3-3 lists the activation procedures for the Mk 13 Mod 0 launching system; warmup of the missiles is shown in figure 3-1 O.

AUTOMATIC LOADING

The operational sequence in automatic loading with a Mk 13 launching system is as follows. The launcher guide arm is empty and the launcher is at LOAD position.

1. Missile warmup is applied automatically for a minimum of 24 seconds to the selected number of missiles (1, 2, or 3).

2. Ready service ring rotates. The ready service ring inner and outer magazine latches retract, the ready service ring positioner retracts, and the ready service ring indexes CW (clockwise) to place a missile at the hoist. The ready service ring positioner extends, and missile warmup is applied for a minimum of 24 seconds.

3. Hoist hydraulic control is selected. After the warmup period, hydraulic control is transferred from the ready service ring to the hoist.

4. Hoist raises to intermediate position. The raise latch retracts and the hoist raises to the intermediate position, where the hoist pawl contacts the missile aft shoe.

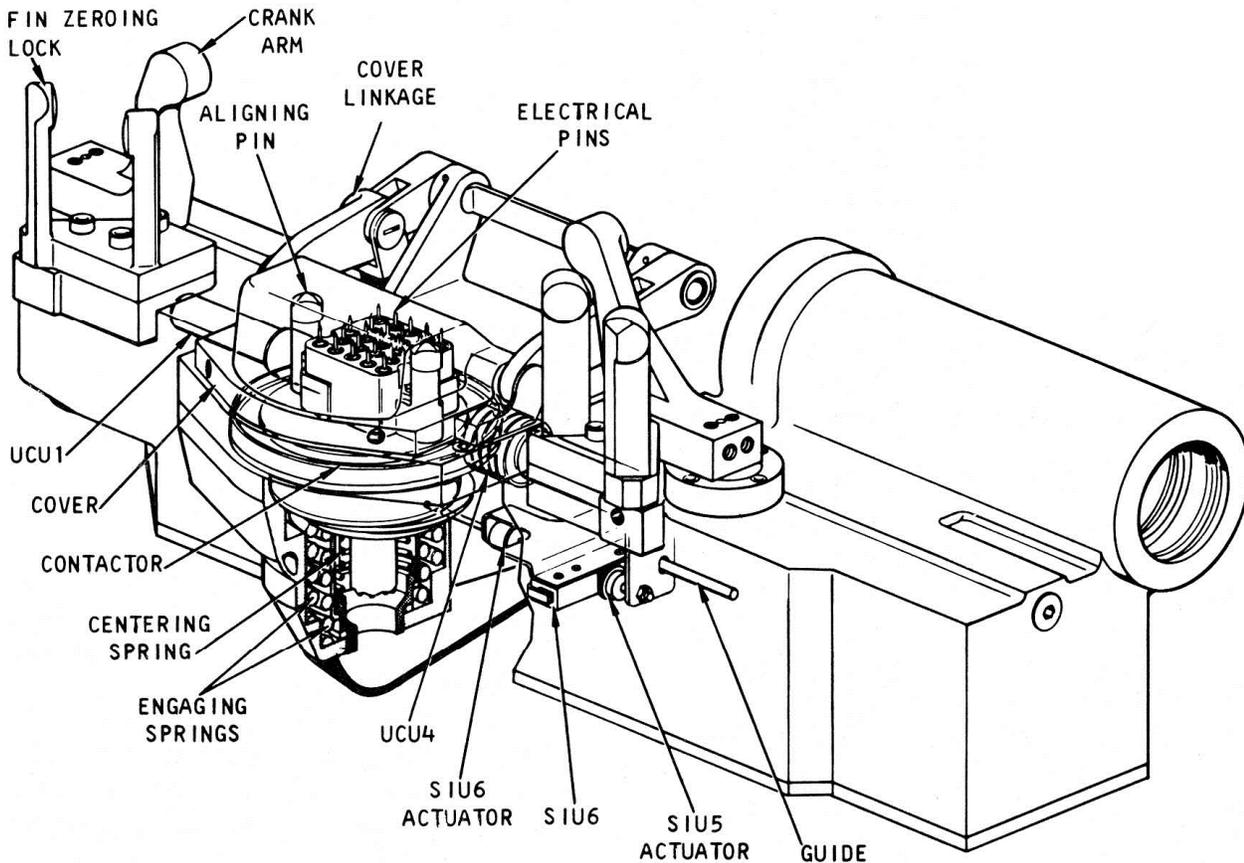
5. When the hoist is at the intermediate position, the magazine retractable rail extends to align the fixed magazine rail (track) with the magazine door span track (rail).

6. The blast door opens and extends a span track. The span track completes the missile track from the magazine retractable rail to the launcher rail.

7. The elevation positioner extends into the open blast door to secure and align the launcher in elevation (90°) during a load or unload cycle.

8. The hoist intermediate raise latch retracts and the hoist raises a missile to the launcher.

9. Aft motion latch extends. When the loaded hoist completes its raise cycle, the launcher aft motion latch extends to secure the missile on the guide arm. The warmup contactor on the launcher engages the missile (fig. 4-6) and warmup power is applied for a minimum of 1.8 seconds. The fin openers engage the fins for



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Figure 4-6.—Fin opener and contactor, Mk 13 launching system (Tartar).

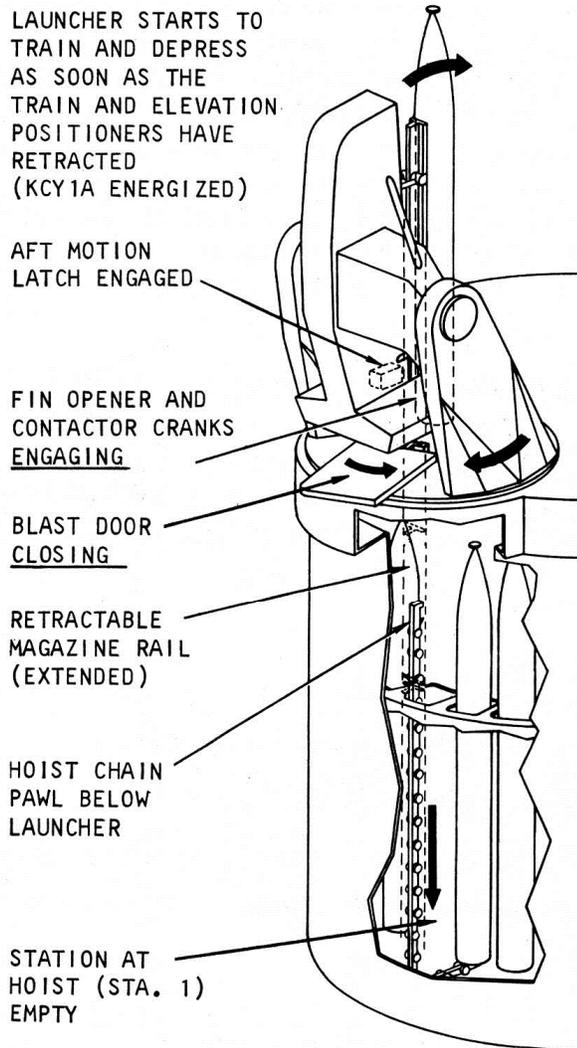
unfolding. Mods 1, 2, and 3 have minor differences in the fm opener and housing.

10. Hoist lowers to magazine position. When the hoist is below the launcher, the train positioner retracts, freeing the launcher in train. The elevation positioner retracts into the launcher guide arm, clear of the blast door. (See figure 4.7).

11. Blast door closes and retracts span track. The closed blast door provides a flameproof seal to the magazine.

A new loading cycle starts if continuous loading has been ordered by the weapons control station. Up on the launcher, a target is assigned and the launcher slews to the ordered train and elevation positions and the missile fins are unfolded. As soon as the blast door is closed, the missile may be armed and ignited, and the

forward motion latch unlocked. When the missile is ignited, the contractor and the fin-opener cranks retract behind shields that protect them from missile blast. The forward motion latch holds the missile on the guide arm until thrust reaches 2330 pounds. Then the latch retracts, allowing free forward movement of the missile. When the missile has moved approximately 11 inches, the forward missile shoe contacts the rail retract trigger, causing the rail to retract. When the guide arm is empty, the fin-opener cranks reset in position for receiving another missile, the aft motion latch retracts, the forward motion latch extends and locks, the arming tool retracts, and the launcher returns to LOAD position. As the launcher returns to LOAD position to either the inner or outer ring, depending on the position of the hoist chain shifter the launcher rail extends. The launcher is then ready to accept the next missile.



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Figure 4-7.—Mk 13 launching system: Missile on launcher, hoist lowered below launcher, and blast door closing.

