TM 9-2350-300-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S MANUAL

FOR

GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED

20-MM, M163

(2350-00-999-4392)

This copy is a reprint which includes current pages from Changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY

MARCH 1971

WARNING

MONOXIDE POISONING CAN BE DEADLY

Monoxide is a colorless, odorless, DEADLY POISONOUS gas which, when breathed, deprives the body of oxygen and causes SUFFOCATION. Exposure to air contaminated with monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, coma. Permanent BRAIN DAMAGE or DEATH can result from severe exposure.

It occurs in the exhaust fumes of fuel-burning heaters and internal-combustion engines and becomes DANGEROUSLY CONCENTRATED under conditions of INADEQUATE VENTILATION. The following precautions MUST be observed to ensure the safety of personnel whenever the personnel heater, main, or auxiliary engine of any vehicle is operated for maintenance purposes or tactical use.

a. DO NOT operate heater or engine of vehicle in an enclosed area unless it is ADEQUATELY VENTILATED.

b. DO NOT idle engine for long periods without maintaining ADEQUATE VENTILATION in personnel compartment.

c. DO NOT drive any vehicle with inspection plates, cover plates, or power plant compartment doors removed, unless necessary for maintenance purposes.

d. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected personnel from vehicle and treat as follows: expose to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, administer artificial respiration.

THE BEST DEFENSE AGAINST MONOXIDE POISONING IS ADEQUATE VENTILATION.

Danger, monoxide gas: Secure power plant access panels before starting engine.

Exhaust fumes are dangerous. Notify organizational maintenance personnel immediately if fumes are detected in personnel compartment.

Use only diesel fuel of proper grade in vehicle fuel compartment.

WARNING

HIGH VOLTAGE

is used in the operation
of this equipment

DEATH ON CONTACT

may result if personnel fail
to observe safety precautions.

The infrared power pack must be completely de-energized before the power cable is disconnected. The power cable must be installed in the periscope, not stowed before power is turned on. Failure to turn both the main light switch lever and infrared power pack switch to OFF positions before disconnecting the cable will result in arcing, which may cause injury to personnel and damage to equipment. Before disconnecting cable from periscope after use, wait 1 minute until residual charge in system has drained off and then immediately move cable from periscope to grounding plug on master switch panel and secure receptacle down. Do not under any circumstances touch end of cable when moving from one plug to another, because voltage of power pack exceeds 16,000 volts.

WARNING

LOW VOLTAGE ALSO CAN BE DANGEROUS

Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

WARNING

RADIATION HAZARD

There is a potential radiation hazard to personnel when the radar is energized. Personnel should not be within 3 feet in front of the radiating feedhorn (located in center of antenna dish, fig. 3-16) from which the beam is transmitted.

WARNING

RADAR ANTENNA

Do not at any time lean on or hang from antenna or installed boresight telescope. Remove boresight telescope prior to vehicle movement or firing.

WARNING

M168 CANNON

When using, servicing, or maintaining M168 cannon:
Always clear cannon before using, servicing, or maintaining.
Because of the possibility of a cook-off, never attempt to remove a chambered round until the weapon is cool enough to touch.
The weapon will be kept trained on the target and all personnel will stand clear of the barrels. When gun has been in action, clear gun before anyone moves in front of muzzle.

WARNING

VEHICLE DESTRUCTION

When destroying the vehicle by burning to prevent enemy use: Cover must be taken without delay, because an early explosion of the explosive ammunition (if present) may be caused by the fire. Due consideration should be given to the highly flammable nature of fuel and its vapor. Carelessness in its use may result in painful burns. The danger zone, if explosive ammunition is present, is approximately 500 years.
When destroying the vehicle by gunfire to prevent enemy use: At ranges of 500 yards or less, artillery should be fired from cover. Rifle grenades and antitank rockets should be fired from cover.

WARNING

REFUELING VEHICLE

When handling fuel, provide metallic contact between container and vehicle to prevent generation of static electricity, and observe all related safety rules.
Turn off all electrical switches before refueling vehicle.

WARNING

OPERATING VEHICLE

Alert all personnel in and around vehicle before lowering or raising ramp, if situation permits. Make certain ramp personnel door is closed and locked before operating ramp.
When driver's hatch cover is open, secure cover with hook to prevent injury to driver.

Do not extend any part of your body above hatch when mount is rotating.

Survey any damage to flotation pods prior to water operation. Assure that the flotation pod and mounting flanges are not damaged. During water operation, buoyant forces on a damaged mounting flange could cause the flotation pod to break loose.

Check to see that loose items are properly installed and tied down for proper load distribution before entering water.

Do not use tow cable when differential of disabled vehicle is disconnected. The disabled vehicle has no steering or brake control.

WARNING

CHASSIS BATTERIES

Do not handle ammunition in vehicle while chassis batteries are being serviced. Rounds will discharge if dropped onto the batteries.

Vapor from the battery electrolyte can be explosive. Do not permit smoking or open flames in the vicinity while servicing chassis batteries.

Do not drop tools onto the batteries. Severe arcing will result, with possible injury to personnel or damage to the batteries.

WARNING

SOLVENTS

Dry cleaning solvent or mineral spirits paint thinner is flammable and should not be used near an open flame. Fire extinguishers should be provided nearby when these materials are used. Use only in well ventilated places.

WARNING

GENERATOR SET (APU)

This equipment generates dangerous electrical power which can cause bodily injury if safety precautions are not observed. Ensure that both the auxiliary power unit (generator set) circuit breaker and vehicle MASTER SWITCH are in the OFF position before connecting or disconnecting the auxiliary power cable. Do not operate the auxiliary power unit until you are familiar with operating procedures set forth in TM 5-6115-323-15.

CAUTION

RADAR / MOUNT SERVO / RADIO INTERFERENCE

Do not transmit with radio RT-524 receiver-transmitter during active target tracking or engagement (para 2-27d (5)).

Reproduction for non-military use of the information or illustrations contained in this publication is not permitted. The policy for military use reproduction is established for the Army in AR 380-5, for the Navy and Marine Corps in OPNAVINST 5510.1B, and for the Air Force in Air Force Regulation 205-1.

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE

On a changed page, the portion of the text affected by the latest change is indicated by a vertical line or other change symbol, in the outer margin of the page.

Total number of pages in this manual is 107 consisting of the following:

Page No.	* *Change No.*	*Page No.*	* *Change No.*
Cover	0	2-65—2-72	1
Cover (Warning)	0	2-73—2-76	3
Warning	2	2-77—2-82	1
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1-1—1-2	3	2-84.2 blank	3
1-2.1	2	2-85—2-96	1
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1-5—1-10	0	2-98.1—2-98.2	3
1-11—1-12	2	2-99—2-100	1
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1-31—1-34	0	3-1—3-2	3
2-1—2-3	3	3-3—3-4	1
2-5—2-40	1	3-5—3-15	3
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* Zero in this column indicates an original page

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TECHNICAL MANUAL
No. 9-2350-300-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *10 March 1971*

OPERATOR'S MANUAL

FOR

GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED:

20-MM, M163

(2350-999-4392)

***This manual superseded TM 9-2350-300-10, 5 July 1968, including C 1, 22 January 1969; C2, 6 June 1969; C3, 22 October 1969; and C4, 9 June 1970.**

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual contains instructions for operation and maintenance of 20-mm Self-propelled Air Defense Artillery Gun, M163 (M163 system) by operator and crew. It also contains Appendix A which is a list of current references, including supply manuals, technical manuals, and other available publications applicable to the M163 system. Operator data contained within this manual takes precedence over any other data covering similar equipment. Appendix B contains the Basic Issue Items List (BIIL) and the Items Troop Installed or Authorized List (ITIAL). The basic issue items include those items absolutely essential for sustained operation and crew maintenance of the M163 system. The items troop installed or authorized are those items which at the discretion of the unit commander may accompany the system.

1-2. Forms and Records

Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-3. Equipment Serviceability Criteria

The equipment serviceability criteria (ESC) for the M163 system are included in TM 9-2350-300-ESC. The prescribed maintenance responsiblities at operator / crew level, as allocated in the maintenance allocation chart (MAC), are reflected in this manual. Where the nature of repair, modification or adjustment is beyond the scope of the operator / crew, you will request assistance from organizational maintenance.

1-4. Reports of Errors

The individual user is encouraged to report errors, omissions and any recommendations for improving this publication. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded directly to Commander, US Army Armament Command, ATTN: AMSAR-MAS-T, Rock Island, IL 61201.

Section II. DESCRIPTION AND DATA

1-5. Description

a. General. The 20-mm self-propelled air defense artillery gun M163 (M163 system, fig 1-1) is a lightweight, low-silhouette weapon. The system is designed to provide close-in defense against low-flying aircraft, and ground targets such as personnel, trucks and light armored vehicles. The system is capable of amphibious operation on streams and small lakes, of extended cross-country travel over rough terrain, and of high-speed operation on improved roads or highways. The system is designed to be operated by a crew of four. Movement of the tracks propels and steers the chassis on both land and water. The system can be transported by cargo aircraft. The major components comprising the M163 system are the full tracked weapon chass M741, the 20-mm cannon M168, the gun mount M157, the radar set AN / VPS-2, and the automatic lead computing sight M61. Refer to table 1-0 for other components.

Table 1-0. Component Items

Item	Qty	Reference number and manufacturer code	Illustration	
			Fig No.	Item No.
Indicator Assembly, Azimuth	1	8437917 (19204)	1-16	
Mount, Telescope, M164	1	11728180 (19200)	1-16	
Periscope M17	5	7043549 (19207)	3-11	
Periscope M19	1	7652971 (19200)	2-73	
Telescope, Straight, M134	1	11728190 (19200)	1-16	

b. M741 Chassis. The M741 chassis is a modified M113A1 full tracked chassis that provides a stable gun platform (fig. 1-2 and 1-3).

(1) *Definition of terms.* The terms "right," "left," "front," and "rear" are used to designate areas or sides of the chassis. Think of these terms as viewed when standing at the ramp end facing toward the front, with the cannon pointing toward the front.

(2) *Hull.*

(a) Construction. The M741 chassis hull is constructed of aluminum armor plate reinforced with internal framing. The all-welded construction provides a watertight hull. Hatches, door, and other openings have watertight seals. A trim vane (fig 1-2) on the front of the hull stablizes the chassis during water operation.

(b) Power plant compartment. The power plant compartment (fig 1-4) is located in the front section of the hull and is closed off by bulkheads from the personnel and driver's compartments. The power plant is accessible by removing access panels in the bulkheads or through the hinged power plant door on the front slope of the hull. Air intake and exhaust grilles (fig 1-2) are welded components of the power plant grille. An air grille curtain (fig 2-46) is provided for use during water operation to prevent water from being splashed into intake and exhaust grilles.

(c) Driver's compartment. The driver's compartment (fig 1-5A) is located at the front left side of the chassis. A hatch above the driver's compartment (fig 1-2) is fitted with a torsion-spring counter-balanced hatch cover. The hatch has four M17 periscopes positioned around it. One M19 periscope (infrared) is stowed on the hull wall to the left of the driver. The M19 periscope can be quickly installed in the driver's hatch cover when needed. The driver's hatch cover is provided with a safety switch (fig 1-6). This is to prevent injury of personnel, from the cannon barrels during mount movement, when the hatch is open.

(d) Personnel compartment. The personnel compartment (fig 1-5) in the rear hull section has a folding seat for personnel. The seat is located on the left side to the right of the ammunition storage area. The commander's seat and foot rest are in the right side of the compartment. The radio and intercom are mounted on the right bulkhead. An auxiliary power unit (APU) is stowed to the right of the commander's seat.

1. The personnel seat accommodates two passengers and can be moved, allowing access to the ammunition stowage area.

2. A hydraulically operated ramp (fig 1-3) can be lowered for access and ammunition handling. A door in the ramp provides for personnel entry or exit when the ramp is up.

3. The commander's hatch (fig 1-2), located above the commander's seat, is fitted with a torsion-spring counterbalanced cover. This hatch is also provided with a safety switch (fig 1-6) to prevent personnel injury.

(3) *Power train.* The power train (fig 1-7) consists of a diesel engine, transfer gearcase, automatic transmission, steering control differential, final drives, and associated dirve shafts and universal joints. All items of the power.

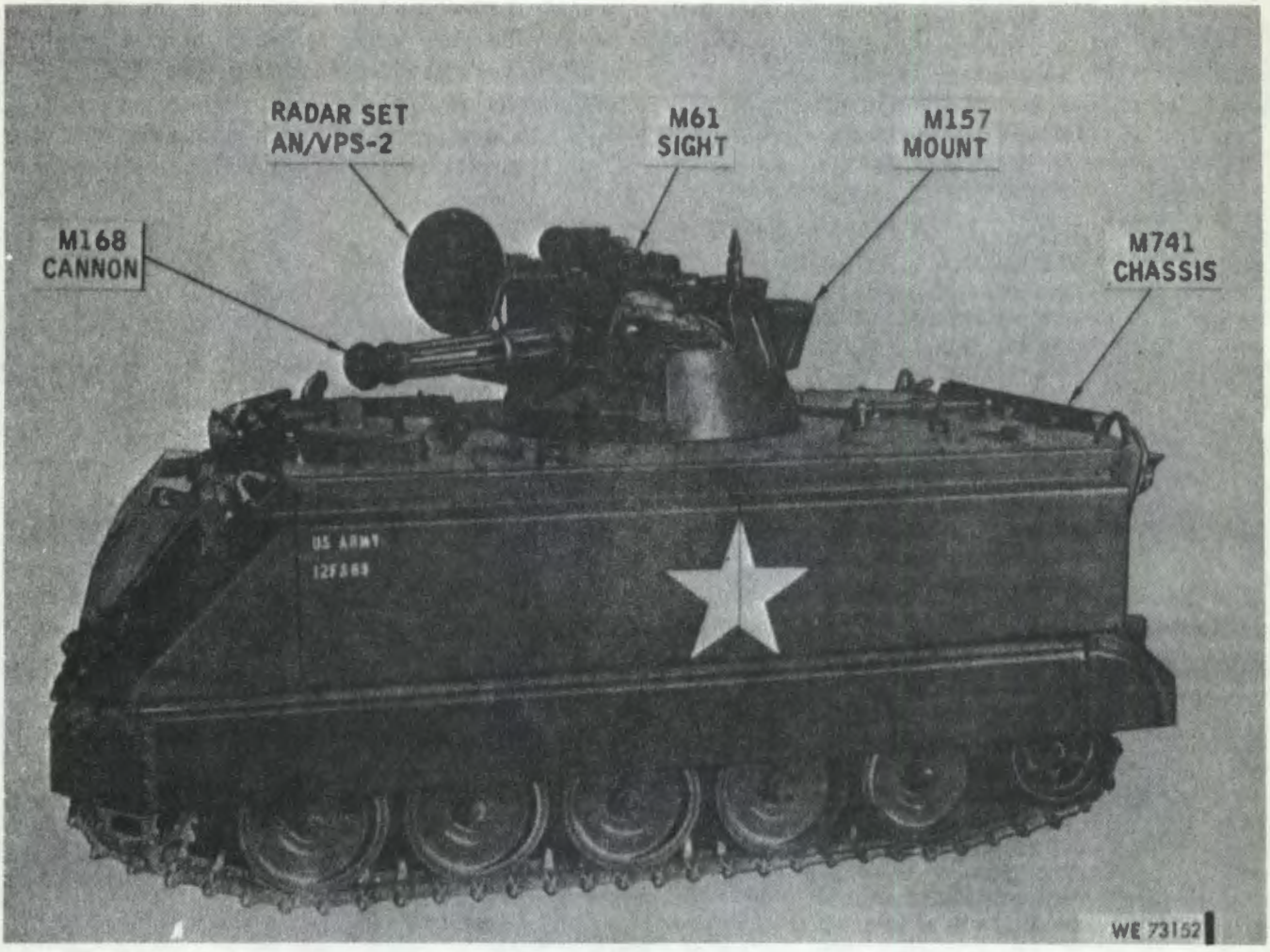


Figure 1-1. M163 system.

train, except final drives, are mounted in the power plant compartment (fig 1-4). Power is transmitted through the differential to both left and right final drives, which connect directly to track drive sprockets.

(4) *Fuel system.* The fuel compartment is located directly to the rear of the oddment bin (fig 1-5A). The fuel compartment is filled through a fuel filler on the top deck and emptied through a drain near the top of the left rear fender. A manual fuel flow control valve (fig 1-5A) is located in the fuel line in the personnel compartment. A manual fuel cut-off control (9, fig 2-1) is located on the right side of the driver's compartment directly above the hand throttle control.

(5) *Electrical system.* The 24-volt dc electrical system for the M741 chassis consists of several systems interconnected by wiring harnesses and cables. These systems are: the horn and lighting system, chassis batteries and generating system, starter system, instrument and warning lights panels, and various transmitters and control switches. Two 12-volt batteries, connected in series, provide the chassis electrical system power. The batteries are located in the battery box in the personnel compartment (fig 1-5). The generator, rectifier, and regulator provide charging current for the chassis batteries and the mount batteries. The instrument panel to the left of the driver (2, fig 2-1)

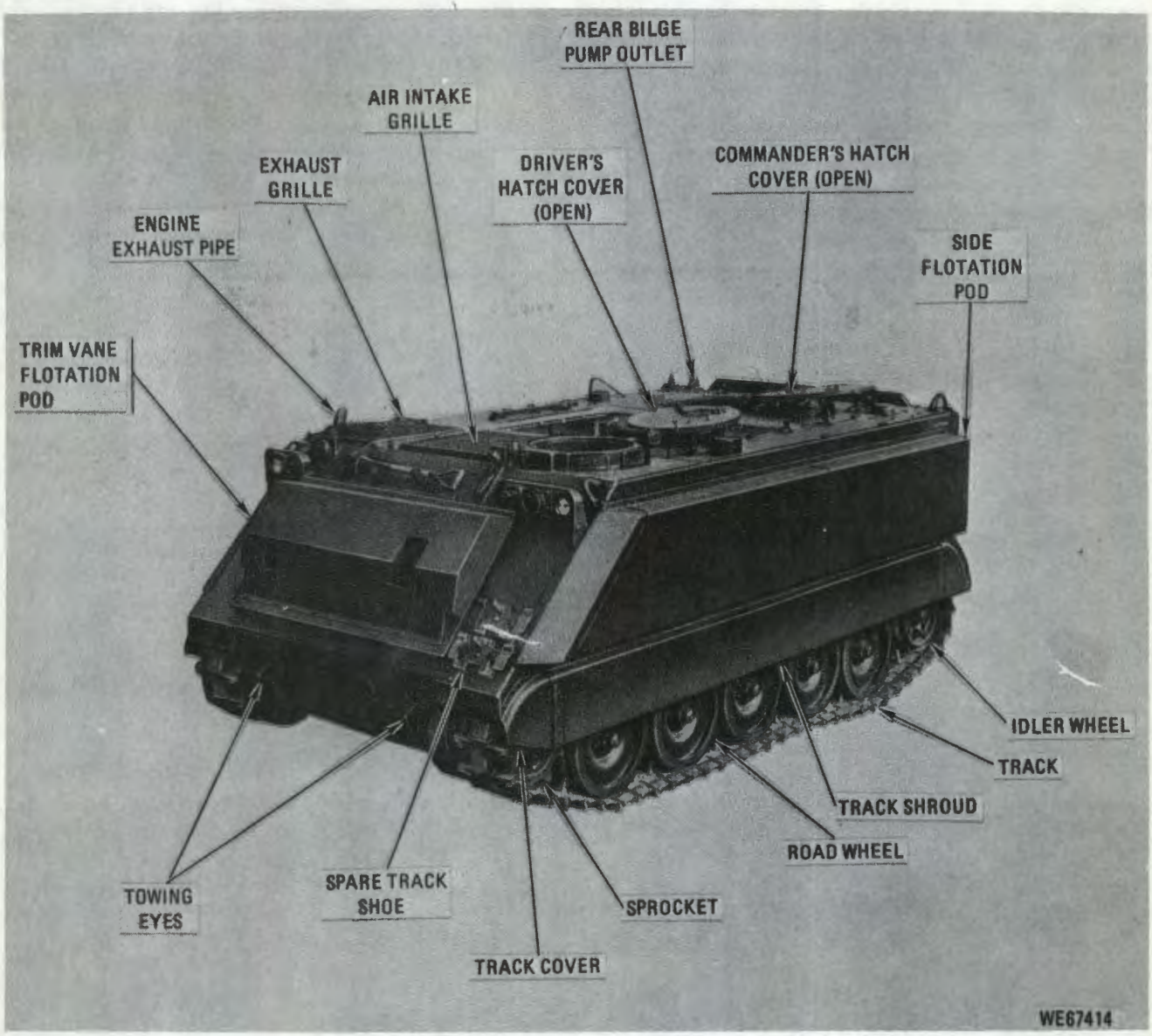


Figure 1-2. M741 chassis, left front view.

contains the various hand-operated switches, indicators, and automatic reset circuit breakers. Warning indicator lights and the horn switch are located on the warning lights panel mounted under the forward periscope directly in front of the driver.

(6) *Tracks and suspension (fig 1-7).* Ten dual road wheels mounted on torsion bars support the vehicle. The rubber-tired road wheels and steel idler wheel travel on tracks on each side of the vehicle. The rubber-padded steel tracks are driven by drive sprockets attached to final drives at the front of the hull. Track tension adjusters connected to the idler wheel maintain track tension, and center guides on the track blocks maintain track alignment. Two shock absorbers and one rubber bumper on each side aid the torsion bars in absorbing road shocks. A suspension lockout (fig 1-8) is incorporated to provide a more stable gun platform when emplaced.

(7) *Hydraulic system.* The hydraulic system (fig 1-8) is a self-purging system consisting of a tank, a pump, a ramp hydraulic cylinder and eight suspension lockout cylinders. The ramp cylinder and suspension lockout system are connected through individual control valves in the driver's compartment.

(8) *Fire extinguishers.* A fixed fire extinguisher for the power plant compartment is located on the chassis left wall behind the driver's station. Actuating handles are located inside and outside the chassis. A portable fire extinguisher (fig 1-6B) mounts in a bracket in the right rear corner of the personnel compartment. Each extinguisher contains five pounds of carbon dioxide (CO_2).

(9) *Bilge pumps.* Two bilge pumps (fig 1-9) mounted on the hull bottom below floor level, remove accumulated water from the chassis. The rotor-type pumps are electrically operated and controlled by a single switch on the instrument panel. The pump discharge outlets are located at the top of the hull, one at the left front and the other at the right rear. Pump intakes are covered with metal strainers to prevent pump damage.

c. *M168 Cannon.* The M168 cannon (fig 1-10) is a six-barrel, rotary, electrically operated air-cooled weapon that fires electrically primed ammunition. The cannon is mounted on the M157 mount. The major components of the cannon are:

(1) *Barrel cluster.* The barrel cluster consists of six barrels which are mounted in a circular configuration to the rotor assembly.

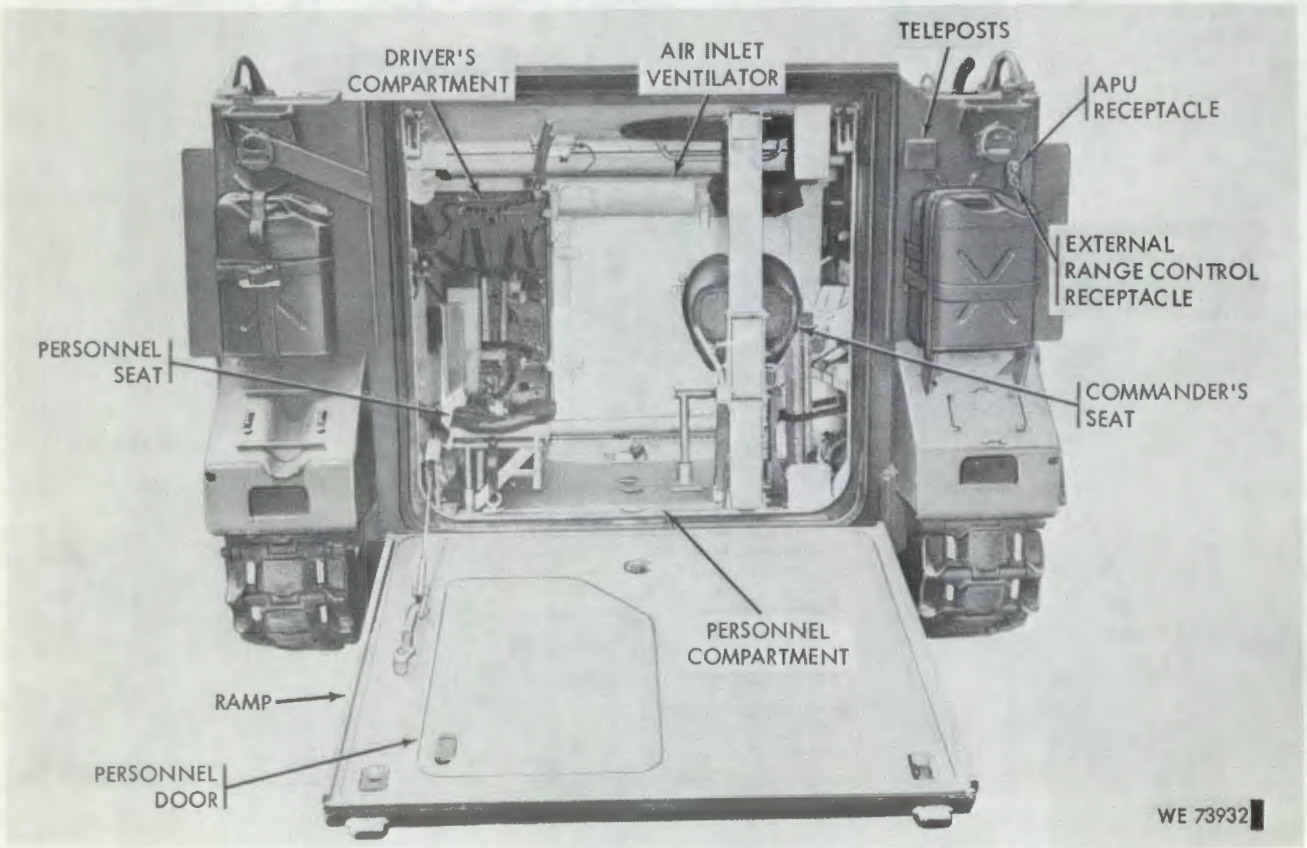


Figure 1-3. M741 chassis, rear view (ramp down).

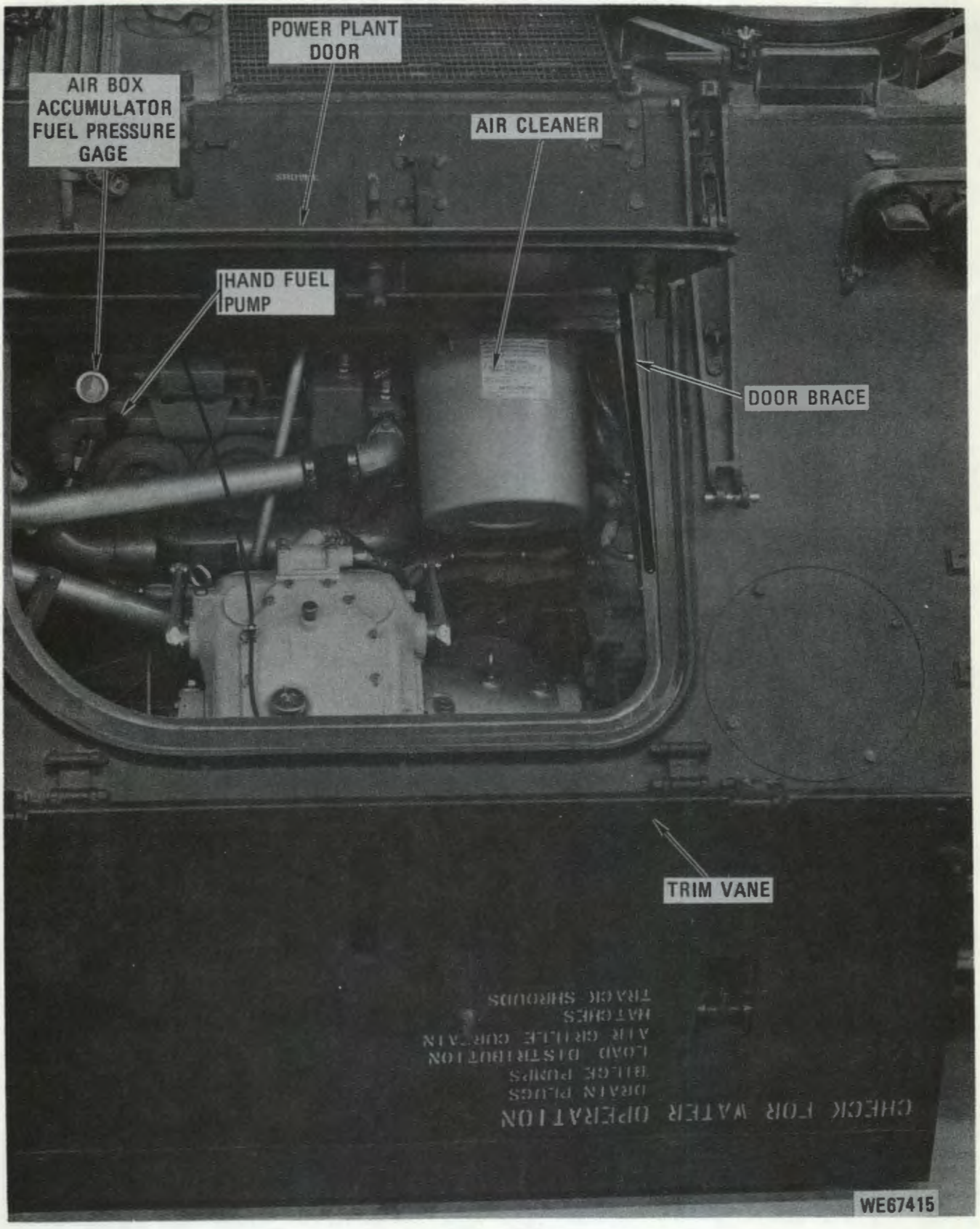


Figure 1-4. Power plant compartment.

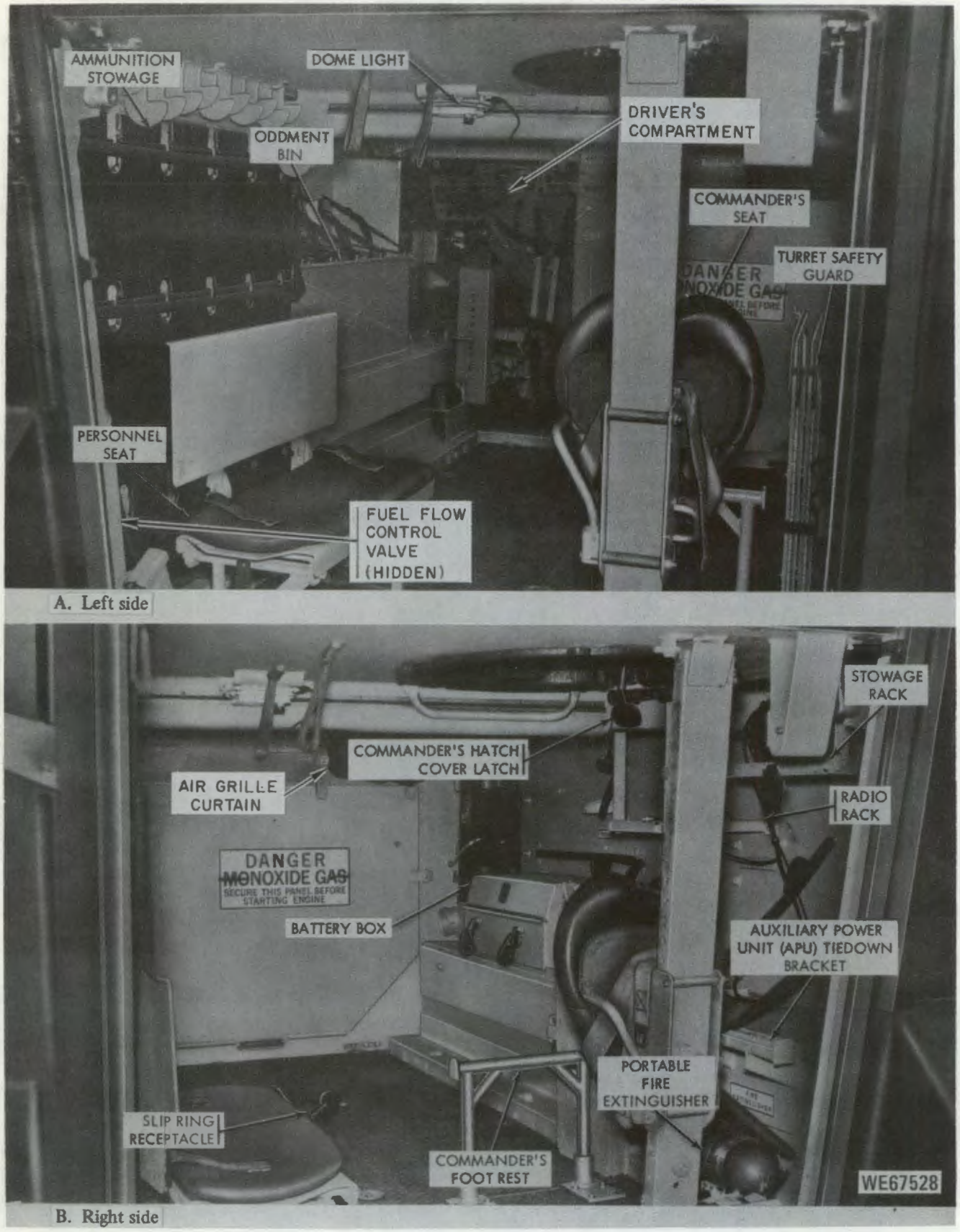


Figure 1-5. Personnel compartment.

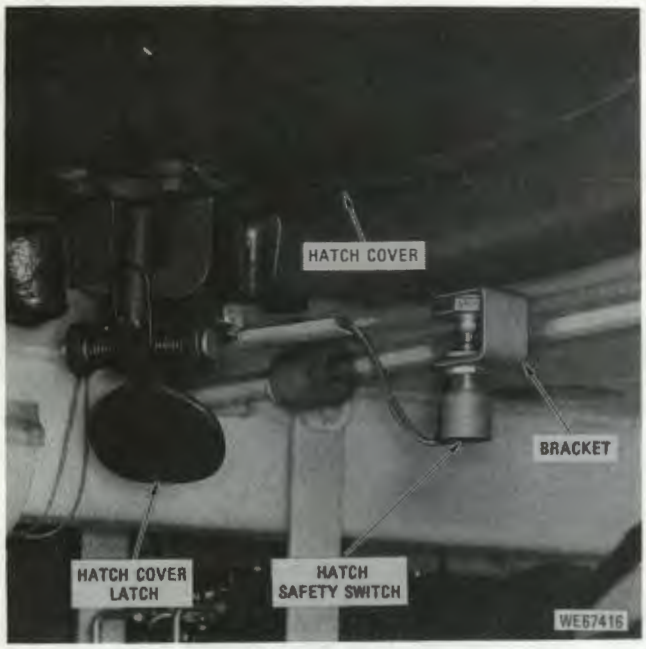


Figure 1-6. Hatch safety switch (typical).

(2) ***Muzzle clamp assembly.*** The muzzle clamp assembly is mounted at the muzzle end of the barrel cluster. Two muzzle clamps are provided for different dispersion patterns for antiaircraft and ground role modes. The antiaircraft muzzle clamp provides a wide angle dispersion pattern and the ground role muzzle clamp provides a concentrated dispersion pattern.

(3) ***Centering clamp assembly.*** The centering clamp assembly locks the barrels in place.

(4) ***Rear housing assembly.*** The rear housing assembly encloses and supports the rotor assembly. It functions as a mount for the recoil adapter assemblies, the declutching feeder assembly, and the gun drive motor. The rear housing assembly also contains cam paths for the locking, unlocking, and clearing cams.

(5) ***Rotor assembly.*** The rotor assembly (within the rear housing assembly) functions as a mount for the breech bolt assemblies. When the rotor revolves, there is an interaction between the housing and rotor by means of cams and gearing. This causes the various weapon functions of feeding, chambering, locking, firing, extraction, and ejection.

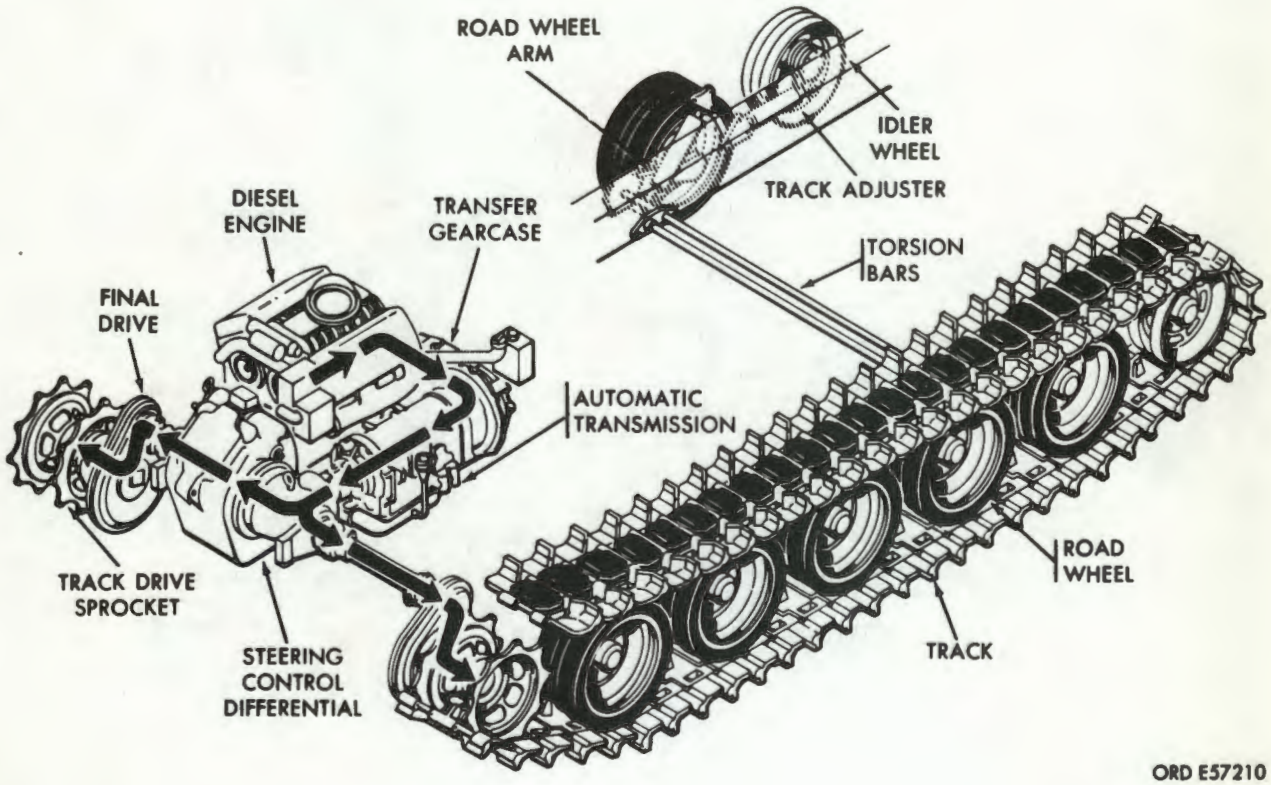
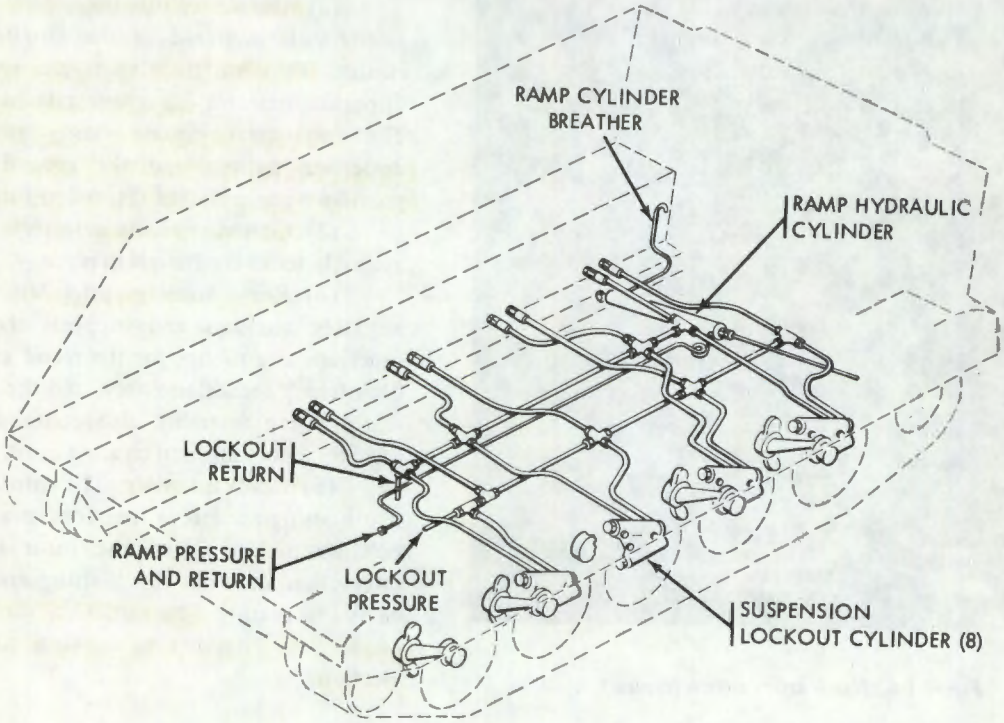
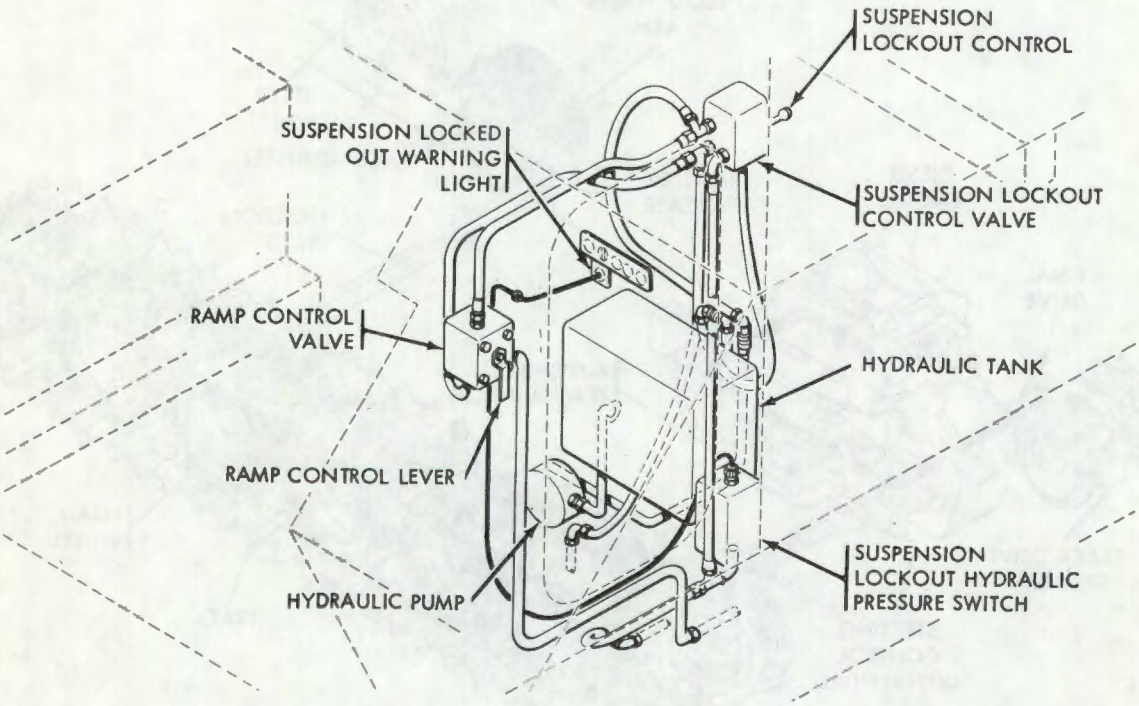


Figure 1-7. Power train.