AUTOMATIC UNLOADING

Unloading may be ordered if the tactical situation changes and the weapons control station decides to stow the missile, or if the missile is a dud or a misfire and WCS decides to stow the missile for future servicing. The steps in unloading depend on the location of the missile at the time the decision is made to stow the missile. In the first situation, the missile may be on the launcher or it may be on its way. It would continue to finish the load cycle in normal operation and could be considered as on the launcher. In the second and third situations it is on the launcher but the conditions are not

the same. In the misfire, the arming device must be retracted; but the contactor and the fin-opener cranks do not have to be retracted, as they are already disengaged. In all situations the fins are manually folded after the fin cranks are disengaged. Folding the fins after the launcher has trained and elevated to the LOAD position may be difficult, but sometimes it is necessary to use that position. Remember the warning about danger from launcher movements. Place the firing safety switch on the EP-2 panel at SAFE (which breaks the power lines to the motors in the train, elevation, and launcher power units), remove the switch lever, manually fold the fins of the missile on the launcher, then return the switch lever to the panel and reposition the switch to close the motor circuits, and re-start the motors. Then depress the fins manually-folded switch, and automatic unloading resumes.

The missile has to be returned to the same ready-service ring from which it was taken. If the hoist chain positioner has been moved to the other ring, reposition it. In automatic unloading the chain shifter will automatically shift to the proper ring; The ready-service ring then rotates counterclockwise (CCW) to the empty cell position. Hydraulic control then shifts to the hoist, the blast door opens and extends the span track, and the hoist rises to intermediate position. The retractable rail extends when the hoist leaves the magazine. When the hoist reaches the launcher, the aft motion latch retracts and the hoist pawl engages the missile aft shoe. The hoist (with the missile) then retracts to the intermediate position. As soon as the hoist is below the launcher, the elevation positioner retracts into the guide arm, clear of the blast door, which then closes and retracts the span track. Beneath the blast door, the hoist moves from the intermediate position, where it separates the hoist pawl from the missile aft shoe, to the magazine.

During automatic load and unload the associated step control circuits are required to be open. The Mk 11 launching system cannot be unloaded in automatic control.

STEP CONTROL

During step operations, the control selector switch on the EP-2 panel is on STEP. This

breaks the automatic load and unload circuits, and prevents feed-back into the automatic circuit. Step operation is used for all exercise operations and if the automatic mode malfunctions. (Parts of exercise circuits and step control circuits are not the same.)

Strikedown, off-loading, and checkout procedures are also done in step control. The same equipment is used in both strikedown and offloading, but the procedures are reversed. The same switching conditions are used for both procedures. A slower speed is used during offloading. Reducing the air pressure that drives the air motor on launcher reduces the speed when transferring a missile from the launcher to the transfer dolly in off-loading. The pressure reduction prevents the chain from buckling when the chain engages the missile off the guide

arm. The weight of the missile and the steep angle of unloading would move the missile at too great a speed if it were not slowed down.

Figure 4-8 is a schematic of step operation of fin openers and contactors on the Mk 13 launching system. The step control switches on the EP-2 panel are manually actuated after the system is placed in step control. The broken lines in the drawing represent unload and exercise circuits; the solid lines are load circuits.

TARTAR DUD JETTISONING

The dud-jettisoning equipment for the Mk 11 and the Mk 13 Tartar launching systems differ in a number of important details, so they will be treated separately.

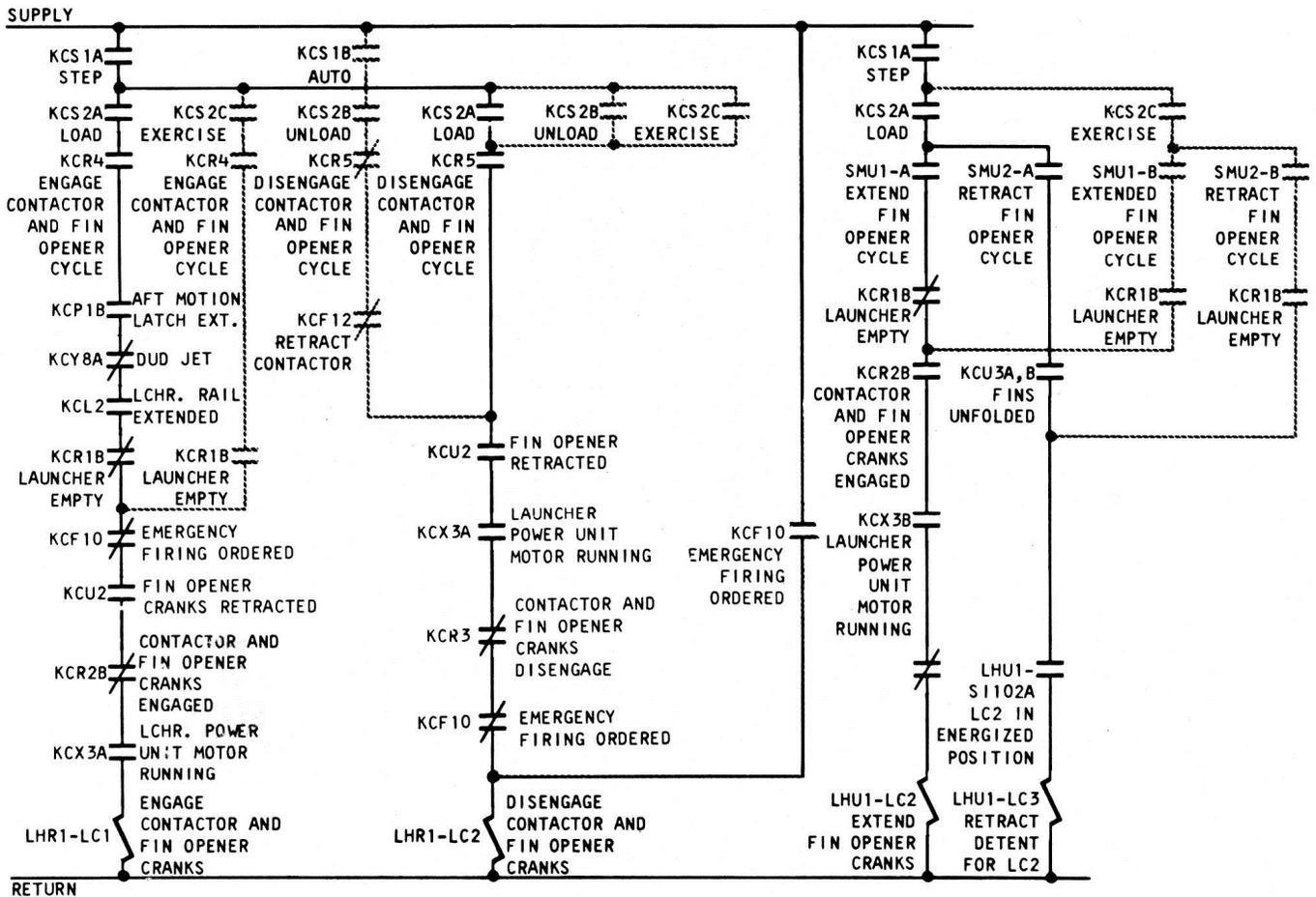


Figure 4-8.—Step operation of fin openers and contactor, load circuits, Mk 13 Mod 0 launching system.

Dud and Misfire Handling in the Mk 11 Launching System

The dud jettisoning unit, figure 4-9, jettisons defective missiles from the guide arms when the

tactical situation requires it or if the missile is unsafe for return to the magazine. The dud jettisoning unit consists of two ejectors, one for each guide arm, and a dud jettisoning control valve panel. The ejectors align with the aft end of the

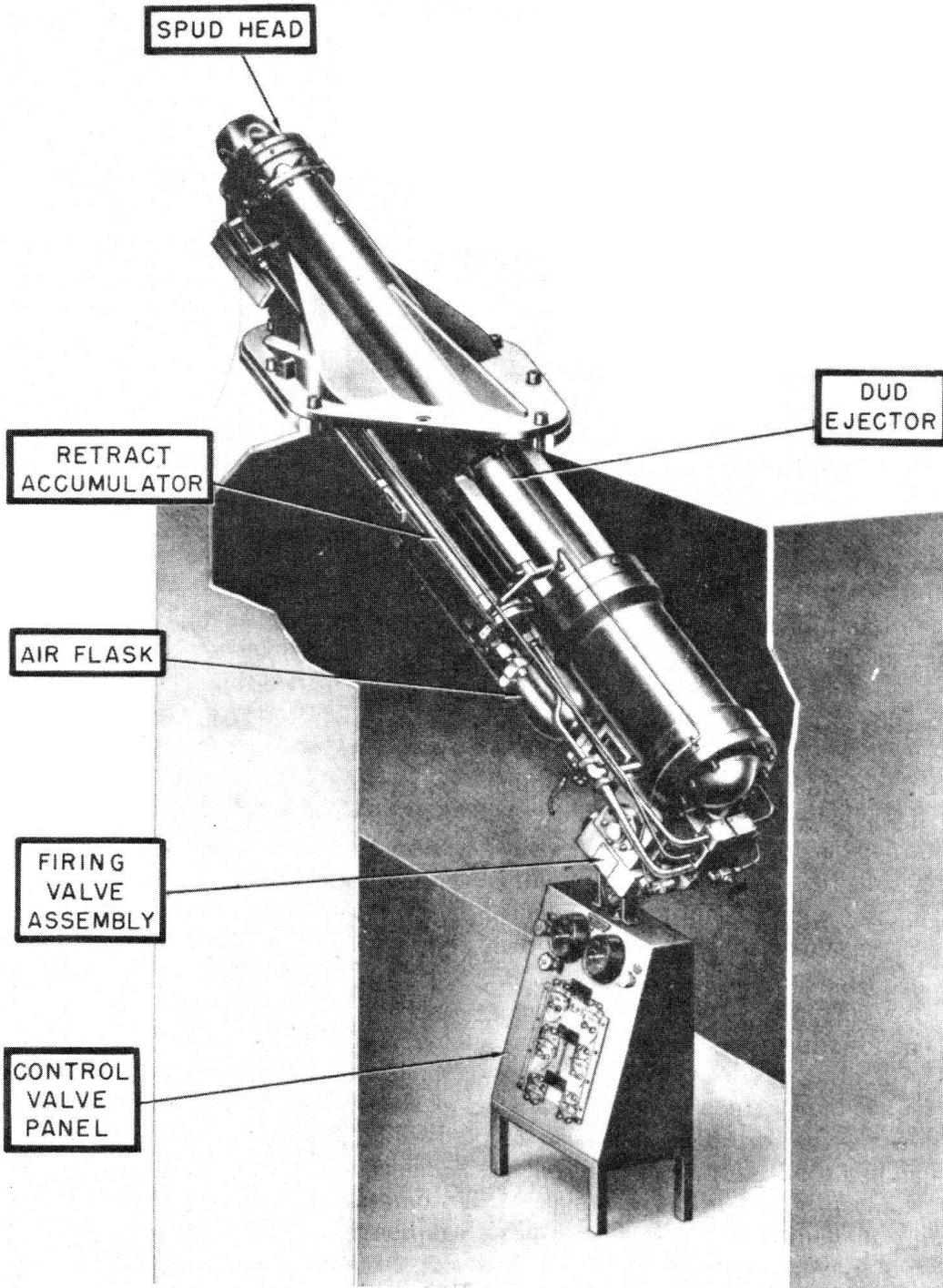


Figure 4-9.—Dud-jettison unit in position to ram, Mk 11 launching system.

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missile on the launcher when the launcher is moved to either dud jettison position. The ejector spud extends hydraulically to contact the missile. Air pressure from the accumulator, in conjunction with hydraulic pressure, acts on the ejector piston to move the spud forward and force the missile off the guide arm and overboard. The dud jettisoning unit can be operated either automatically or manually.

To jettison a missile, the launcher is trained and elevated to either the "A" or "B" dud jettison position, where the applicable guide arm aligns with a dud ejector unit. A spud attached to the booster piston, extends to contact the missile, then ejects the missile at sufficient velocity to clear the ship structure. The spud then retracts, and the launcher returns to a load position if missile firing is to be continued.

The dud ejector unit is controlled and operated by a combination of compressed air and hydraulic pressure. Pressurized hydraulic fluid controlled by pneumatic-hydraulic accumulators generates the fluid pressure. Low pressure air (100 psi) generates the hydraulic pressure to extend and retract the spud; high pressure air (2100 psi) generates the hydraulic pressure to eject the missile from the guide arm.

Dud and Misfire With the Mk 13 Launching System

The jettison device is identical in the Mk 13 Mods 0, 1, 2, and 3 except that in Mods 1 and 2 there is a nitrogen booster pump to aid in charging the jettison accumulator. It is mounted to the top of the inner structure inside the magazine assembly. It is manually operated.

The dud-jettisoning device in the Mk 13 launching system is in the launcher arm (fig. 4-10). It is a nitrogen-actuated piston that applies force to the aft face of the forward missile shoe. The piston is hydraulically retracted after jettisoning. It is controlled locally from the launcher control panel. When switch SMY1 (located on EP2 panel) is positioned to dud jettison local or remote and when the train positioner is retracted, the launcher will slew to a fixed dud jettison position. The difference between dud jettison local and dud jettison remote is that the fire control stable element is introduced into the launcher elevation control

system to compensate for the ship's pitch and roll when SMY1 is positioned to dud jettison remote. When the dud jettison push button is pressed, the jettison piston extends to jettison a missile. The following safety precautions apply during dud jettisoning.

WARNING: Make sure that communications have been established between the safety observer, and the launcher captain before jettisoning. Obtain permission from the weapons control station before jettisoning.

CAUTION: Do not attempt to jettison with less than 2000 psi nitrogen pressure.

Do not jettison when the ship is rolling excessively in the direction away from the anticipated path of the missile. Observe the inclinometer to determine the degree and direction of roll (local control only).

Operation of the jettisoning device consists of four steps: (1) positioning the launcher, (2) jettisoning, (3) retracting the piston, and (4) returning to a load position to resume launcher operations (re-extending the launcher rail).

The launcher must be positioned broadside, the launcher rail retracted, and the arming tool extended (forward motion latch lock retracted). In step control, the EP-2 operator initiates launcher rail retraction and extension of the arming device. If the control selector switch is on AUTO, these operations take place automatically. Setting the dud-jettison remote switch energizes the jettison relay to retract the launcher rail, extend the arming tool, and unlock the forward motion latch. The launcher moves to the jettison position, which is a 40° fixed-in-space position controlled by the stable element. In local control, the elevation position of the launcher guide is fixed relative to the deck of the ship. Observe the inclinometer near the EP-2 panel and do not jettison until the ship is on the downroll.

When the LAUNCHER SYNCHRONIZED light is on, depress the dud-jettison-extend pushbutton on the EP-2 panel. Since nitrogen pressure is always present inside the jettison piston, the piston creeps forward. As the piston creeps, the aft shoe of the missile forces the forward motion latch out of the way, and the dud-jettison pawls engage the missile forward shoe.

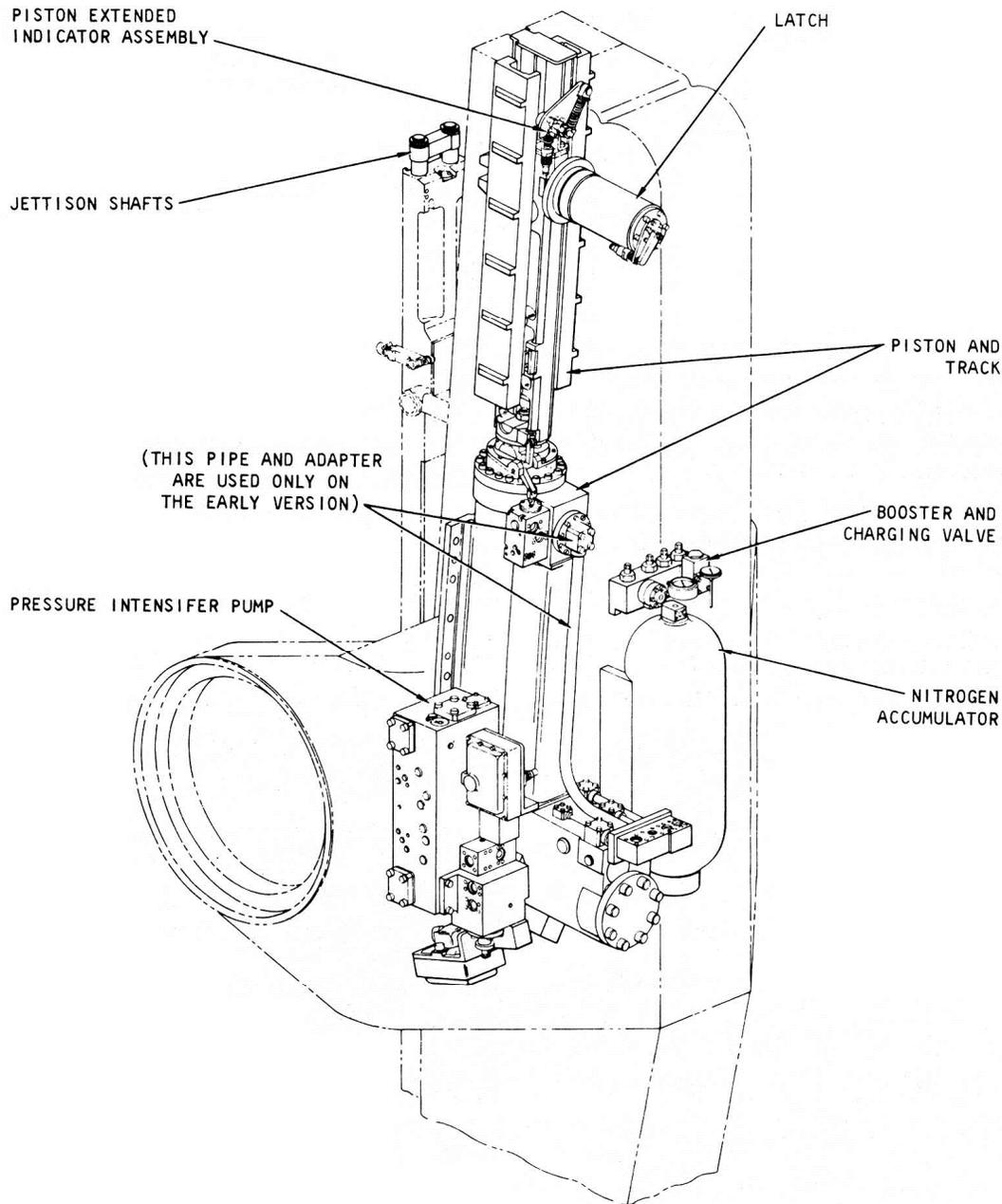


Figure 4-10.—Jettison device components in launcher arm, Mk 13 launching system.