A. Connecting lines and cylinders.



B. Hydraulic tank and controls.

WE 14042

Figure 1-8. Hydraulic system.

(6) *Breech bolt assemblies.* Six breech bolt assemblies ride on tracks in the rotor assembly. The assemblies carry the ammunition to the firing chamber, fire it electrically, and then extract and eject the empty cases.

(7) *Recoil adapters.* Two recoil adapters secure the cannon to the XM157 mount. They reduce the recoil forces transmitted to the mount.

(8) *Firing contact assembly.* The firing contact assembly supplies current to each breech bolt firing pin as it comes into firing position.

(9) *Indexing pin assembly.* This spring-loaded assembly is located just forward of the declutching feeder assembly. The index pin is used to position the rotor assembly for rotor-declutching feeder timing and for boresighting.

(10) *Chute adapter assembly.* The chute adapter assembly guides the empty cases into the case chute assembly for ejection from the cannon after firing.

d. XM157 mount. The XM157 mount (fig. 1–11) supports the XM168 cannon, XM61 sight, and AN/VPS-2 radar. The mount is bearing mounted to a plate attached to the top deck of the XM741 chassis. The mount can be rotated continuously in azimuth. The components of the XM157 mount are divided into the following functional groups: structure, power and signal distribution, ammunition storage and feed, cannon control, mount positioning, and fire control groups.

(1) *Structure group.* The structure group consists of various mechanical assemblies that support the entire weight of the mount, permit the mount to rotate continuously in azimuth, provide equipment and personnel protection, and provide mounting points for the other mount functional groups.

(2) *Power and signal distribution group.* The power and signal distribution group consists of the mount batteries, cables, portions of the distribution box, inverter, and slip ring assembly.

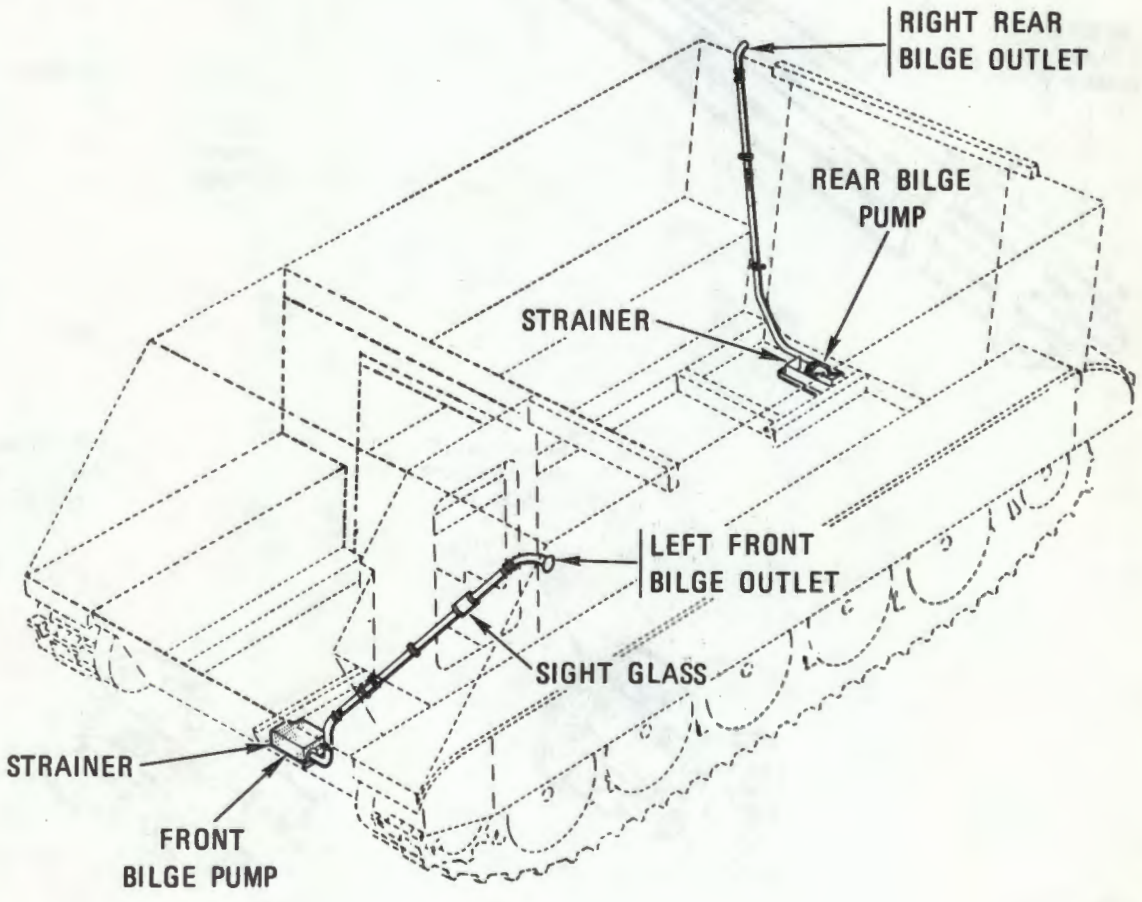


Figure 1-9. Bilge pumps.

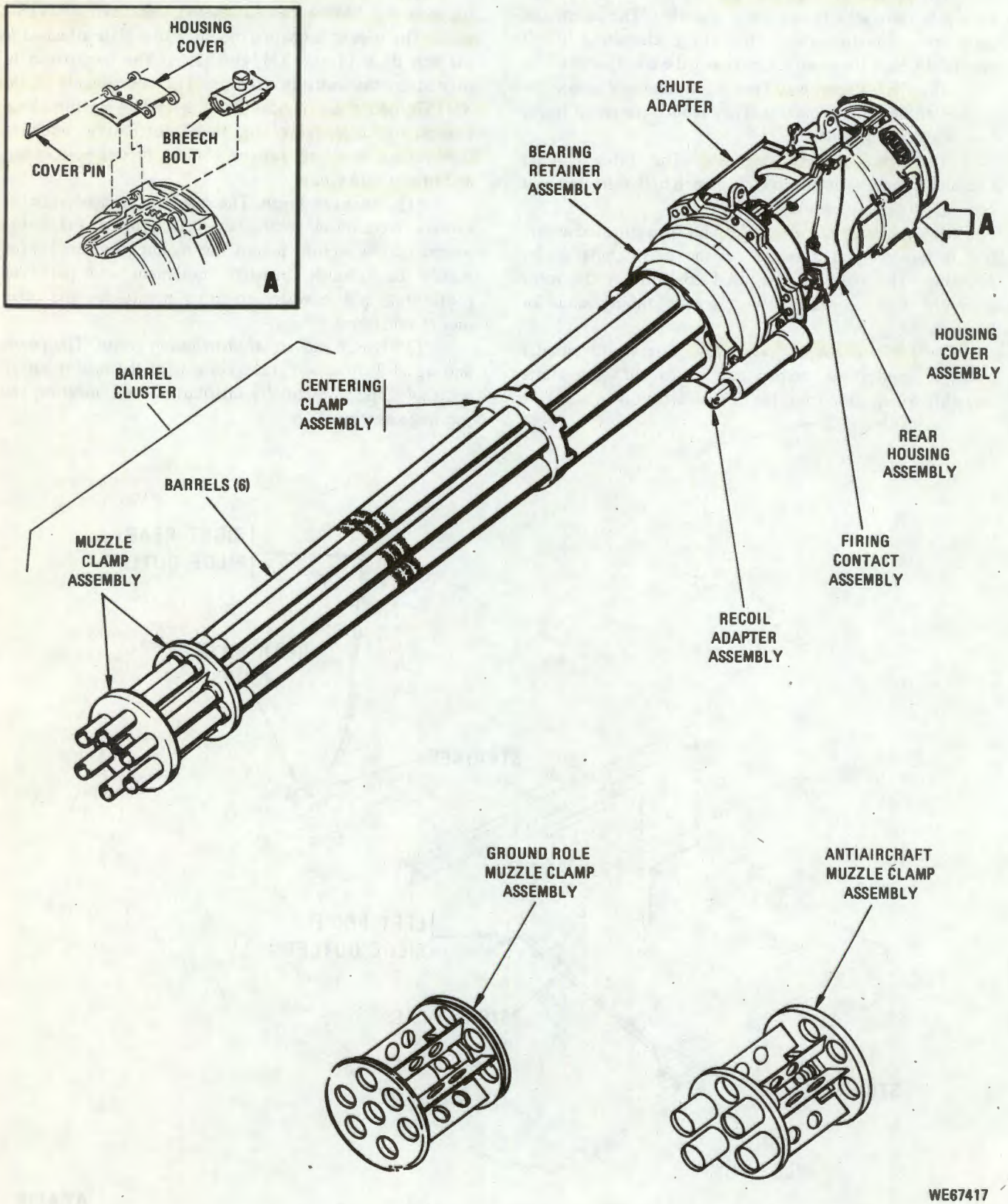


Figure 1-10. XM168 cannon.

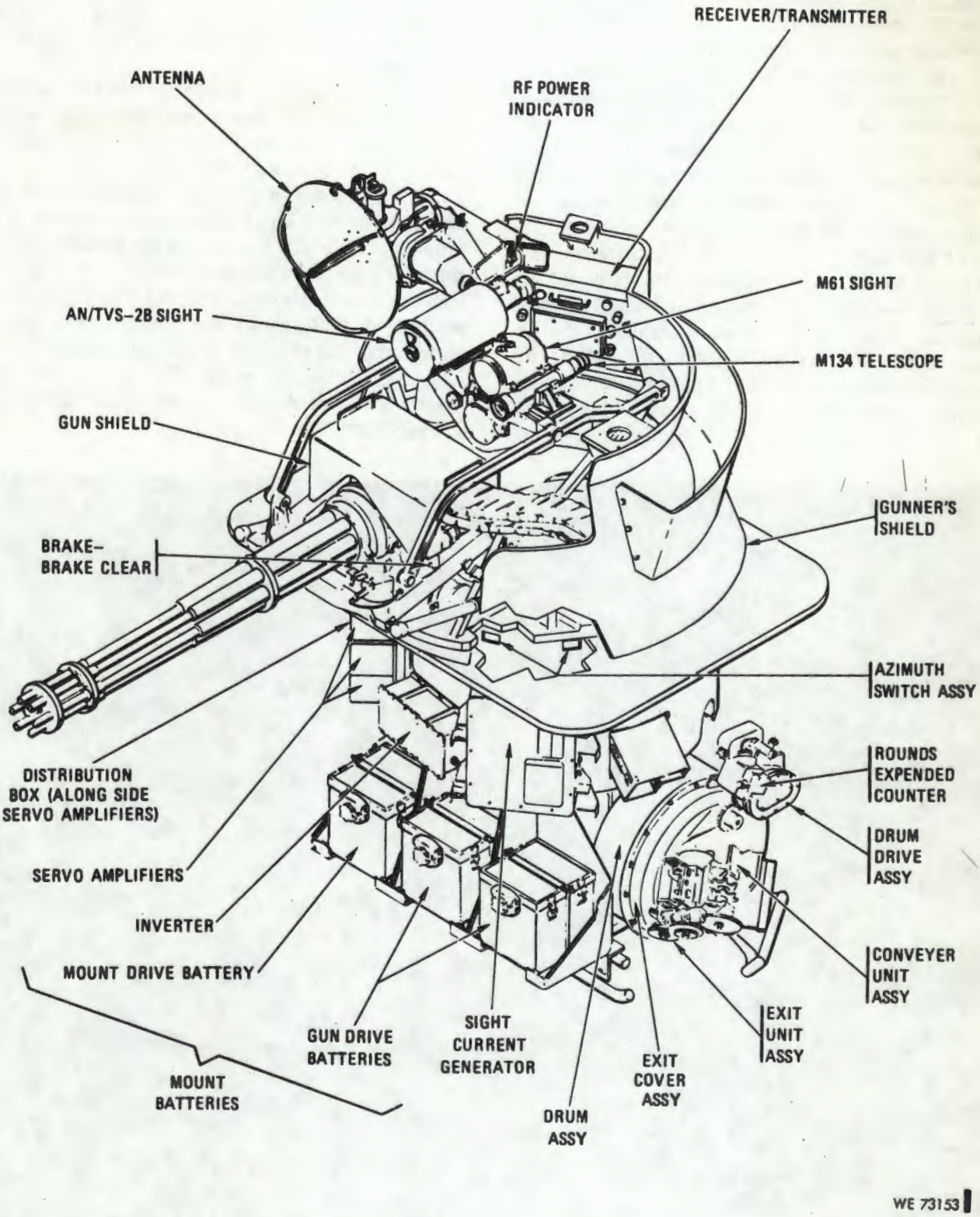


Figure 1-11. M157 mount.

(a) Mount batteries. Three nickel-cadmium batteries (fig. 1-11) supply power to operate the mount, gun, and radar. Two batteries supply power to the gun drive and loading motors and one battery provides power for all remaining circuits.

(b) Distribution box. The distribution box (fig. 1-11 and 1-12) contains the circuitry necessary to: distribute 24 Vdc battery power throughout the mount; provide for overload protection and main power disconnect; provide the time delays required by the system; route signals to various mount assemblies (except the communications system); convert 24 Vdc battery power to 330 Vdc firing voltage; and route the ac and dc voltage outputs of the inverter to the sight gyro motor and sight current generator. In addition to circuit breakers, the exterior of the distribution box contains meters for monitoring battery charging (current and voltage), a switch for static firing and an elapsed time indicator.

(c) Inverter. The inverter (fig. 1-11) converts the 24-Vdc mount battery power to an ac voltage for application to the M61 sight gyro motor. The inverter also converts the battery output into various dc and ac voltages for application to the sight current generator.

(d) Slip ring assembly. The slip ring assembly (fig. 1-12) provides electrical continuity between the M157 rotating mount and the M741 chassis. It allows unlimited azimuth rotation.

(3) *Ammunition storage and feed group.* The ammunition feed and storage group consists of the drum assembly (fig. 1-11), conveyor system, and case chute. It also includes the universal joint (fig. 1-13), transfer drive assembly and the flexible shaft assembly which transmit drive power from the declutching feeder assembly to the drum assembly.

(a) Drum assembly (fig. 1-11). The drum assembly stores delinked ammunition in ready-to-fire condition. The

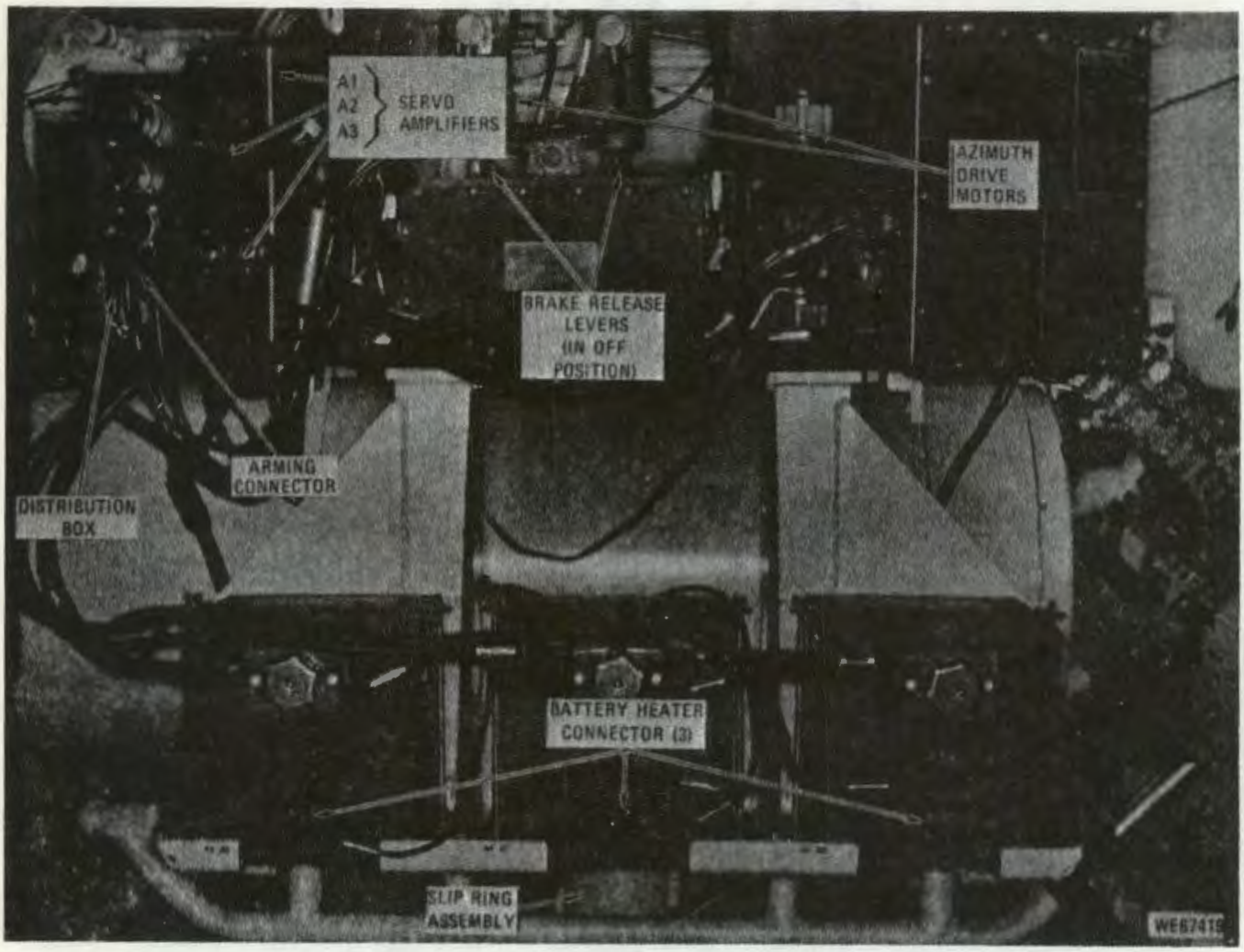


Figure 1-12. Lower M157 mount components, front view.

drum assembly consists of the outer drum, internal drum, drum drive, exit unit, conveyor detection and aft cover assemblies.

1. Outer drum assembly. The outer drum assembly houses the partitions and last round switch assembly, the inner drum, and the scoop disc assembly. The partition assemblies hold the rounds in a radial pattern on the inner surface of the outer drum assembly. The drum assembly contains electrical and mechanical provisions for halting ammunition loading when the drum assembly is full and to prevent the drum from being completely emptied during firing.

2. Internal drum assembly. The internal drum assembly consists of an inner drum, scoop disc assembly, and exit cover assembly. The inner drum is a double helix which, when rotated, slides the rounds along the partition assemblies on the inner surface of the outer drum. A scoop disc assembly, mounted at the front end of the inner drum, transfers the rounds from the partition assemblies to the exit cover assembly.

3. Drum drive assembly. The drum drive assembly (fig. 1–14) drives the inner drum and scoop disc assembly through gears in the exit cover assembly. The drum drive assembly provides three modes of operation: F (fire), N (neutral), and L (load). In the fire mode, the assembly links the flexible shaft to the gears on the exit cover so that the drum is driven in a direction to feed ammunition. In the neutral mode, the exit cover assembly gears are free to be driven manually for maintenance and timing. In the load mode, the exit cover assembly gears are driven opposite to the fire direction by a motor on the drum drive assembly. The motor is controlled by a loading switch on the drum drive assembly.

4. Exit unit assembly. The exit unit assembly (fig. 1–14) performs two functions. During loading, it removes ammunition links from the rounds and feeds the rounds to the exit cover assembly. During firing, the exit unit assembly transfers rounds from the exit cover assembly to the conveyor elements in the conveyor unit assembly.

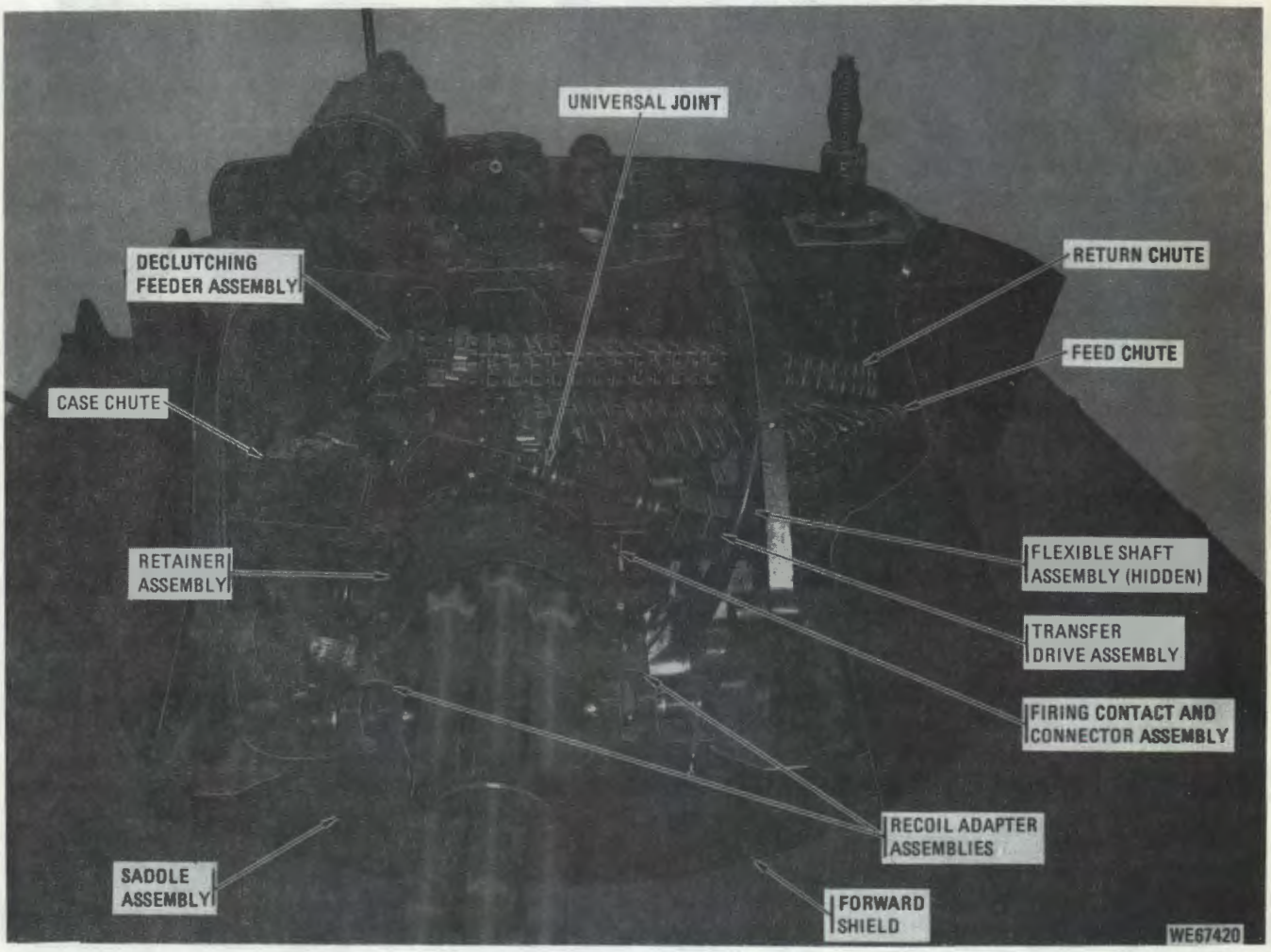


Figure 1-13. Upper XM157 mount components, front view.

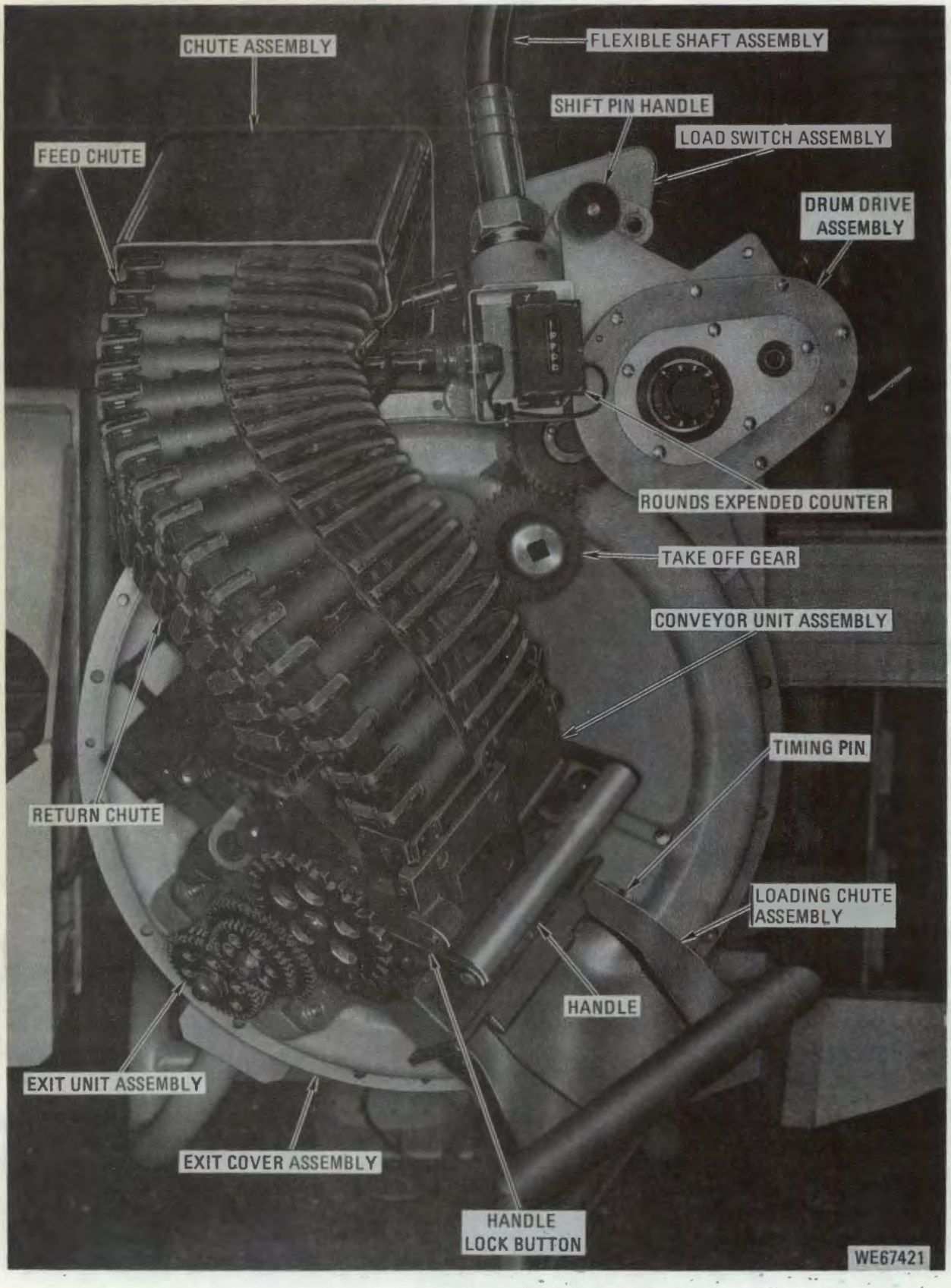


Figure 1-14. Lower XM157 mount components, left end view.

5. Conveyor detection assembly. The conveyor detection assembly (4, fig. 1–15) detects the position of the conveyor unit assembly. It also prevents loading when the conveyor unit assembly is in the firing position, or prevents firing when the conveyor unit assembly is in the loading position.

(b) Conveyor system. The conveyor system consists of a conveyor unit assembly, feed chute, return chute, conveyor elements, chuting covers, and declutching feeder assembly.

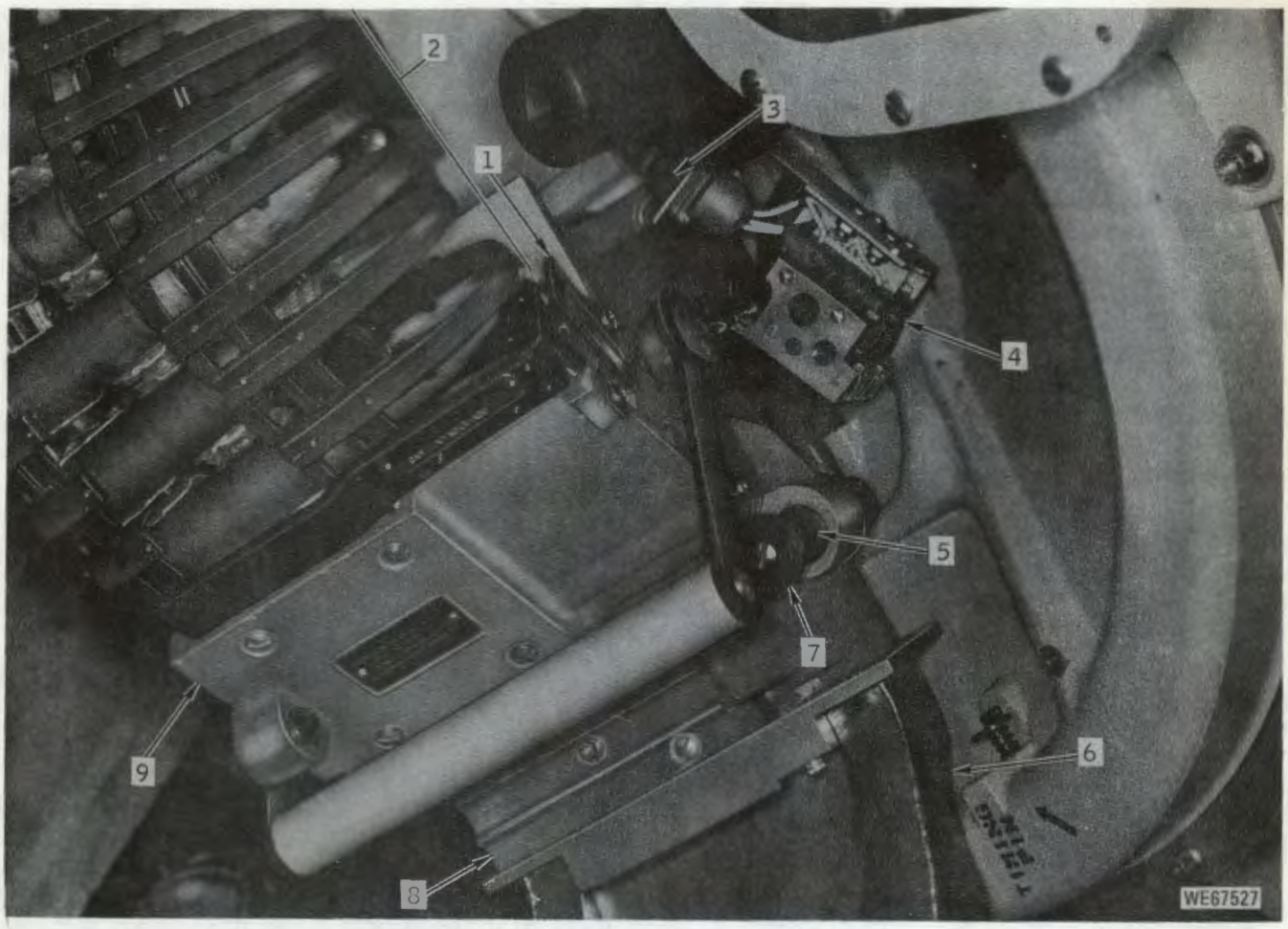
1. Conveyor unit assembly. During firing, the conveyor unit assembly (fig. 1–14) guides the conveyor elements from the return chute past the exit unit assembly, where a round is inserted, and into the feed chute. During loading, the conveyor unit assembly is locked in an inoperative condition away from the exit unit assembly.

2. Feed chute. The feed chute (fig. 1–14) conducts round-filled conveyor elements from the conveyor unit assembly to the declutching feeder assembly. (fig. 1–13).

3. Return chute. The return chute (fig. 1–14) conducts empty conveyor elements from the declutching feeder assembly to the conveyor unit assembly.

4. Conveyor elements. There are 123 conveyor elements joined to form an endless conveyor belt circulating through the conveyor unit assembly, feed chute, declutching feeder assembly and return chute. The conveyor elements transport the rounds from the conveyor unit assembly to the declutching feeder assembly.

5. Declutching feeder assembly. The declutching feeder assembly (fig. 1–13) takes round-filled conveyor elements from the feed chute, feeds the rounds into the



1 Spring clip
2 Feed chute (return chute hidden)
3 Connector (A7A2J1 & W4P3)
4 Conveyor detection assembly
5 Positioning rail
6 Loading chute
7 Stop
8 Exit unit
9 Conveyor unit assembly

Figure 1-15. Lower XM157 mount components location, left end detail view.

cannon, and guides the empty conveyor elements into the return chute. The declutching feeder assembly contains a solenoid-operated clutch that disengages the assembly from the cannon at the end of a firing cycle to clear the cannon of all ammunition.

6. Chuting covers. Fabric chuting covers are provided to protect the feed and return chutes, conveyor elements and rounds of ammunition from dirt and foreign material.

(c) Case chute. The case chute (fig. 1–13) guides empty shell cases or unfired rounds from the chute adapter assembly to an area clear of the cannon.

(4) *Cannon control group.* The cannon control group consists of the arming connector, gun drive assembly, portions of the control assembly, and portions of the distribution box. The gun drive assembly drives the cannon rotor. Circuits in the control assembly control the length of the bursts and control the electrical trigger circuits for firing the cannon. The cannon drive and trigger circuits are disabled when the arming connector is disconnected from the distribution box (fig. 1–12).

(5) *Mount positioning group.* The mount positioning group consists of the components necessary to drive and control the XM157 mount in azimuth and elevation. The group consists of portions of the control assembly, three servo amplifier assemblies, azimuth drive assembly, elevation drive assembly, azimuth switch assembly, and elevation limit switch assembly.

(a) Control assembly. The control assembly (fig. 1–16) consists of a control panel assembly and an elevation control assembly. The control panel assembly contains controls and indicators required to operate the XM163 system (less XM741 chassis). The elevation control assembly, which extends from the lower portion of the control panel, controls the azimuth and elevation positioning of the cannon, firing of the cannon, and electrical caging of the XM61 sight gyro.

(b) Servo amplifier assemblies. Three identical servo amplifier assemblies (fig. 1–12) are employed in the group. One is used in the elevation drive and two are used in the azimuth drive. The elevation servo amplifier causes the elevation drive motor to move the cannon up or down, depending upon the position of the elevation control assembly. The azimuth servo amplifiers perform a similar function for azimuth positioning.

(c) Azimuth drive assembly. The azimuth drive assembly and two azimuth drive motors drive the mount in azimuth (fig. 1–12). The assembly is directly above the two drive motors.

(d) Elevation drive assembly. The elevation drive assembly (fig. 1–17) and the elevation drive motor drive the mount in elevation.

(e) Azimuth switch assembly. The azimuth switch assembly (fig. 1–11) defines the safety sectors in azimuth over the personnel hatches.

(f) Elevation limit switch. The electrical switch assembly (elevation limit switch) (fig. 1–17) defines the safety sectors in elevation over the personnel hatches.

(g) Azimuth indicator. The azimuth indicator (fig. 1–16) is set by the operator during system emplacement to indicate zero azimuth with the cannon pointed in any predetermined position. The indicator is connected to the azimuth gear train and will indicate the azimuth of the cannon.

(6) *Fire control group.* The fire control group contains the elevation potentiometer assembly, sight current generator, portions of the control assembly, the foot switch assembly and the radar. These components, with the exception of the foot switch assembly, operate in conjunction with the XM61 sight to automatically generate a lead angle when the system is operated in the manual mode. The foot switch assembly operates in conjunction with the radar.

(a) Elevation potentiometer. The elevation potentiometer assembly (fig. 1–17) provides data, representing the cannon elevation, to the sight current generator.

(b) Sight current generator. The sight current generator (fig. 1–11) contains two controls, AIR DENSITY and MUZZLE VELOCITY, to provide ballistic corrections to the sight lead computing circuits. These inputs contribute to the solution of the air defense gunnery problem in the manual and radar mode of operation. The sight current generator contains a double ended circuit board (ballistics correction circuit board). One end of this board is plugged in for use with M220 ammunition and the other end is used with M246 ammunition.

(c) Control assembly. Circuits in the control assembly (fig. 1–16) enable the operator to set in target range and target speed information. The operator supplies this information to the sight current generator when the system is operated in the manual mode.

(d) Foot switch assembly. The foot switch assembly is used to cause the radar to radiate during radar mode of operation.

e. XM61 Sight. The XM61 sight (fig. 1–16) is a gyro-stabilized, lead computing sight. The housing of the sight is physically aligned with the axis of the cannon. The movable sight reticle consists of two concentric circles: the outer is 60 mils in diameter; the inner is 15 mils in diameter. In the solution of the fire control problem, the reticle is displaced from the axis of the cannon by the lead angle. Thus, when the target is centered in the reticle, the cannon will deliver a burst to the point in space where the target will be when the burst arrives. The sight gyro can be electrically caged to prevent damage during mount slewing, or mechanically caged by the CAGED knob. Mechanical

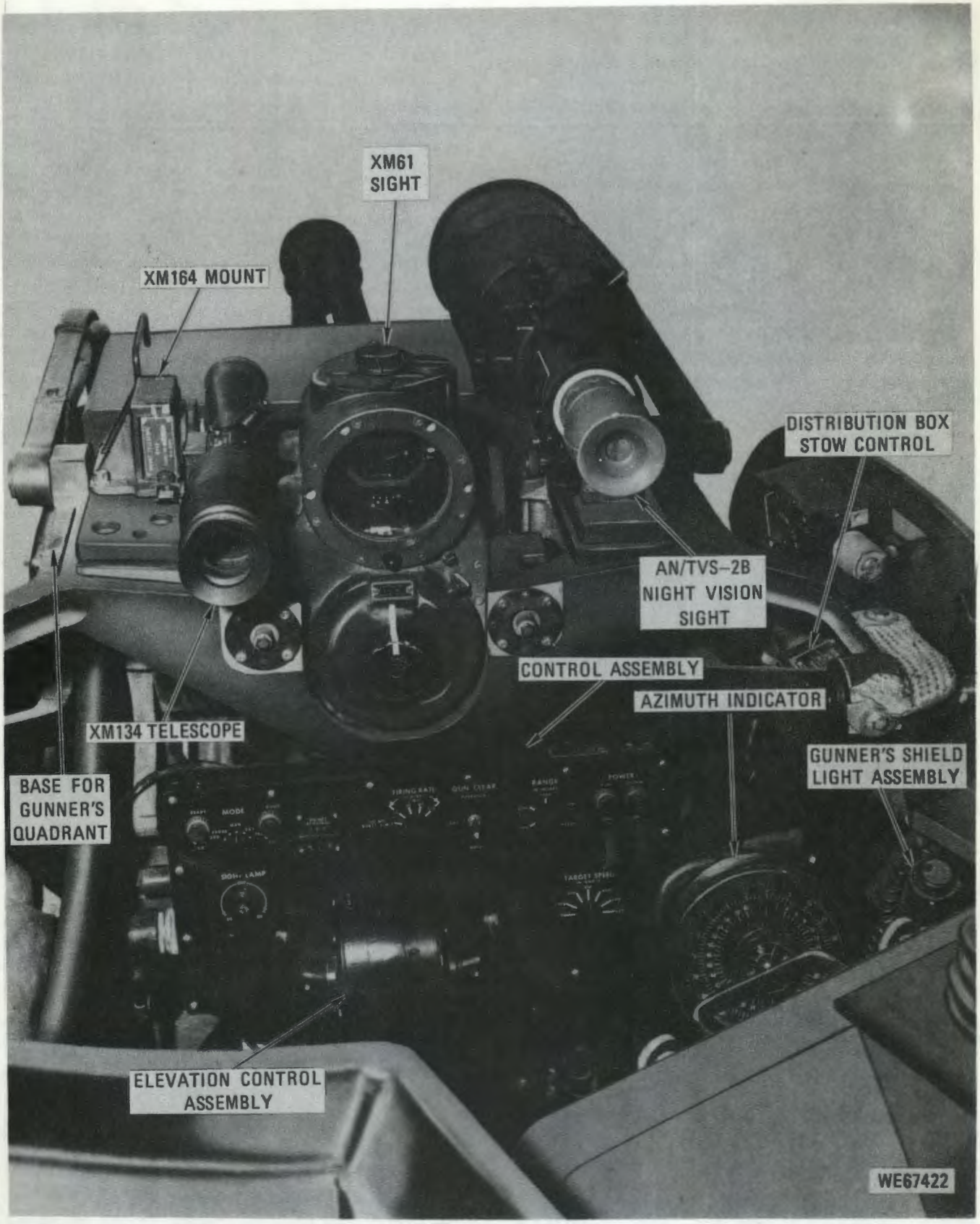


Figure 1-16. Control assembly.

caging depresses the reticle 7-1/2 mils to provide correct aiming for fixed targets when the system is used in ground role. The conditional functions of the ready-to-fire indicator are covered in chapter 2. The XM61 sight is equipped with a 50 percent neutral-density filter.

f. Boresight Kit. The boresight kit (fig. 1–18) is used to boresight the XM163 system. It consists of a boresight kit case, muzzle adapter, mandrel assembly, elbow telescope M109 and four socket head screw keys.

g. External Range Control Assembly. The external range control assembly (fig. 1–19) allows an operator outside of the vehicle to insert range information into the XM163 system when used in the EXT mode. The assembly is connected to the system through the external range control assembly receptacles (one interior and one exterior) located on the right rear of the vehicle.

h. Radar Set AN/VPS-2. Radar Set AN/VPS-2 measures target motion along the line of sight as range and range rate. Range and range rate data from the radar are continuously applied to the sight current generator. The sight current generator then computes target motion lead angles. The radar can operate on any one of six transmit frequencies. This feature permits simultaneous operation of up to six weapon systems in clustered deployment without concern for mutual interference between radars. Frequency selection is afforded by plug-in crystal oscillator subassemblies and subsequent retuning of the klystron power amplifier. The radar is composed of six major units. Table 1–1 lists all of the units with their military and common nomenclature. The antenna and transmitter-receiver (fig. 1–11) and the stow control (fig. 1–16) are mounted on the exterior of the mount. The receiver, range computer, and power supply (fig. 1–20) are mounted in the interior of the mount.