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After the piston jettisons the missile, the jettison pushbutton light goes on, showing that the piston is extended. The next step is to retract the piston by depressing the dud-jettison-retract pushbutton, and the retractable-rail-retract button. After that, loading operations can be resumed.

When the jettison device is exercised (operated when the guide is empty), it operates

the same as when jettisoning except that the rate of travel of the piston is retarded while it is extending. If it were not retarded when not loaded with a missile, damage to the equipment would result. The throttle valve and the main check valve control the speed by restricting the passage of hydraulic fluid from the front side to the back of the jettisoning piston land. During jettisoning, the main check valve lifts, permitting

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the hydraulic fluid to flow to the back of the piston land and accelerating the piston to eject the missile. Two seals near the forward end of the piston spud prevent leakage of the nitrogen pressure, and thus prevent mixing of the hydraulic fluid and the nitrogen.

The OP for the equipment contains schematics, circuit diagrams, and detailed illustrations of the parts of the jettisoning equipment. In order to be able to make repairs and adjustments, you need to have a grasp of what happens inside the equipment when you push a certain button on the control panel. Study the OP for the system you have aboard. On the schematics, trace through the actions as they are described in the OP.

The nitrogen booster pump used with the jettison device of Launching Systems Mk 13 aids

in charging the jettison accumulator. This pump is mounted to the top of the inner structure inside the magazine assembly. It is a manually operated pump (fig. 4-11) that boosts the pressure of the nitrogen supply system. When the jettison tank is to be recharged and the pressure is found to be low, run a temporary line from the discharge port of the nitrogen booster pump to the nitrogen-charging valve block for the jettison accumulator tank. The nitrogen line that connects to the adapter block (supply connection) is a permanent one. Opening the supply valve when the handle of the booster pump is in stow position permits nitrogen to flow until pressure stabilizes. If the pressure then is less than that required by the jettison device, turn the pump handle to the pressure (PRESS.) position. This permits nitrogen from the supply area

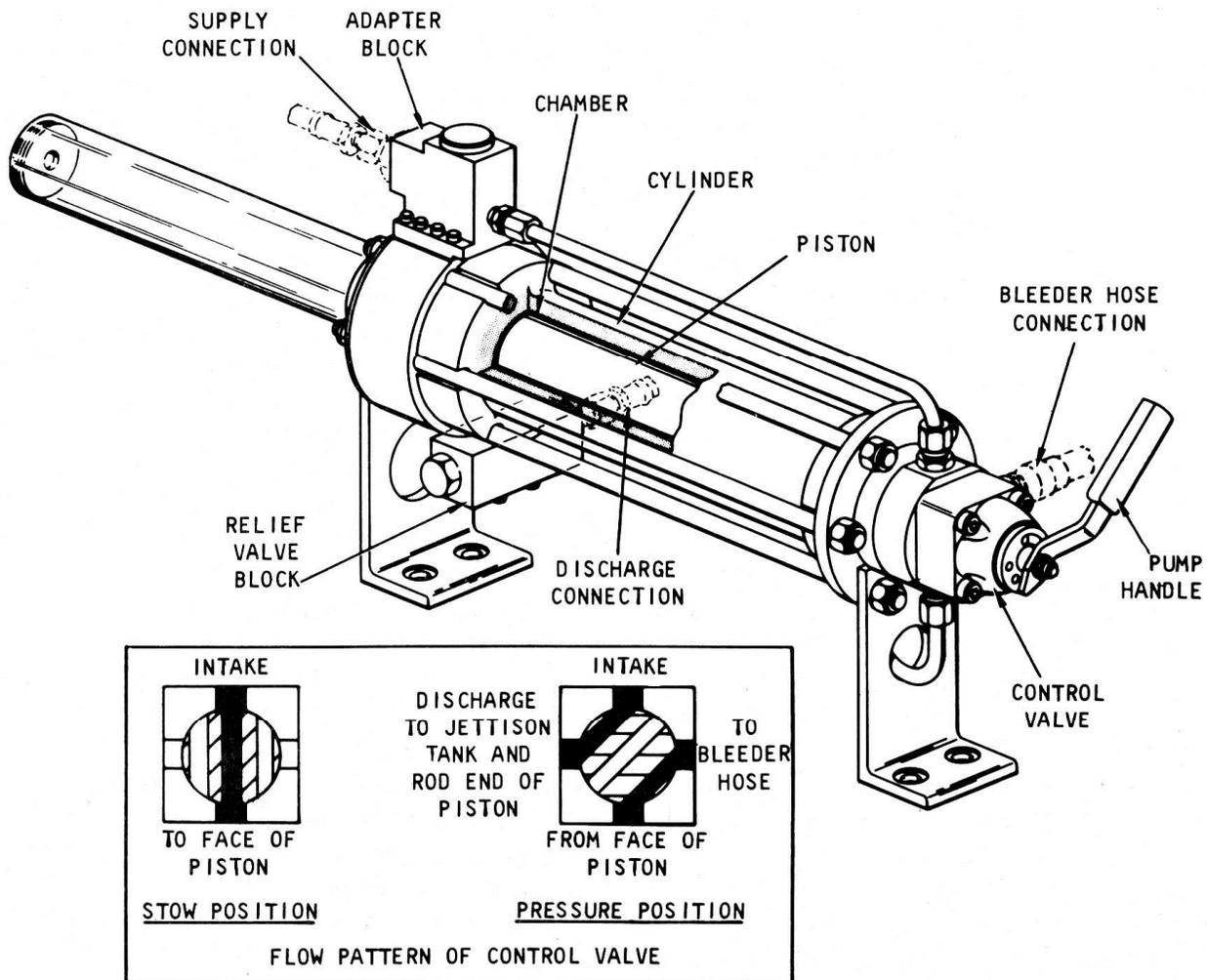


Figure 4-11.—Nitrogen booster pump assembly for jettison device.

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to push against the piston head, forcing back and permitting nitrogen to flow to the jettison accumulator and increase the pressure. When the piston is fully extended, move the pump handle to the stow position. In this position, nitrogen on the face of the piston escapes to the atmosphere and nitrogen pressure on the back of the piston forces it to its former position. Continue stroking the piston by moving the handle as above until the required pressure is reached. A safety valve prevents excessive buildup of pressure.

MAINTENANCE AND REPAIR OF JETTISON DEVICE.-The nitrogen pressure in the jettison accumulator tank should be checked every week, and the tank recharged as necessary. The nitrogen charging assembly, located in the righthand yoke of the launcher guide, is reached by opening the hinged access door with the special tool provided.

WARNING: Before doing any work on the launcher, remove the firing safety switch handle from the EP-2 panel so the launcher cannot be activated inadvertently.

The pressure required varies with the temperature and depends on whether the jettison piston is retracted or extended. There should be a table posted on the inside of the access door; but if there isn't, refer to the table in the OP. If the nitrogen pressure is normal (within 15 psi of required pressure), be sure all the valves are positioned for system operation and nitrogen plug is firmly secured. Then close and secure the access door and return the firing safety switch handle to the EP-2 panel. However, if the pressure is not within limits, proceed to charge or bleed the tank to the required pressure. Follow the instruction in Navord PMS/SMS 2665 volume 2. Be sure the launcher is inactivated by removing the handle of the firing safety switch from the EP-2 panel. The method of charging differs with the source of the available nitrogen supply: 3500 psi, 2200 psi, or 2015 psi (70°F).

In addition to weekly checking of the pressure, once every two weeks cycle the jettison device to keep the lubricants distributed and to detect (and correct) any malfunction. At the same time check the jettison device for sign of corrosion.

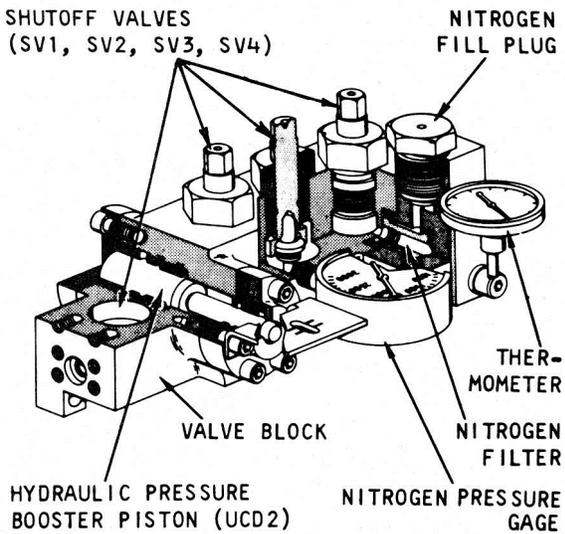
WARNING. If the nitrogen tank must be disconnected for repair work, first vent nitrogen to the atmosphere by opening SV 4, SV3, SV2, and SV1 (fig. 4-12).