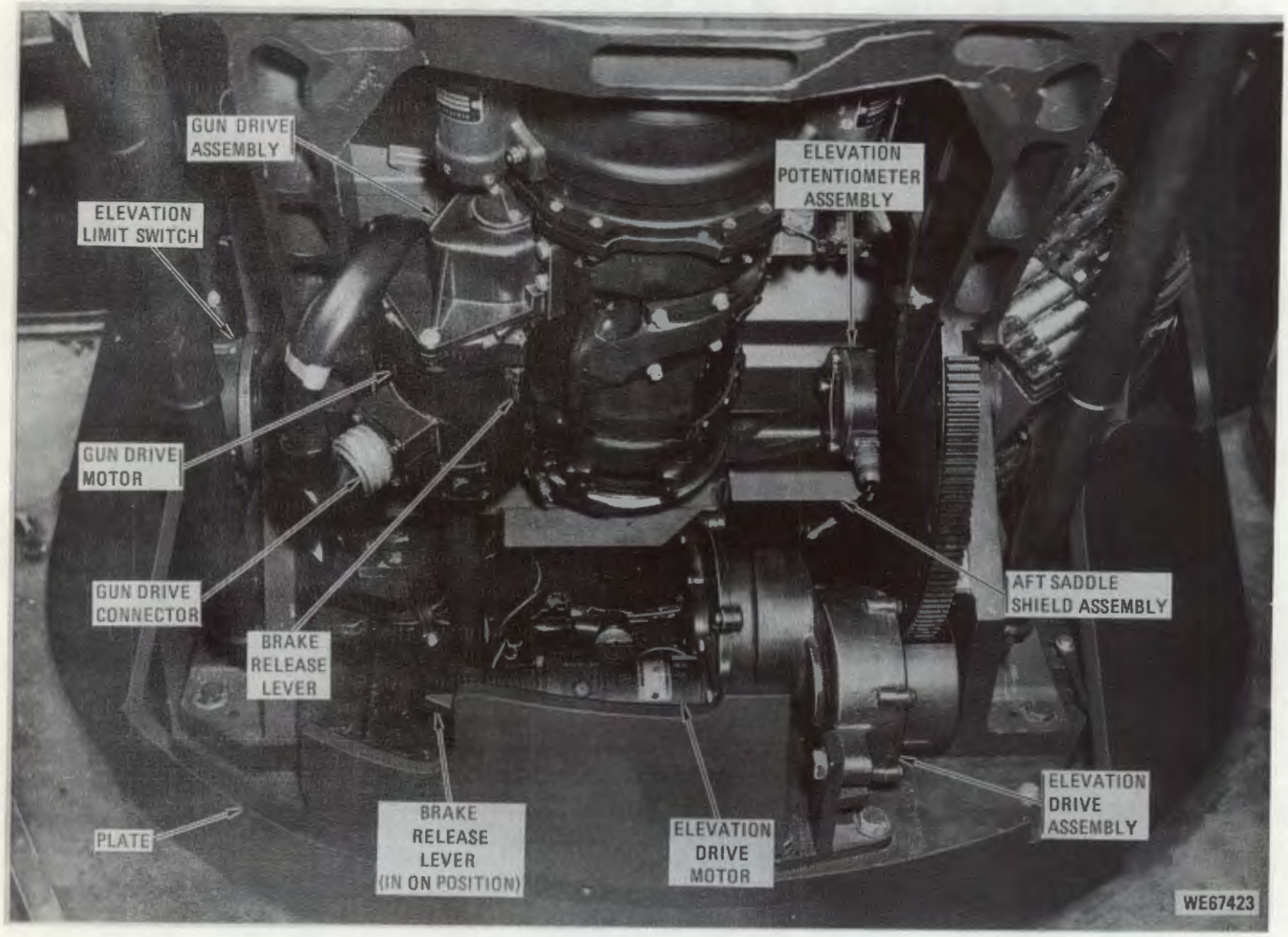


Figure 1-17. Elevation drive.

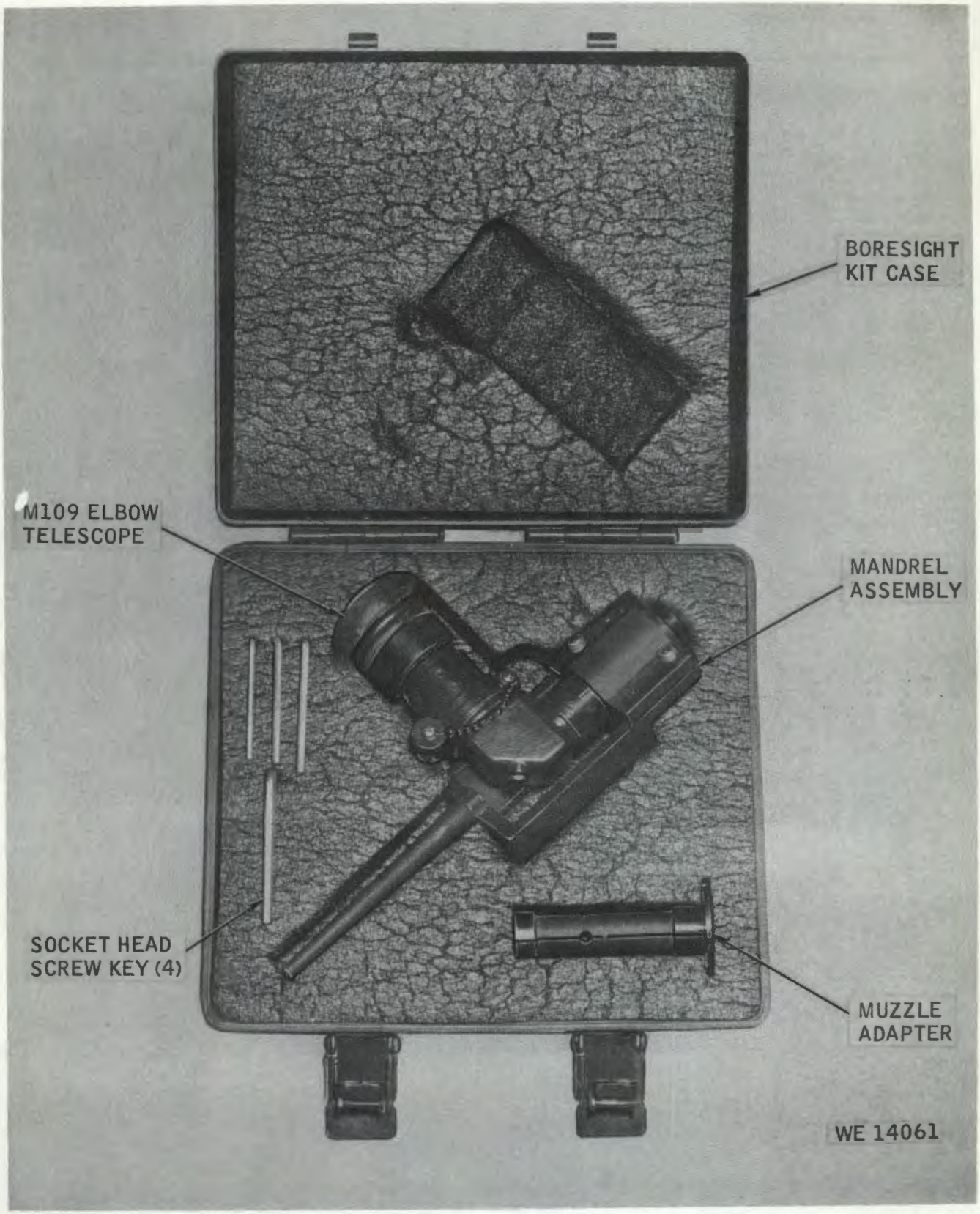


Figure 1-18. Boresight kit.

Table 1-1. Major Units of Radar Set AN/VPS-2

Unit no.	Military nomenclature	Common name
1	Antenna, AS-2049/VPS-2	Antenna
2	Receiver-Transmitter, Radar RT-860/VPS-2	Transmitter-receiver
3	Receiver, Radar R-1475/VPS-2	Receiver
4	Computer, Range CP-888/VPS-2	Range computer
5	Power Supply, PP-4812/VPS-2	Power supply
6	Distribution Box	Stow control

Figure 1-19. External range control assembly.

(1) *Antenna.* The antenna (fig. 1–21) consists of the reflector and feed assembly, traverse and elevation servo drive assemblies, and waveguide traverse and elevation rotary joints. Electrical power is provided by two cables that connect between the stow control and A2J1 and A3J1. Energy for the antenna is routed through a waveguide that connects to the waveguide input.

(a) Reflector and feed assembly. The reflector and feed assembly consist of a reflector, a feed, which protrudes through the center of the reflector, a housing, and a boresight telescope mounting bracket. The feed emits radar energy to the reflector, which focuses the energy into a narrow beam. The housing supports the reflector, the feed, and the traverse rotary joint. A bracket, fastened to the lip of the reflector at three points, protects the feed against damage by impact.

(b) Elevation servo drive assembly. The elevation servo drive assembly consist of a housing containing a servo-driven gear train, which moves the antenna in elevation. Two mechanical stops, bolted to the housing, limit the amount of antenna travel in elevation. The gun elevation shaft coupling connects the servo drive assembly output shaft to the gun elevation input shaft. The elevation boresight is adjusted by moving this coupling at the gun elevation shaft end.

(c) Traverse servo drive assembly. The traverse servo drive assembly consists of a housing containing a servo-driven gear train, which drives the antenna in azimuth. The reflector and feed assembly is mounted to the traverse servo drive assembly at the base of the reflector and feed housing. Two rubber bumpers, attached to the housing, limit antenna travel in azimuth.

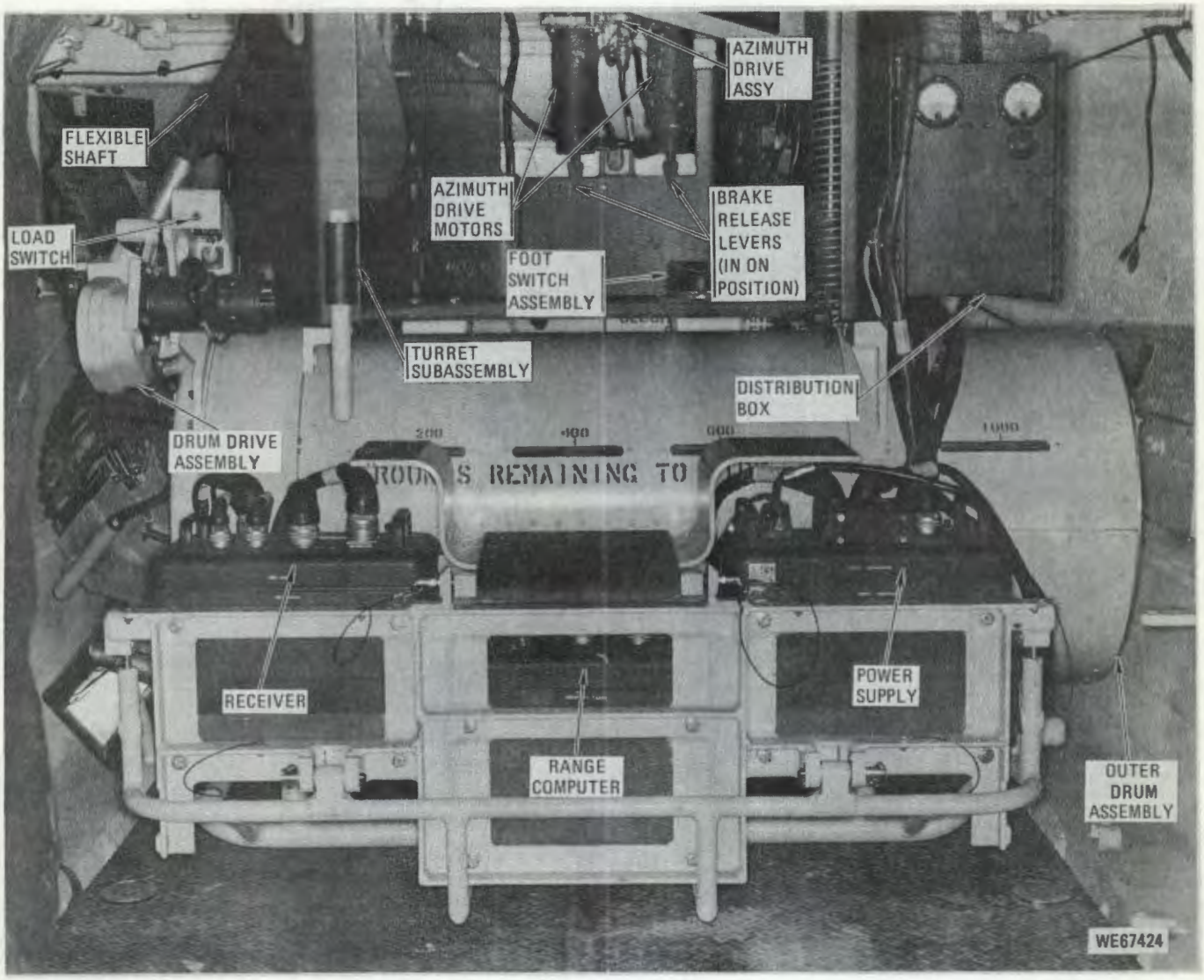


Figure 1-20. Lower XM157 mount components, rear view.

(2) *Transmitter-receiver.* The transmitter-receiver (figs. 1-11 and 1-22) houses the chassis which generates the high power transmit pulse for radiation into space by the antenna. In addition, the transmitter-receiver picks up return target echoes and sends them to the receiver. The frequency determining crystal oscillator plugs into the internal chassis. The five alternate oscillators, as well as the tuning tool, are stored within the transmitter-receiver unit. The hinged front panel swings down to provide access to the interior for frequency selection and tuning.

(3) *Receiver.* The receiver (fig. 1–23) receives and processes the return target echo from the transmitter-receiver and sends it to the range computer for use in solving fire control problems.

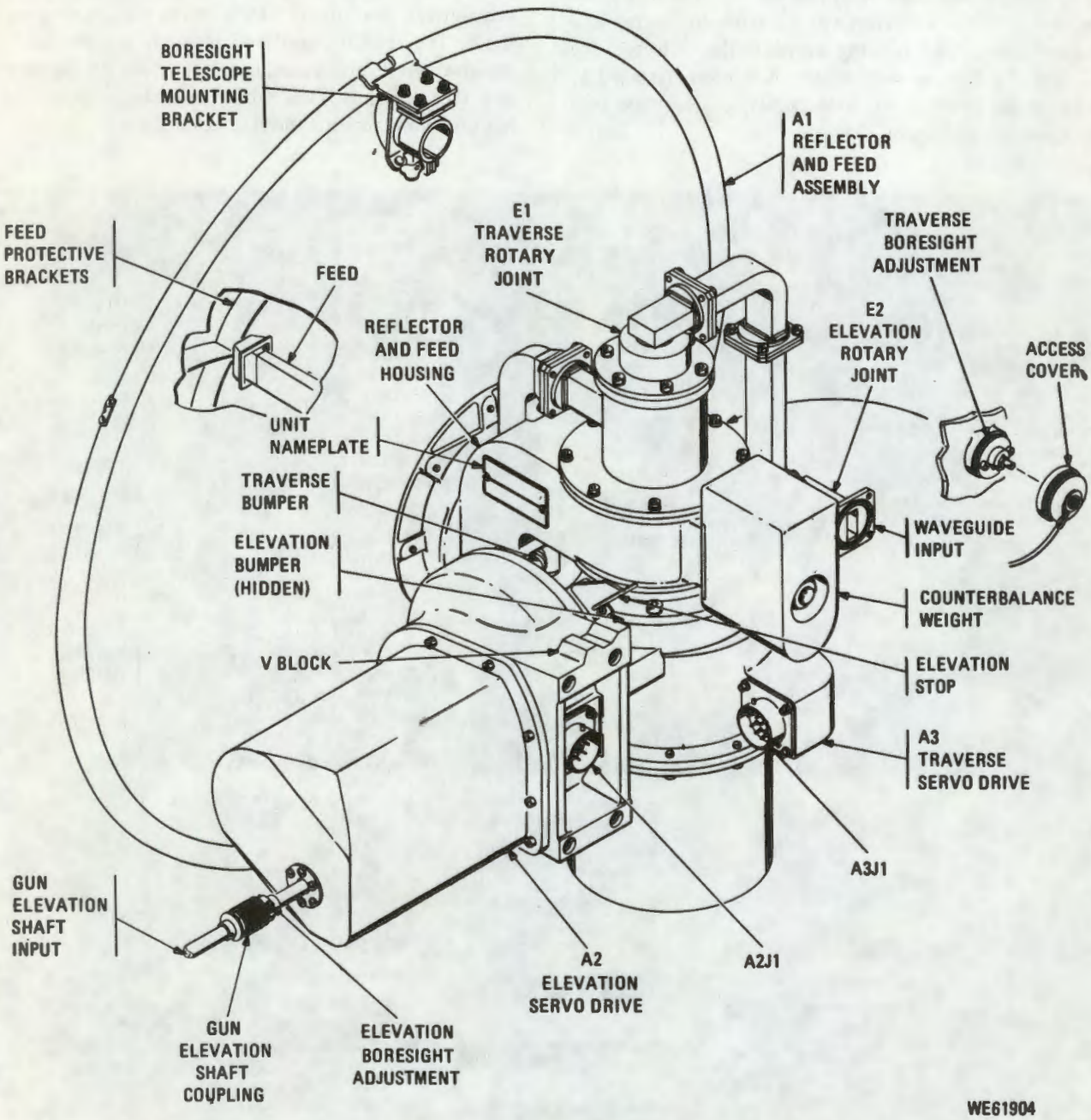


Figure 1-21. Antenna.

(4) *Range computer.* The range computer (fig. 1–24) generates range and range rate data from the signals it receives from the receiver. The range computer applies this information to the sight current generator where it is used in solving the fire control problem. A front panel switch and indicator provide a convenient means of checking the range computing capabilities of the unit.

(5) *Power supply:* The primary power input to the power supply is 24 volts dc, which is obtained from the mount batteries. From this input, the power supply (fig. 1–25) develops, regulates, and distributes all power required by the radar. Circuit breakers on the front panel provide overload protection for the internal circuits.

(6) *Stow control.* The primary function of the stow control (fig. 1–26) is to select the mode of operation for antenna positioning. In addition, the stow control serves as a junction point for electrical interface between the antenna and other units of the radar set. The front panel of the stow control contains controls to position the antenna for stowing and testing.

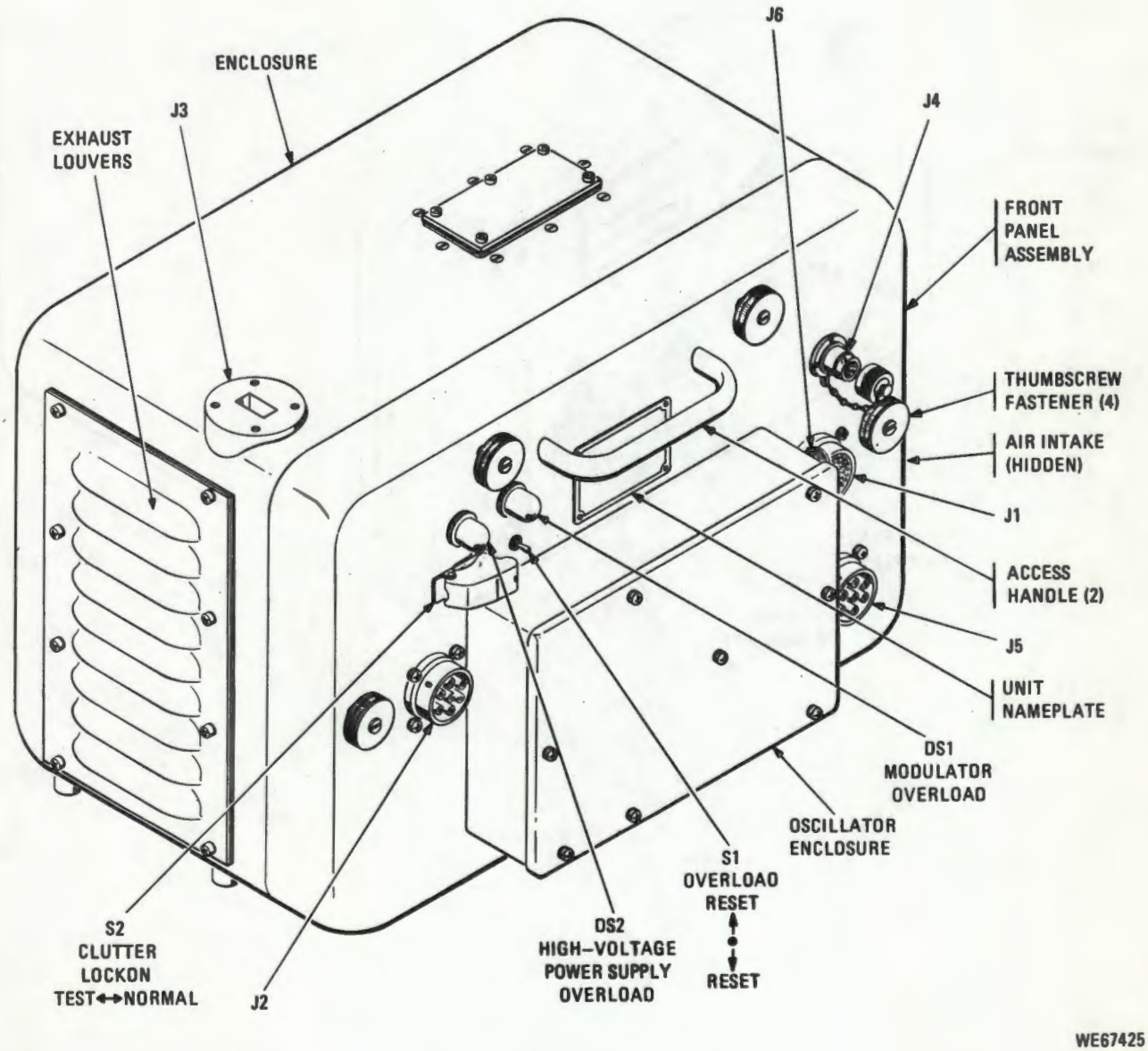


Figure 1-22. Transmitter-receiver.

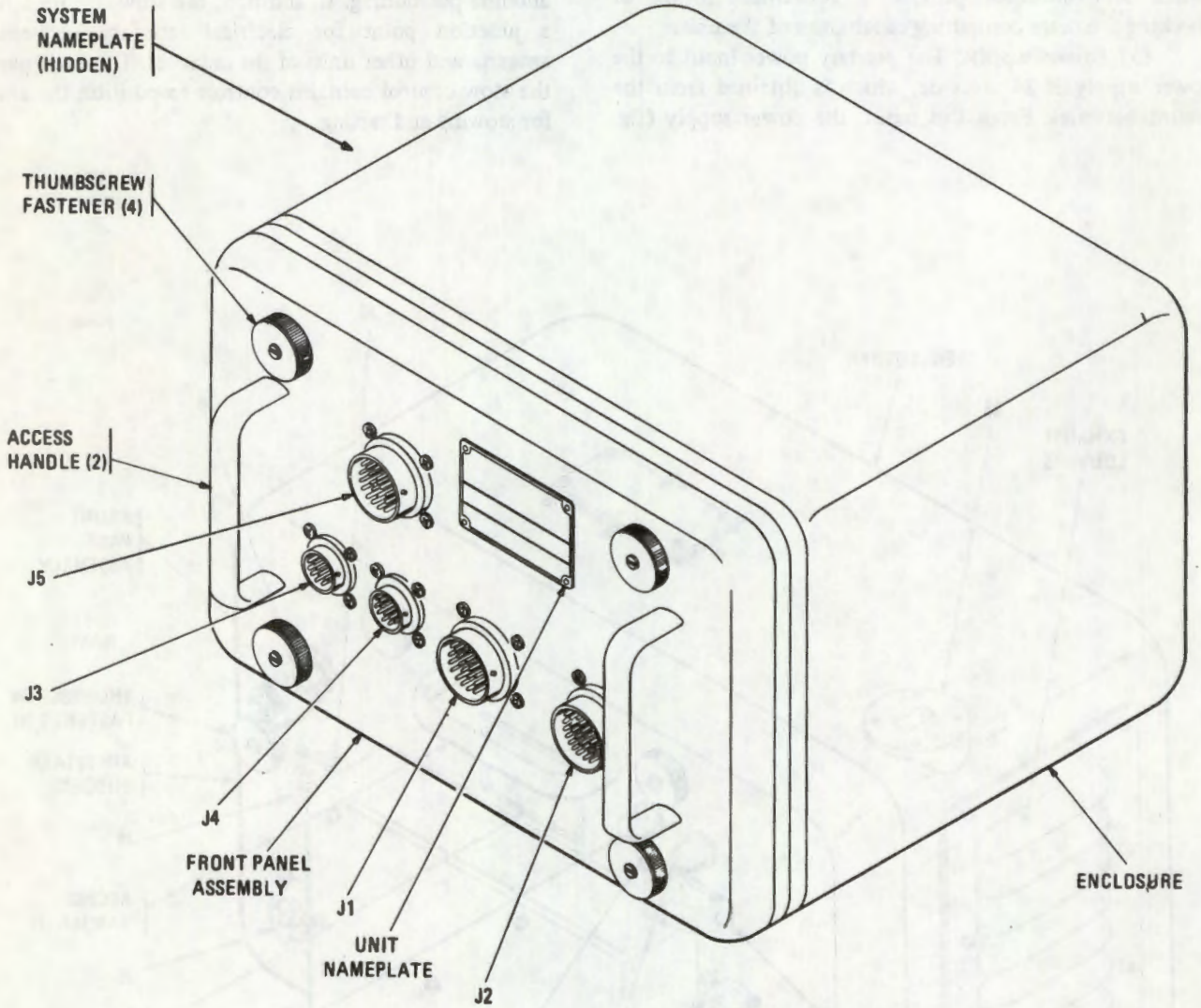


Figure 1-23. Receiver.

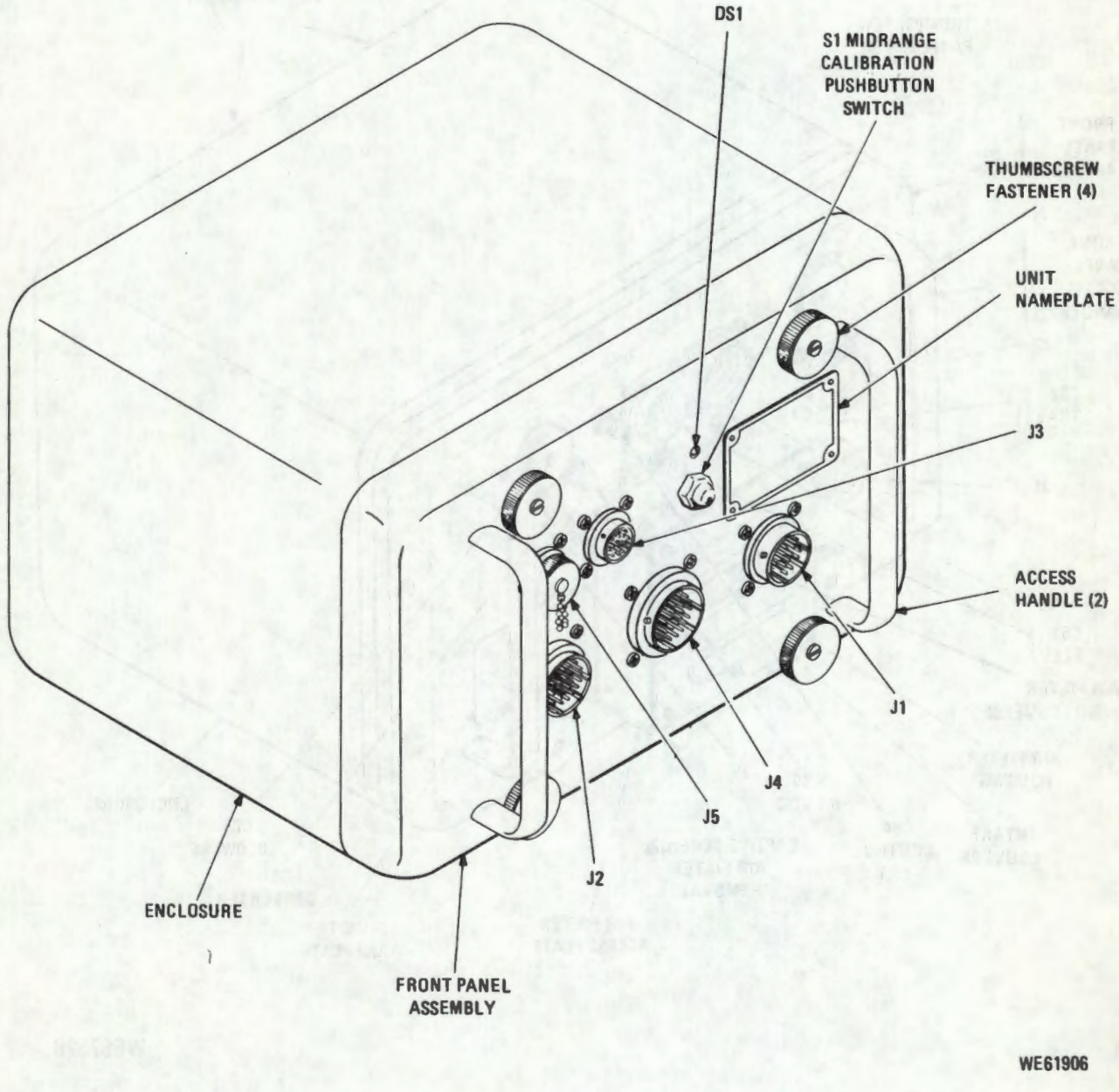


Figure 1-24. Range computer.

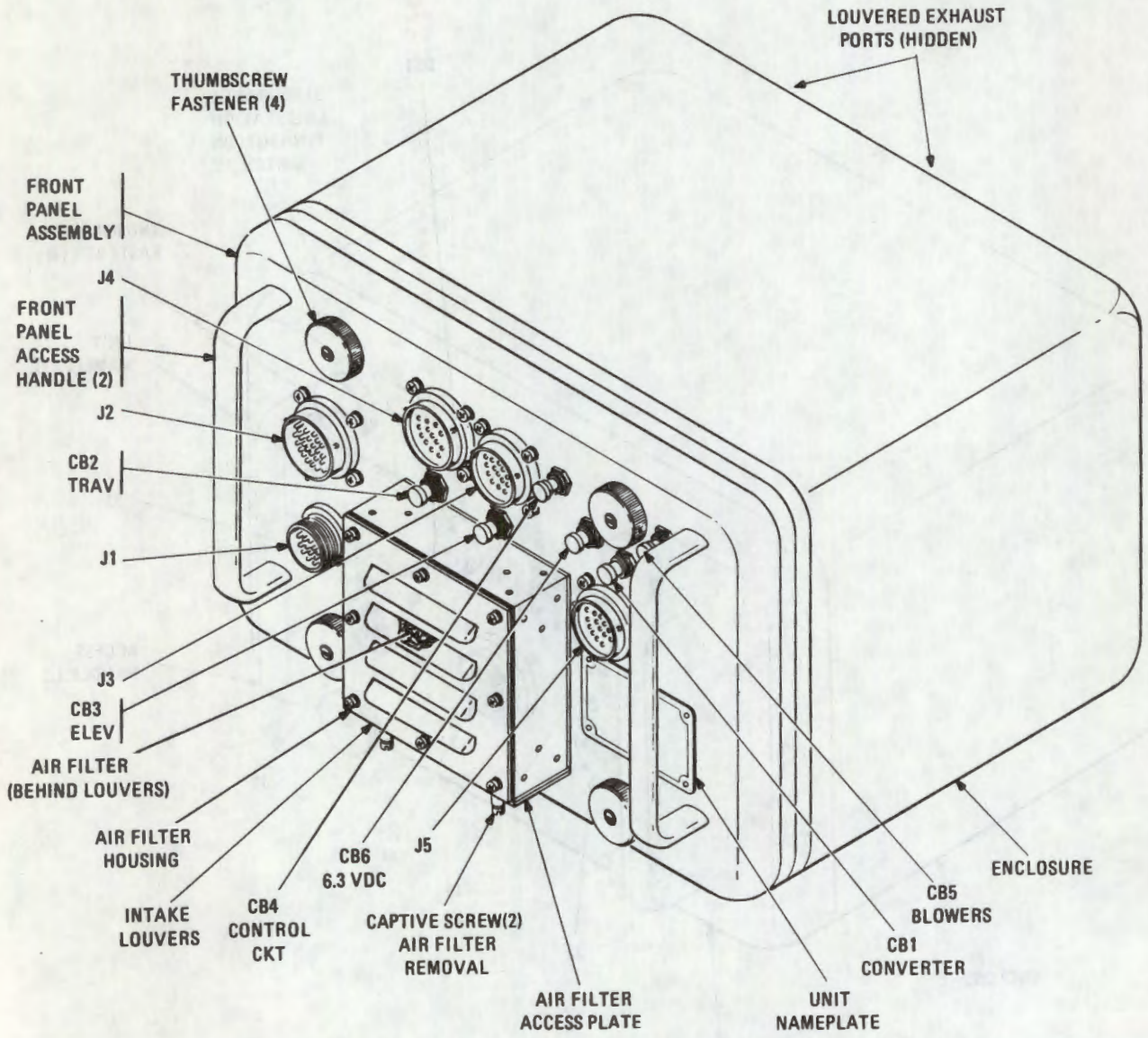


Figure 1-25. Power supply.

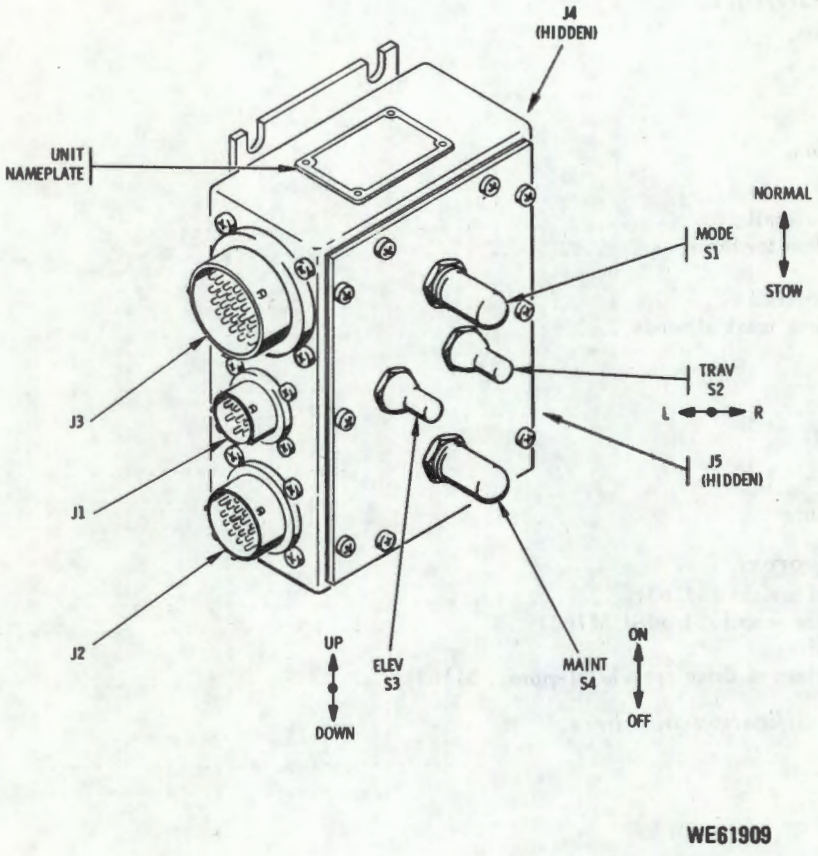


Figure 1-26. Stow control.

1-6. Tabulated Data

a. Physical Characteristics.

(1) M741 chassis.

(a) Capacity.

Crew	4

(b) Dimensions.

Length:	
Maximum, overall	191-½ in
Minimum, less towing eyes	190 in
Width:	
Maximum, overall	112.4 in
Minimum, less track shrouds	100 in
Height:	
Maximum	115 in
Minimum	79-½ in
Ramp opening:	
Height	49-½ in
Width	54 in
Ground clearance	16-⅛ in

(c) Weight (approx).

Combat loaded weight (M163)	26,450 lb
Ground pressure (combat-loaded M163)	8.3
Center of gravity:	
From centerline of drive sprocket (approx, M163)	80-¾ in

(d) Bridge classification numbers.

Empty	10
Cross country	12

(e) Performance

1. On land.

Maximum speed forward	Range	Miles per hour
	1	10
	1-2	21
	1-3	40
	2-3	40

Maximum speed reverse	9 mph
Cruising range (approx)	275 mi
Fuel consumption (approx)	3.4 mpg
Minimum turning radius (with steering levers)	24 ft
Minimum turning radius (with pivot steering levers)	14 ft
Maximum grade	60 pct
Maximum side slope	30 pct
Maximum vertical wall	2 ft
Maximum trench	5.5 ft
Maximum towed load	14,500 lb

2. On water.

Speed forward (approx)	3.6 mph
Fording depth	Unlimited
Freeboard (static): combat loaded with gun barrels position aft (M163)	
Front (average)	11.5 in
Rear (average)	10.5 in

(f) Engine.

Type	Two-cycle diesel-compression-ignition
Idle speed	550-600 rpm

No load governor speed ..... 2,925-2,975 rpm
Fuel types:
Grade DF-2 (VV-F-800) ..... Do not use below +32° F
Grade DF-1 (VV-F-800) ..... Do not use below—10° F
Grade DF-A (VV-F-800) ..... Use for all temperatures
CITE (MIL-F-46005) ..... Use for all temperatures
JP-5 (aircraft turbine engine ..... Emergency conditions above —40° F

(g) Transmission.

Speeds ..... 3 fwd, 1 rev
Ranges ..... 4 fwd, 1 rev

(h) Bilge pumps.

Type ..... Submersible
Bilge pump output (each) (approx) ..... 44 gpm

(i) Vision devices.

1. Periscope, M17 ..... Driver's hatch, 4
Stowed spare, 1

Optical Characteristics

Power ..... Unity power (no magnification)
Horizontal field of view ..... 150 deg
Vertical field of view ..... 50 deg

2. Periscope, M19 ..... Stowed, 1
Stowed spare head, 1

(a) Optical characteristics.

Power (approx) 1X
Field of view ..... 26.8 deg
Effective focal length of objective 2.012
Effective focal length of eyepiece 1.452

(b) Operating voltage 16,000

(j) Suspension lockout system

Type ..... Hydraulic actuated
Control ..... Manually operated
Pressure ..... 675 to 725 psi

(k) Ammunition.

Caliber 20-mm

(l) Component capacities, (approx).

	Refill	Dry
Engine cooling system	40 qt	45 qt
Engine oil system	18 qt	22 qt
Transmission oil system	16 qt	20 qt
Differential oil system	20 qt	24 qt
Transfer gearcase	5 pt	5 pt
Final drive (each)	3 pt	3 pt
Ramp and suspension hydraulic system	7 qt	8 qt
Fan gear box	½ pt	½ pt
Fuel compartment	95 gal	95 gal
Pivot steer master cylinders (each)	½ pt	½ pt

(m) Maximum safe fuel acceptance rate ..... 50 gpm

(2) *M168 cannon.*

Caliber 20-mm
Overall length ..... 72 in (approx)
Number of barrels 6
Length ..... 60 in
Lands 9
Twist ..... Gain twist rh
Rotation of barrels ..... Clockwise viewed from muzzle end
Firing rate (rounds per minute):
High 3000
Low 1000
Burst limits ..... High rate: 10, 30, 60 or 100 rounds selected burst. Low rate: no selection of burst.

Weight (less barrels, recoil adapters, mid-barrel and muzzle clamps) ..... 134 lb (approx)
Barrel (each) ..... 18 lb (approx)

(3) *M157 mount.*

Ammunition feed ..... Linkless
Type of ammunition storage ..... Drum
Rounds stored in drum ..... 1,100 (approx.)
Drum loading speed ..... 100 rounds per min
Elevation limits ..... —5 to +80 deg

(4) *M61 sight.*

Height ..... 14-¼ in
Width ..... 12-¼ in
Depth ..... 10-½ in
Weight ..... 31 lb

b. Electrical Characteristics (M163 System Less Chassis).

(1) *Power requirements.*

Standby ..... 20 amperes
Cannon elevating and slewing ..... 113 amperes
Firing ..... 663 amperes

(2) *Power source.*

Mount drive battery ..... 24 volts, 34.0 ampere-hours
Gun drive batteries (2) ..... 24 volts, 68.0 ampere-hours

c. Radar Functional Characteristics.