The HYDRAULIC FLUID LEVEL in the jettison booster piston also must be checked daily. This cannot be done with the launcher system inactivated, so you do not remove the safety switch handle. Instead, station a safety man at the EP-2 panel to make sure that the train and/or elevation power drives are not J started. The hydraulic booster assembly is located in the nitrogen-charging valve block (fig. 4-12A), and is reached by the same access door in the launcher guide. The hydraulic pressure sight gage (fig. 4-12B) is marked with red lines to indicate the recharging area. If the indicator (rod end of the booster piston) can be seen in the marked area; the fluid level is unsatisfactory and recharging is necessary. Follow the instructions in the OP for the launching system. When preparing a checklist you need the correct designation for each pushbutton, switch, and valve to be used. In figure 4-12, valves SV 1, SV2, SV3, and SV4 are shown for the Mk 13 Mod 0 launching system

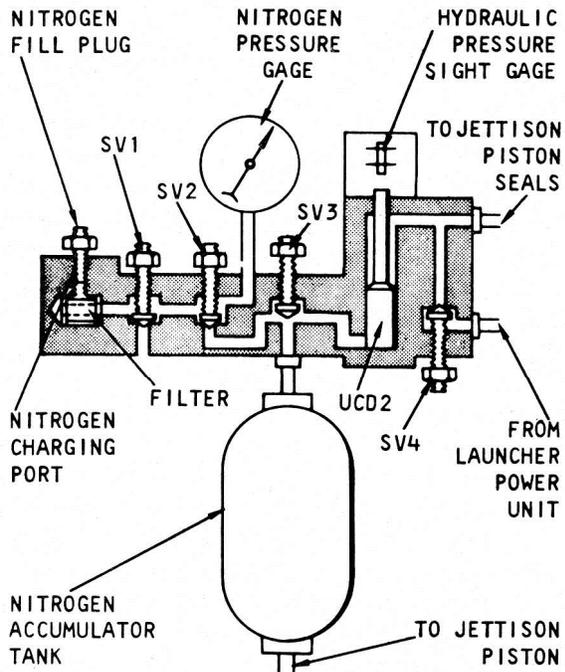
MISFIRE.-If the rocket motor fails to ignite when the missile-firing relay is energized, the firing relay remains energized and gives a misfire indication on the EP-2 panel, and in weapons control. The misfire light remains on until the missile is cleared from the rail, whether by dud-jettisoning, emergency firing, or unloading. The course of action will be determined by ship's doctrine, and the situation. In practice sessions, the missile is unloaded and stowed for repair, or, if it is dangerous, it is jettisoned. Under combat conditions the Dud/Emergency Firing Key may be used to clear the rail quickly and with some chance of a tactical launching resulting.

The Dud/Emergency Firing key is pressed in weapons control. If the missile still does not fire, another circuit energizes and starts contactor retraction and missile arming. After a brief delay, the rocket squibs fire, regardless of the contactor position.

The daily operation of the equipment, using a training missile, includes checking of Normal firing and misfire, and Normal firing resulting in a dud. Firing of a dud and emergency firing, using the Dud/Emergency Firing key, are tested



VIEW A



VIEW B

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Figure 4-12.—Nitrogen-charging valve block and booster for jettison device on Mk 13 launching system.

weekly. In any testing of circuits, be sure that switch SMW2 on the EPI panel is on EXERCISE, so that no missiles in the magazine will be put on warmup. Tartar Dud Jettisoning Slug Mk 1 Mod 0 is used to test the operability of the dud jettison device. Emergency firing is tested with a training missile in three phases: for normal firing conditions to simulate an attempted firing; with the training missile set for dud; and with the training missile set for dud but with the electrical contactor extended. The operator of the EP2 panel notes the sequence of action in each case by the lights on his panel. The correct sequence is given in the OP.

Timing tests are made at 3-month intervals. . To test the timing of the jettison device, use a stop watch and record the time it takes for the jettison piston to retract. The allowable time is 20 seconds after depressing the Dud Jettison RETRACT pushbutton. No missile is on the guide arm for this test. The conditions of the test are simple; they are the OP.

Once a year the jettison device is serviced by : draining any seepage of hydraulic fluid. The drain plug is at the base of the jettison cylinder. Before attempting to do this, the nitrogen in the accumulator tank must be vented to the atmosphere. This nitrogen is under 2400 psi pressure. Open SV1 and SV2 (fig. 4-12) on the nitrogen-charging valve assembly. After cleaning up the seepage and replacing the drain plug, the accumulator must be recharged, the same as in daily maintenance procedures.

Use only compressed nitrogen gas to charge accumulator flask bladders. Never charge with oxygen or compressed air. A mixture of oxygen and hydraulic fluid is extremely explosive.

NOTE: Since nitrogen and oxygen are both furnished in metal cylinders, use extreme caution to avoid taking the wrong cylinder by mistake. An oxygen cylinder is green colored; a nitrogen cylinder is gray colored with one or two black bands near the top.

Mk 22 Launcher Dud-Jettison System

The dud-jettison device in the Mk 22 launching system is in its guide arm (it has only one). The complete description of its operation is given in OP 3115 volume 2, *Guided Missile*

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Launching System Mk 22 Mod 0, Magazine Launcher Miscellaneous Subsystems. If normal firing was ordered on an Auto-Load cycle and the missile does not leave the rail, a light on the EP2 panel gives a dud indication. If the missile firing relay energizes but the missile does not fire, a misfire indication appears on the EP2 panel. WCS must then decide whether to jettison the missile or return it to the magazine for later rework. If the decision is to jettison, the EP2 operator turns SMY1 to Remote Dud Jettison. The remote-jettison sequence automatically disengages the contactor and the fin-opener cranks, extends the arming device, and unlocks the forward motion latch, if these actions did not take place during the Auto-Load sequence as they should have. The retract-launcher-rail cycle then starts. When the Launcher Synchronized Light goes on, indicating that the launcher has trained and elevated to the jettison position, the EP2 operator pushes the JETTISON pushbutton and the jettison piston ejects the missile overboard. The aft motion latch retracts, and when the JETTISON light turns steady, the EP2 operator pushes the Jettison RETRACT button. While the jettison piston retracts, the operator returns switch SMY1 to REMOTE.

Loss of launcher synchronization breaks the firing circuit. If the period of loss is short, the firing sequence resumes from the point of interruption, but if synchronization is lost for some time, the missile may have to be fired as a dud or misfire. The internal power supply of the missile is reduced rapidly once it is activated, so if the missile is not fired quickly, its range may be greatly reduced. In each case, Weapons Control will decide how to dispose of the missile. If possible, the missile will be returned to the magazine, marked as a dud, to be repaired later. The emergency firing circuit has a power supply independent of the normal firing circuit; it is resorted to in a tactical situation when a dud or misfire missile must be disposed of. The Dud/ Emergency key in the Weapons Control Station is closed in a second attempt to activate the APS squibs in the missile. If this does not clear the rail, the dud firing circuit switches to the emergency firing circuit. If the failure was in the contactor retract circuit, and the contactor did not retract, this method of firing will damage the contactor pad, and therefore it is used only as a

last resort if the missile endangers the ship or its personnel.

Time intervals mentioned actually are very short. From the moment the Dud/Emergency Firing Key is pressed until the rocket motor ignites and launches the missile is less than two seconds.

LOADING ASROC MISSILES

Loading the Asroc missile from the magazine of the Terrier Mk 10 Mod 7 launching system is similar to loading Terrier missiles but has a few different steps. If the decision is made to use an Asroc weapon (torpedo or depth charge form), the ASROC MODE switch on the EP-2 panel is pushed upon orders from Weapons Control, to change the launching system to the Asroc mode of operation. Automatic control is used except for exercise, testing, or in an emergency. The indicating lights on the EP2 panel show the steps taking place in the loading operation.

In the assembly area, motor fins are attached to the Asroc. The missile fin assemblymen assist the motor fin assemblymen, as there are no missile fins on the Asroc. The snubbers on the Asroc adapter rails have to be retracted and secured, after firing. The ready service ring tray does not shift from hoist to ring after bringing the missile to the assembly area, as it does with Terrier, because the adapter tray must first be returned to it, which is done after the Asroc is launched.

The type of Asroc missile must be visually identified when it arrives in the assembly area. If it is not the one ordered, it must be returned to the magazine and the correct one brought up. The circuit to identify the missile in the adapter is energized through the loader pawl warmup contactor. This causes the identification light to blink on the EP-4 or EP-5 panel and the operator can notify WCS and the EP-2 operator.

When the Asroc is at assembly, the Asroc arming tool is energized. (There is another arming tool for Terrier.) If the missile is a Y-type, the Y stop keylock switch must be positioned to LOAD, or the blast doors will not open to permit loading the launcher. When the missile is on the launcher, the arming tool winds and retracts, and this opens the snubbers on the

adapter rail. The missile battery is then activated, and the battery ignites the motor.

Although the Asroc does not have an APS (auxiliary hot-gas power generation system), the missile activation indication is supplied to the Asroc relay transmitter and is required by Asroc fire control before it supplies the Asroc missile ready indication on the panel. However, as mentioned before, an Asroc failure on the launcher is very unlikely.