(1) *Range:*

Minimum ..... 250 meters
Maximum ..... 5000 meters (1sq meter target)

(2) *Minimum tracking velocity.*

Fixed wing propellerless aircraft ..... +15 meters / second
Propeller driven or rotary ..... 0 meter / second provided that power in doppler spectrum from rotating aircraft parts is sufficient for tracking

(3) *Power requirements:*

Voltage range (input) ..... +22 to +30 volts (+24 volts nominal)
Power consumption (standby) ..... 670 watts maximum (including momentary 450-watt power consumption for antenna slewing)
Power consumption (radiate) ..... 970 watts maximum (including momentary 450-watt power consumption for antenna slewing)

(4) *Antenna positioning:*

Elevation limits ..... —10 to +95 degrees (normal operation)
—73 to +96 degrees (stow)
Traverse angle limits ..... +25 degrees (normal operation)
+27.5 degrees (stow)

(5) *Antenna:*

Gain ..... 33 db

Reflector type . . . . . 24-inch diameter paraboloid
Feed type . . . . . Split horn
Height . . . . . 25-1/8 in
Width . . . . . 29-1/2 in
Depth . . . . . 23-3/4 in
Weight . . . . . 65 lb.

(6) *Transmitter-receiver:*
Height . . . . . 12-15/32 in
Width . . . . . 18-15/32 in
Depth . . . . . 12-5/16 in
Weight . . . . . 84 lb.

(7) *Receiver:*
Height . . . . . 8-25/32 in
Width . . . . . 13-25/32 in
Depth . . . . . 11-1/32 in
Weight . . . . . 37 lb.

(8) *Range computer:*
Height . . . . . 8-25/32 in
Width . . . . . 13-25/32 in
Depth . . . . . 11-1/32 in
Weight . . . . . 29 lb

(9) *Power supply:*
Height . . . . . 8-25/32 in
Width . . . . . 13-25/32 in
Depth . . . . . 11-5/8 in
Weight . . . . . 48 lb

(10) *Stow control:*
Height . . . . . 6-1/2 in
Width . . . . . 4-3/8 in
Depth . . . . . 2-5/8 in
Weight . . . . . 5 lb

(11) *Radar accessories:*
Radar cables (including waveguide) . . . . . 27 lb
Antenna mounting bracket
(including waveguide protective housing) . . . . . 24 lb

1-7. Name, Caution, and Identification Plates

Table 1–2 lists the name, caution, and identification plates associated with the major items of the XM163 system.

Table 1-2. Name, Caution and Identification Plates

Name	Location
XM741 Chassis	
Engine Disconnect Lever Plate	Driver side of power plant cooling fan cowling.
Fan Oil Gauge Decal	Beside Engine Disconnect Plate.
Monoxide Warning Decals (4)	Directly above engine access panels in both personnel compartment and driver's compartment.
	Center part of personnel compartment engine access panel and lower center portion of the driver compartment access panel.
Power Train Maintenance Plate	Top right of driver's compartment engine access panel.
Vehicle Operation Plate	Top central position of driver's compartment engine access panel.
Vehicle Shipping Plate	Lower forward of driver's compartment engine access panel.
Pivot Steering Caution Plate	Top forward of driver's compartment engine fire wall above range selector.
Stall Check Warning Plate	Top forward of driver's compartment engine fire wall above range selector.
Ramp Instruction Plate	Center forward of driver's compartment engine access panel.
Air Cleaner Instruction Decal	In engine compartment on front top of engine air filter unit.
Air Vent Decal	Above personnel compartment engine access panel and to the right of the air inlet ventilator (behind air grille curtain).
Battery Service Instruction Plate	Front right side of personnel compartment on cover of chassis battery box.
Portable Fire Extinguisher Nameplate	On portable fire extinguisher near commander's seat, right rear of chassis.
Master Switch Instruction Plate	Lower left side of driver's compartment on master switch panel.
Gear Selector Operation Plate	Lower forward of driver's compartment engine fire wall.
Fire Extinguisher Caution Plate	Above fixed fire extinguisher on left rear side of driver's compartment.

Table 1-2. Name, Caution and Identification Plates—Continued

Name	Location
M163 System (Chassis) Nameplate	Above and to the left of the driver's compartment engine access panel.
Hatch Opening Warning Plates	To right of driver on engine compartment bulkhead and on roof beam forward of commander's hatch.
M163 System with Equipment Nameplate	Above and to the right of the driver's compartment engine access panel.
Ramp Lock Warning Plate	Centered above the driver's compartment engine access panel.
Ramp Lock Lever Instruction Panel	Centered above the driver's compartment engine access panel and just below the ramp lock warning plate.
Manual Downshift Speed Limits Plate	Top left of the driver's compartment engine access panel.
Ramp Operation Plate	Below range selector in the driver's compartment.
High Power Power Pack Warning Decal	Front lower left side of the driver's compartment on the high voltage power pack.
Pull to Stop Engine-Push Before Start Instruction Decal	Forward, right side of driver's compartment above fuel cutoff control.
Hydraulic Oil Level Decal	Behind driver's compartment engine access panel, lower right, on hydraulic tank.
Pivot Steer Cylinder Caution Tags (2)	Lower front of driver's compartment on pivot steer master cylinders.
Suspension Lockout Instruction Plate	Upper right side of driver's compartment engine fire wall. To the rear of the engine access panel.
Water Operation Plate	Center of the driver's compartment engine access panel.
Communications Equipment Caution Decal	On master switch panel directly above MASTER SWITCH.
Engine Voltage Regulator Nameplate	On top of engine voltage regulator, toward the left front of the driver's compartment.
Final Drive Nameplate (2)	Left Final Drive: Toward the front on the right side of the final drive. Right Final Drive: Toward the rear on the left side of the final drive.
Differential Nameplate	Top right side of differential.
M168 Cannon	
Cannon Nameplate	Underside of rear housing assembly.
Gun Drive Assembly Nameplate	Underside of drive assembly housing.
M157 Mount Nameplate	Mount base plate, left front.
Elevation Drive Assembly Nameplate	Top right side of elevation drive assembly.
Elevation Drive Motor Nameplate	Top of elevation drive motor housing.
Declutching Feeder Assembly Nameplate	Right side of declutching feeder assembly.
Exit Unit Assembly Nameplate	Top left of exit unit assembly.
Conveyor Assembly Nameplate	On front side of conveyor unit.
Drum End Drive Assembly Nameplate	On top, left side of drum drive assembly below shift pin handle.
Internal Drum Assembly	On exit end of drum below take-off gear.
Azimuth Drive Assembly Nameplate	Bottom on azimuth drive assembly.
Azimuth Drive Motor Nameplate (2)	Left side of azimuth drive motor.
M61 Sight Plate	Right side of M61 sight housing.
M61 Sight Gyro Caging Instruction Plate	Lower rear of M61 sight housing.
Control Assembly Nameplate	Top right of control assembly.
Distribution Box Plate	Jack end of distribution box assembly.
Servo Amplifier Assembly Plate	Top of servo amplifier assembly base (not visible).
Inverter Plate	Bottom on inverter assembly.
Sight Current Generator Plate	End of sight current generator assembly near air density and muzzle velocity knobs.
Muzzle Velocity and Air Density Charts	On side of sight current generator assembly.
Mount Component Assembly Nameplate	Lower left of personnel compartment, gunners access, near loading motor.

Table 1-2. Name, Caution and Identification Plates—Continued

Name	Location
Azimuth Indicator Nameplate	On top of azimuth indicator housing.
Radar Set AN / VPS-2 Nameplate	Left side of receiver unit (unit 3).
Antenna Nameplate	Left side of reflector and feed housing.
Receiver-Transmitter Nameplate	Top left of front panel assembly.
Receiver Nameplate	Top center of front panel.
Range Computer Nameplate	Top right of front panel.
Power Supply Nameplate	Bottom right of front panel.
Distribution Box Nameplate	Top center of distribution box (stow control).

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

2-1. General

This section describes the various controls and instruments and provides the operator / crew with sufficient information to assure proper operation of the M163 system.

2-2. Control and Instruments

The M163 system controls and instruments are listed in tables 2-1 through 2-5 and are illustrated in figures 2-1 through 2-38.

Table 2-1. Controls and Instruments, M741 Chassis

Control	Function	Reference
	DRIVER'S COMPARTMENT	
Fixed fire extinguisher		1. Fig 2-1
Interior actuating handle	Actuates power plant compartment fire extinguisher from inside the chassis.	Fig 2-2B
Exterior actuating handle	Actuates power plant compartment fire extinguisher from outside the chassis.	Fig 2-2A
Instrument Panel		2. Fig 2-1
I.R. POWER switch	Turns on power to the M19 periscope.	1. Fig 2-3
Lights switch assembly UNLOCK lever	Momentarily unlocks main and panel light switch levers. The switch has two positions, the UNLOCK and spring return lock position.	2. Fig 2-3 Fig 2-4
Panel lights switch lever	Selects panel lights. The switch has four positions. PARK-Unused. OFF-Turns off all panel lights. DIM-Turns panel lights on dim. PANEL BRT.-Turns panel lights on bright.	Fig 2-4
Main lights switch lever	Selects driving lights for normal and tactical situations. The switch has five positions as shown in fig. 2-4.	Fig 2-4
IR-BO SELECT	Selects infrared headlights (when M19 periscope is used) or blackout headlights.	3. Fig 2-3
START pushbutton switch	Energizes the engine starter.	4. Fig 2-3
BATTERY-GENERATOR indicator	Indicates battery voltage when MASTER switch is ON and engine is off and generator voltage when engine is on. The colors on the dial designate: RED (left) .....Low voltage YELLOW (middle) ....Medium voltage GREEN (right) .....High voltage RED (far right) .....Excessive voltage.	5. Fig 2-3
Panel lights	Illuminate the instrument panel.	6. Fig 2-3
FUEL indicator	Indicates amount of fuel remaining in fuel compartment.	7. Fig 2-3
AIR BOX HEATER switch	Turns on air box heater for cold weather starting. Switch is spring loaded to off.	8. Fig 2-3
Speedometer	Measures ground speed in miles per hour. An odometer shows accumulated mileage.	9. Fig 2-3
MASTER SWITCH ON indicator	Lights when MASTER SWITCH on master switch panel is set to ON or when APU is being used to charge batteries.	10. Fig 2-3
Engine TEMP F indicator	Indicates engine operating temperature in degrees Farenheit.	11. Fig 2-3
BILGE PUMPS ON		
REAR indicator	Lights when rear bilge pump is turned on.	12. Fig 2-3
FRONT indicator	Lights when front bilge pump is turned on.	14. Fig 2-3
Tachometer	Measures engine speed in revolutions per minute (rpm).	13. Fig 2-3
BILGE PUMPS switch	Turns on front and rear bilge pumps.	15. Fig 2-3

Table 2-1. Controls and Instruments, M741 Chassis—Continued

Control	Function	Reference
	DRIVERS COMPARTMENT—Continued	
Warning lights panel:		3, Fig 2-1
DIFF OIL-HI TEMP indicator	Lights to indicate that temperature of differential oil is too high for safe operation (300° to 310° F).	Fig 2-5
TRANS OIL-HI TEMP indicator	Lights to indicate that temperature of transmission oil is too high for safe operation (300° to 310° F).	Fig 2-5
ENGINE OIL-HI TEMP LO PRESS indicator	Lights to indicate that temperature of oil is too high for safe operation (300° to 310° F) or that oil pressure is too low for safe operation (0-13 psi).	Fig 2-5
HORN pushbutton switch	Operates the horn.	Fig 2-5
HEADLIGHTS-HI BEAM indicator	Lights to indicate that headlights are on high beam.	Fig 2-5
SUSP LOCKED OUT indicator	Lights to indicate suspension system is locked out.	Fig 2-5
Pivot steer levers	Used for short radius turns, emergency stops, and water operation.	4, Fig 2-1
Range selector	Selects proper transmission range.	5, Fig 2-1
SUSPENSION LOCKOUT control	Activates chassis suspension lockout system: EXTEND position—lockout cylinders engaged. RETRACT position—lockout cylinders disengaged.	6, Fig 2-1
Power plant access panel handle (4 on each panel)	Releases access panels to provide access to the power plant compartment.	7, Fig 2-1
Ramp locking handle	Locks ramp when fully raised.	8, Fig 2-1
Fuel cutoff control	Shuts off fuel supply to stop the engine.	9, Fig 2-1
Hand THROTTLE control	Sets engine speed to any selected rpm.	10, Fig 2-1
Ramp actuating lever	Used to lower an raise the ramp.	11, Fig 2-1
Beam selecting switch	Switches the headlights between high and low beam.	12, Fig 2-1
Accelerator pedal	Controls engine speed and transmission detent.	13, Fig 2-1
Differential steering levers	Used to turn, slow or stop the chassis when it is moving forward or backward, on land or in water.	14, Fig 2-1
Brake lock buttons	Locks brake(s) on when depressed.	15, Fig 2-1
Master switch panel MASTER SWITCH	Disconnects the chassis batteries from chassis wiring. (Power to communications equipment is not affected.)	16, Fig 2-1 Fig 2-6
Auxiliary power receptacle	Provides for use of external 24-volt power to start engine, charge chassis batteries, or operate chassis electrical equipment. Cannot be used to charge M157 mount batteries or to operate M157 mount.	Fig 2-6
Infrared stowage receptacle	Holds the M19 periscope power cable when cable is not in use.	Fig 2-6
Utility outlet	Provides electrical power for 24-volt accessories from the chassis electrical system.	Fig 2-6
Dome light control (2)	Turns on red or white dome light. Turned to first stop turns red light on. With button depressed and turned to second stop turns white light on.	Fig 2-7
Driver's seat:		
Vertical control handle	Allows vertical adjustment of the seat.	Fig 2-8
Horizontal control handle	Allows horizontal adjustment of the seat.	Fig 2-8
Driver's hatch cover	Provides access to driver's compartment.	Fig 2-9
Interior latch	Secures the hatch cover closed from inside.	Fig 2-9A
Exterior hold-open latch	Secures the hatch cover open away from the driver's head.	Fig 2-9B
Exterior hold-closed latch	Secures the hatch cover closed from outside the vehicle.	Fig 2-9C
Sight glass	Provides a visual indication of front bilge pump discharge.	Fig 1-9

Table 2-1. Controls and Instruments, M741 Chassis—Continued

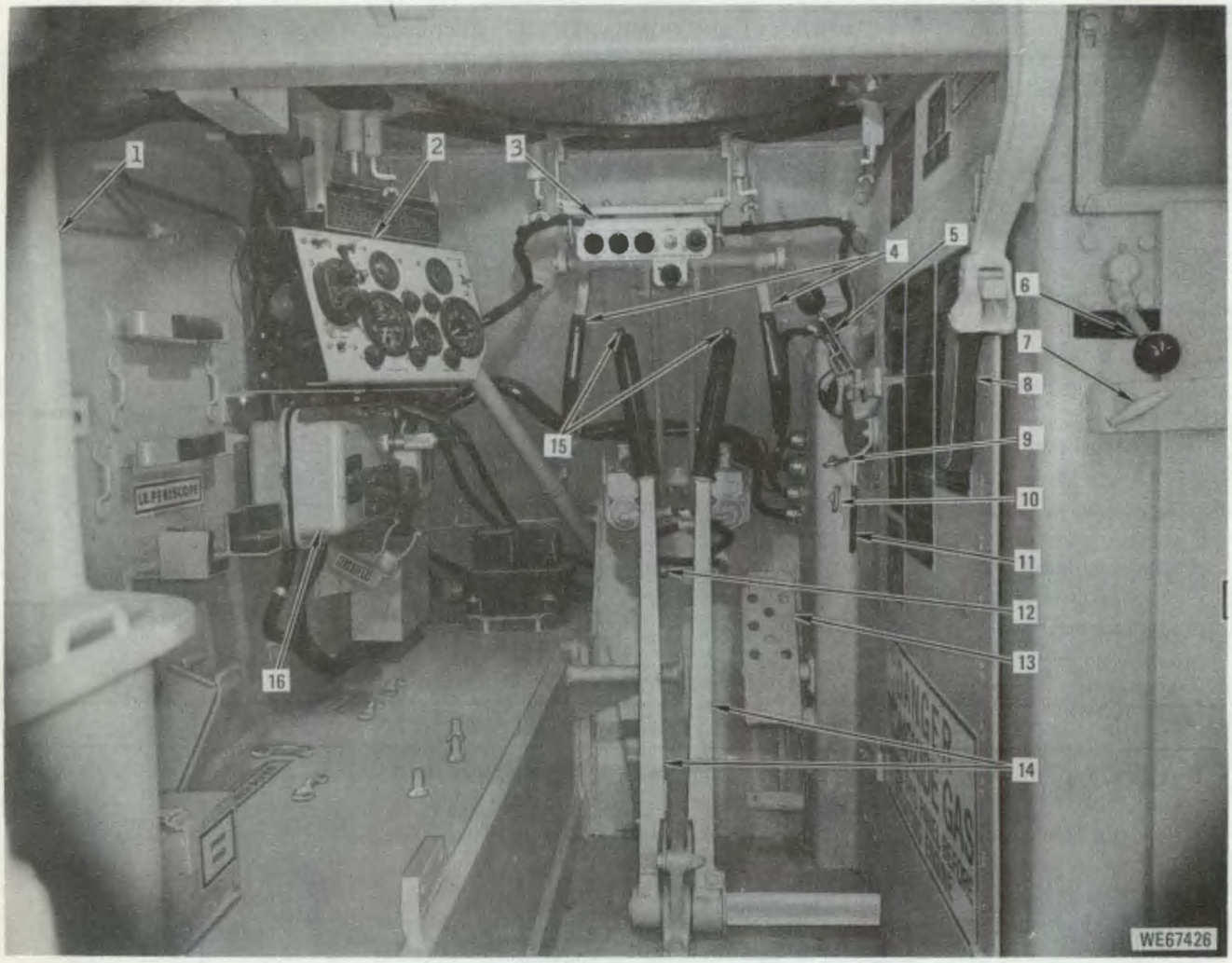
Control	Function	Reference
	PERSONNEL COMPARTMENT	
Fuel flow control valve	Shuts off the fuel flow to the engine at the fuel compartment.	Fig 2-10
Personnel compartment ventilator handle	Opens or closes ventilator.	Fig 2-11
Commander's seat:		
Seat release handle	Used to stow the seat in the up position when not in use.	Fig 2-12A
Vertical control handle	Used to adjust height of seat.	Fig 2-12B
Commander's hatch cover	Provides access to the commander's position from the top of the chassis.	Fig 2-13
Interior latch	Secures hatch in closed position.	Fig 2-13A
Exterior latch	Secures hatch in open position.	Fig 2-13B
Ramp personnel door	Provides access to personnel compartment when ramp is raised and locked.	Fig 1-3
Interior handle release	Locks the door handle in the closed position.	Fig 2-14A
Interior handle	Unlatches personnel door from inside of vehicle. When handle is in the fully open position locks the ramp to prevent lowering the ramp.	Fig 2-14B
Exterior handle	Unlatches the personnel door from outside the vehicle if the interior handle is in the unlocked position.	Fig 2-14C
Exterior hold open hook	Secures the personnel door in the fully open position.	Fig 2-14D
	POWER PLANT COMPARTMENT	
Power plant door	Provides access to the power plant compartment from front of vehicle.	Fig 2-16A

Table 2-1. Controls and Instruments, XM741 Chassis - Continued

Control	Function	Reference
POWER PLANT COMPARTMENT - Continued		
ACCESS DOOR RELEASE handle	Releases and secures the power plant access door.	Fig. 2-16A
Hold open brace	Braces the power plant access door open.	Fig. 2-16B
Interior combat lock	Actuated by handle in driver's compartment. Locks the power plant access door in the closed position during combat operations.	Fig. 2-16C
Air box heater:		
Pressure indicator	Indicates air box heater accumulator pressure.	Fig. 2-17
Hand fuel pump	Used to build up the fuel pressure in the accumulator for cold weather starting of the engine. To release plunger, push in and turn 90° counterclockwise.	Fig. 2-17
Engine disconnect control handle (in back of driver's compartment access panel)	Disengages the engine from rest of the power train.	Fig. 2-18
Coolant filler	Used to fill the radiator with coolant.	Fig. 2-19
MISCELLANEOUS EXTERNAL CONTROLS		
Fuel filler cap	Allows access to fill the fuel compartment with diesel fuel.	Fig. 2-20B
Interior combat lock	Used to lock the filler cover closed during combat operations.	Fig. 2-20A
Trim vane handle	Extends trim vane to stabilize the chassis during water operations.	Fig. 2-21A
Trim vane quick release	Releases trim vane for access to power plant compartment.	Fig. 2-21B
Towing pintle	Used to pull a disabled chassis. Latch used to open pintle.	Fig. 2-22

Table 2-2. Controls, XM168 Cannon

Control	Function	Reference
Index pin	Timing cannon	Fig. 2-23
Muzzle clamps	Control dispersion pattern for antiaircraft or ground role applications.	Fig. 1-10



1 Fixed fire extinguisher (hidden)
2 Instrument panel
3 Warning lights panel
4 Pivot steer levers
5 Range selector
6 Suspension lockout control
7 Power plant access panel handle
8 Ramp locking handle
9 Fuel cutoff control
10 Hand throttle control
11 Ramp actuating lever
12 Beam selecting switch
13 Accelerator pedal
14 Differential steering levers
15 Brake lock buttons
16 Master switch panel

Note: Driver's seat removed for clarity.

Figure 2-1. Driver's compartment, controls and instruments.

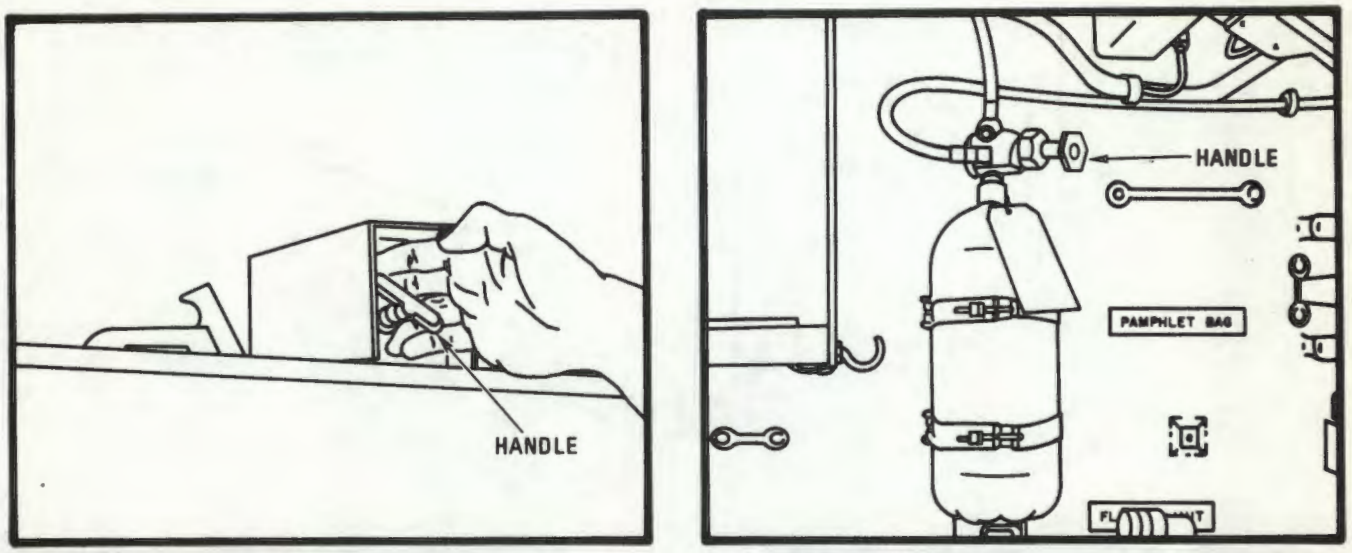


Figure 2-2. Fixed fire extinguisher controls.

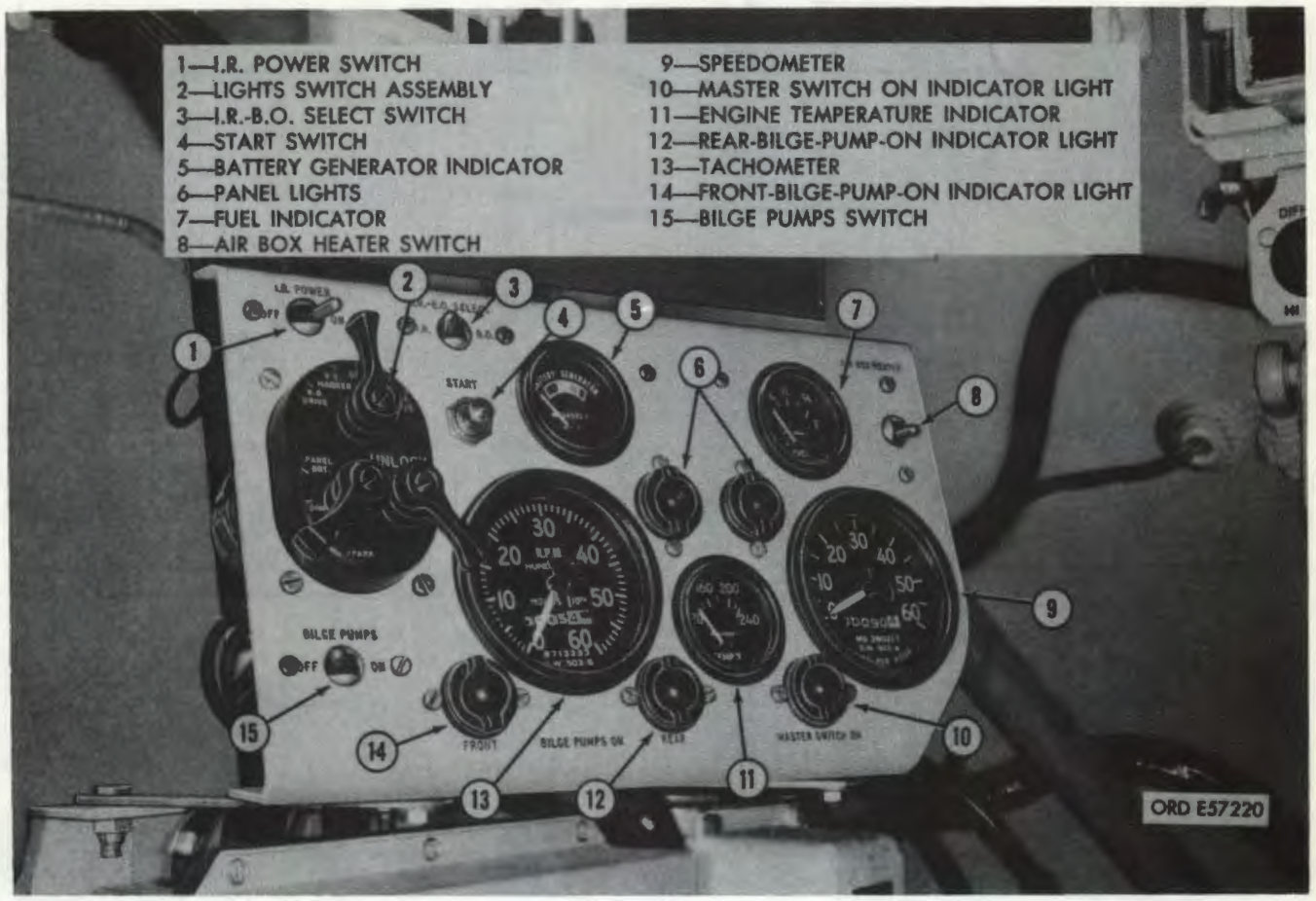


Figure 2-3. Instrument panel.

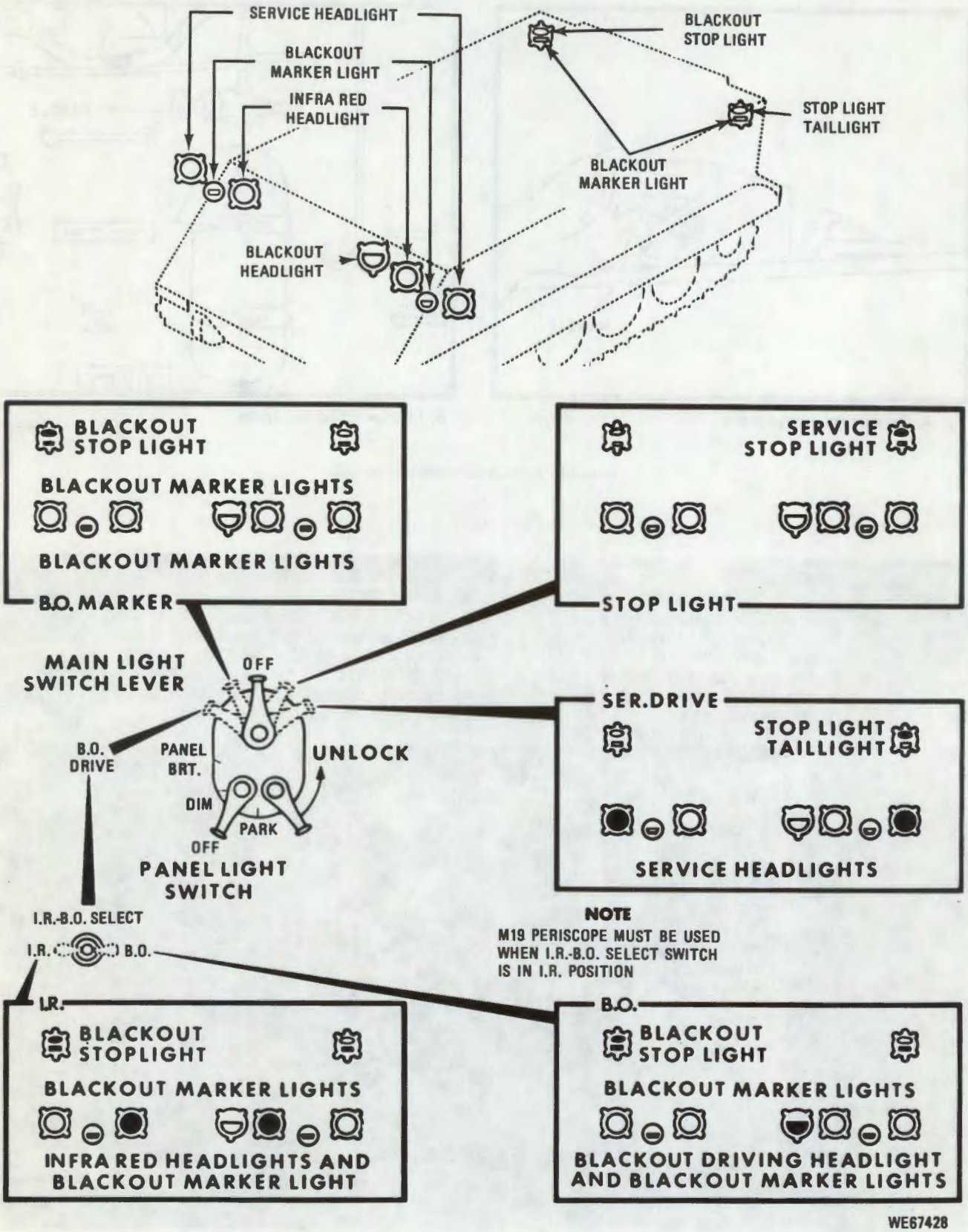


Figure 2-4. Driving lights chart.

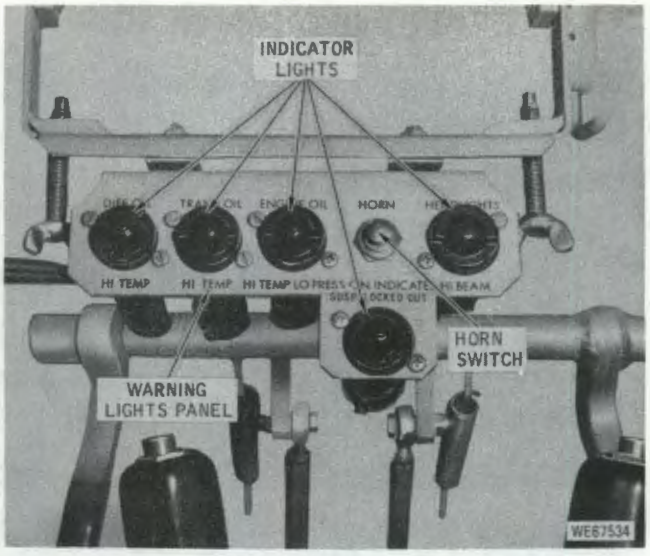


Figure 2-5. Warning lights panel.

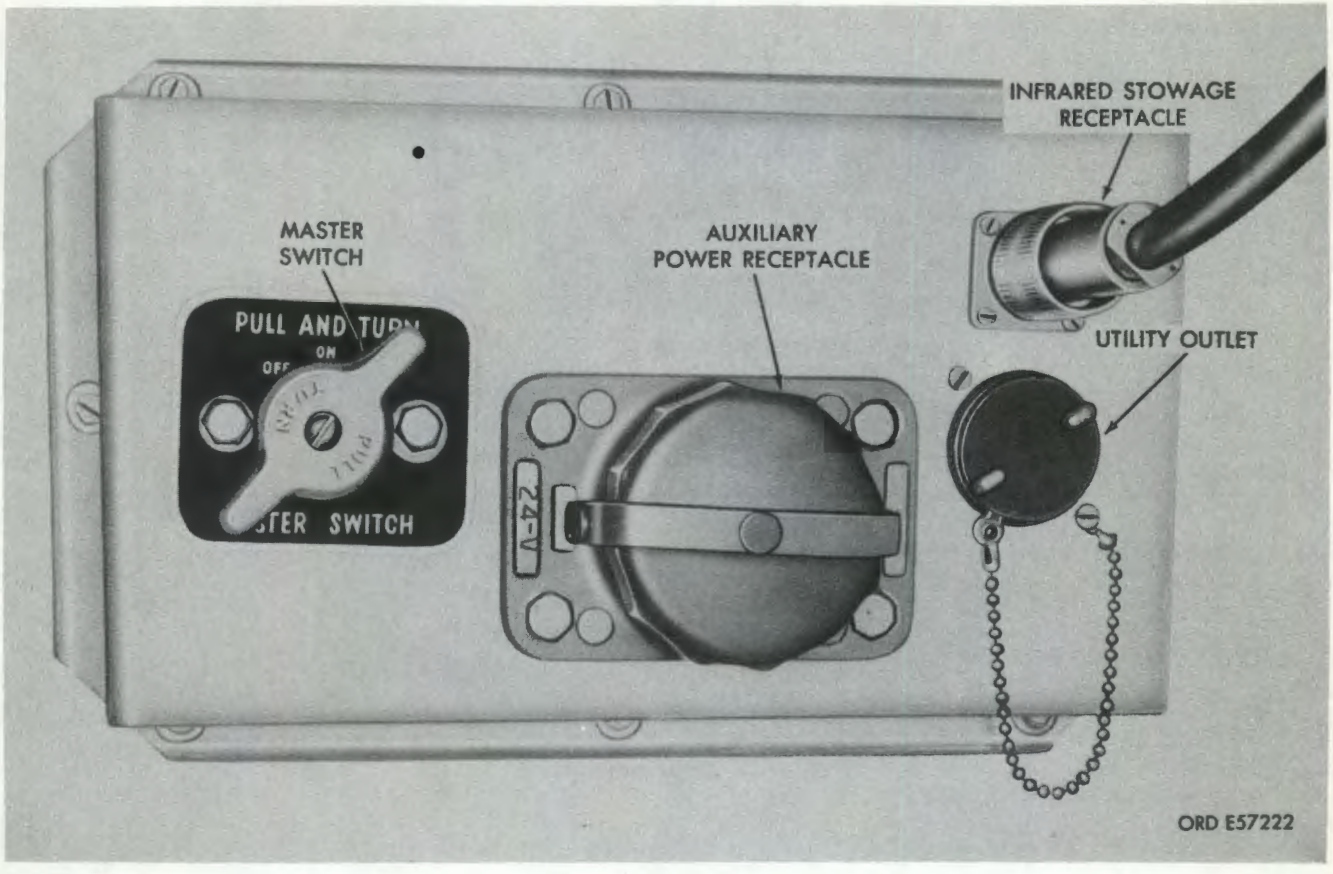


Figure 2-6. Master switch panel.

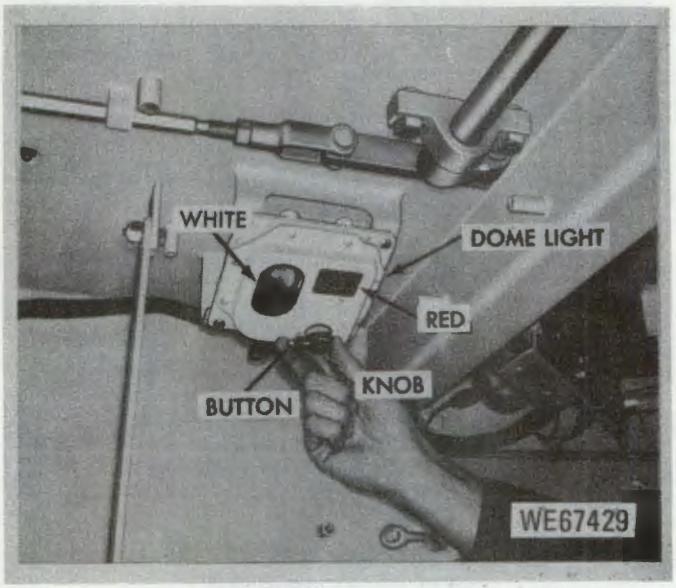


Figure 2-7. Dome lights control.

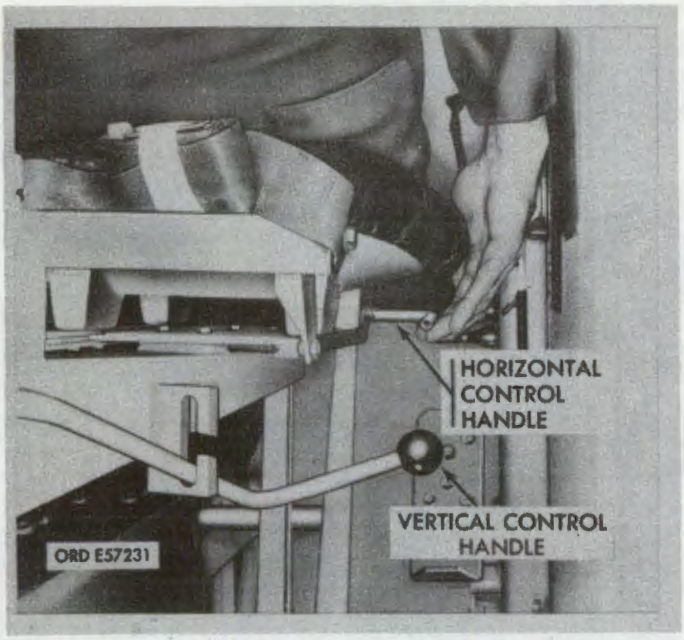
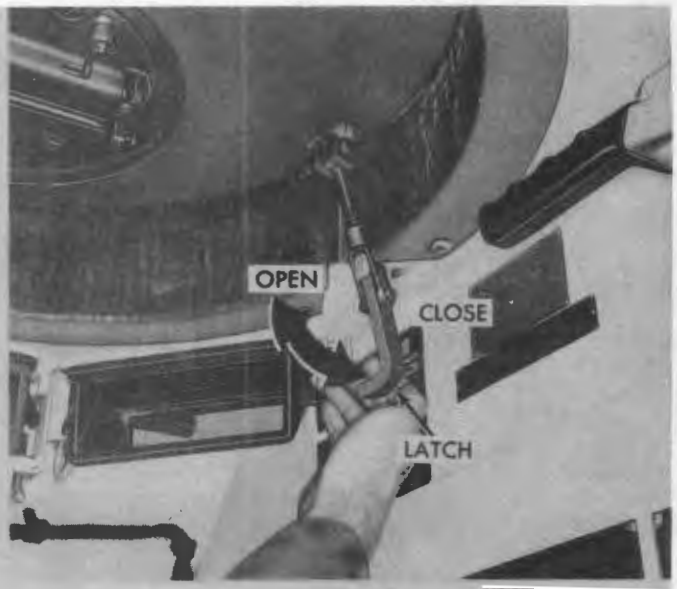
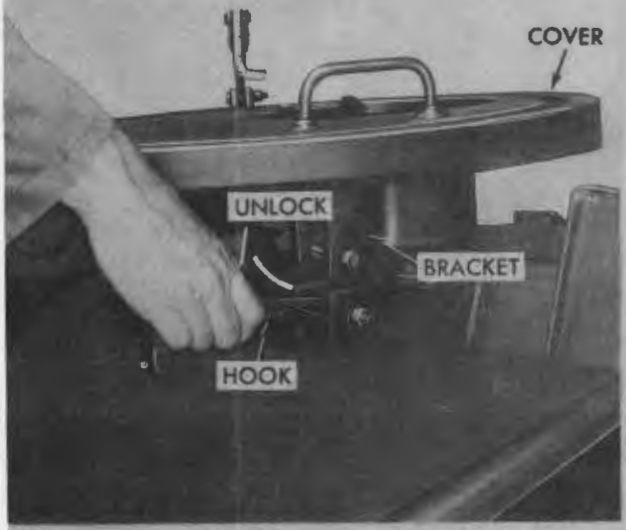


Figure 2-8. Driver's seat control.

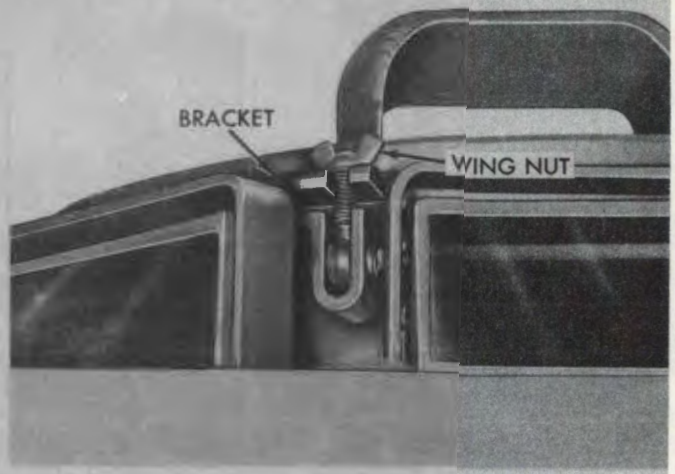
WARNING: When driver's hatch cover is open, secure cover with hook to prevent injury to driver.



A. Interior latch.



B. Exterior hold-open hook.



C. Exterior hold-closed latch.

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Figure 2-9. Driver's hatch cover control.