When enough thrust has developed, the Asroc travels the length of the adapter rail into ballistic flight. After firing, the adapter rail is then returned to the magazine tray in an unload sequence. When it arrives in the assembly area on its return trip, the snubbers must be closed manually (with the aid of special tools). A new umbilical cable will need to be inserted in the adapter, and this is done in the checkout area. This may be done later, depending on tactical circumstances.

Care of Cable Assemblies

The umbilical Cable Mk 10 provides the necessary electrical connection between the adapter and the Asroc missile. Each time an Asroc missile is launched from an adapter, the umbilical cable must be removed and replaced with a new cable. The replacement cables are supplied with the replacement missiles. The cables are enclosed in a dust cover (fig. 4-13). Do not remove the dust covers from Cable Mk 10 until just before installing the cable.

Remove the cable cover by loosening the locking studs (fig. 4-13A) with a snubber cam wrench. Lift the forward end of the cover upward, and slip the after end of the cover free of the cover retainer bar. Remove the expended cable by disconnecting the cable connectors at the after end and disengaging the missile retractor-connector from its support. The location of the cable is shown in figure 4-13 B on the after handling shoe support. The new cable is placed in the trough of the after handling shoe support and the cable connectors are attached to the adapter wiring connectors.

Cable assemblies frequently are damaged while being connected or disconnected. The keyways must be properly aligned; proceed carefully when connecting the cable plug to the ISA

(Ignition Separation Assembly) receptacle to avoid breaking or bending the receptacle pins. Lubricate the rubber ring on the receptacle and inspect the seating surfaces. Consult the OP or the SWOP for the correct lubricant. If the rubber ring has raised out of the groove, it prevents proper plug latching or positive electrical connection of the cable assembly. This work is done in the checkout area when loading an Asroc missile into the adapter before loading it into the magazine.

Loading Depth Charges

Before loading depth charges into the launcher, remove all four tapes so the depth charge will operate properly. The tapes, with lead foil barrier, are placed over the hydrostatic ports of the depth charge fuze to prevent entry of dirt, etc. The tape is not a safety device. The red streamers attached to the tape are merely a reminder to remove the tapes.

As the Rocket Thrown Depth Charge Mk 2 is shorter than the torpedo configuration and somewhat larger in diameter, the magazine trays have to be adjusted. Side and bottom snubbers in the adapter prevent lateral movement of the missile; a missile-restraining mechanism prevents fore-and-aft motion.

When the Asroc is fired, as the arming tool winds it triggers the release of the snubbers. It requires approximately 2000 pounds of thrust to cause the forward restraining latch to release. A positive stop on the launcher guide arm holds the adapter rail so it is not fired with the missile. The blast doors will not open for the Y-type missile until the Y stop key-lock switch is positioned to LOAD. When the missile is on the launcher and the missile type indications appear on the EP-2 panel and the attack console panel, the operator of the attack console panel immediately checks out the missile.

As the depth charge is larger in diameter than the torpedo configuration of Asroc, inserts are not needed in the adapter rail when the depth charge is to be loaded.

The steps in loading an Asroc into the adapter must be followed exactly. Be sure to stand clear of the snubbers when they are being unlocked before placing the missile on the adapter. In the

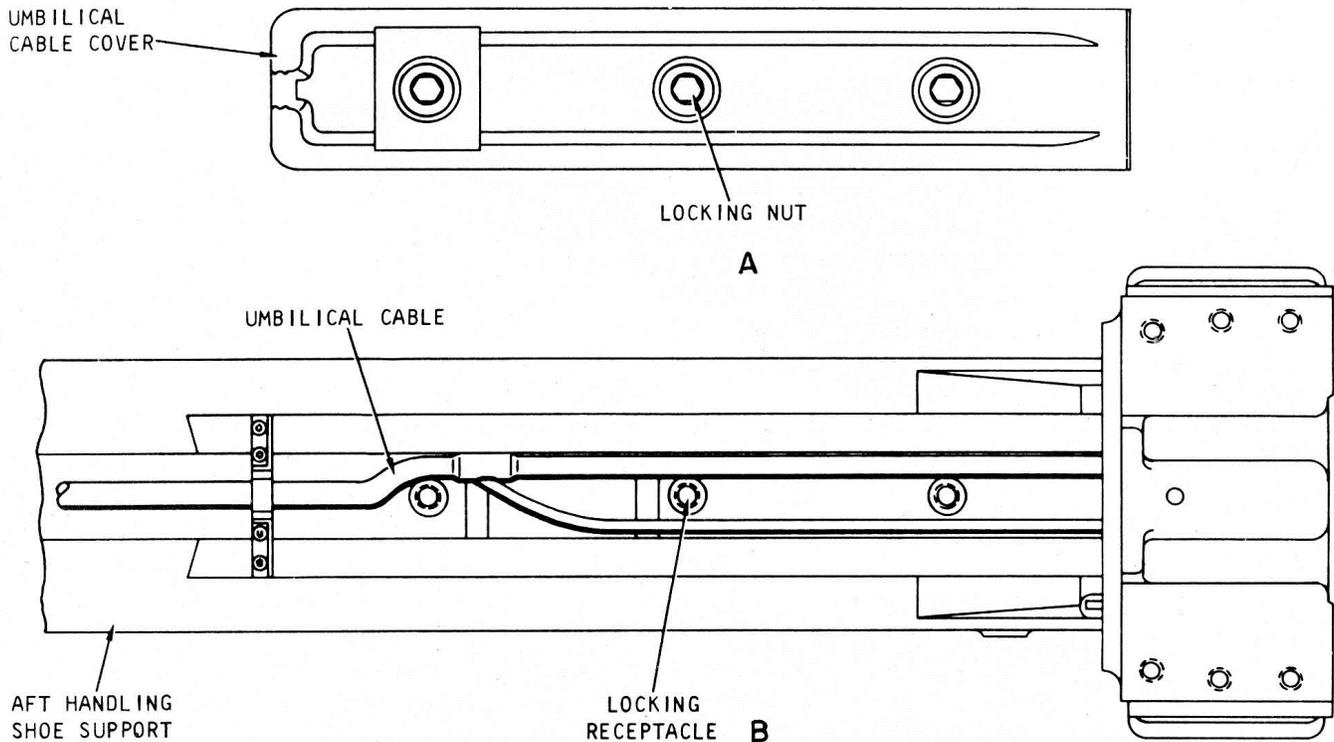


Figure 4-13.—Umbilical cable for Asroc missile: A. Umbilical cable cover; B. Location of umbilical cable on aft handling shoe support.

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launch cycle, the snubbers are operated hydraulically, but they have to be released or closed with a special wrench when the Asroc is being loaded (or unloaded) into the adapter.

UNLOADING ASROC MISSILES

To return the Asroc to the magazine or to the assembly area, automatic unloading may be used. After each firing of an Asroc, the adapter must be unloaded before another missile can be brought up and placed on the launcher. If there are any weapons in the assembly area, they must be unloaded before a weapon or an adapter can be brought back from the launcher. The assemblymen must remove and store the fins or fold the fins of the weapons in the assembly area before giving the signal to return the missiles to the magazine. When the assembly area is clear, the EP-2 operator can proceed to return the missile (or the adapter) that is on the launcher guide arm.

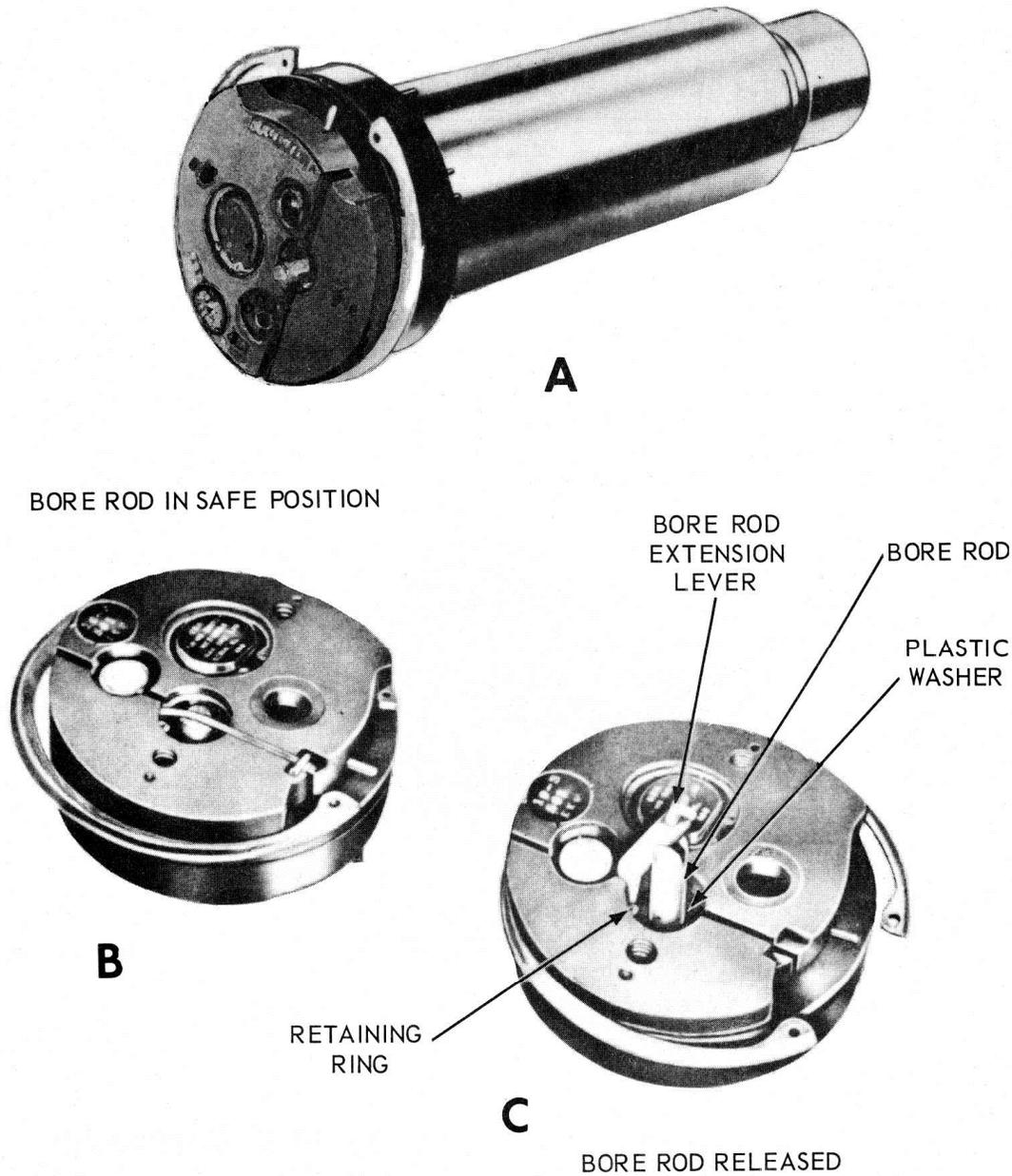
Unloading the Asroc Torpedo

The Asroc with a torpedo warhead uses a torpedo exploder, which must be in the safe position when the missile is in the magazine, or the assembly area, and until it is to be fired. It must be returned to the safe position before it can be unloaded. Figure 4-14 shows one type of exploder. Follow the instructions in the OP for the exploder that is on your missile. It must be safed before the missile can be returned to the magazine or the check-out area.

Unloading Depth Charges

Before starting unloading operations for an Asroc Depth Charge, verify that the Safety Plug P1 is on the Launcher Captain's control panel and is not inserted. It may be kept in the custody of the ASW officer or it may be locked in a dummy receptacle on the panel. The depth charge is disarmed by installing the thrust

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Figure 4-14.—Torpedo Exploder Mk 19: A. Assembled exploder; B. Safe position of bore rod; C. Unsafe position of bore rod.

neutralizer (fig. 4-15A) on the missile. Note that a special wrench is used. Do not tighten the screws too much, or the pins in the nozzle plate may be sheared off. The torque requirement is 100 ± 25 foot pounds.

If the power supply (fig. 4-15B) is to be removed from the depth charge (and this is not always the policy), replace it with the blanking plate (fig. 4-15C) and seal which had been removed from it and placed in storage. If the

depth charge is being returned to the ready service ring in the Mk I 0 Mod 7 or 8 Terrier system, the only change involved is the removal of the fins as the missile halts in the assembly area. If the missile is to be off-loaded, have the container placed in position on deck so the missile can be lowered into it with the trolley hoist, without striking or bumping the missile. Attach the container ground wire to the thrust

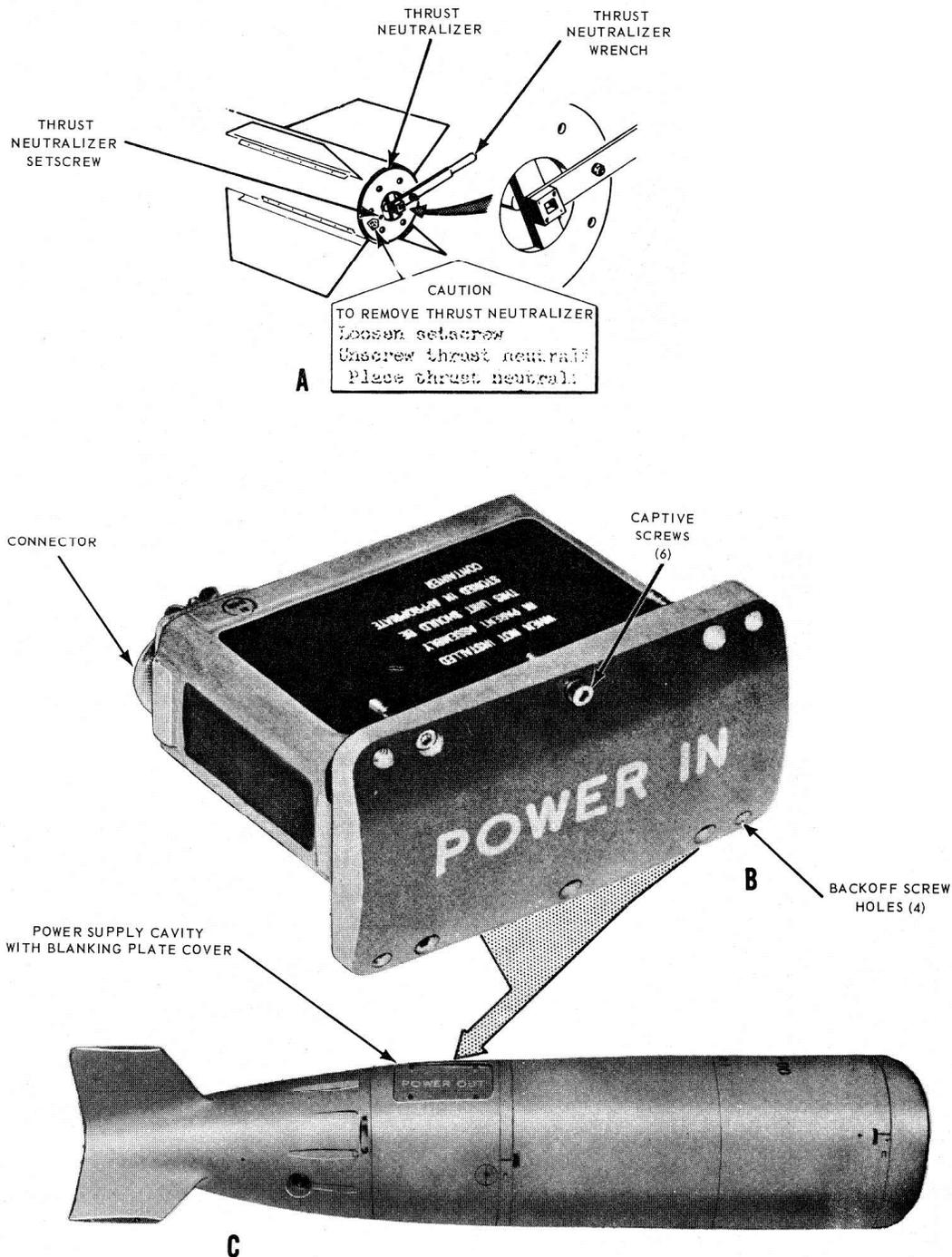


Figure 4-15.—Safing devices restored to Asroc weapon when unloaded: A. Thrust neutralizer; B. Power supply with cover; C. Asroc Depth Charge, showing blanking plate cover placed over power supply cavity.

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neutralizer (fig. 4-16) before disconnecting the hoist from the missile. The ground strap receptacle to which the wire is to be attached is on the neutralizer and should NOT be removed at any time. Secure the missile in its container so it cannot shift. As a GMM 1 or C you may be supervising and directing the work of unloading

and packaging the missile or you may be operating the launcher captain's panel.

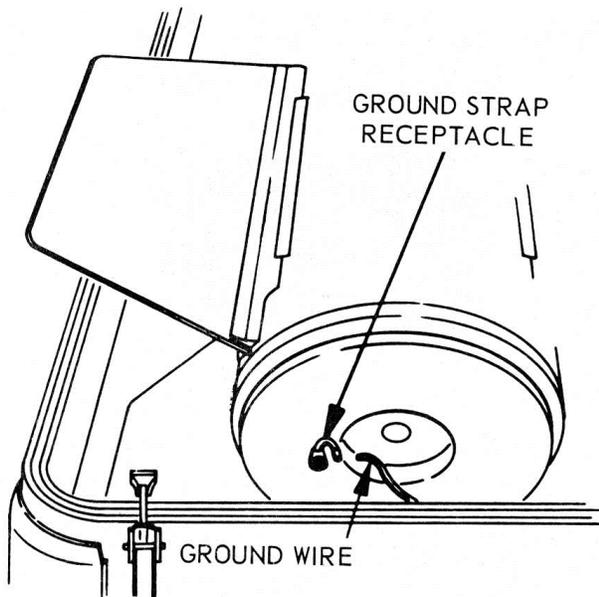
ASROC DUDS AND MISFIRES

As described earlier in this chapter, an Asroc dud or misfire is handled by the Mk 10 Mod 7 or 8

system in the same manner as a Terrier dud or misfire. The methods of safing the torpedo and the depth charge forms are different.