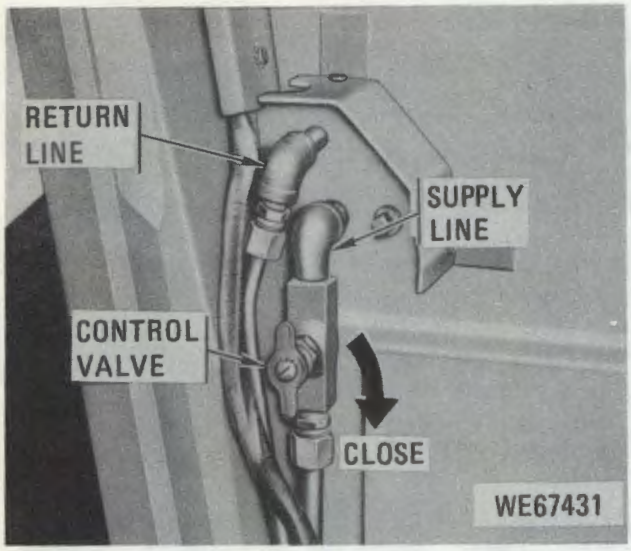


Figure 2-10. Fuel flow control valve.

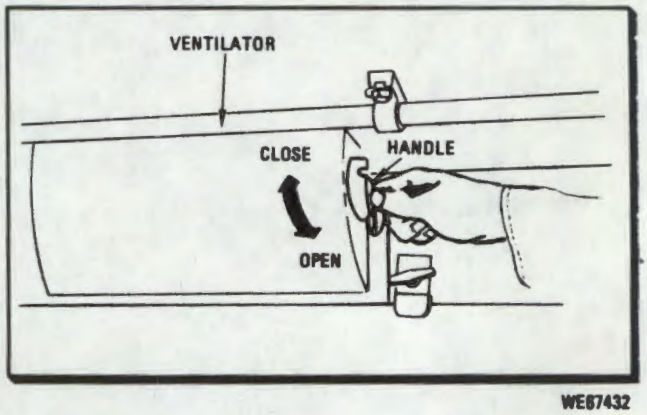


Figure 2-11. Personnel compartment vent handle.

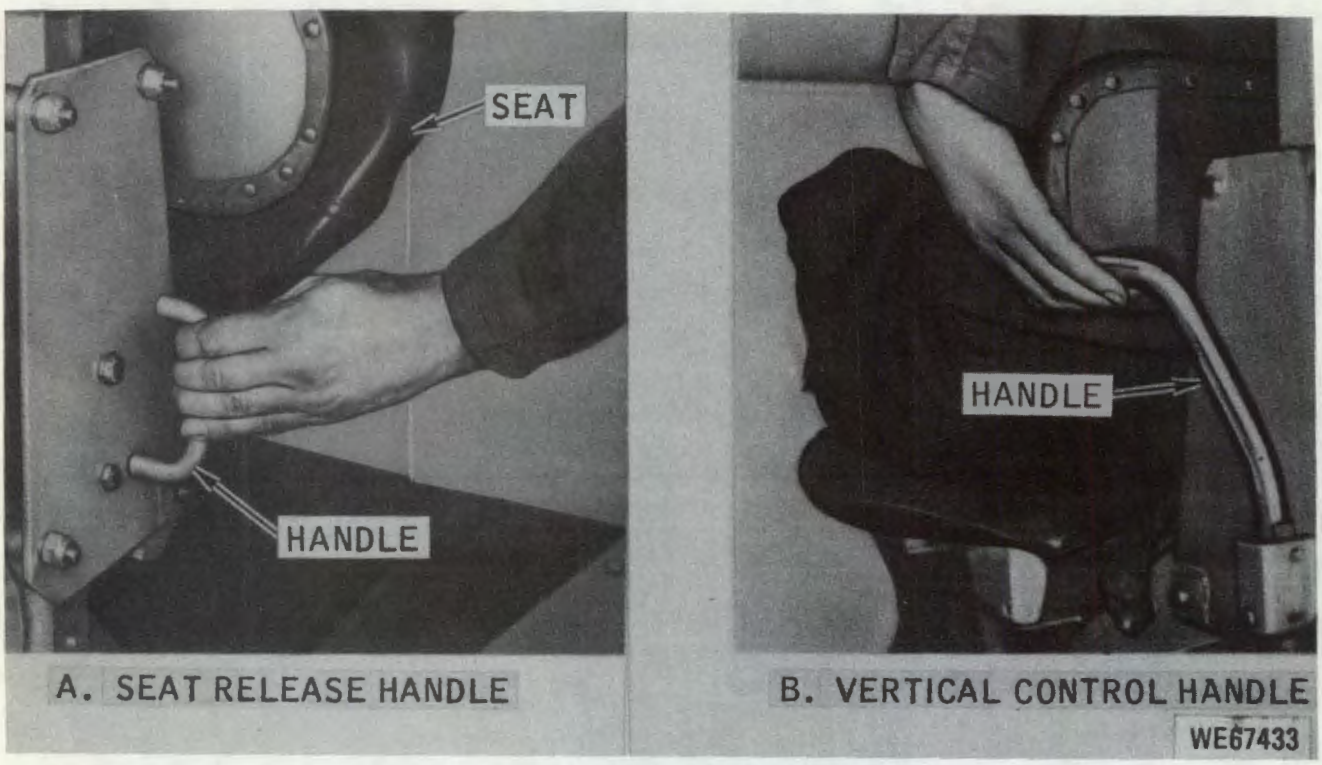


Figure 2-12. Commander's seat control.

Figure 2-13. Commander's hatch control.

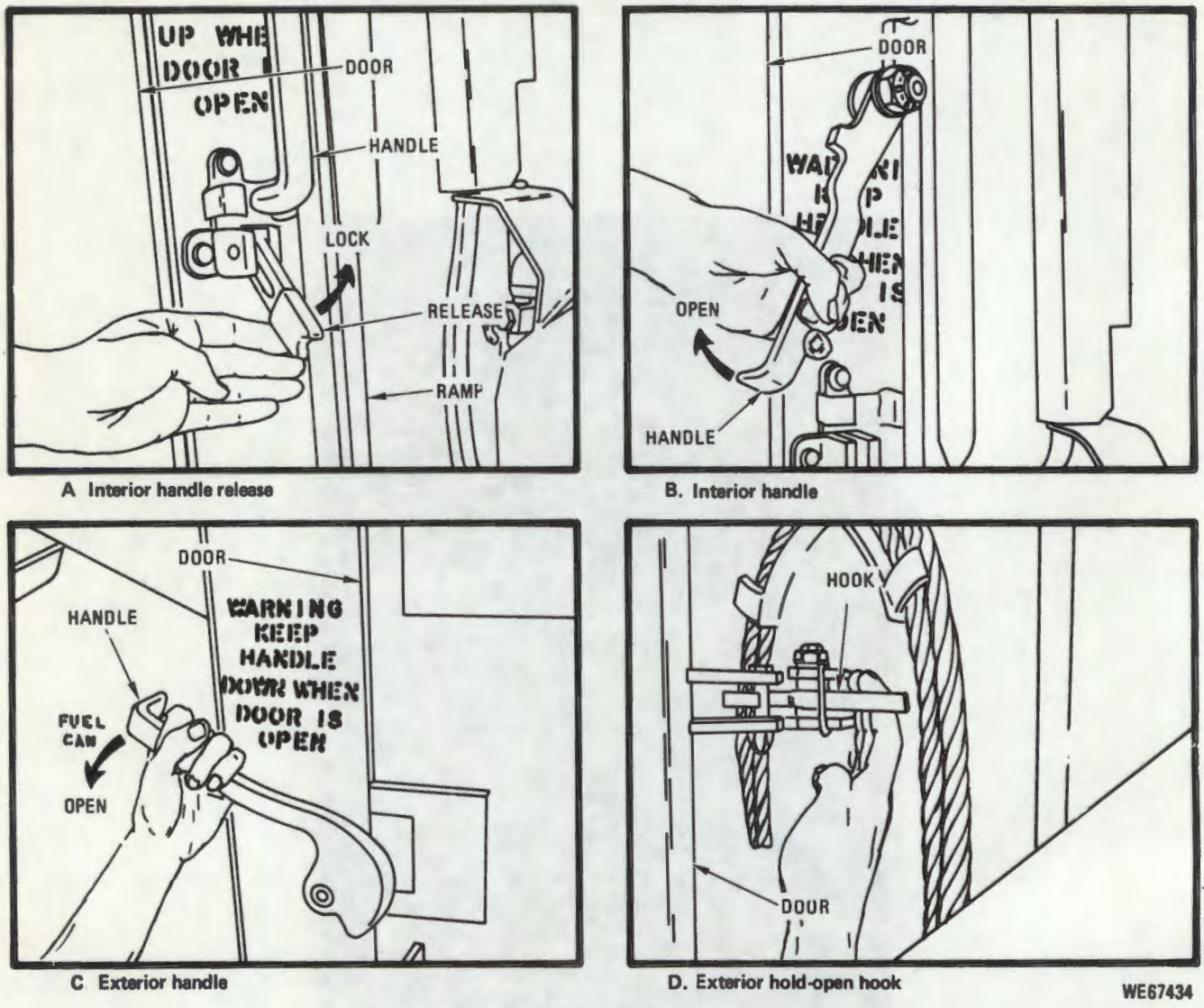


Figure 2-14. Ramp door controls.

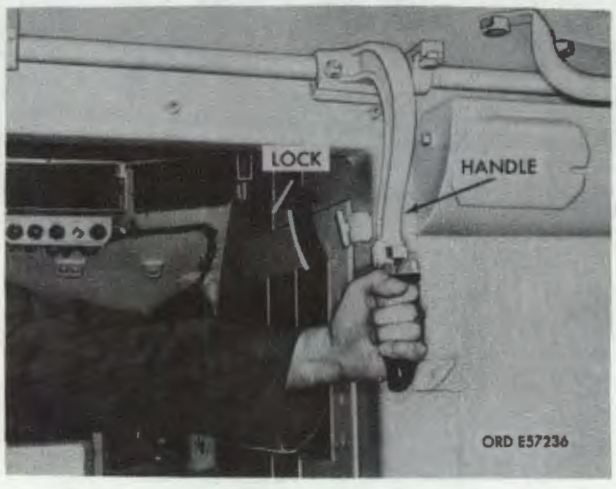
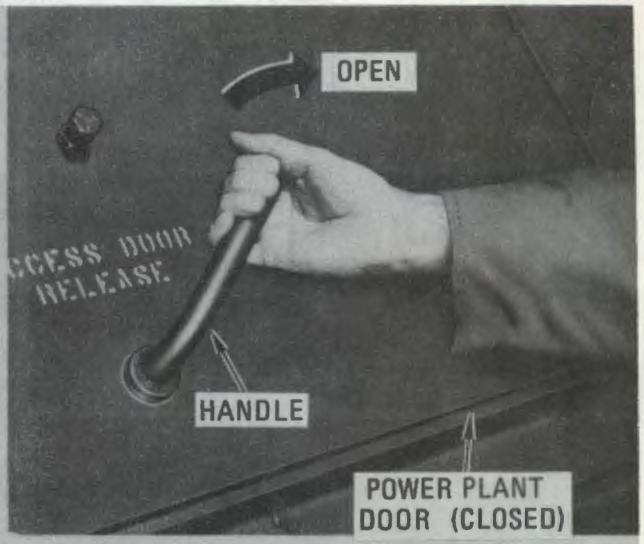


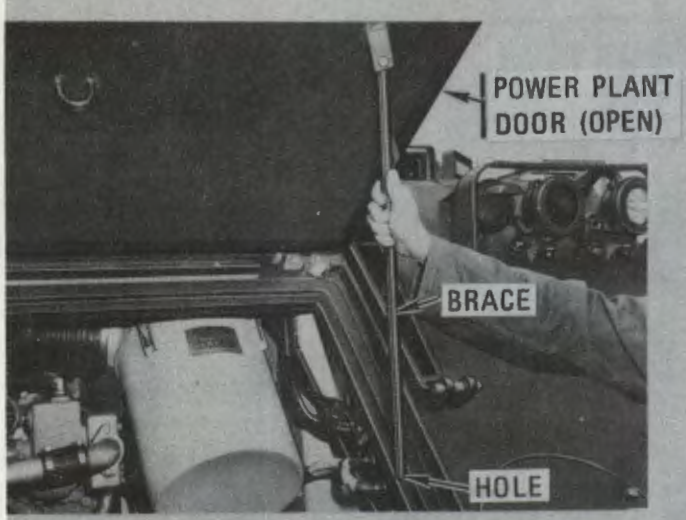
Figure 2-15. Ramp locking handle.

NOTE

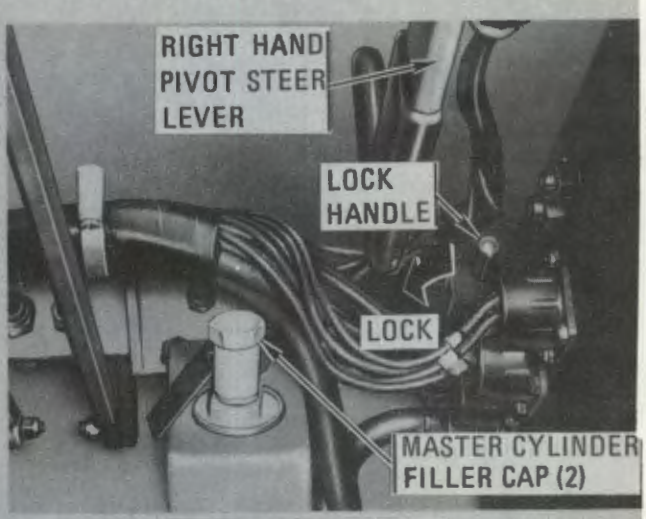
Make certain brace is in hole before releasing power plant door. Combat lock is locked when pointing down and forward.



A. Access door release handle



B. Hold-open brace.



C. Interior combat lock handle (located in driver's compartment)

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Figure 2-16. Power plant access door controls.

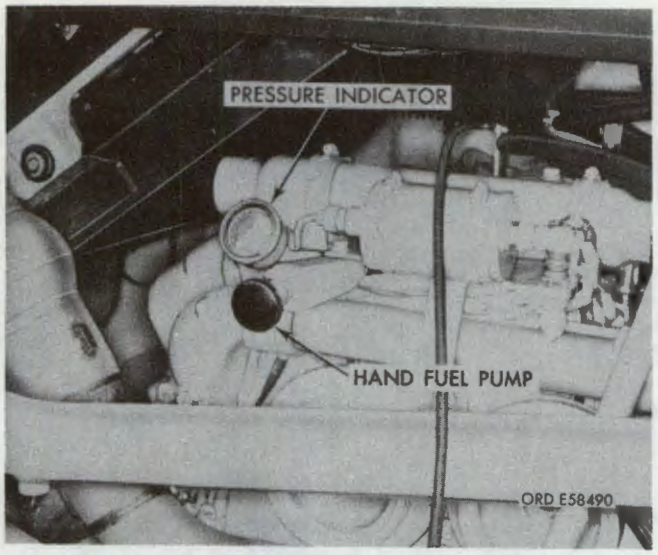


Figure 2-17. Air box heater control.

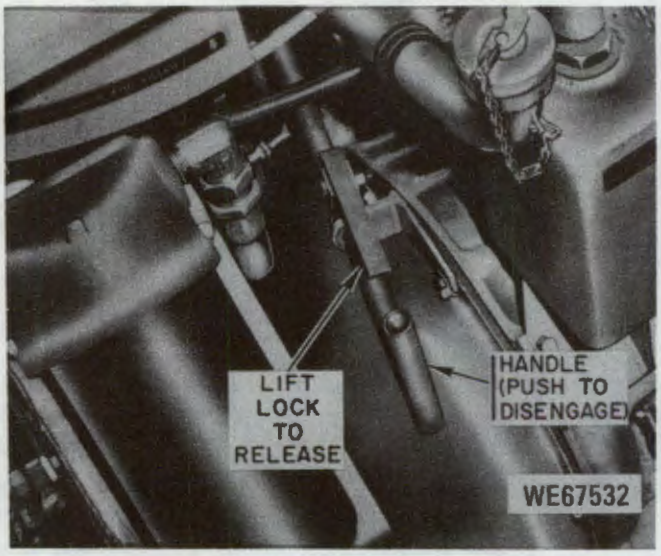


Figure 2-18. Engine disconnect control handle.

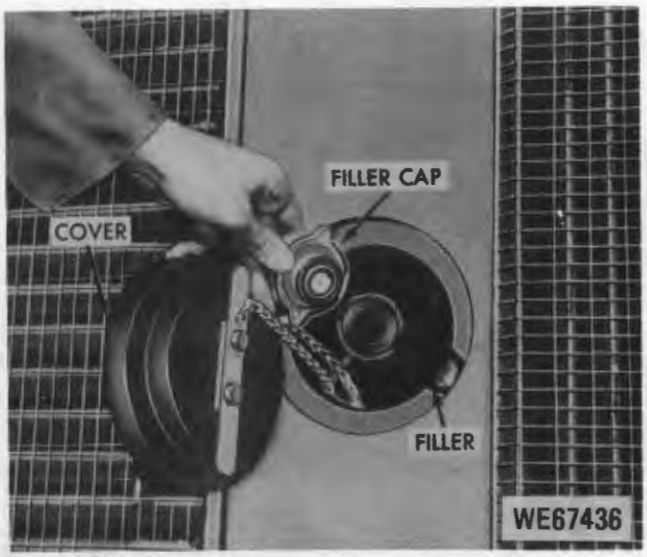
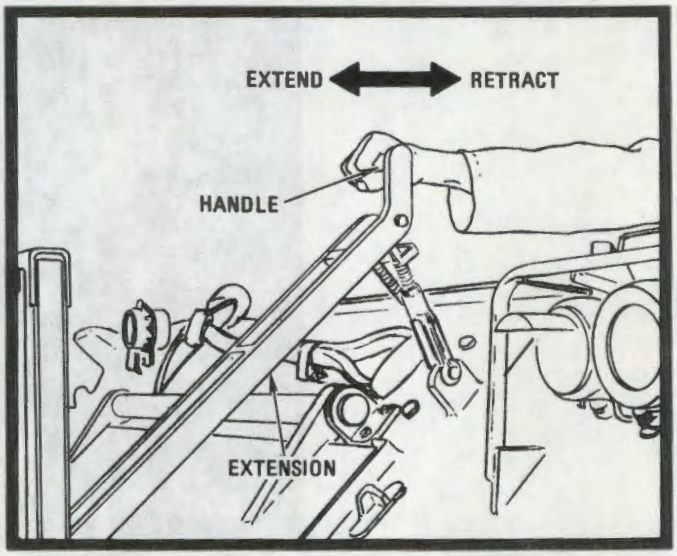


Figure 2-19. Coolant filler.

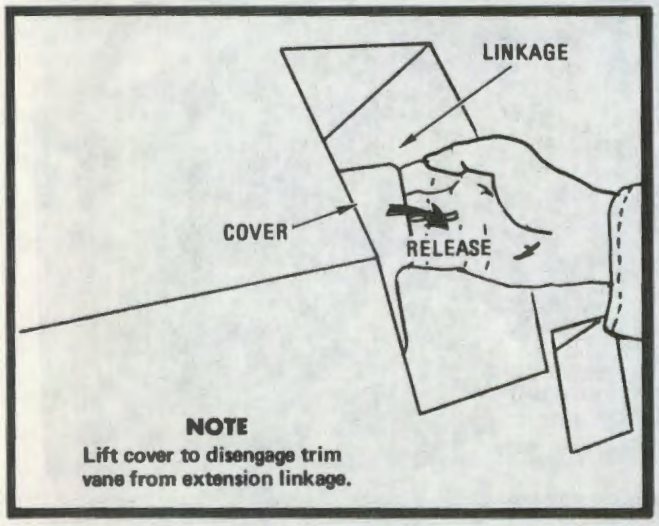
Figure 2-20. Fuel filler.

CAUTION

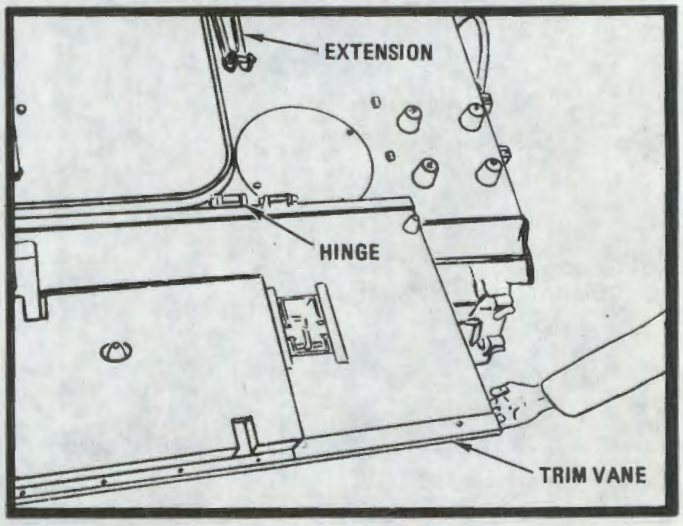
Check tightness of trim vane release before extending. If loose, notify organizational maintenance personnel.



A. Operating trim vane



B. Quick release



C. Trim vane released

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Figure 2-21. Trim vane control.

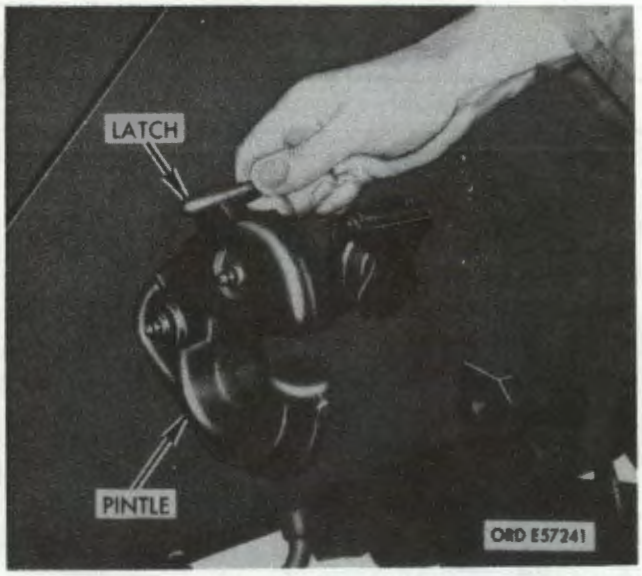


Figure 2-22. Towing pintle.

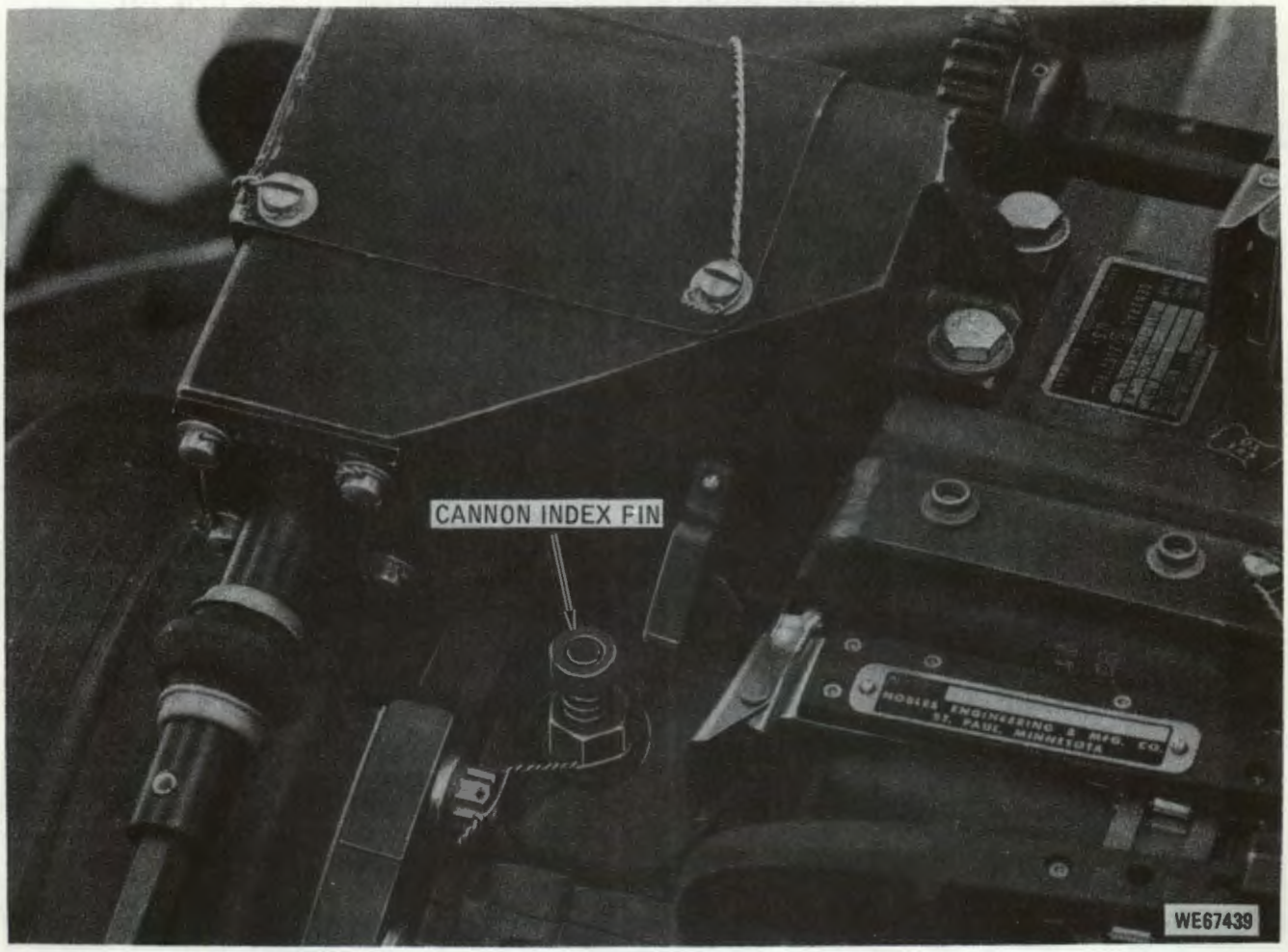


Figure 2-23. Cannon index pin.

Table 2-3. Controls and Instruments, XM157 Mount

Control	Function	Reference
	MISCELLANEOUS MOUNT CONTROLS	
BRAKE - CLEAR AND BRAKE switch	When held in BRAKE position, releases gun motor drive brake. Performs same function in CLEAR AND BRAKE position, but also declutches feeder, stopping cycling of ammunition. The switch is spring-loaded to center (off) position.	Fig. 2-27
Azimuth drive motor brake release lever (2)	Releases brakes on azimuth drive motors manually. (Brakes on with levers vertical; brakes off with levers horizontal.)	Fig. 1-20
Elevation drive motor brake release lever	Releases elevation drive motor brake manually. (Brake is on with lever in line with motor; brake is off with lever perpendicular to motor.)	Fig. 1-17
Gun drive motor brake release lever (2) (1 is hidden).	Releases gun drive motor brake.	Fig. 1-17
Declutching feeder assembly: Index pin	Used to time declutching feeder assembly to gun.	Fig. 2-31
Foot switch assembly	Activates Radar Set AN/VPS-2 to radiate condition while in radar mode of operation.	Figs. 1-20 and 2-34
	CONTROL ASSEMBLY	
GOOD WHEN LIT indicator	Lights in test mode as part of prefire check.	1, Fig. 2-24
ROUNDS REMAINING counter	Indicates, in 10-round increments, number of rounds remaining in ammunition drum. Resets manually.	2, Fig. 2-24
FIRING RATE switch	Selects firing rate and limits the number of rounds fired in high-rate only: LO-NO BURST LIMIT HI-BURST LIMIT - 10 rounds per burst - 30 rounds per burst - 60 rounds per burst - 100 rounds per burst	3, Fig. 2-24
GUN CLEAR switch	Selects one of the following gun clearing modes: AUTO - The cannon is automatically cleared after firing. OPERATOR (Spring-loaded) - When GUN CLEAR switch is held in this position and either action switch is closed, clearing of the cannon occurs. OFF - The cannon is not cleared after firing.	4, Fig. 2-24
RANGE IN METERS knob	Provides estimated target range to the SCG in manual mode.	5, Fig. 2-24
GUN POWER indicator	Lights when cannon power is applied to the firing circuits.	6, Fig. 2-24
SYSTEM POWER indicator	Lights when power is applied to the system.	7, Fig. 2-24

Table 2-3. Controls and Instruments, XM157 Mount - Continued

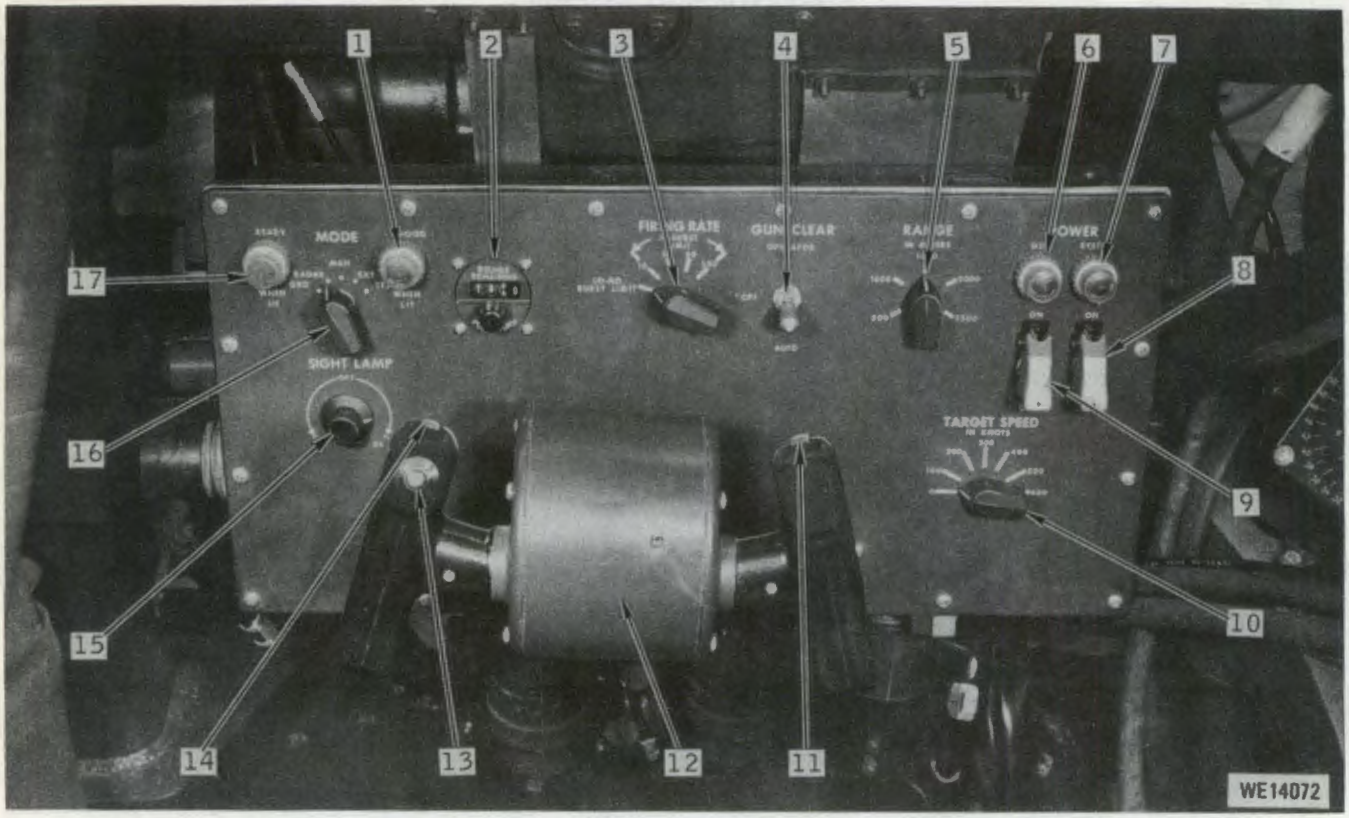
Control	Function	Reference
	CONTROL ASSEMBLY - Continued	
SYSTEM POWER switch	Applies power to the system (excluding the chassis).	8, Fig. 2-24
GUN POWER switch	Applies power to cannon firing circuits.	9, Fig. 2-24
TARGET SPEED IN KNOTS knob	Provides estimated target approach velocity to SCG in manual mode.	10, Fig. 2-24
Elevation control assembly	When rotated clockwise or counterclockwise, causes mount to slew in direction of rotation; when pivoted forward or back, causes the mount to follow movement of controls in elevation.	12, Fig. 2-24
Action switches	When either or both action switches are closed, enables cannon to be positioned and fired.	Figs. 2-25 and 2-26
Sight cage switch	Cages sight gyro electrically when depressed.	13, Fig. 2-24
Trigger switch (left grip assembly)	Dummy - no function.	14, Fig. 2-24 and Fig. 2-25
Trigger switch (right grip assembly)	Fires cannon.	11, Fig. 2-24 and Fig. 2-26
SIGHT LAMP knob	Controls XM61 sight reticle lamp intensity.	15, Fig. 2-24
MODE switch	Selects one of the following modes of operation: GRD - Lead computing feature of the sight is not used. RADAR - Range and target speed information are set into the system automatically by the radar. MAN - Range and target speed are set into the system by the operator. EXT - Range data is supplied to the system by means of the external range control. TEST - Activates selftest circuitry in sight current generator (used in prefire checks).	16, Fig. 2-24
READY WHEN LIT indicator	Lights when RADAR is operational (2-minute warmup is complete).	17, Fig. 2-24
	DISTRIBUTION BOX	
NORM - STATIC - TEST switch	Limits servo operation as follows: NORM position - The system can be operated normally. STATIC position - Both azimuth and elevation drives are disabled. Brakes are not electrically released. TEST position - Brakes are not electrically released. Azimuth drives are enabled and elevation drive is disabled.	1, Fig. 2-28

Table 2-3. Controls and Instruments, XM157 Mount - Continued

Control	Function	Reference
	DISTRIBUTION BOX - Continued	
SIGHT GYRO PWR circuit breaker	Protects sight gyro motor.	2, Fig. 2-28
SCG PWR circuit breaker	Protects sight current generator.	3, Fig. 2-28
INVERTER PWR circuit breaker	Protects inverter.	4, Fig. 2-28
SYS PWR circuit breaker	Protects weapon system.	5, Fig. 2-28
VOLTS meter	Indicates output voltage of external voltage source used to charge system and gun batteries.	6, Fig. 2-28
AMPS meter	Indicates current drawn from power source (either APU or chassis generator).	7, Fig. 2-28
ELAPSED TIME meter	Indicates total time system power is applied (in tenths of hours).	8, Fig. 2-28
	SIGHT CURRENT GENERATOR (SCG)	
AIR DENSITY switch	Provides air density input to the SCG.	Fig. 2-30
MUZZLE VELOCITY switch	Provides muzzle velocity input to the SCG.	Fig. 2-30
Ballistics correction circuit card assembly	Provides ballistics corrections within the SCG.	Fig. 2-31
	OUTER DRUM ASSEMBLY	
ROUND REMAINING TO FIRE windows	Provide a visual means of checking the approximate number of rounds in the drum.	Fig. 1-20
	DRUM DRIVE ASSEMBLY	
Load switch	Energizes loading motor in either MOMENTARY ON or ON position. Spring-loaded in MOMENTARY ON position to return to center (off) position.	Fig. 1-14
Shift pin handle	Locks drum drive, as follows: F (fire) position - Inner drum is driven by gun drive assembly. N (neutral) - Inner drum is disconnected from gun drive assembly and loading motor. L (load) - Inner drum is driven by loading motor.	Fig. 1-14
Rounds expended counter	Records cumulative number of rounds cycled through the system.	Fig. 1-14
TIMING PIN	Used to time the drum assembly.	Fig. 1-14
Take-off gear knurled knob	Provides a means of manually rotating the inner drum.	Fig. 1-14

Table 2-3. Controls and Instruments, XM157 Mount - Continued

Control	Function	Reference
	CONVEYOR UNIT ASSEMBLY	
Handle	Provides a means for locking the conveyor unit assembly in either loading or firing position.	Fig. 1-14
Handle lockbutton	Locks conveyor unit assembly handle.	Fig. 1-14
Timing lock	Holds conveyor gear in timed position when conveyor unit assembly is in loading position.	Fig. 2-29
	EXIT UNIT ASSEMBLY	
Round positioning pin	Used to position first round in exit unit assembly.	Fig. 2-55
Locking pin	Secure double link-stripping guide in loading or firing position.	Fig. 2-29
Double link-stripping guide	Guides linked ammunition into the link stripper during loading.	Fig. 2-29
	GUNNER'S SEAT ASSEMBLY	
Pivot knob	Permits seat to be pivoted.	Fig. 2-33
Vertical positioning lever	Permits seat to be raised or lowered.	Fig. 2-33
Gunner's shield light assembly	Illuminates control panel and interior of XM157 mount during night operations.	Fig. 1-16
	EXTERNAL RANGE CONTROL	
METERS X100 knob	Provides estimated target range to the sight in external mode.	Fig. 1-19
Pushbutton switch	Lights ready-to-fire indicator to inform gunner when to fire.	Fig. 1-19



1 Good-when-lit indicator
2 Rounds remaining counter
3 Firing rate switch
4 Gun clear switch
5 Range in meters knob
6 Gun power indicator
7 System power indicator
8 System power switch
9 Gun power switch
10 Target speed knob
11 Trigger switch
12 Elevation control assembly
13 Sight cage switch
14 Trigger switch (dummy)
15 Sight lamp knob
16 Mode switch
17 Ready-when-lit indicator

Figure 2-24. Control assembly.

Figure 2-25. Left grip assembly.

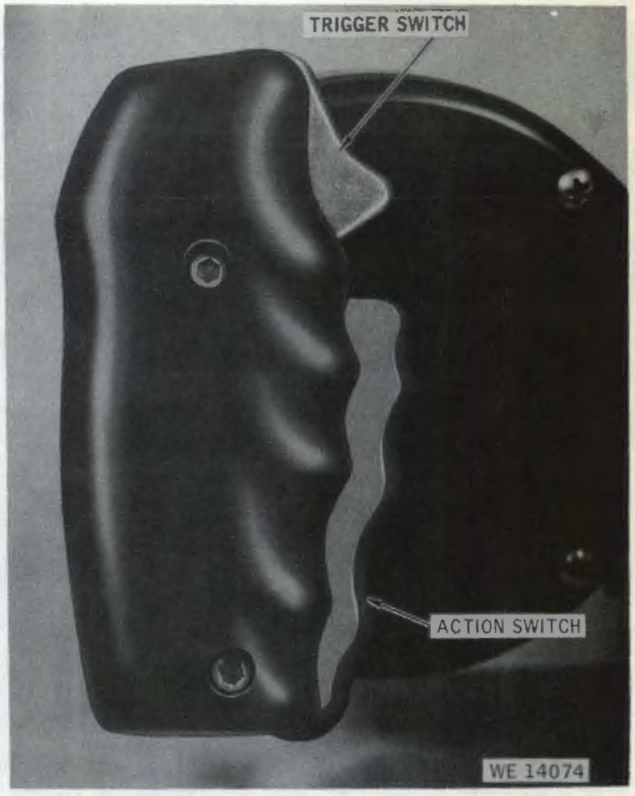


Figure 2-26. Right grip assembly.

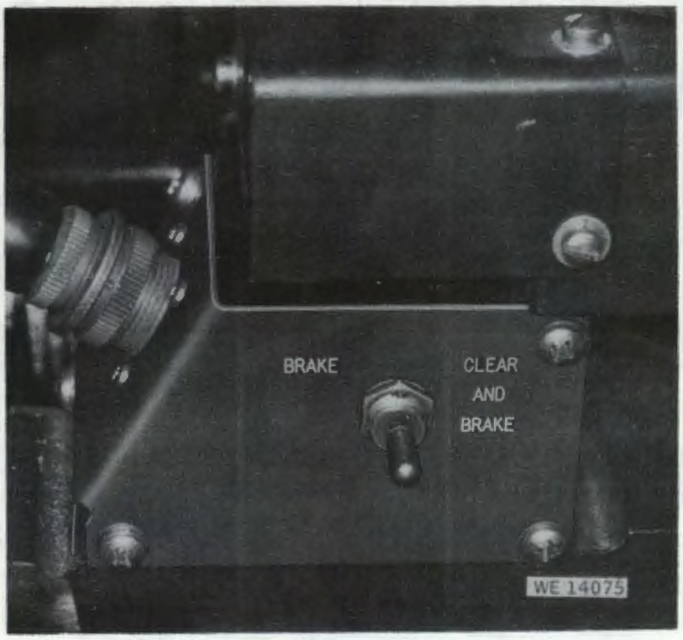
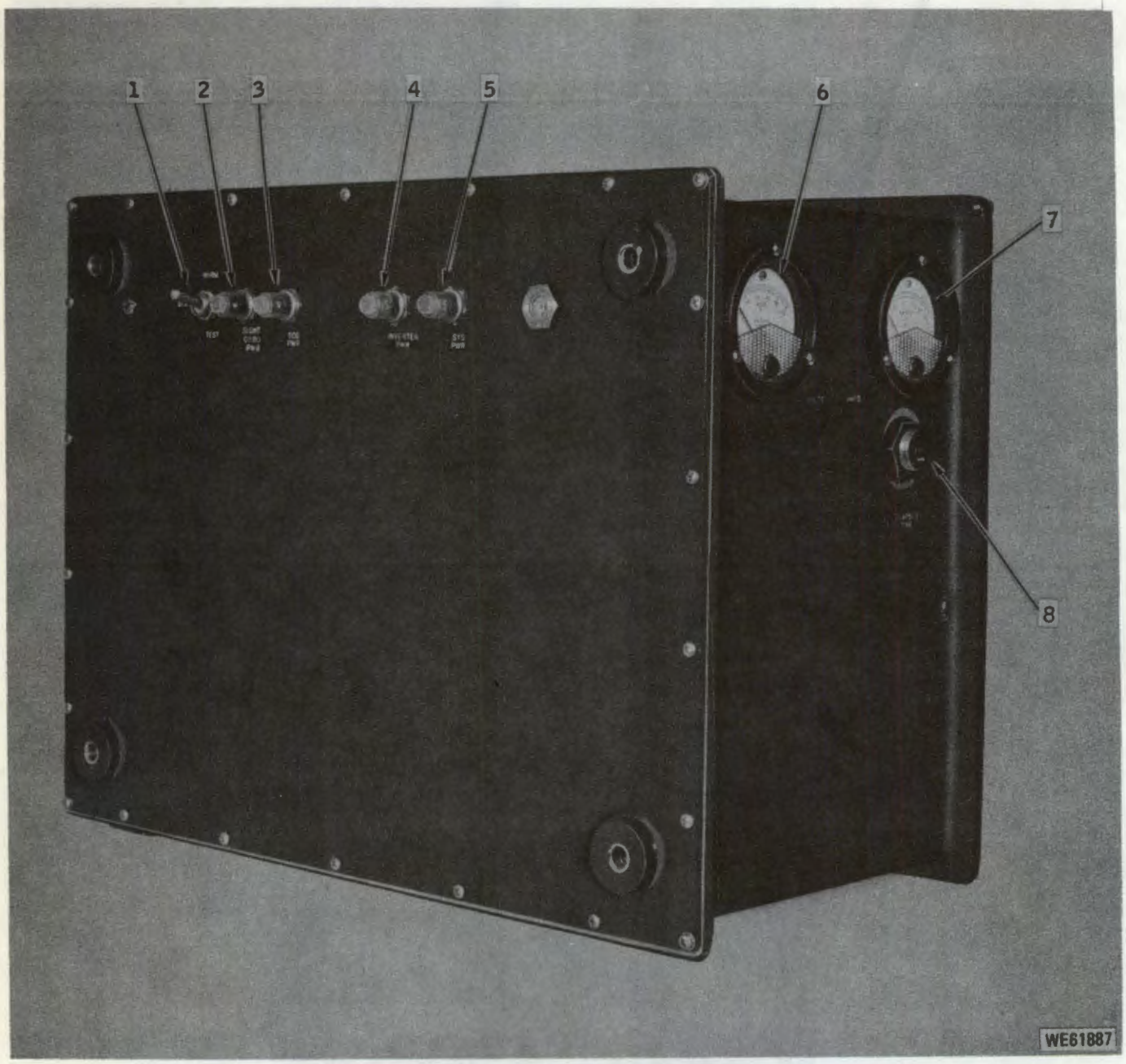


Figure 2-27. BRAKE - CLEAR AND BRAKE switch.