Depth Charge Mk 17

The missile configuration that carries the depth charge payload is designated as Rocket-Thrown Depth Charge Mk 2. If a dud or restrained firing occurs, notify the ASW officer. He will decide whether to return the missile to the magazine or to package it into a container and return it to a depot for repair. A dud is stowed, inspected and repaired later. You will check the missile and the warhead. The missiles in the other trays of the magazine may be used to continue the firing exercise (or in action). If a misfire signal shows on the launcher captain's control panel and/or the attack console, you must safe the depth charge at once, before it is removed from the launcher. The nuclear weapons officer must decide, in accordance with rules established for these weapons, what to do with it. After the weapon has been safed, proceed with unloading according to the checklist, observing all the safety precautions. If the weapon is to be off-loaded you will need to have a missile container for it, and two Hand Lift



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Figure 4-16.—Thrust neutralizer ground connection to container.

Trucks Mk 41 or Mk 42. If your ship does not carry these, you have to store the missile, order the missile container, the hand trucks, and other needed material, and when these arrive, unload the missile into the container. You will need thrust neutralizers and ISA shorting plugs, but these are normally carried on the ship; check the supply and order replacements if necessary. The thrust neutralizer and shorting plug (fig. 4-15) were removed when the missile was stowed during replenishment. The blanking plate and power supply seal were placed in stores at the time they were removed when the depth charge was loaded into the magazine. These are drawn from stores and reused when the power supply is removed from the depth charge.

Few ships have GMTs aboard; you need to know how to safe the depth charge. Depth charge safing (disarming) consists of resetting the ARM/SAFE switch to the SAFE position and removing the power supply (fig. 4-15B). Use the checkoff list from SWOP W44.34.1 and follow it precisely.

Asroc Torpedo

There is no provision for jettisoning the Rocket-Thrown Torpedo Mk 3. If, upon attempting to fire the torpedo, the DUD light goes on, auxiliary firing may be tried, or the missile can be returned to the magazine to be inspected and repaired later. It might be unloaded into a container and returned to a depot for repair.

To remove the dud or misfire missile to a shipping container, follow the checkoff list for unloading.

Safing the Asroc for Unloading

Asroc torpedoes must be returned to a tender; or deport every 6 to 12 months for maintenance procedures, and therefore must be unloaded from the cell. If a warshot torpedo has to be unloaded, the position of the torpedo exploder (fig. 4-14A) must be checked before the torpedo can be moved. (Torpedo exploders may also be installed in exercise heads to give an electrical "hit" signal.) The exploder bore rod must be in the cocked depressed position (fig. 4-14B); if it has moved (fig. 4-14C), it must be sterilized by

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turning the sterilizing switch (fig. 4-17). To reach the switch, break the foil seal in the top of the exploder, then turn the itch 90 degrees in either direction by using a screwdriver. This short circuits the exploder power supply. (The arming device is the part of the exploder that

contains the explosive, and must be handled with great care. Spares are packaged and shipped separately, not assembled in the exploder.) All exploders must be considered armed if the bore rod has released. If you have to offload a warshot torpedo and the bore rod on the exploder is

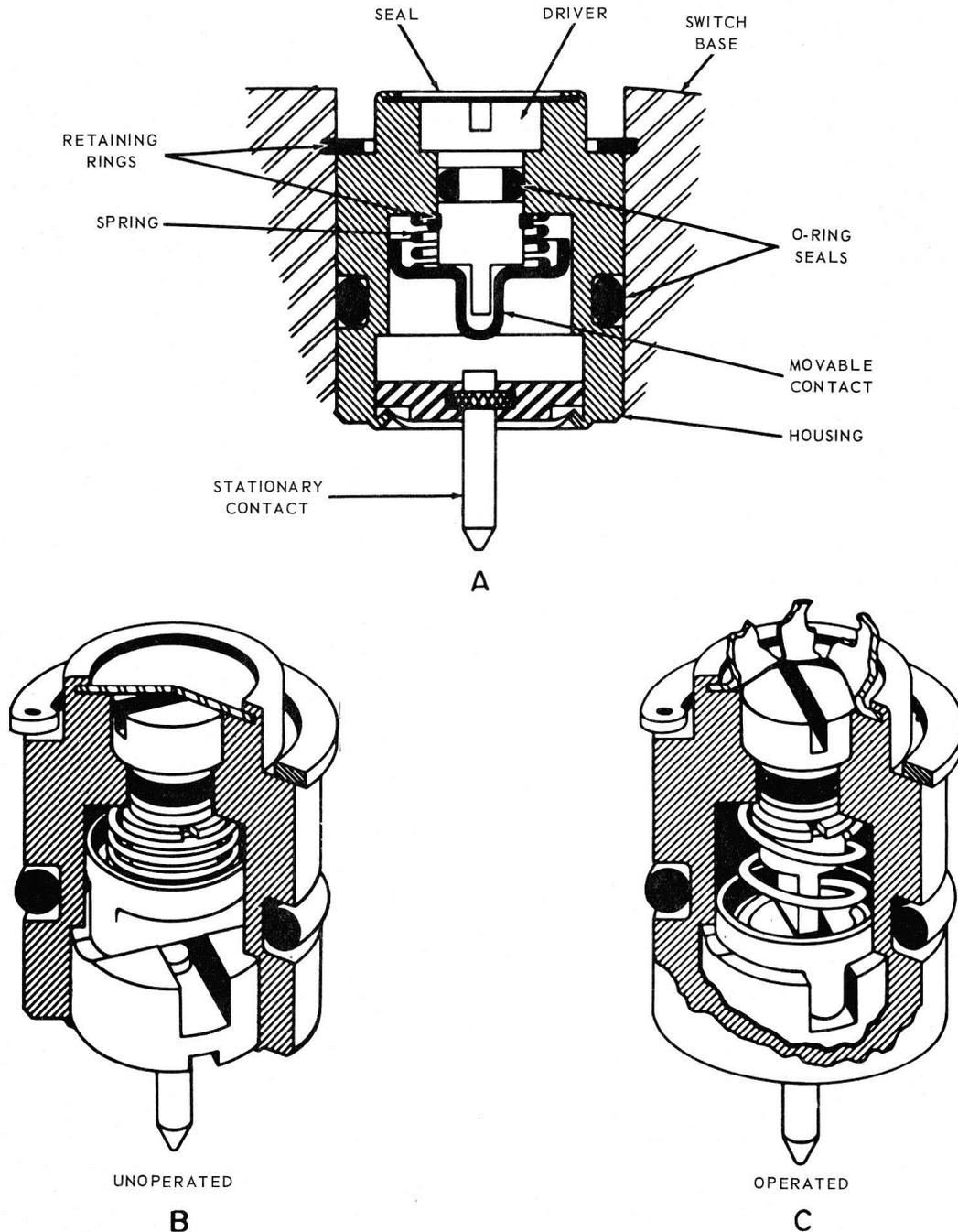


Figure 4-17.—Sterilizing Switch Mk 1 Mod 0: A. Sectional view; B. Unoperated; C. Operated (foil seal broken, switch turned).

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released, sterilize the exploder before moving the torpedo. Once the sterilizing switch has been used, the exploder is useless for firing until a new sterilizing switch is installed (at overhaul). The exploder is removed from the torpedo after it is unloaded from the launcher. Details of different mods of the exploder vary; Exploder Mk 19 Mod 12, for example (used with Asroc), does not have a floor switch, but has a ceiling switch and sterilizer switch. Some mods do not have the bore rod extension lever shown in figure 4-14C. The Mod 12 has a double-acting type of bore rod, with a bore rod latch to lock it in the cocked position. On dummy training missiles, inspection of the exploder bore rod is not necessary, but operation of the depth charge Arm/Safe switch (when the missile is on the launcher) is required for training purposes. Removal and replacement of the thrust neutralizer is also practiced on dummy training missiles. You are not likely to have a dummy training missile on board a firing ship, but will have exercise torpedoes.

SUMMARY

Loading, used in this chapter to mean the placing of missiles on the launcher in preparation

for firing, is described in automatic and in step control for each of the types of missiles currently used by the Navy. When everything works perfectly, loading of missiles (with the possible exception of Asroc) consists chiefly of pushing the right buttons in the right sequence. However, the GMM 1 and C must be prepared to locate and correct trouble in the intricate complex of the weapon system. The chapter points out differences between systems. Study the OP of the system you have aboard to acquire detailed knowledge of the mechanical, electrical, pneumatic, and hydraulic operating components of the system. Locating the trouble is a big step in the maintenance of a missile launching system.

The method of disposing of missiles that fail to fire is given with considerable detail for the different missile systems. A missile is too big and expensive an item to be discarded lightly; it must be saved and repaired if possible. (Repair of the missile is usually done at depots.)

At all times, safety rules must be remembered and enforced. You are expected to be, ready to risk your life in battle; but do not throwaway your life, or that of any of your men, by neglect of safety precautions.