1 Norm-static-test switch
2 Sight gyro power circuit breaker
3 SCG power circuit breaker
4 Inverter power circuit breaker
5 System power circuit breaker
6 Volts meter
7 Amps meter
8 Elapsed time meter

Figure 2-28. Distribution box assembly.

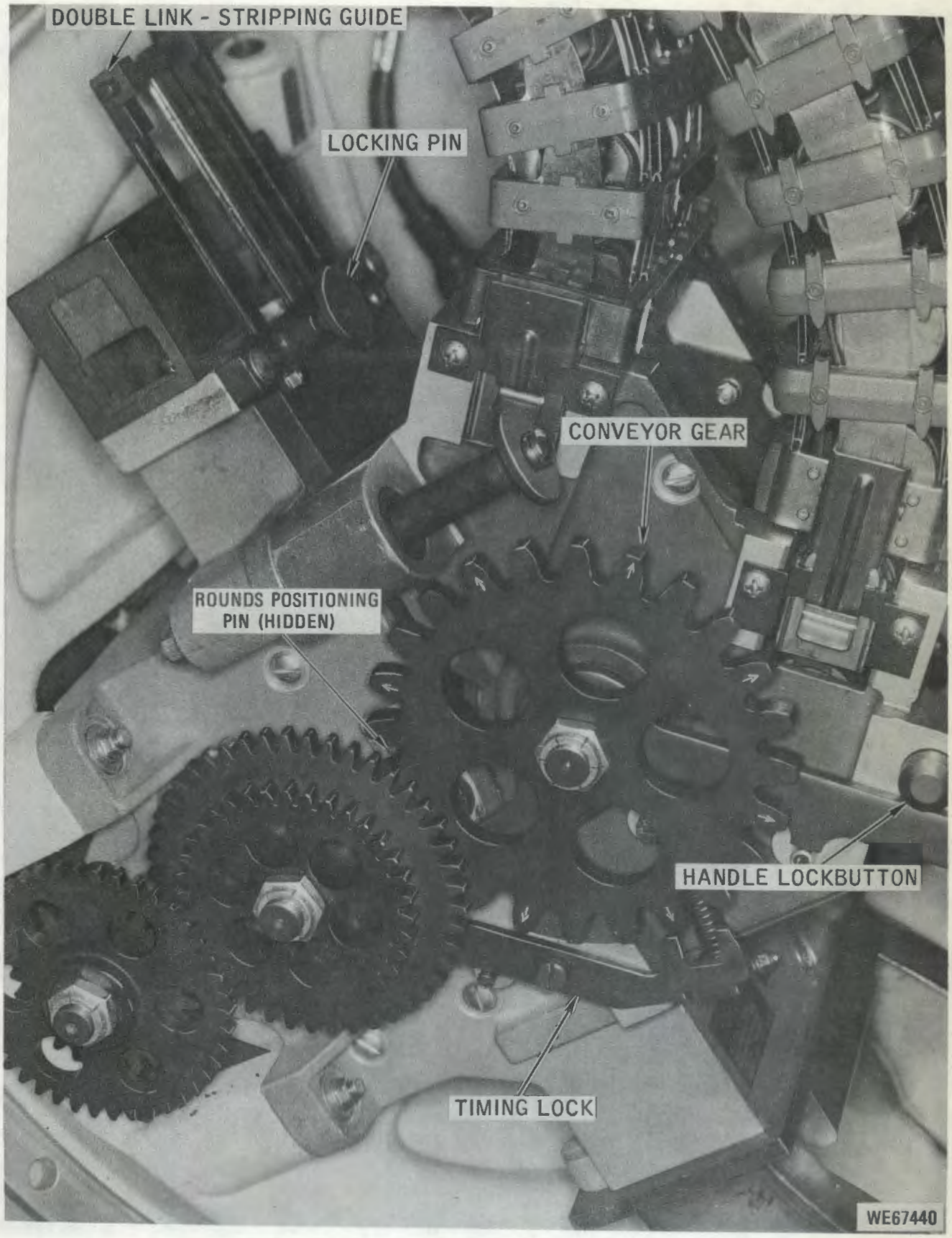


Figure 2-29. Exit and conveyor units - controls.

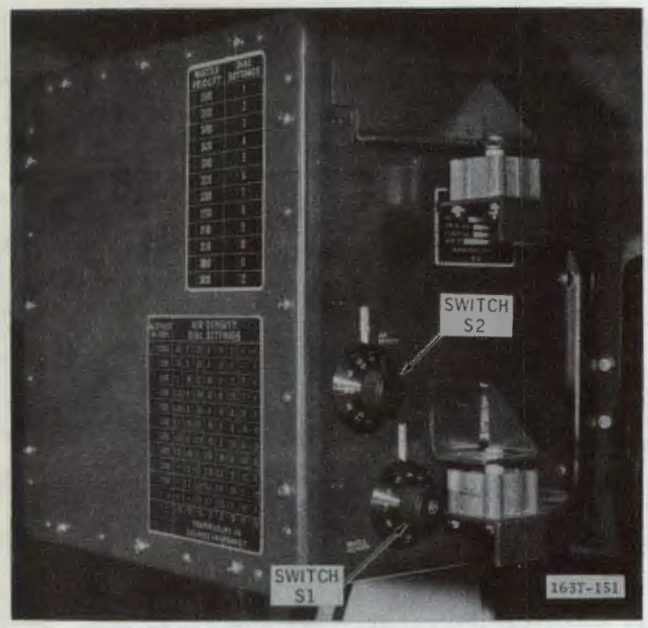


Figure 2-30. Sight current generator.

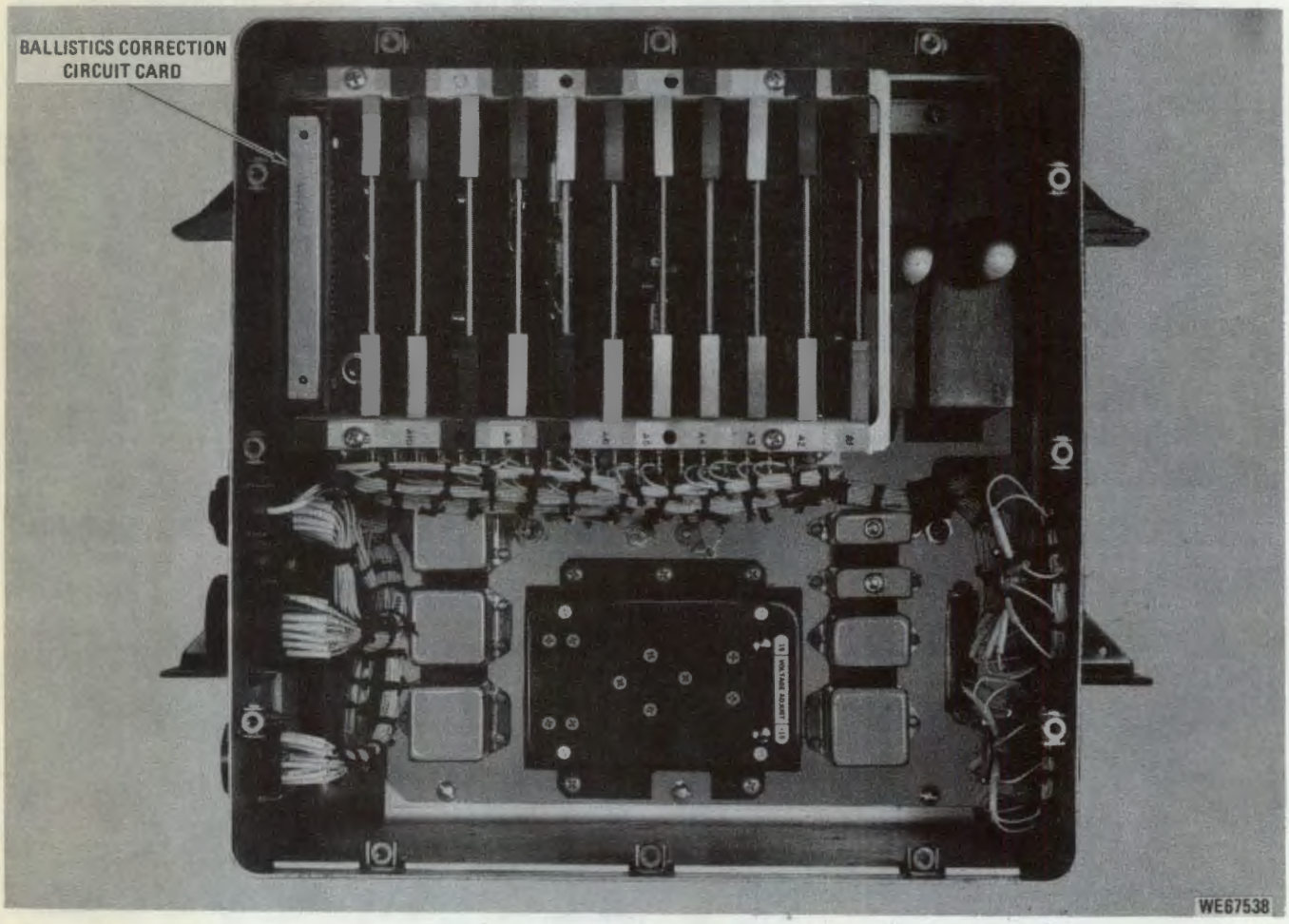


Figure 2-31. Sight current generator, location of ballistics correction circuit card.

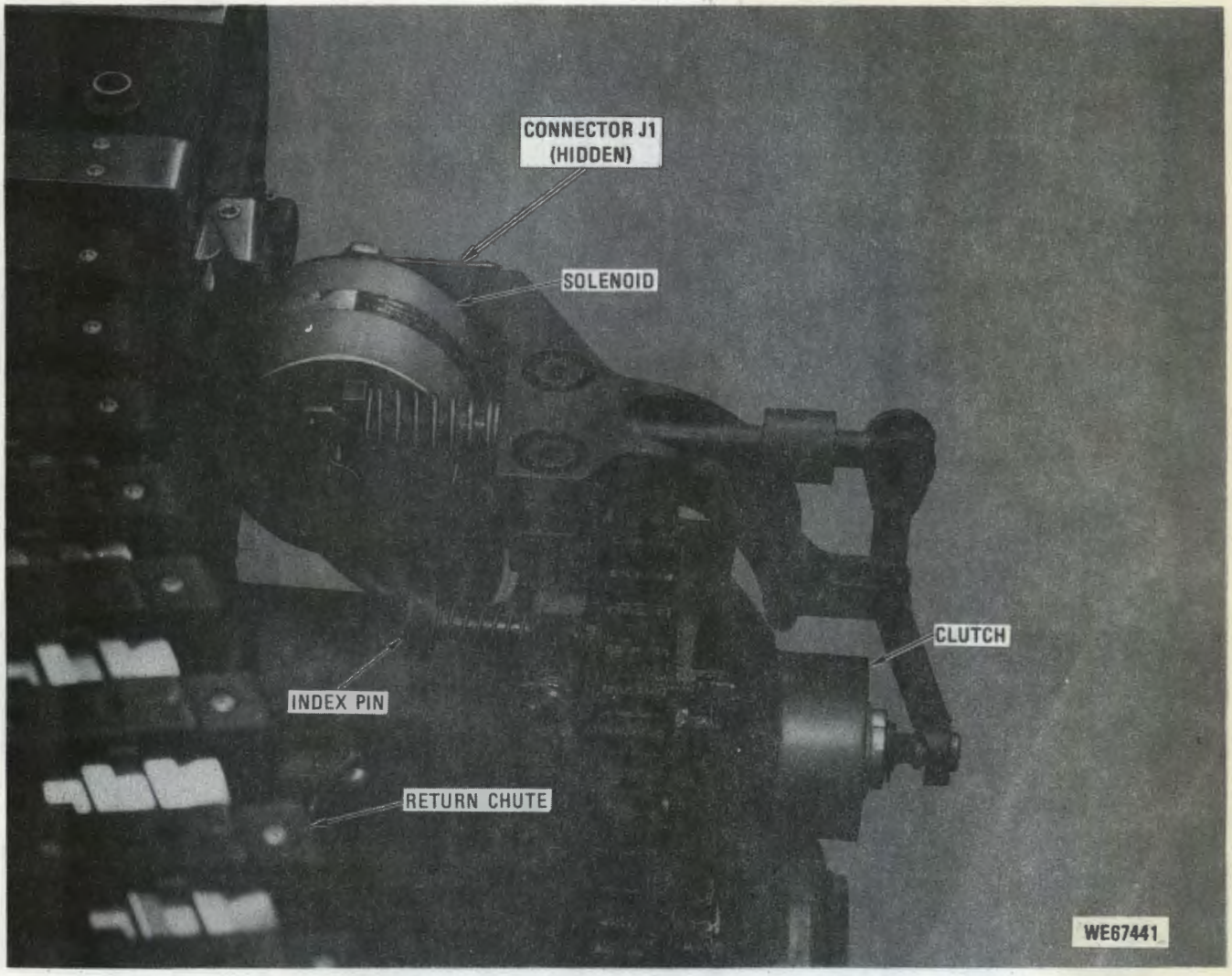


Figure 2-32. Declutching feeder assembly.

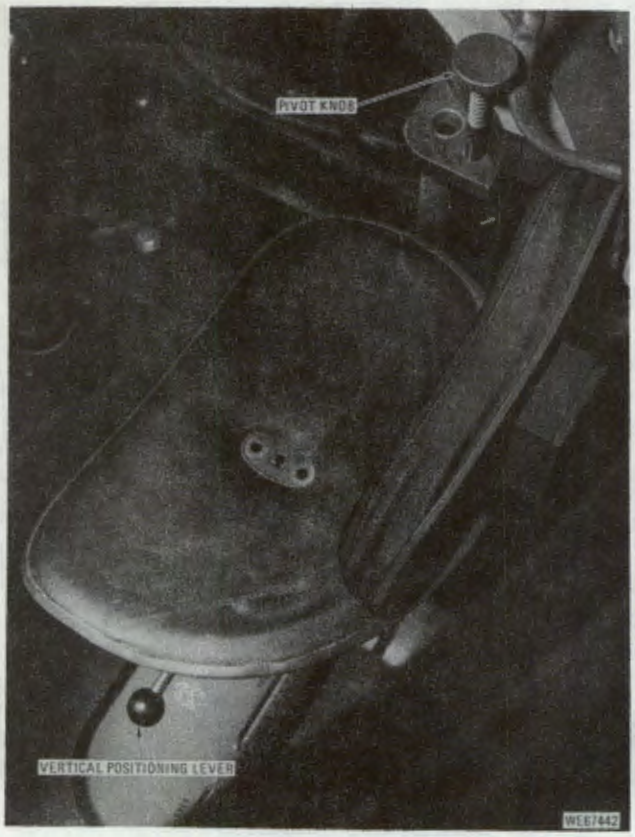


Figure 2-33. Gunner's seat assembly - controls.

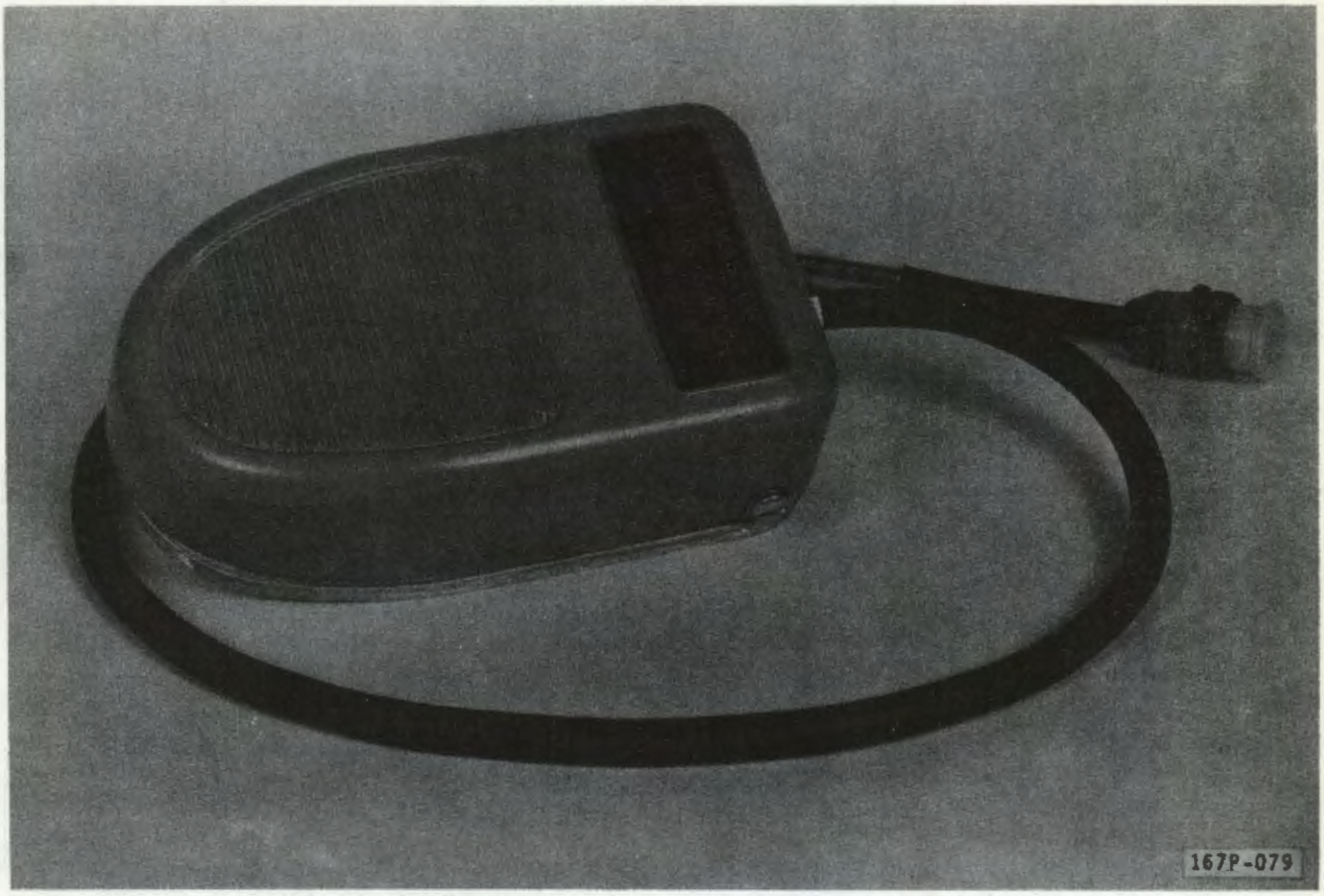


Figure 2-34. Foot switch assembly.

Table 2-4. Controls and Instruments, XM61 Sight

Control	Function	Reference
CAGED knob	Mechanically cages sight gyro.	Fig. 2-35
Ready-to-fire indicator	Provides the gunner with an indication that he may fire when he has the target centered in the reticle.	Fig. 2-35
Lead angle marks	Five calibrated marks (200, 100, 0, 100 and 200) used in conjunction with lead angle index to indicate lead angle in mils.	Fig. 2-35
Lead angle index	Indicates lead angle zero reference point.	Fig. 2-35
Hour meter	Records hours sight is on. Located internally on the left side of the sight. Visible only through the front of the sight.	
Sight reticle	Consists of two concentric rings. A gap in the inner ring is used in the ground mode.	Fig. 2-36
Sight elevation boresight adjustment	Used during sight boresighting to establish elevation alignment of the sight with the axis of the cannon.	Fig. 2-37
Sight azimuth boresight adjustment	Used during sight boresighting to establish azimuth alignment of the sight with the axis of the cannon.	Fig. 2-37

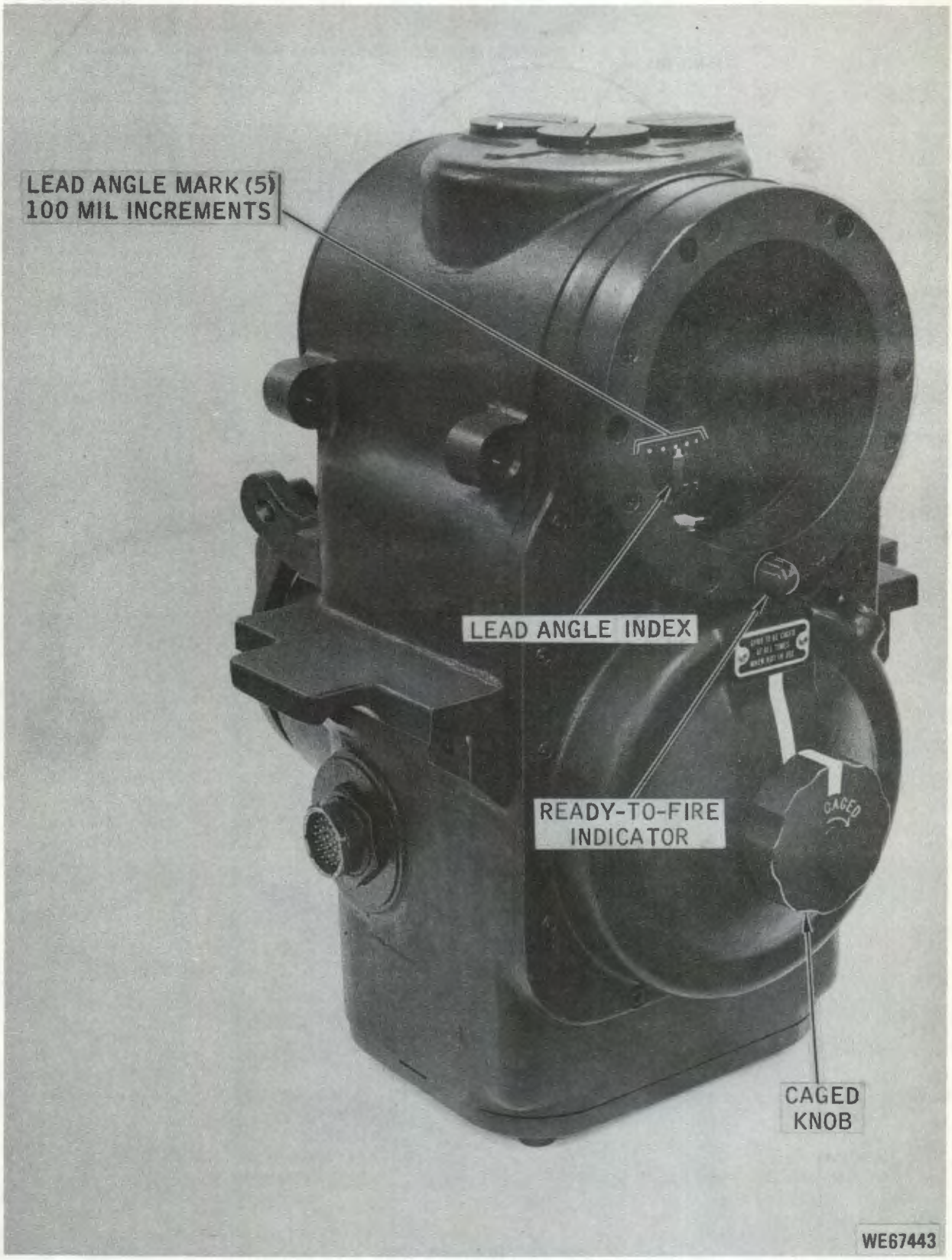


Figure 2-35. XM61 sight.

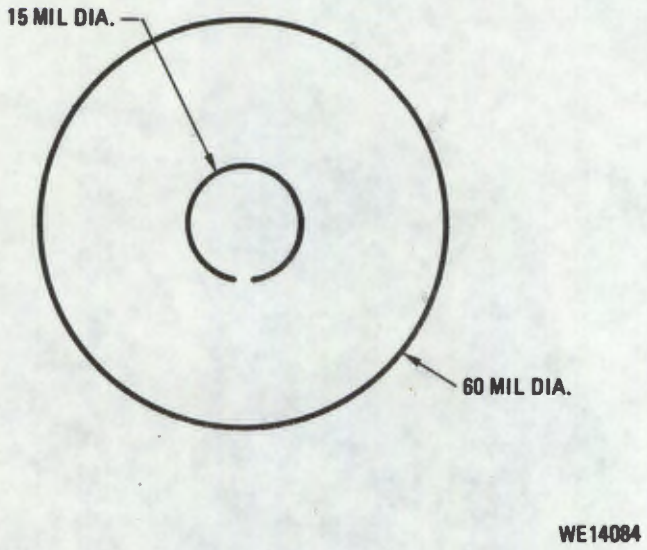


Figure 2-36. XM61 sight reticle.

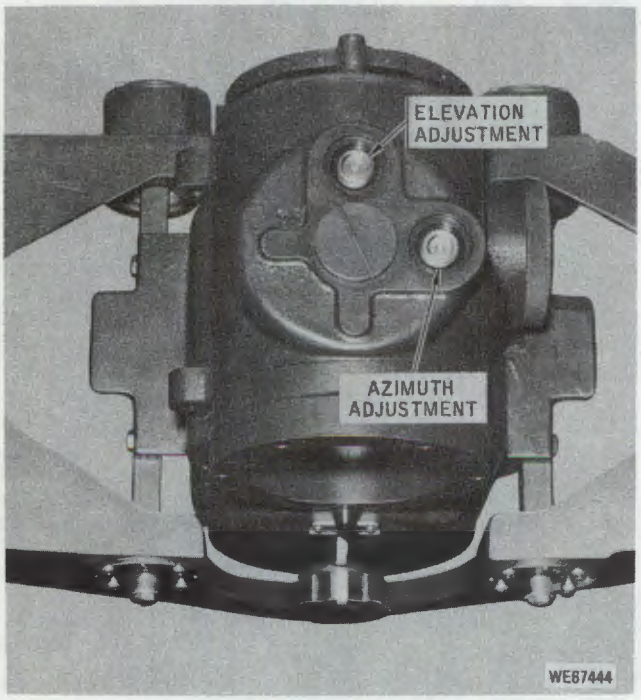


Figure 2-37. Sight adjustments.

Table 2-5. Controls and Instruments, AN/VPS-2 Radar Set

Control or Instrument	Function	Reference
	ANTENNA	
Traverse boresight adjustment	Used during antenna boresighting procedure to establish traverse alignment of antenna electrical axis with the XM61 sight reticle.	Fig. 1-21
Elevation boresight adjustment	Used during antenna boresighting procedure to establish elevation alignment of antenna electrical axis with the XM61 sight reticle.	Fig. 1-21
Radar interconnecting waveguide		
RF power indicator	When lighted, indicates that radar is radiating RF energy.	Fig. 1-11
	TRANSMITTER-RECEIVER	
MODULATOR OVERLOAD indicator	When lighted, indicates overload condition in modulator circuit.	Fig. 1-22
HIGH-VOLTAGE POWER SUPPLY OVERLOAD indicator	When lighted, indicates overload condition in high-voltage power supply circuit.	Fig. 1-22
OVERLOAD RESET switch	Resets modulator and high-voltage power supply overload sensing circuits. (Momentary actuation-spring load to center (off) position.)	Fig. 1-22
CLUTTER LOCKON switch	In TEST position, actuates built-in test circuitry to enable radar to lockon to a stationary target for clutter lockon test. In NORMAL position, disables the test circuitry.	Fig. 1-22
Interlock switch (S3)	Activates when transmitter-receiver front panel assembly is opened to remove power from unit. For servicing, switch actuator is pulled forward and out, restoring power to unit.	Fig. 2-38
Power indicator lamp (DS3)	Associated with interlock switch. When lighted, indicates that power is applied to transmitter-receiver.	Fig. 2-38
SERV RAD CONT switch (S6)	In ON position, bypasses radiate foot switch, energizing radar to radiate.	Fig. 2-38
M2 hours meter	Indicates total time power has been applied to klystron power amplifier.	Fig. 2-39
DC MICROAMPERES RF power meter	Indicates relative magnitude of RF power produced by radar transmitter.	Fig. 2-39
Klystron power amplifier cavity tuning adjustments	Establish frequencies of resonant cavities of the klystron power amplifier.	Fig. 2-39
Tuning tool	Adjustment tool used to tune klystron cavities. Self-contained dial provides an indication for coarse tuning of the cavities.	Fig. 2-39

Table 2-5. Controls and Instruments, AN/VPS-2 Radar Set - Continued

Control or Instrument	Function	Reference
	RANGE COMPUTER	
MID RANGE CALIBRATION:		
Pushbutton (S1)	Activates built-in test circuitry in radar to perform mid-range calibration check.	Fig. 1-24
Indicator (DS1)	Under normal conditions indicator flashes once per second. During midrange calibration test, lights continually if test is good.	Fig. 1-24
	POWER SUPPLY	
CONVERTER circuit breaker (CB1)	Protects converter circuitry from overload.	Fig. 1-25
TRAV circuit breaker (CB2)	Protects antenna traverse servo drive circuitry from overload.	Fig. 1-25
ELEV circuit breaker (CB3)	Protects antenna elevation servo drive circuitry from overload.	Fig. 1-25
CONTROL CKT circuit breaker (CB4)	Protects control circuitry from overload.	Fig. 1-25
BLOWERS circuit breaker (CB5)	Protects blower from overload.	Fig. 1-25
6.3 VDC circuit breaker (CB6)	Protects the 6.3 vdc range computer circuitry from overload.	Fig. 1-25
	STOW CONTROL	
MODE switch (S1)	In NORMAL position, antenna is positioned using sight positioning signals. In STOW position, antenna is positioned using signals supplied by ELEV and TRAV switches.	Fig. 1-26
ELEV switch (S3)	Provides an elevation signal used when testing or stowing radar antenna.	Fig. 1-26
TRAV switch (S2)	Provides a traverse signal used when testing or stowing radar antenna.	Fig. 1-26
MAINT switch (S4)	Energizes antenna servo drives for maintenance purposes in lieu of action switch on grip assemblies.	Fig. 1-26

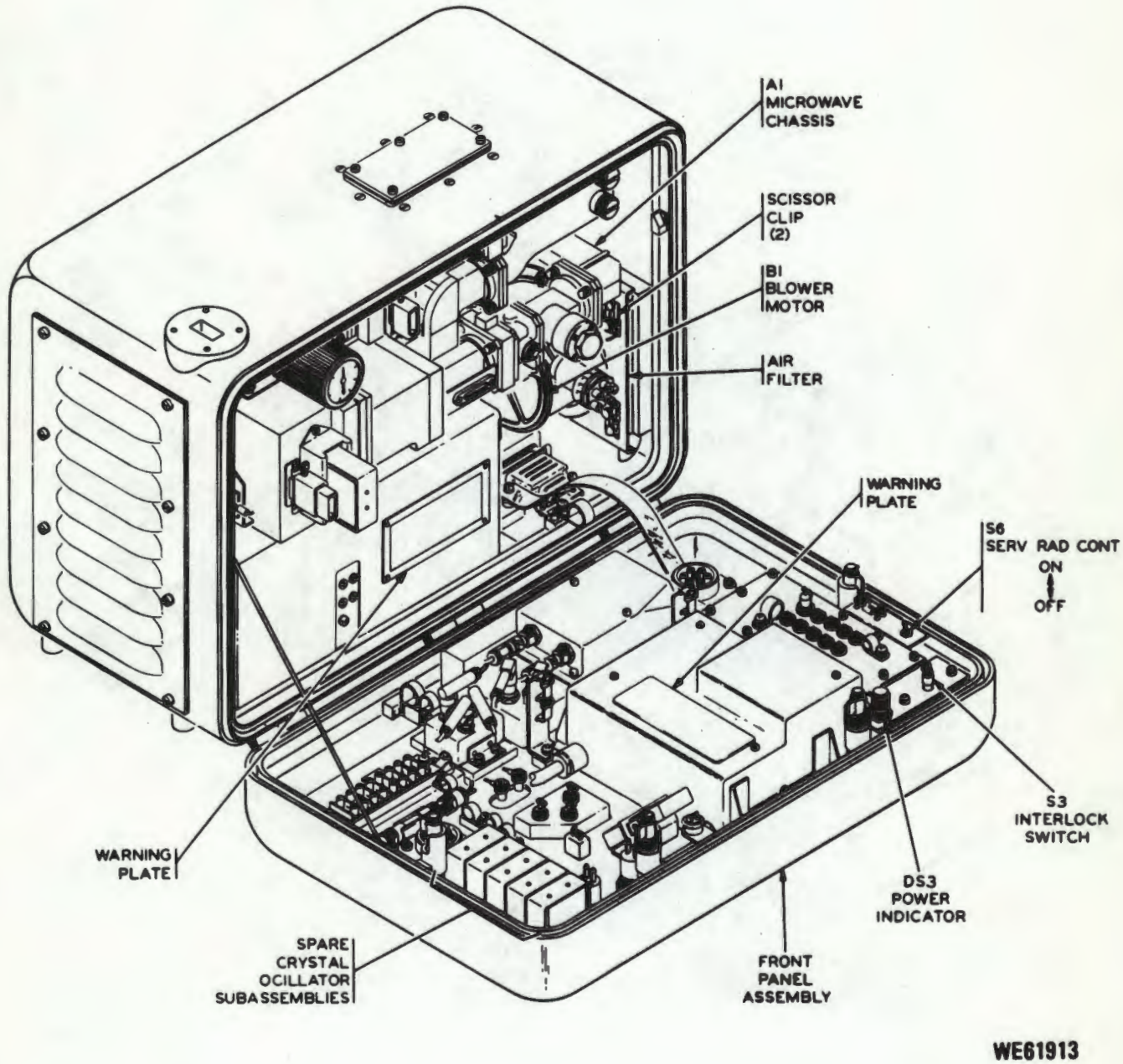


Figure 2-38. Transmitter-receiver - unit 2 interior view.

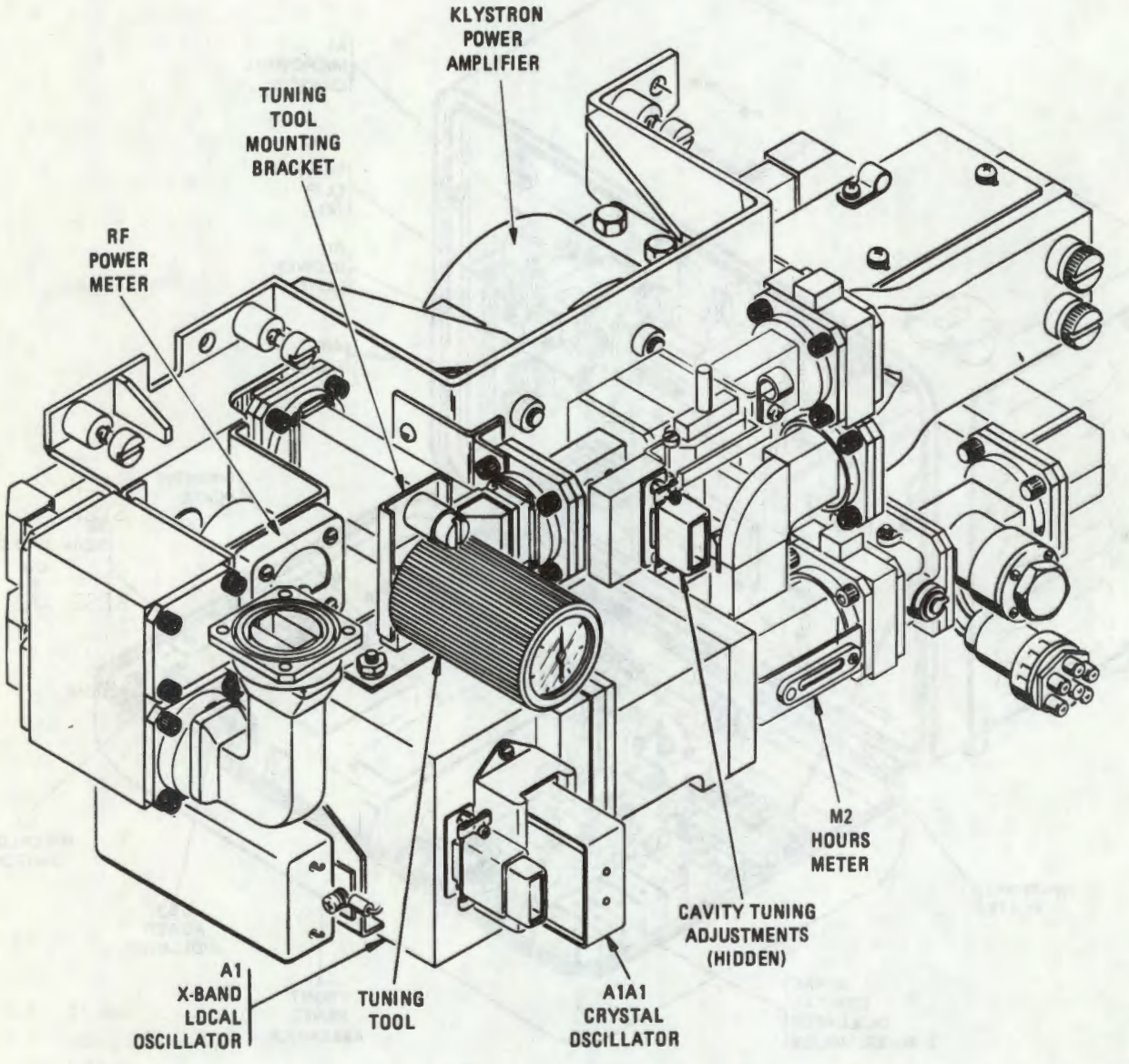


Figure 2-39. Microwave chassis assembly-2A1.

Section II. OPERATION UNDER USUAL CONDITIONS

2-3. General

This section contains the specific procedures required by the operator/crew to operate the XM163 system under normal conditions of temperature and humidity.

2-4. Starting Engine (above 40° F).

WARNING

Monoxide gas may be present in vehicle if interior power plant access panels are not in place. Before starting assure that panels are properly installed.

CAUTION

Do not let tachometer reading exceed 2,975 rpm under any circumstances.

a. Perform before-operation maintenance steps 1 through 6 (table 3–2) before starting engine.

b. Insure that fuel flow control valve is open (fig. 2–10).

CAUTION

Radar unit 5 (power supply) may be damaged if power is not turned off before engine start.

c. Verify that all electrical, communications, and radar equipment in the driver's compartment, mount, and personnel compartment is turned off.

d. Apply and lock brakes by pulling back both differential steering levers and depressing brake buttons (15, fig. 2–1).

e. Set range selector to N (5, fig. 2–1).

NOTE

A neutral start switch within the selector housing prevents the engine from starting if the range selector lever is in any position except N.

f. Verify that bilge pumps are off.

g. Pull out MASTER SWITCH and set to ON (fig. 2–6).

h. Check instrument and warning lights panels (2 and 3, fig. 2–1).

NOTE

With engine stopped and MASTER SWITCH set to ON, the MASTER SWITCH ON light will be lit. All warning lights should be off except ENGINE OIL-HI TEMP-LO PRESS. Ignore SUSP. LOCKED OUT light. BATTERY-GENERATOR indicator (fig. 2–3) should be in the yellow zone and fuel level indicator (7, fig. 2–3) should indicate FUEL level.

i. Push fuel cutoff control fully in (9, fig. 2–1).

CAUTION

Do not crank engine for more than 15 seconds. Wait 30 seconds before pressing START switch again. If engine does not start after second attempt, notify organizational maintenance.

j. Unlock the hand THROTTLE (10, fig. 2–1) by rotating counterclockwise and push in.

k. Press START switch (4, fig. 2–3) to start engine.

CAUTION

ENGINE OIL-HI TEMP-LOW PRESS indicator should extinguish within 10 seconds after the engine starts and all other warning lights should remain extinguished. If any warning lights (except SUSP. LOCKED OUT light) light after engine has started, pull out fuel cutoff control to stop engine and notify organizational maintenance.

l. Continually check instrument and warning lights panel (2 and 3, fig. 2–1) while engine is operating.

NOTE

BATTERY-GENERATOR indicator should indicate in the green zone and engine TEMP F indicator (11, fig. 2–3) should not exceed 200°F. The tachometer should indicate 550 to 600 rpm idle speed.

NOTE

Use accelerator foot pedal to aid in setting hand THROTTLE control.

m. Set hand THROTTLE control for an 800 to 1000 rpm indication on the tachometer (13, fig. 2–3), lock hand THROTTLE in position by rotating control clockwise, and allow the engine to warm up for three to five minutes. After warmup, unlock hand THROTTLE by rotating counterclockwise and push in.

CAUTION

Do not allow engine to idle at 550 to 600 rpm for more than one hour. If required to idle for longer time, set hand THROTTLE for 800 to 1000 rpm.

2-5. Starting Engine (40° F to - 25° F).

WARNING

Monoxide gas may be present in the chassis if interior power plant access panels are not in place. Before starting engine, assure that panels are properly installed.

CAUTION

Do not let tachometer reading exceed 2,975 rpm under any circumstances.

a. Disengage engine from power train by unlocking the engine disconnect control handle (fig. 2–18) and pushing handle to in position (accessible through driver's compartment power plant access panel).

b. Check the accumulator pressure indicator (fig. 2–17) (accessible by dropping trim vane, fig. 2–21, and opening power plant door, fig. 2–16). If necessary, recharge to approximate center of yellow zone with hand fuel pump. The pump plunger is unlocked by pushing in on the knob and turning the knob 90 degrees counterclockwise.

c. Perform steps a. through h. in paragraph 2–4.

d. Pull fuel cutoff control fully out (9, fig. 2–1).

e. Press up on instrument panel AIR BOX HEATER switch for one to two seconds (8, fig. 2–3).

f. Press START switch for four to six seconds (4, fig. 2–3).

CAUTION

ENGINE OIL-HI TEMP-LOW PRESS indicator should extinguish within 10 seconds after the engine starts and all other warning lights shall remain extinguished. If any warning lights (except SUSP. LOCKED OUT light) light after engine has started, pull out fuel cutoff control to stop engine and notify organizational maintenance.

g. Push fuel cutoff control fully in, and continue cranking engine while cycling AIR BOX HEATER switch on for one second and off for two seconds until engine has started. Release START switch but continue to cycle AIR BOX HEATER switch until engine is running.

CAUTION

Do not crank engine for more than 15 seconds. Wait 30 seconds before pressing START switch. If engine does not start after third attempt, notify organizational maintenance.

h. Continually check instrument and warning lights panels while engine is running.

NOTE

BATTERY-GENERATOR indicator should indicate in green zone, coolant TEMP F indicator should begin to rise. Tachometer should indicate 550 to 1000 rpm. It may be necessary to use foot throttle to maintain engine speed.

i. Run engine for three to five minutes at 550 to 1000 rpm.

j. Turn off engine coolant heater, if applicable (para 2-27 *d* (4) (*e*)).

k. Set hand throttle control (10, fig 2-1) for an engine speed of 1200 to 1500 rpm and run engine for five minutes.

l. Push hand throttle control fully in.

m. Pull fuel cutoff control fully out to stop engine.

CAUTION

Do not operate engine disconnect control with engine running.

n. Engage engine with rest of power train by pulling out engine disconnect control handle and lock control in place (fig 2-18).

NOTE

If gears do not mesh, the engine disconnect handle will not lock. Maintain pressure on control handle and momentarily press START switch.

o. Push in fuel cutoff control and press START switch to restart engine.

WARNING

Assure that the brakes are applied and locked by pulling back on both differential steering levers and depressing brake buttons (15, fig 2-1).

p. Set range selector to 2-3 (fig 2-40).

q. Set hand THROTTLE control for an engine speed of 800 to 1000 rpm and run engine for a maximum of 10 minutes to warm up transmission.

2-6. Starting Engine (—25° F to —65° F).

CAUTION

Do not let tachometer reading exceed 2,975 rpm under any circumstances.

NOTE

Do not attempt to start engine below — 25° F unless engine coolant heater has been operating or external heat has been applied.

a. Perform steps *a* through *i* in paragraph 2-5.

b. Turn off engine coolant heater (para 2-27 *d* (4) (*e*)).

c. Perform steps *k* through *q* in paragraph 2-5.

2-7. Starting Engine with Auxiliary Power Unit (Generator Set).

WARNING

This equipment generates dangerous electrical power which can cause bodily injury if safety precautions are not observed. Insure that both the auxiliary power unit (generator set) circuit breaker and the vehicle MASTER SWITCH are in the OFF position before connecting auxiliary power cable. Do not operate auxiliary power until you are familiar with operating procedures set forth in TM 5-6115-323-15.

a. Remove protective cap from auxiliary power receptacle on master switch panel (fig 2-6).

b. Place generator set circuit breaker and vehicle MASTER SWITCH in OFF position.

CAUTION

Insure that polarity of generator set is as marked on auxiliary power receptacle (fig 2-85).

c. Set up generator set as indicated in figure 2-85.

d. Connect auxiliary power cable from generator to auxiliary power receptacle (fig 2-6).

e. Start generator set (TM 5-6115-323-15).

f. Place generator set circuit breaker and vehicle MASTER SWITCH in ON position.

g. Start vehicle in normal manner (para 2-4, 2-5, or 2-6).

WARNING

Insure that following step is performed before removing auxiliary power cable.

h. After vehicle engine has started, place generator set circuit breaker in OFF position and stop generator set (TM 5-6115-323-15).

i. Disconnect auxiliary power cable, and reinstall protective cap on auxiliary power receptacle.

j. Stow generator set (fig 2-85).

2-8. Raising or Lowering Ramp.

NOTE

It is desirable but not required to start the engine to lower the ramp. Engine must be started to raise the ramp.

a. Start engine (para 2-4, 2-5 or 2-6).

b. Adjust hand THROTTLE control to obtain engine speed of 1,500 rpm.

WARNING

Alert all personnel in and around the vehicle before lowering or raising ramp. Make certain ramp personnel door is

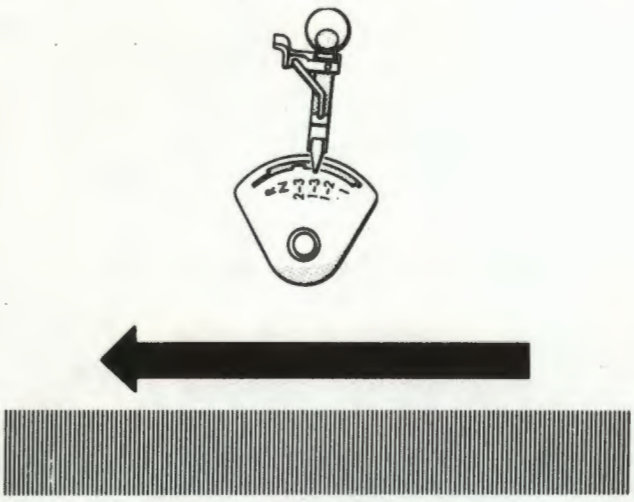
closed and locked before operating ramp.

c. Depress spring latch and swing ramp locking handle down and rearward to unlocked position before raising or lowering ramp (fig 2-15).

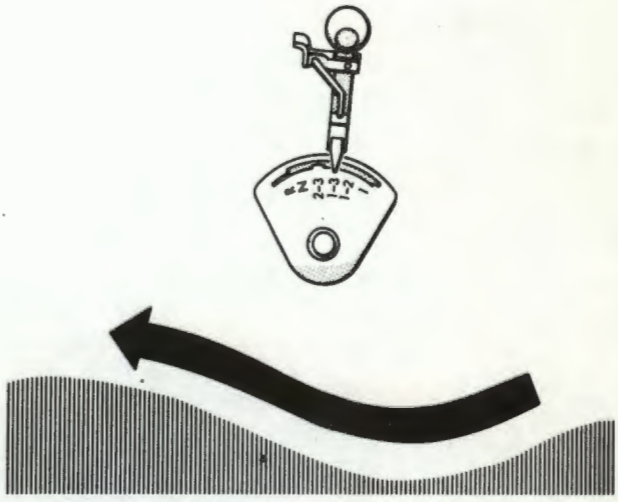
d. Move ramp actuating lever rearward to raise or forward to lower ramp (fig 2-41).

NOTE

The ramp actuating lever is spring loaded to neutral position.



A. Roads and level terrain: 1-3 range.



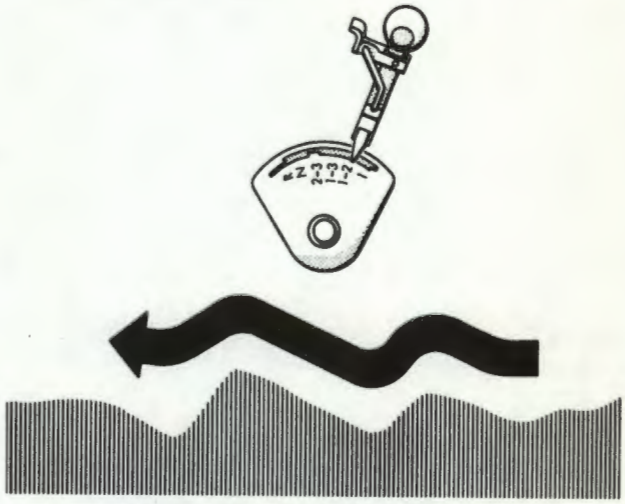
B. Hilly terrain: 1-3 range.

SPEED LIMITS FOR MANUAL DOWN SHIFT WITH SHIFT LEVER

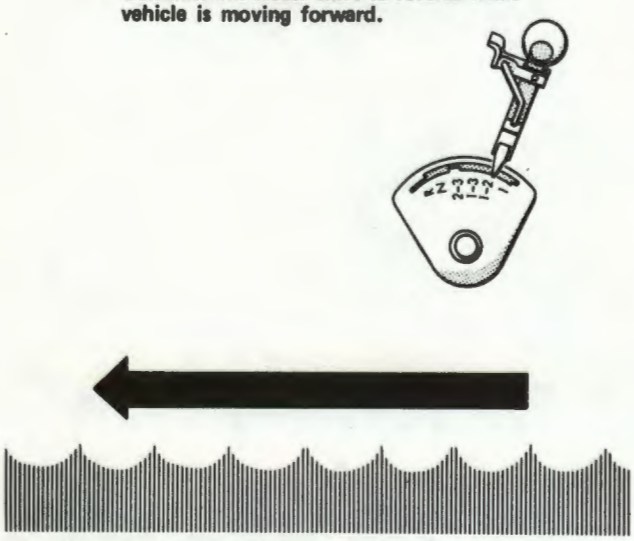
SHIFT RANGE	
2–3 TO 1–2–3 RANGE	40 MPH
1–3 TO 1–2 RANGE	21 MPH
1–2 TO 1 RANGE	10 MPH

CAUTION:

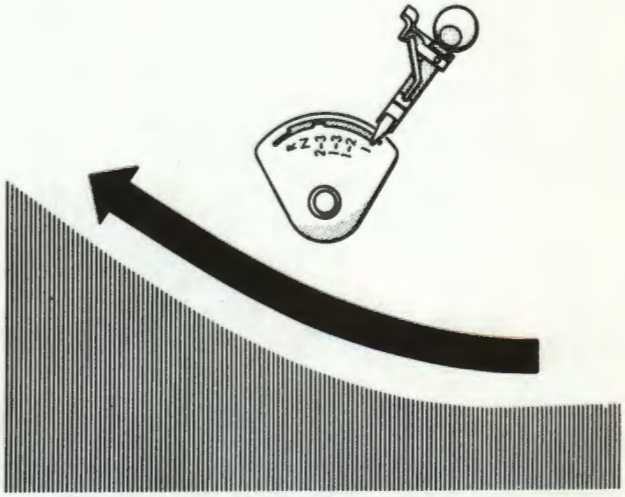
Downshift to lower range at speeds shown or slower to avoid damaging transmission. Never shift to reverse while vehicle is moving forward.



C. Rough terrain and trenches: 1-2 range.



D. Operation in water: 1-2 range.



E. Steep grades, entering or leaving water: 1 range

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Figure 2-40. Range selection and shifting.

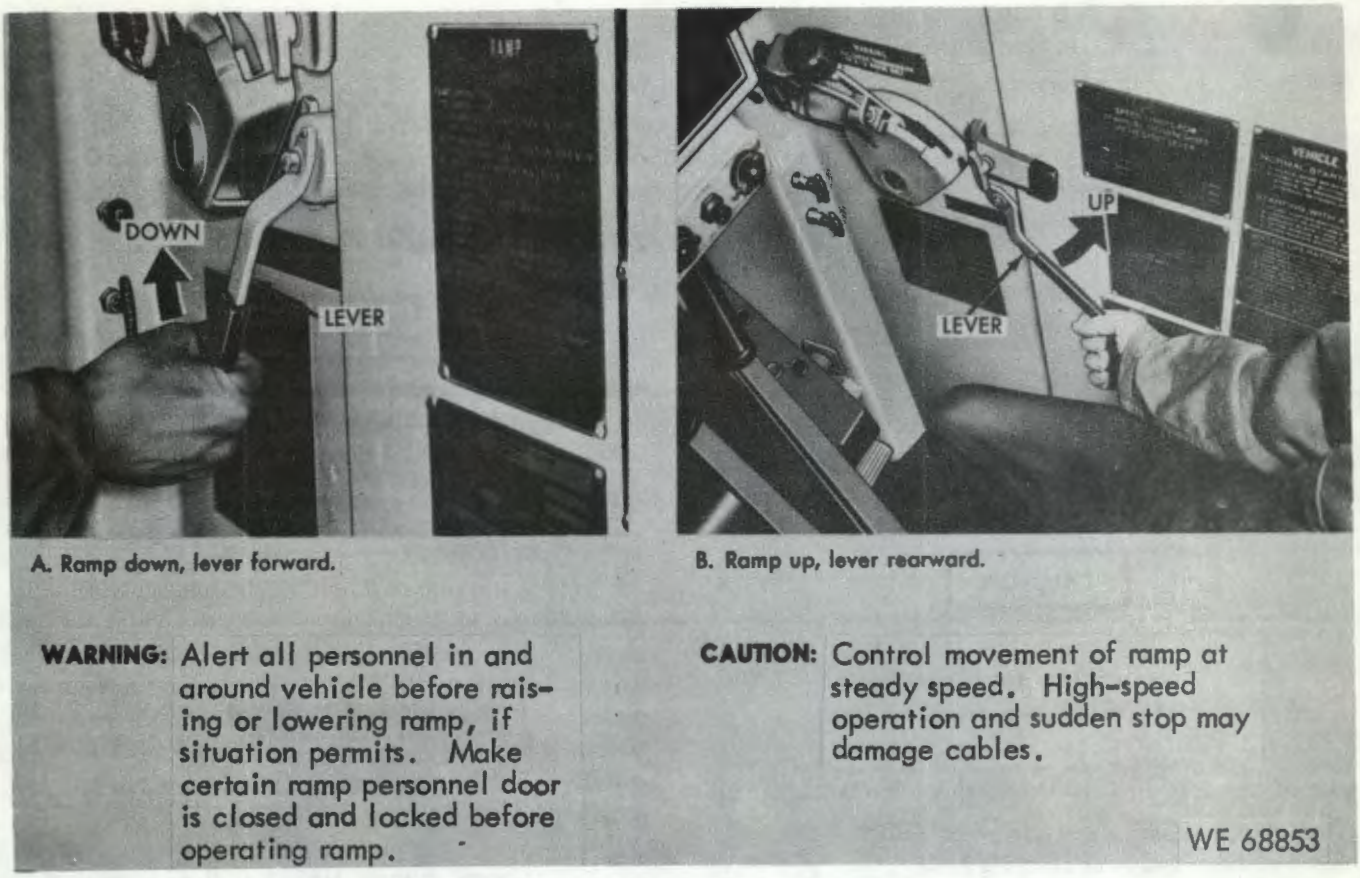


Figure 2-41. Ramp actuating lever.

e. Return ramp locking handle to locked position after ramp has been raised or lowered.

CAUTION

Do not leave the ramp locking handle in the unlocked position due to insufficient clearance.

f. Push hand THROTTLE control in to return engine to idle speed (550 to 600 rpm).

2-9. Operating Suspension System Lockout.

a. Locking Suspension System.

CAUTION

Before operating the suspension lockout system, the vehicle must be brought to a complete stop to prevent damage to the suspension system. Position vehicle on level surface if possible.

(1) With engine running at 1,500 rpm and range selector lever set to N, place suspension lockout control handle in EXTEND position (6, fig. 2–1).

(2) SUSP. LOCKED OUT warning light should light when suspension system is locked in position (fig. 2–5).

(3) Engine may be left running or turned off, depending on situation.

b. Releasing Suspension System.

CAUTION

Before moving vehicle, the suspension lockout system cylinder rams must be fully retracted to prevent damage to the suspension components. Wait at least 20 seconds after SUSP. LOCKED OUT warning light goes out before moving chassis.

(1) With engine running at 1,500 rpm and range selector lever set to N, place suspension lockout control handle in RETRACT position (6, fig. 2–1).

(2) SUSP. LOCKED OUT warning light should extinguish when suspension system is released from locked position.

CAUTION

Lockout control handle must remain in RETRACT position at all times, except when suspension system is to be locked.

2-10. Driving Precautions.

a. Over-steering. When driving on hard pavement, avoid over-steering at speeds that may cause vehicle to go out of control.

CAUTION

Avoid rapid acceleration and/or deceleration which may result in failure of the engine blower quill shaft.

b. Deceleration. Decelerate when vehicle approaches edge of trench or ditch, and at top or on downgrade of hill.

c. Acceleration. Accelerate when vehicle bottoms in trench or ditch, and when climbing a hill.

d. Final Drive or Track. Downshift before starting downhill, and descend slowly. Approach bottom of hill or ditch cautiously to avoid digging-in which may damage final drives or tracks.

e. Reverse. Never set range selector to R when vehicle is moving forward.

f. Transmission. Do not attempt to use transmission to hold vehicle on an incline at any time.

g. Hand Throttle Control. Do not operate vehicle solely with hand throttle control except in an emergency.

2-11. Placing Vehicle in Motion.

WARNING

When driver's hatch cover is open, secure cover with latch to prevent injury to driver or damage to mount.

a. Start engine (par. 2–4, 2–5, or 2–6).

b. Raise the ramp (par. 2–8).

c. Determine proper transmission range (fig. 2–40) and position range selector properly.

d. Alert personnel before placing vehicle in motion.

e. Pull on differential steering levers to release brakes, keeping thumbs clear of lock buttons, then release levers (14, fig. 2–1).

f. Depress accelerator pedal (13, fig. 2–1) slowly and evenly. Control speed and direction with accelerator pedal and differential steering levers (fig. 2–42).

2-12. Driving the Vehicle.

CAUTION

Observe driving precautions in paragraph 2–10 before and during operation of the vehicle.

a. Placing Vehicle in Motion. Refer to paragraph 2–11.

b. Range Selection and Shifting (fig. 2–40).

(1) *Automatic shifting.* The transmission upshifts or downshifts automatically through all gears of any forward range. Shifting is determined by engine speed and accelerator pedal position. If accelerator pedal is depressed through full throttle detent, transmission will remain in same gear as vehicle accelerates or will downshift to lower gear for more power. Transmission cannot upshift until pedal is released.

(2) *Manual shifting.* Manual shifting is required to avoid excessive automatic shifting in the transmission or overloading the engine. Note downshift speeds listed in figure 2–40. A range should be selected in which the vehicle performs best under existing conditions of terrain.

(3) *Proper range selection.* The type of terrain encountered determines the range selection. The following general rules apply:

(a) Level terrain. Set range selector to 1-3 for operation on level roads or hilly terrain when maximum speed is required and can be maintained without excessive automatic shifting.

(b) Rough terrain. Set range selector to 1-2 for cross country travel over rough terrain and when traveling up and down long gradual grades.

(c) Water operation. Set range selector to 1 for entering or leaving water, and 1-2 for operation in water.

c. Steering and Stopping.

(1) See figure 2–42 for steering and stopping vehicle with differential steering levers.

(2) See figure 2–43 for steering and stopping vehicle with pivot steer levers.

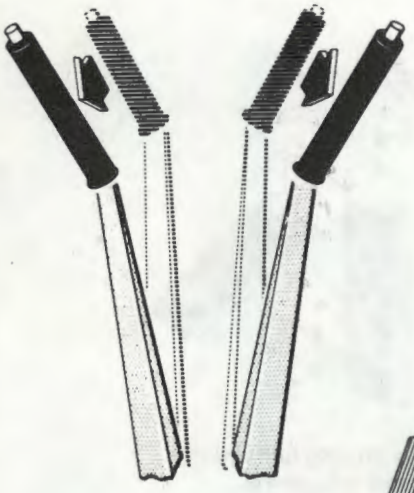
2-13. Stopping the Engine.

a. Apply and lock brakes (fig. 2–42).

b. Set range selector to N (5, fig. 2–1).

CAUTION:

Never use pivot steer levers and differential steer levers at the same time, or differential may be severly damaged.

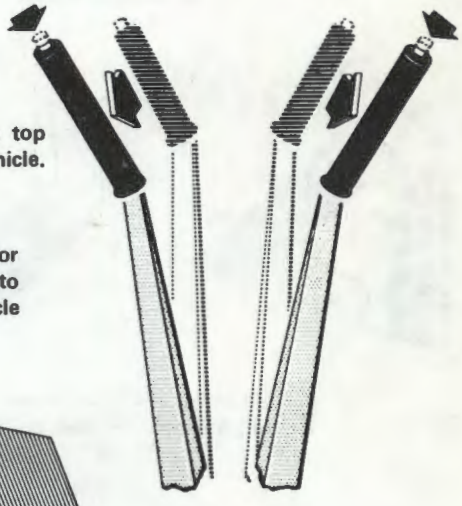


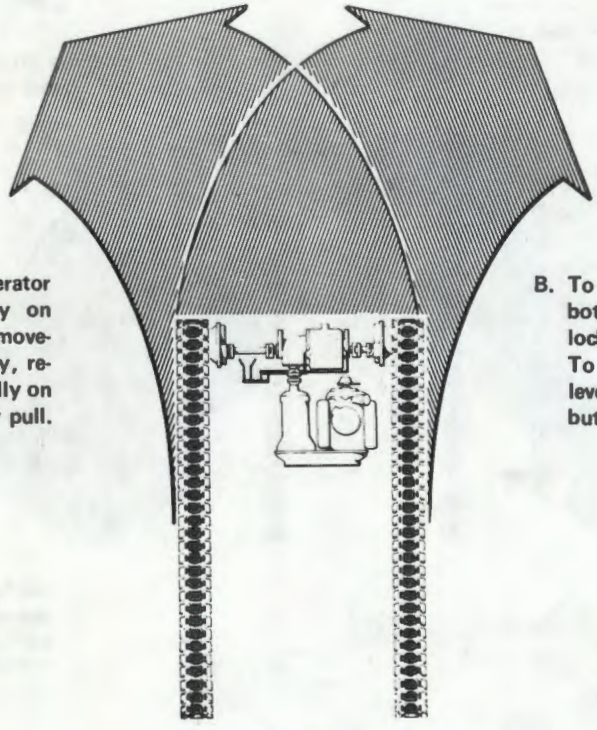
CAUTION:

Never touch lock buttons on top of hand grips when steering vehicle.

NOTE

For normal stop, release accelerator pedal and allow vehicle to come to a stop. Shift to N after vehicle stops.



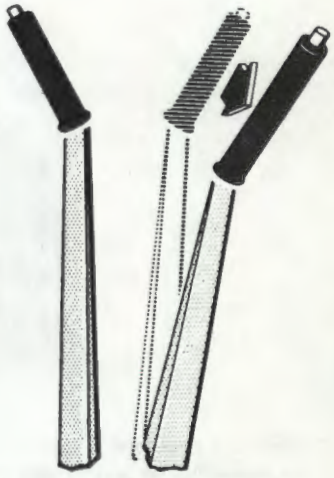


A. To slow vehicle, release accelerator pedal and pull back equally on both levers, using pumping movement. To stop vehicle quickly, release pedal and pull back equally on both levers, using hard steady pull.

B. To lock brakes for parking, pull both levers back tightly and depress lock buttons on top of hand grips. To release brakes, pull back on levers, keeping thumbs clear of lock buttons, then release levers.

CAUTION:

When operating in loose sand, dirt, or rock, especially on side slopes, steer in a series of short turns, rather than one long even turn, to allow debris to feed out of track. Debris accumulation may cause damage to suspension or a thrown track.



C. To turn left when traveling forward or in reverse, pull left lever until turn is complete, then release lever.

D. To turn right when traveling forward or in reverse, pull right lever until turn is complete, then release lever.

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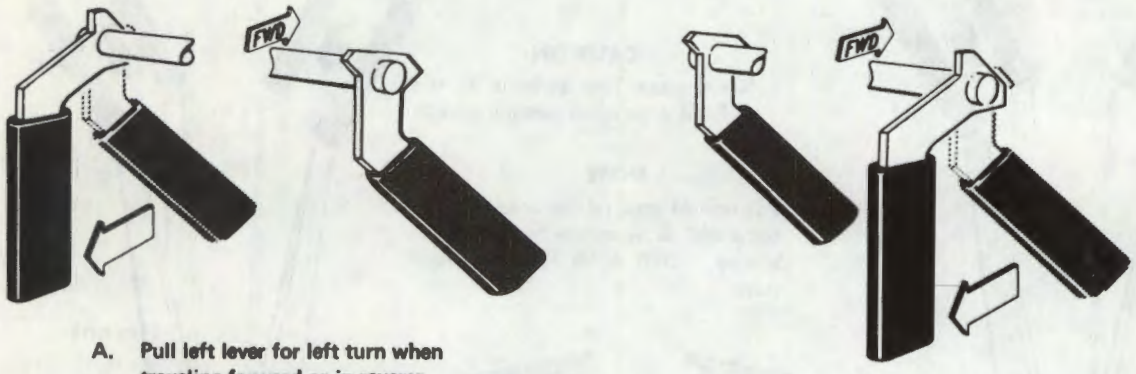
Figure 2-42. Steering and braking chassis.

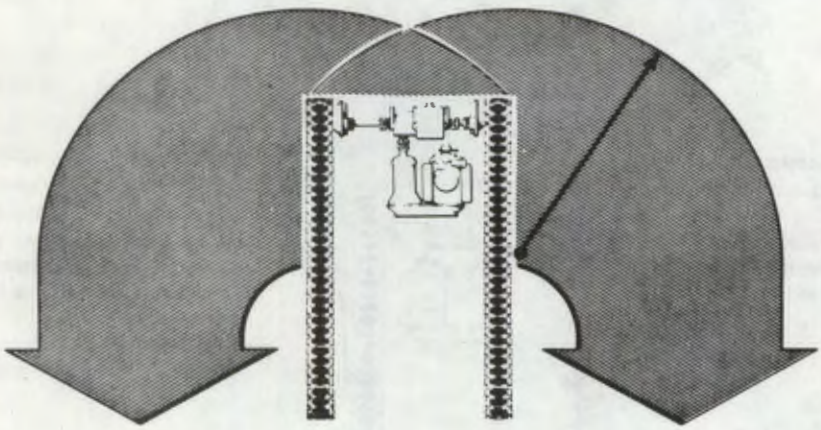
CAUTION:

Never use pivot steer levers and differential steer levers at the same time, or differential may be severly damaged



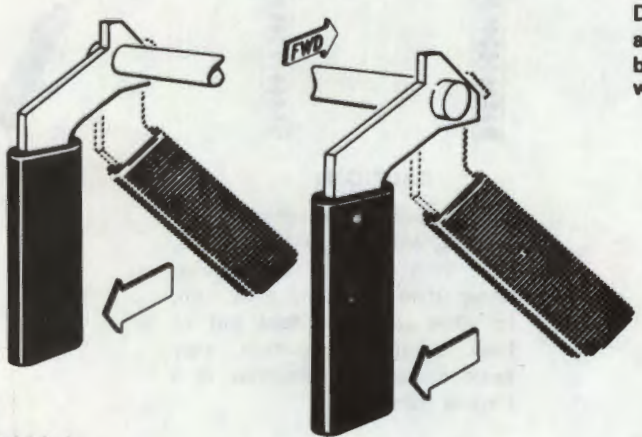
A. Pull left lever for left turn when traveling forward or in reverse.

B. Pull right lever for right turn when traveling forward or in reverse.



CAUTION:

DO NOT use pivot steer at speeds above 15 MPH. Shift lever should be in 1-2 range for maneuvering with pivot steer.



C. Use pivot steer to stop vehicle in an emergency by pulling back on both levers at same time and releasing accelerator pedal.

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Figure 2-43. Operating chassis with pivot steer levers.

c. Adjust hand THROTTLE control (10, fig 2-1) for 1,000 rpm engine speed, and operate engine for 2 minutes.

CAUTION

Return engine speed to idle before setting MASTER SWITCH to OFF, to avoid damage to generator-regulator.

d. Push hand THROTTLE control in.

e. Pull fuel cutoff control out (9, fig 2-1).

f. With engine stopped, release hydraulic system pressure, if vehicle is to be parked for a period of time, by momentarily placing suspension lockout control handle (6, fig 2-1) to EXTEND position and then returning to RETRACT position.

g. Turn lights and radio off.

h. Pull out MASTER SWITCH and set switch to OFF (fig 2-6).

CAUTION

Perform required after-operation preventive maintenance (table 3-2). If air temperature is below or expected to drop below —25° F, start engine coolant heater (para 2-27d) to maintain warm lubricating oil, engine block, and battery electrolyte temperatures.

2-14. Towing M163 System.

a. Towing to Start Engine.

(1) Use towing cable to connect towing vehicle and system to be towed.

(2) Start engine by towing in accordance with the following instructions:

(a) Ensure that controls in towed vehicle are in positions listed below:

1. MASTER SWITCH to ON (fig 2-6).

2. Fuel cutoff control fully in (9, fig 2-1).

1).

3. Range selector to N (5, fig 2-1).

4. Differential steering lever brakes released (B, fig 2-42).

CAUTION

Do not keep towed vehicle in gear more than 5 seconds at a time when trying to start engine.

(b) When speed reaches 10 to 15 mph, move towed vehicle's range selector to 1-3 and depress accelerator pedal half way.

(c) Set range selector to N when engine starts and signal driver of the towing vehicle.

(d) Perform steps *l* and *m* of paragraph 2-4.

b. Towing Disabled Vehicle.

WARNING

Do not use tow cable when differential of disabled vehicle is disconnected. The disabled vehicle has no steering or braking control.

CAUTION

If vehicle is to be towed less than 30 miles and at a speed less than 10 miles per hour, it is not necessary to disconnect any universal joints; however, if vehicle is to be towed more than 30 miles, or at a speed greater than 10 miles per hour, notify organizational maintenance that universal joints between the differential and final drives must be disconnected. Failure to do so will damage transmission and differential due to overheating and lack of lubrication.

(1) Connect tow bar to towing eyes of disabled vehicle (A, fig 2-44).

(2) Connect tow bar to pintle of towing vehicle (B, fig 2-44).

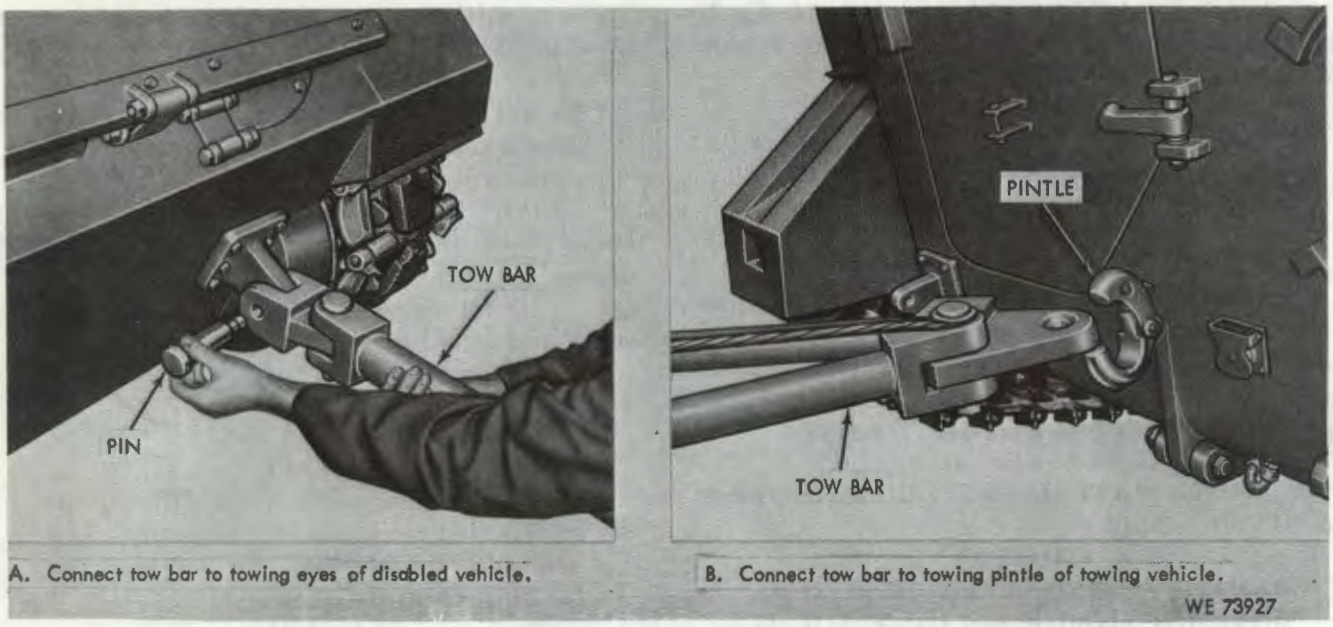


Figure 2-44. Connecting tow bar between vehicles.

2-15. Operation in Water

a. Preparing Vehicle.

WARNING

Survey any damage to flotation pods prior to water operation. Assure that the flotation pod and mounting flanges are not damaged. During water operation, buoyant forces on a damaged mounting flange could cause the flotation pod to break loose.

(1) Check hull drain plugs (fig 2-45) and bolted access covers for tightness.

CAUTION

Make certain hull drain plugs are secured flush with hull bottom and are not tilted.

(2) Check bilge pump operation with chassis on level ground. Any water in the bilge should discharge through the outlets. If the bilge is dry, air should come through the outlets; test by covering each outlet with hand. Inspect screens around bilge pumps for cleanliness. Make certain hole in bilge pump housing is open.

(3) Make certain track shrouds are properly installed and in good condition.

(4) Make certain power plant door is secure.

(5) Raise and lock ramp (para 2-8), and make certain ramp personnel door is secure.

(6) Extend and lock trim vane (A, fig 2-21).

(7) Make certain periscopes are installed (para 2-25 or 2-26).

(8) Turn on chassis interior lights if tactical situation permits.

(9) Rotate engine exhaust toward rear of chassis.

CAUTION

Make certain exhaust outlet is rotated fully to the rear to prevent exhaust gas from burning air grille curtain.

(10) Install air grille curtain (fig 2-46) as follows:

(a) Remove air grille curtain from stowed position on power plant compartment rear bulkhead.

(b) Remove five posts from curtain stowage pocket, and install posts on five studs located around air grilles.

(c) Stretch air grille curtain around five posts to surround air grilles, and fit lower edge of curtain into recess of four retainers under posts.

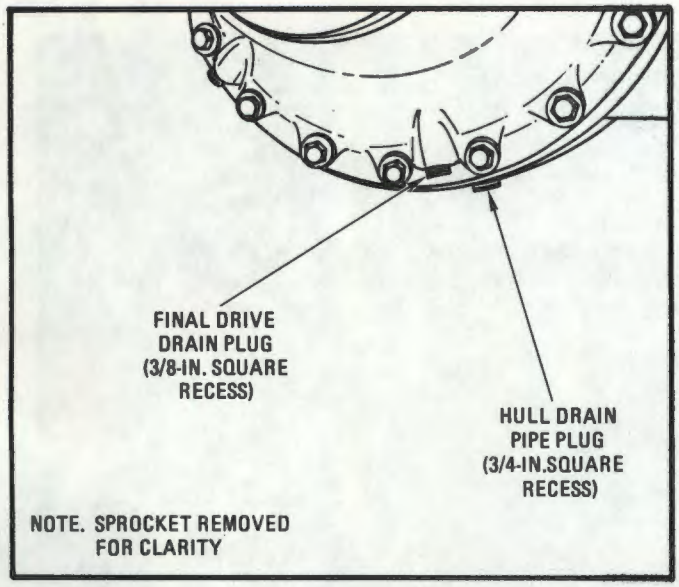
(d) Position upper edge of air grille curtain over top of five posts.

WARNING

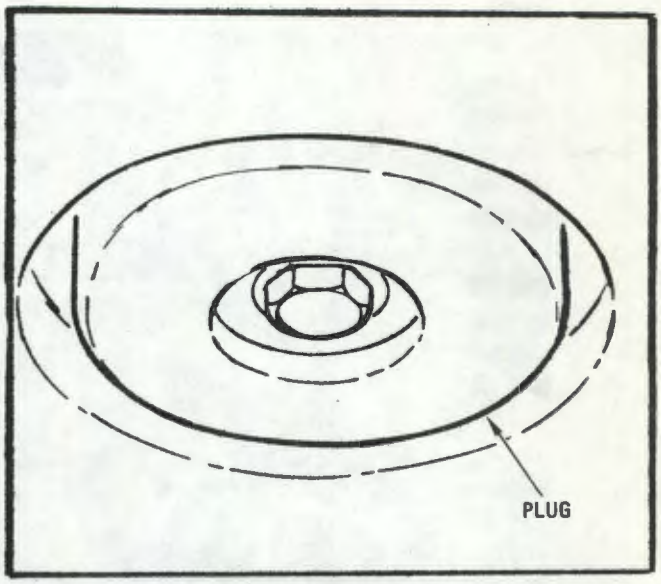
Check to see that loose items are properly installed and tied down for proper load distribution before entering water (refer to fig 2-86.1 and 2-86.2).

(11) Open driver's hatch cover if situation permits.

(12) Before entering water, center and lock gun barrels over rear of vehicle. However, if commander's hatch is to be closed, fully elevate gun barrels to allow for emergency exit through hatch.



A. Hull drain pipe plug. (2)



B. Hull drain pluge assembly. (3)

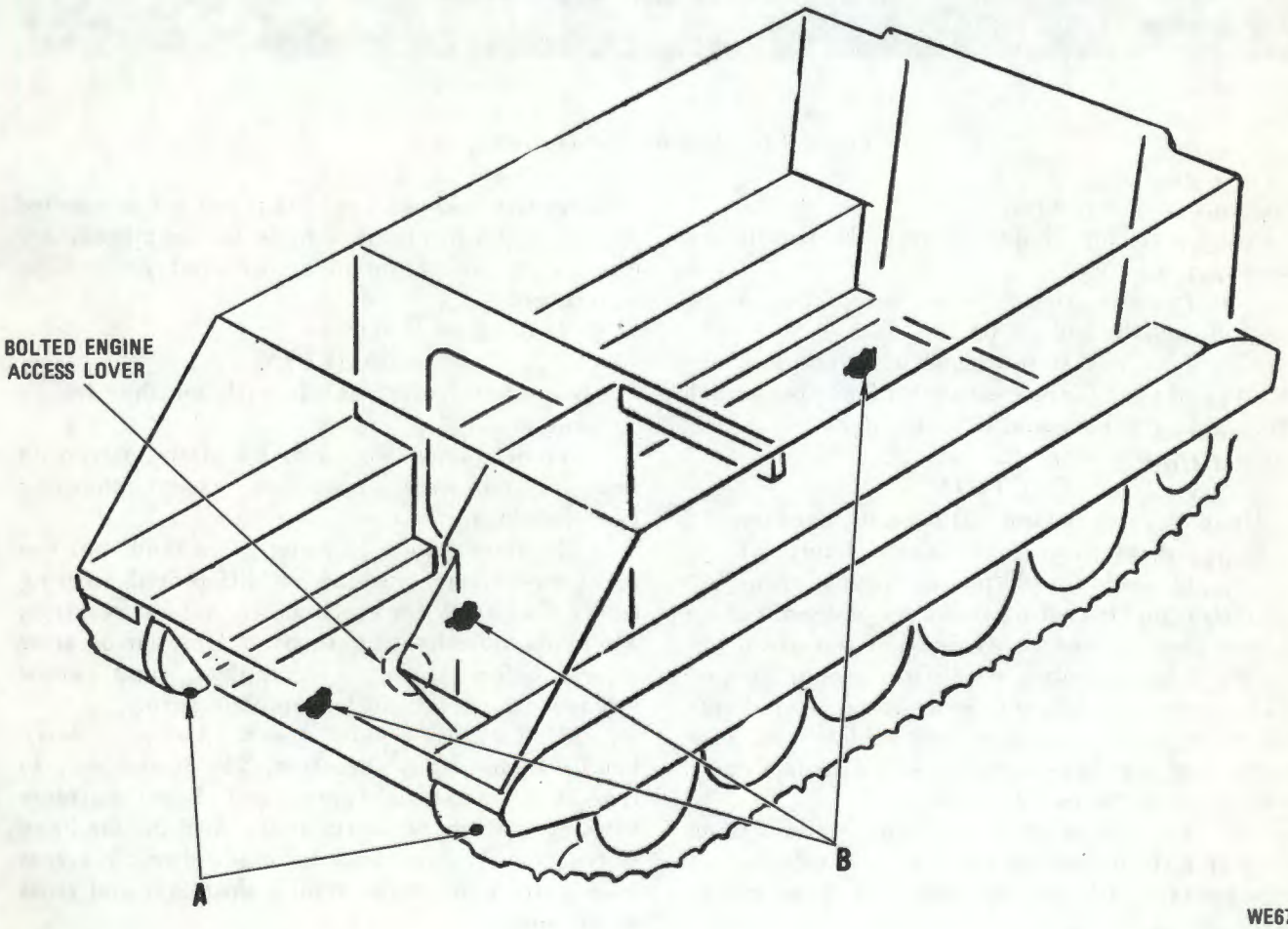


Figure 2-45. Hull drain plugs.

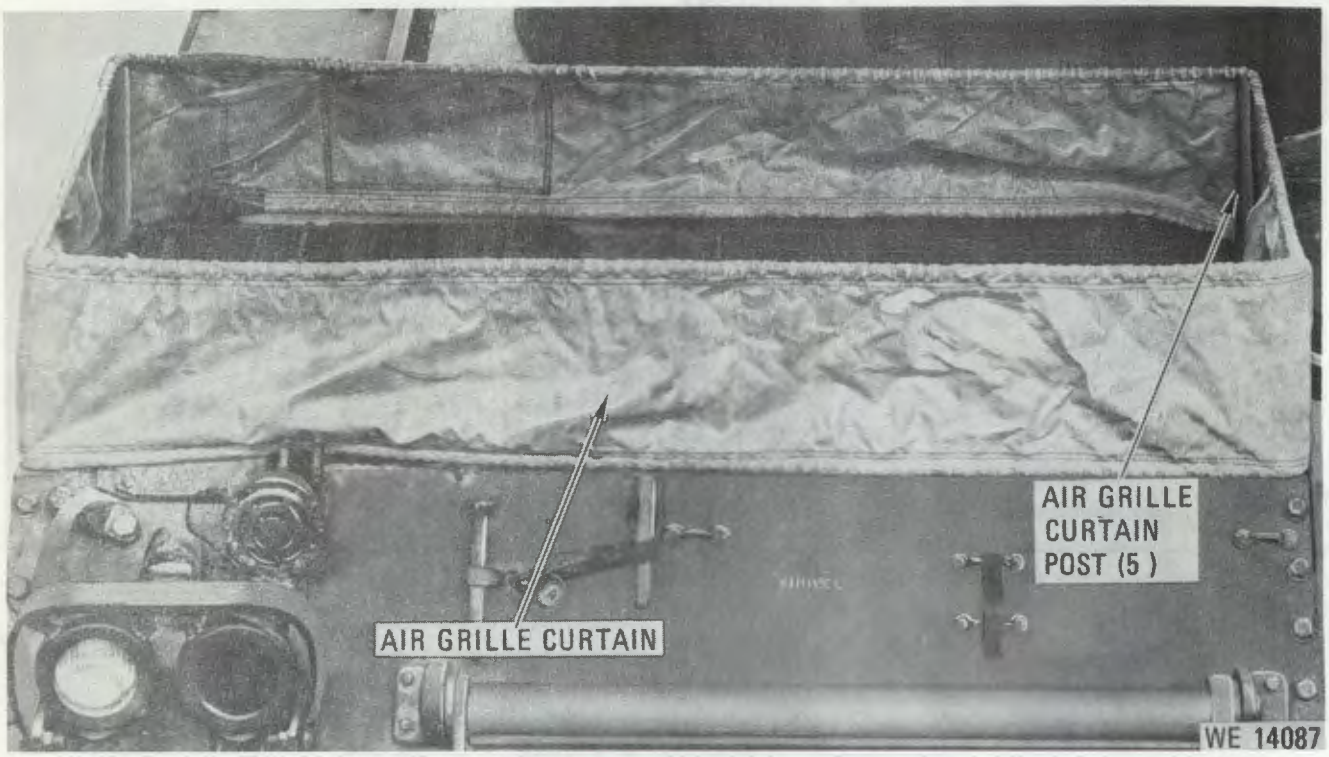


Figure 2-46. Air grille curtain-installed.

b. Safety Precautions.

(1) Open top hatch covers if conditions permit.

(2) If water rises above floorplates, leave inside of vehicle and sit on top deck.

(3) If vehicle shows signs of swamping, accelerate and head for nearest shore. Have personnel leave inside of vehicle and sit on top deck.

c. Entering Water.

CAUTION

Do not enter water with high, choppy waves that may over-wash front of vehicle and flood power plant compartment. Operation in waves exceeding one foot should be avoided if possible.

(1) When possible, select firm ground free of rocks, stumps, or debris to enter water. Avoid soft ground or steep grades where vehicle can lose traction and may mire down or skid. Inspect entry point for underwater obstacles.

(2) When entering from a firm, gradual slope into water deep enough to float the vehicle, set range selector to 1 and use moderate speed not to exceed 10 mph.

(3) When entering from a step slope, or a slope with obstacles, enter water slowly. Maintain a close watch to see that water does not enter intake and exhaust grilles. *If water appears to be swamping vehicle and vehicle is not yet committed to water, back off;* if vehicle is committed, accelerate to raise front of vehicle and get vehicle waterborne.

d. Driving in Water.

CAUTION

Do not tow one vehicle with another in water.

(1) Set range selector to 1-2 after waterborne and for all water operation except stopping (*e.* following).

(2) Steer vehicle in water as on land, but use pivot steer levers instead of differential steering levers, and allow for much slower vehicle reaction. To avoid overshooting turns, release pivot steer levers before turn is complete, and allow momentum of vehicle to complete turn.

(3) To cross a slow stream (2 mph or less), head vehicle in any direction. The fastest way to cross is to head straight across and allow the stream to carry the vehicle downstream until the far bank is reached. If exit must be made directly across from entry point, head vehicle upstream and cross at an angle.

(4) Crossing a swift stream in a straight line should be avoided. The preferred method for crossing a swift stream is to head vehicle diagonally downstream.

(5) If vehicle strikes underwater obstruction, apply brakes to reduce speed, then set range selector to R, back off and go around. Do not try to cross over or go through obstacles; vehicle may roll and take water in through the air intake and exhaust grilles, or hang up.

e. Stopping in Water.

(1) To stop vehicle in water, release accelerator pedal, and pull back on both pivot steer levers. When tracks have stopped, release levers, set range selector to R, and depress accelerator pedal.

CAUTION

Avoid sudden deceleration that will cause vehicle to pitch in direction of travel.

(2) When vehicle forward motion has stopped, release accelerator pedal, and set range selector to N.

f. Leaving Water.

(1) Avoid mushy, muddy, or steep slopes. Avoid exit where there are large rocks or considerable amounts of debris. Approach shore as squarely as possible, and attempt to maneuver vehicle so both tracks strike land at the same time.

(2) Ease up on accelerator pedal to reduce track speed before striking ground, and set range selector to 1 when tracks strike ground.

CAUTION

The critical time during an exit is when the tracks first strike the ground. Once either track strikes, steering becomes difficult until both tracks have enough traction for normal steering. Use pivot steer levers to maintain control until chassis is clear of water.

(3) Climb bank with range selector set to 1, and avoid skidding sideways or spinning tracks.

g. After Water Operation.

(1) Check trim vane hinges for obstructions, and retract trim vane (fig 2-21).

(2) Start bilge pumps; when bilge is clear of water, stop bilge pumps.

(3) Flush all areas of vehicle or components with fresh water after operating in salt water.

(4) Remove air grille curtain (fig 2-46) as follows:

(a) Release lower edge of air grille curtain from four retainers under five posts, and remove air grille curtain from posts.

(b) Remove five posts from five studs located around air grilles, and stow posts in air grille curtain stowage pocket.

(5) Rotate engine exhaust outlet to side of vehicle.

NOTE

If tactical situation permits, refer to paragraph 3-13 *h* for maintenance of vehicle after water operation.

(6) Refer to paragraph 3-13 *h* and perform lubrication and maintenance as directed.

2-16. Loading Ammunition.

WARNING

Electrically primed ammunition is liable to accidental firing when in the presence of radio frequency (RF) fields such as those produced by high powered radar and communications equipment. The main consideration is the avoidance of contact of any kind with the primer, especially with metallic objects such as tools. Detailed information regarding handling of this type of ammunition may be found in TM 9-1900 and TM 9-1300-206.

CAUTION

Take precautionary measures when loading ammunition in drum to prevent dirt, sand, gravel or other debris from entering the linkless feed system. Make sure the vehicle floor and ramp are clean and use a suitable ground cover when ammunition is strung outside the vehicle.

a. General. Ammunition is linked and delinked with the M25 linker-delinker. Refer to figure 2-47 for operation of the linker-delinker. The green leading and green tail links (fig 2-48) shall be used when loading ammunition. Refer

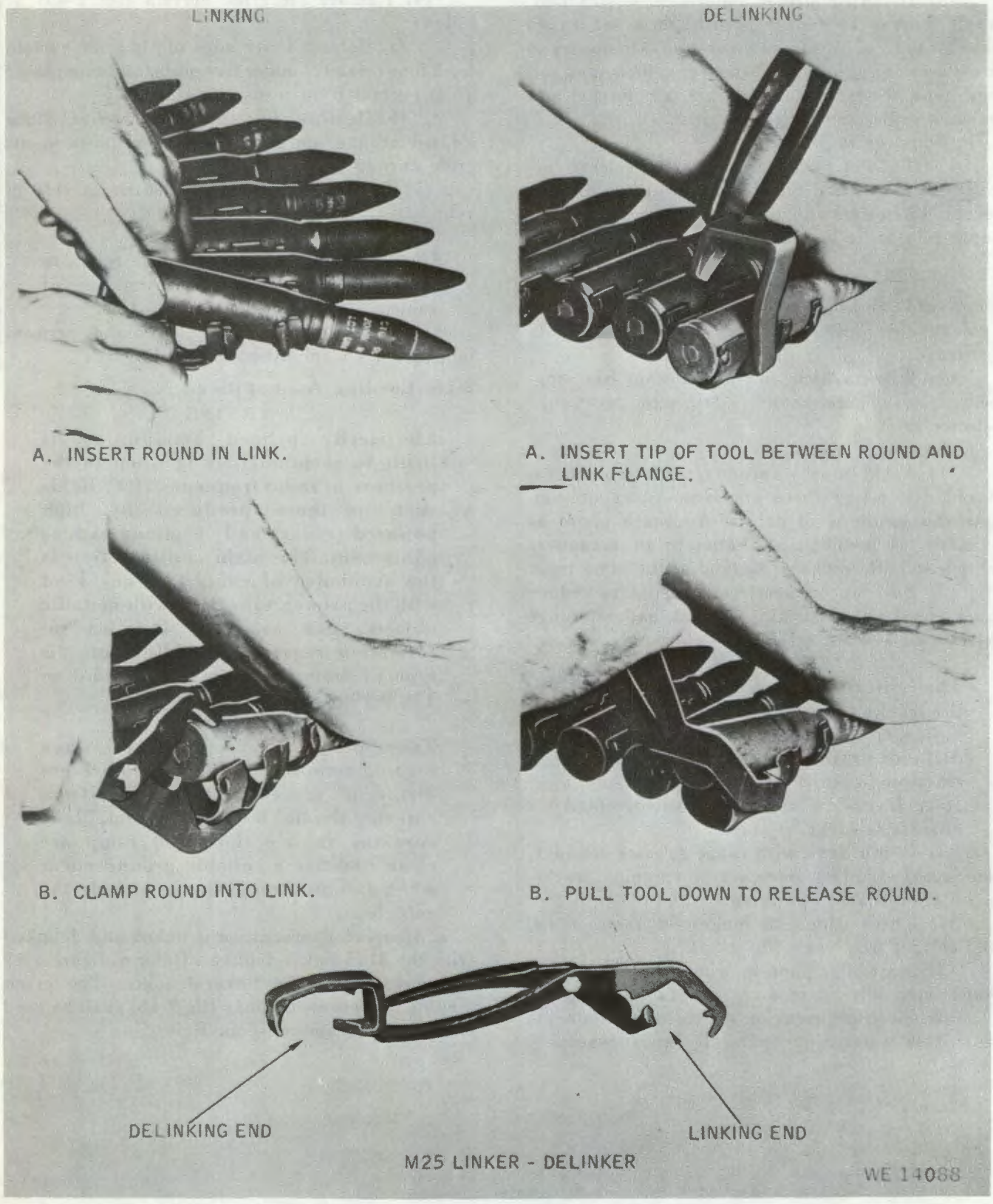


Figure 2-47. Operation of M25 linker-delinker.

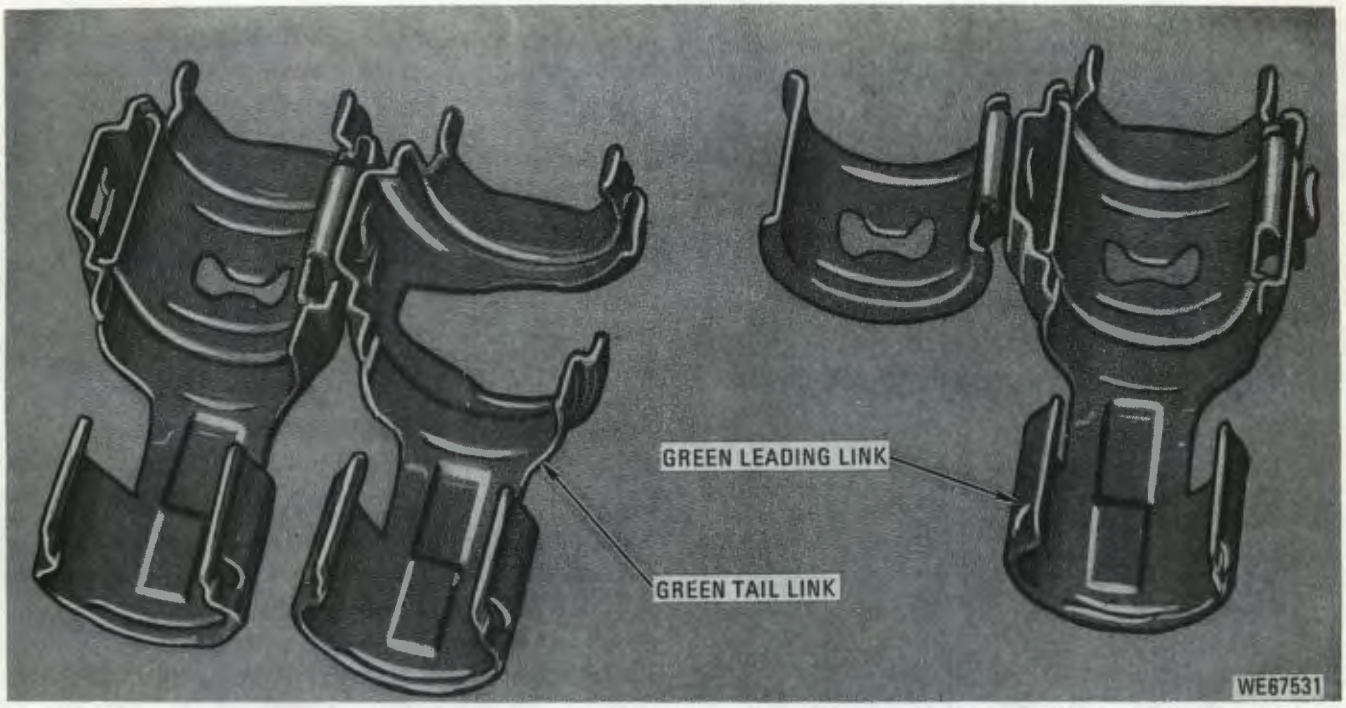


Figure 2-48. Green leading and tail links.

to figure 2–49 for linking the leading and tail links. Refer to figure 2–50 for connecting two belts together.

WARNING

If live rounds are removed from ammunition storage and joined together to form link belts the belts should be spread out or stacked in such a way that no part of a round or link may come into contact with the primer end of another round.

(1) Check that nothing will interfere with the motion of the turret in azimuth.

(2) Remove the turret cover.

(3) Release the cannon from the travel lock and stow the travel lock.

(4) Position the mount approximately 1600 mils to the left of the travel position (radar antenna mounting bracket points to travel lock), and approximately 0 mils elevation.

(5) Gain access for loading by stowing the turret safety guard as follows:

(a) Raise commander's seat in the full up position and remove commander's foot rest.

(b) Release the left latch and 3 gate locks (fig. 2–51). Fold the guard against the right wall. Stow with the web strap.

(8) If stowed ammunition is to be loaded, remove ammunition as follows:

(a) Lower the personnel seat back rest (fig. 2–52B).

(b) Release the front web strap and swing personnel seat up towards ramp door.

(c) Remove ammunition cover (fig. 2–53).

(d) Release web straps securing ammunition to left wall of vehicle and remove ammunition starting at ramp end of stowage rack.

(9) Load ammunition into drum as described in b. following.

b. Loading Ammunition into Partially Filled or Completely Empty Drum.

(1) Set the drum drive assembly shift pin handle (fig. 1–14) to N.

(2) With knurled knob on takeoff gear, rotate the takeoff gear in feed direction (clockwise) until an arrow on a conveyor gear tooth (index tooth) is nearly opposite notch in timing lock as shown in figure 2–54.

(3) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the unlocked (up) position.

(4) Pull the conveyor unit assembly out from the exit unit assembly into the load position (fig. 2–54).

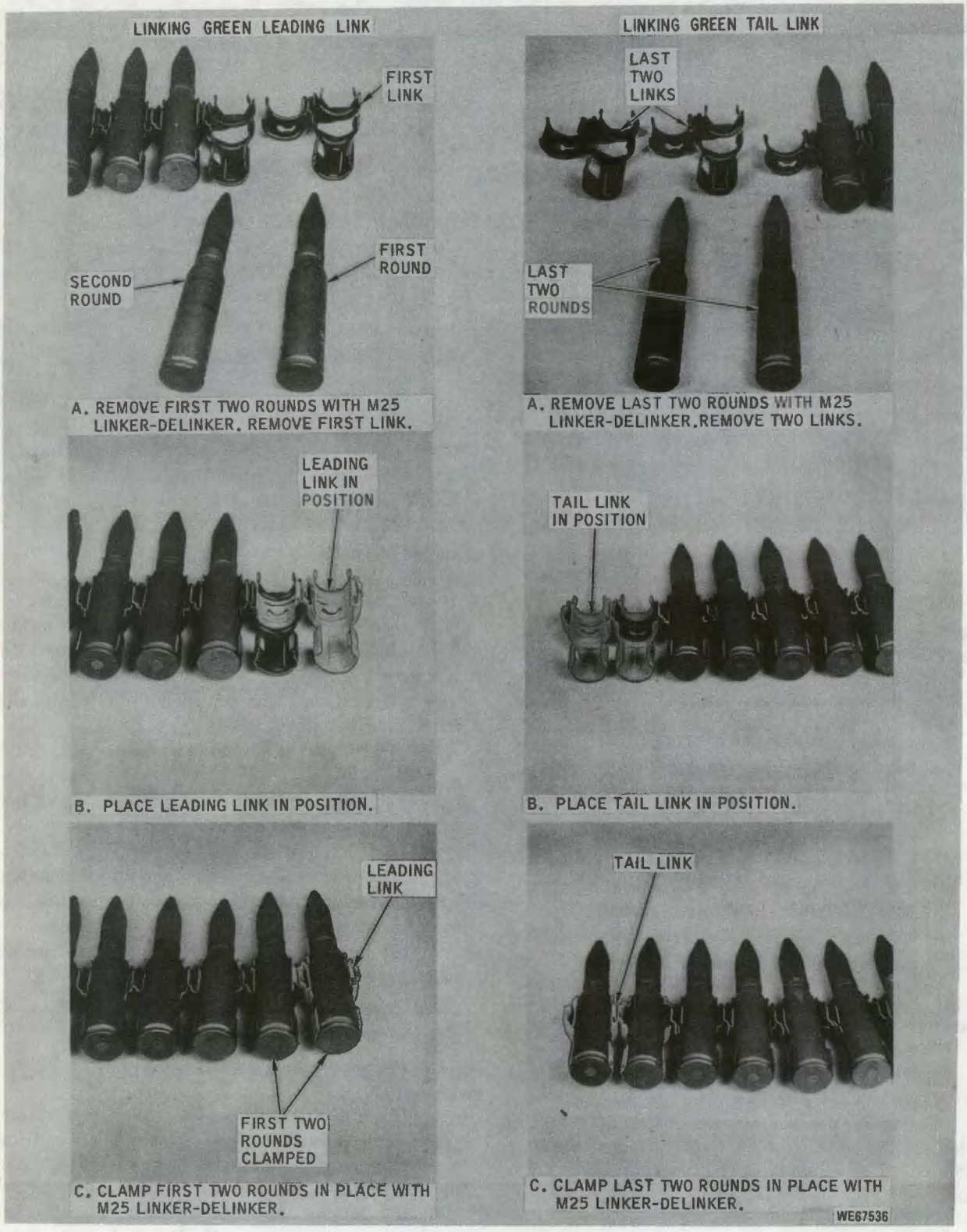


Figure 2-49. Linking the green leading and green tail links.

(5) Depress the conveyor unit assembly handle lockbutton and rotate handle to locked (down) position. Check that timing lock notch has engaged an indexed tooth (in time). Conveyor unit is now in load position.

Figure 2-50. Connecting two belts of ammunition.

NOTE

If the timing lock notch has not engaged an indexed tooth, manually disengage the timing lock and rotate the conveyor gear until the notch will engage an indexed tooth.

(6) If loading ammunition into a completely empty drum, proceed to step (11); if loading ammunition into a partially filled drum continue with step (7).

(7) Using the knurled knob on takeoff gear, turn takeoff gear counterclockwise until round positioning pin can be depressed.

(8) Depress round positioning pin; turn takeoff gear in feed direction (clockwise) until round is against pin. Apply and maintain slight pressure to takeoff gear in feed direction (clockwise) to hold round positioning pin in.

(9) Apply pressure to drum timing pin and slowly turn takeoff gear counterclockwise until round positioning pin is released and the timing pin can be depressed (fig 1-14). Release take-off gear knurled knob, then the timing pin.

(10) Proceed to step 12.

(11) Rotate takeoff gear in feed direction (clockwise) until timing mark on scoop disc assembly is nearly aligned with timing marks on exit cover assembly (fig 2-55).

(12) Momentarily pull out double link-stripping guide locking pin and push down double link-stripping guide until locking pin engages with the upper hole in the stripping guide (load position) (fig 2-55).

(13) Lay out ammunition so that open side of links are down and check that each round in belt is linked correctly (fig 2-56).

(14) Replace first link with leading link (fig 2-49) supplied with system.

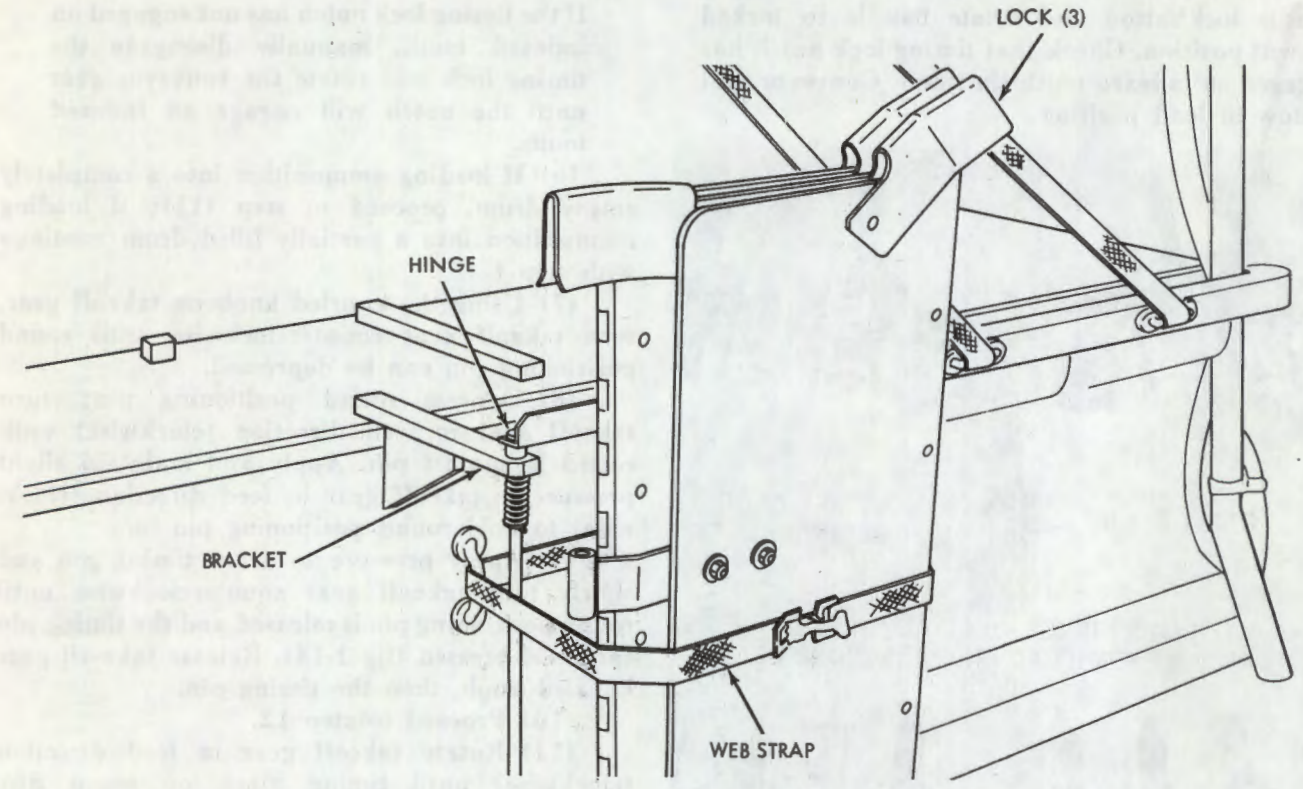
CAUTION

At completion of step 15, visually check that first round enters the exit unit assembly and sprocket.

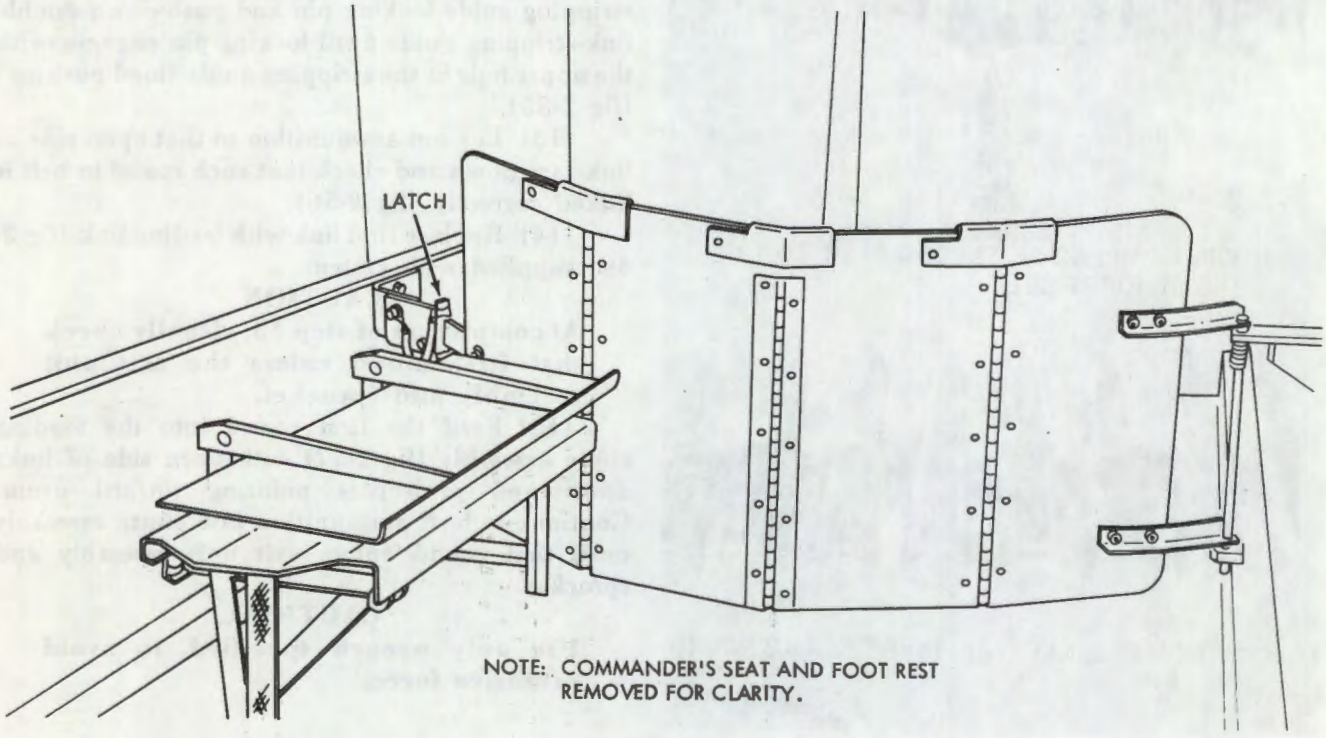
(15) Feed the first round into the loading chute assembly (fig 2-57) with open side of links down and projectiles pointing toward drum. Continue to feed ammunition into chute assembly until first round enters exit unit assembly and sprocket.

CAUTION

Use only wrench specified, to avoid excessive force.



A. Stowed position



B. Open position

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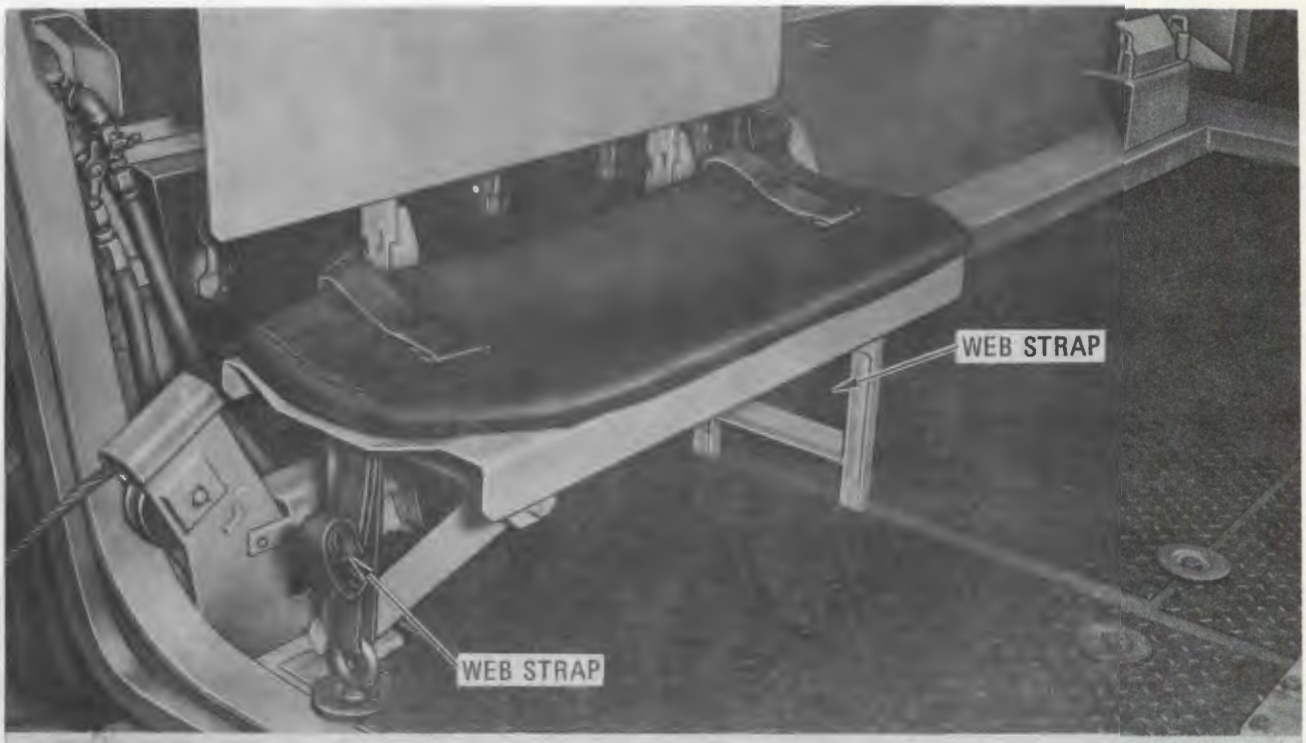
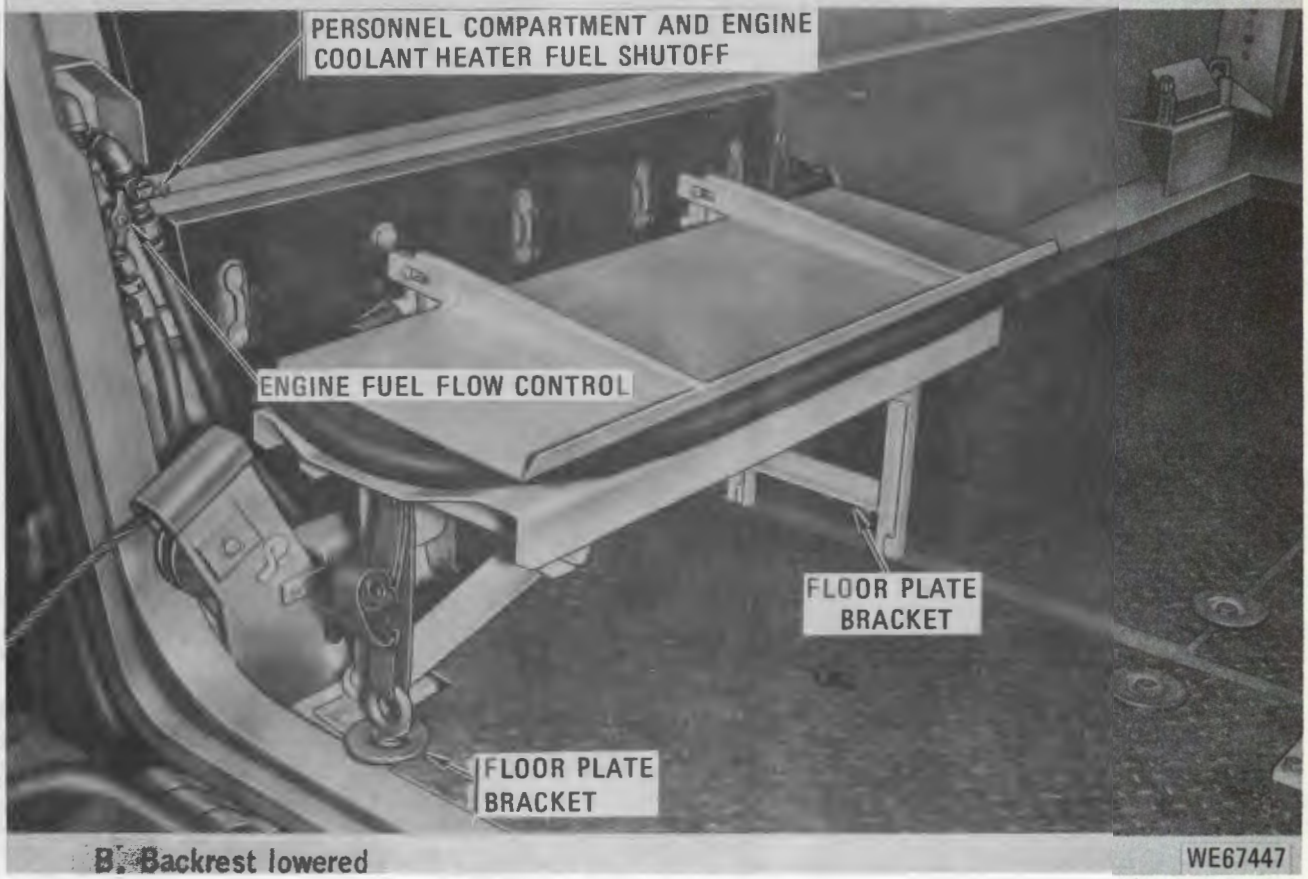
Figure 2-51. Turret safety guard.



A. Backrest up



B. Backrest lowered

Figure 2-52. Personnel seat.

Figure 2-53. Ammunition cover-installed.

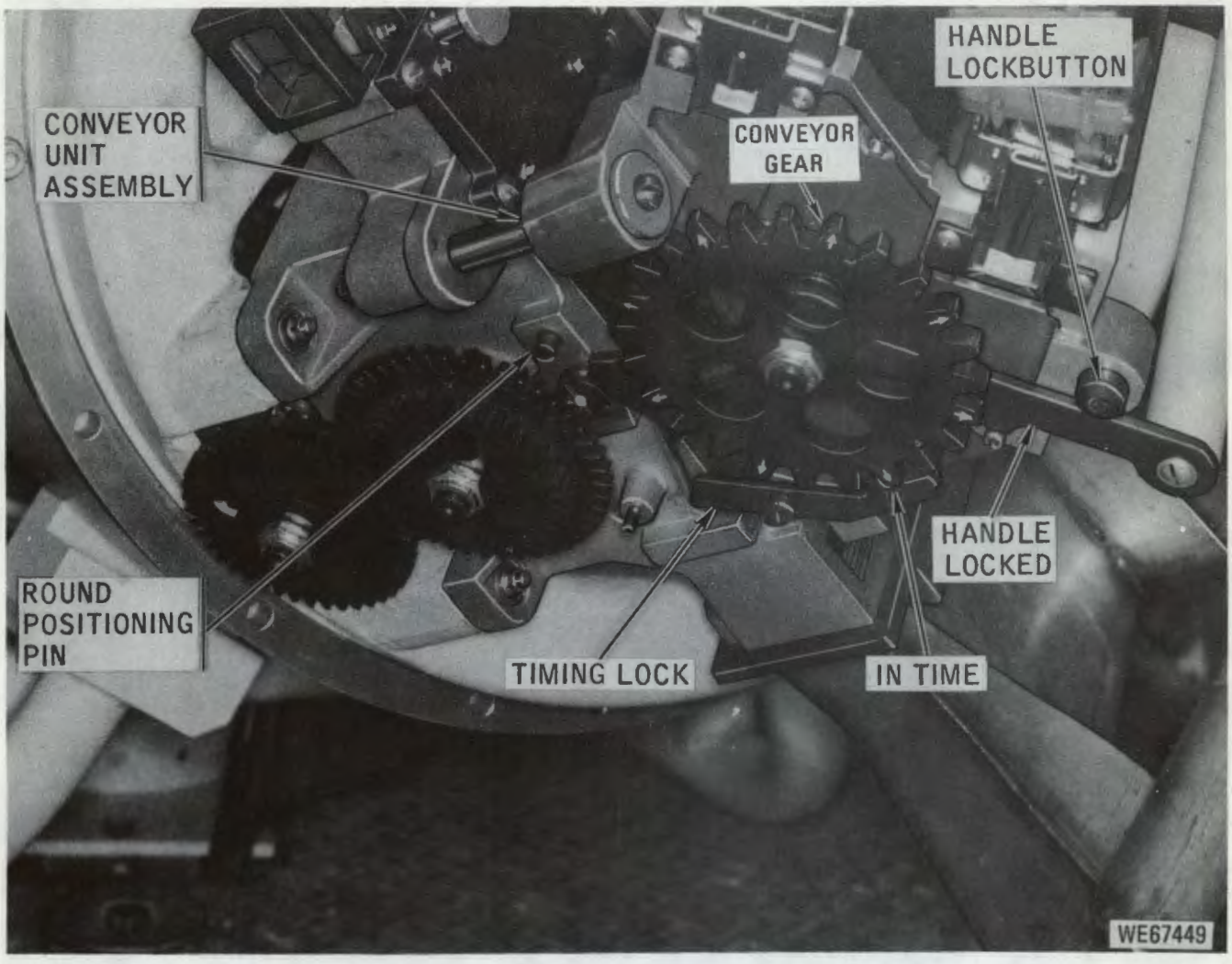


Figure 2-54. Conveyor unit assembly in load position.

(16) Insert socket wrench handle (speed wrench) into takeoff gear knurled knob (fig. 2–57), and slowly turn takeoff gear counterclockwise until leading link engages double link stripping guide "T" rail guide (fig. 2–58). Approximately 1/4-turn is required to engage leading link; a click will be heard when it engages.

(17) Turn handcrank counterclockwise until two rounds have been delinked.

(18) Remove socket wrench handle and set shift pin handle to L position.

NOTE

If shift pin does not engage, rotate takeoff gear slightly in feed direction (clockwise) until pin can be engaged.

(19) Connect tail link (fig. 2–48) to last round on belt if complete belt is to be loaded into drum.

(20) Place suitable container under exit unit to catch stripped links.

(21) When loading long belts of ammunition proceed to step (22). Load short belts of ammunition as follows:

(a) Momentarily hold load switch to MOMENTARY ON position; releasing switch before belt is fully loaded. Recover leading link.

(b) Splice a new belt to the end of belt being loaded (fig. 2–50). Check that each round in belt is linked properly (fig. 2–56).

(c) Repeat (a) and (b) until drum is sufficiently loaded or drum is completely full.

NOTE

Loading motor will deenergize automatically when drum is completely full.

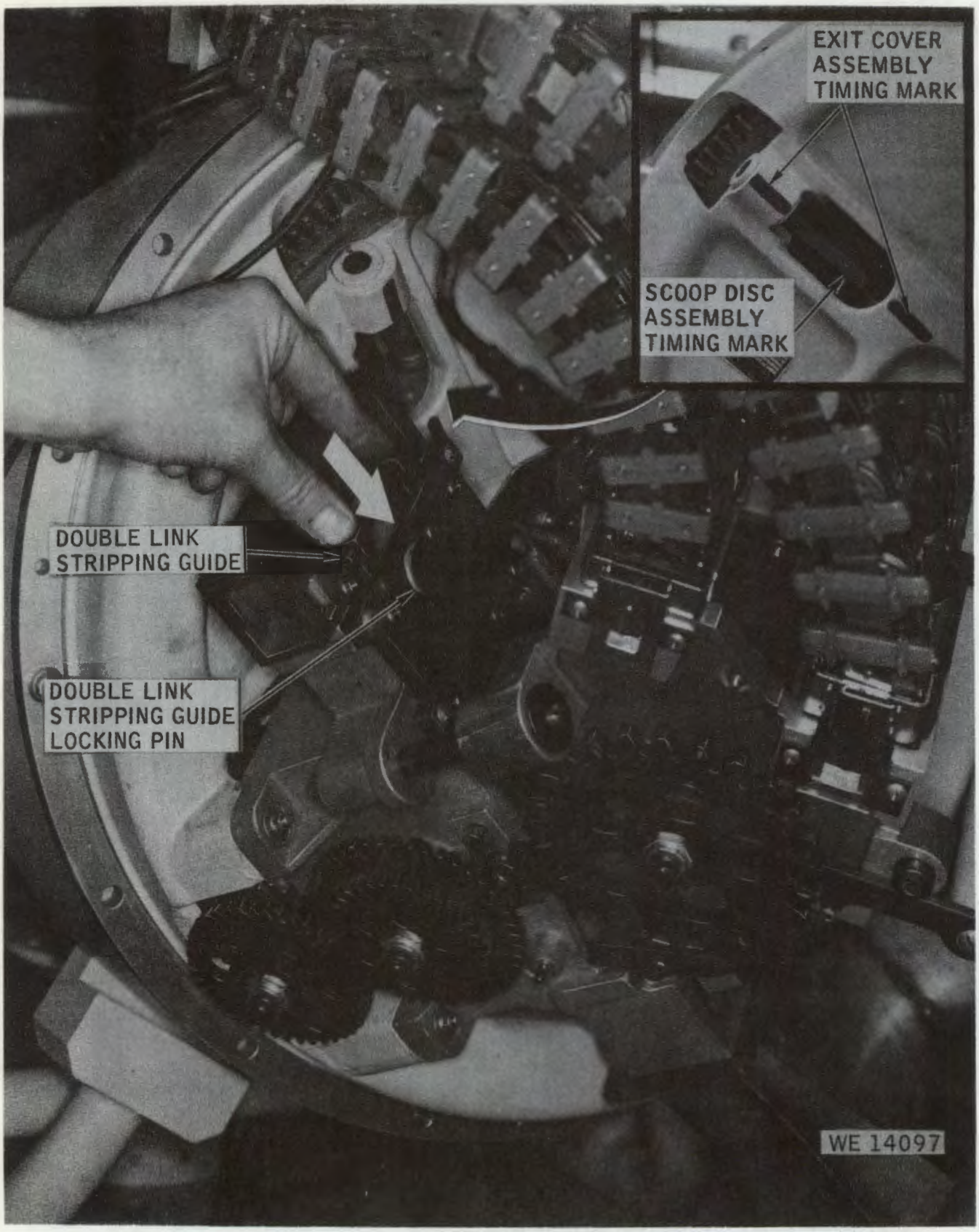


Figure 2-55. Placing double link-stripping guide in load position.

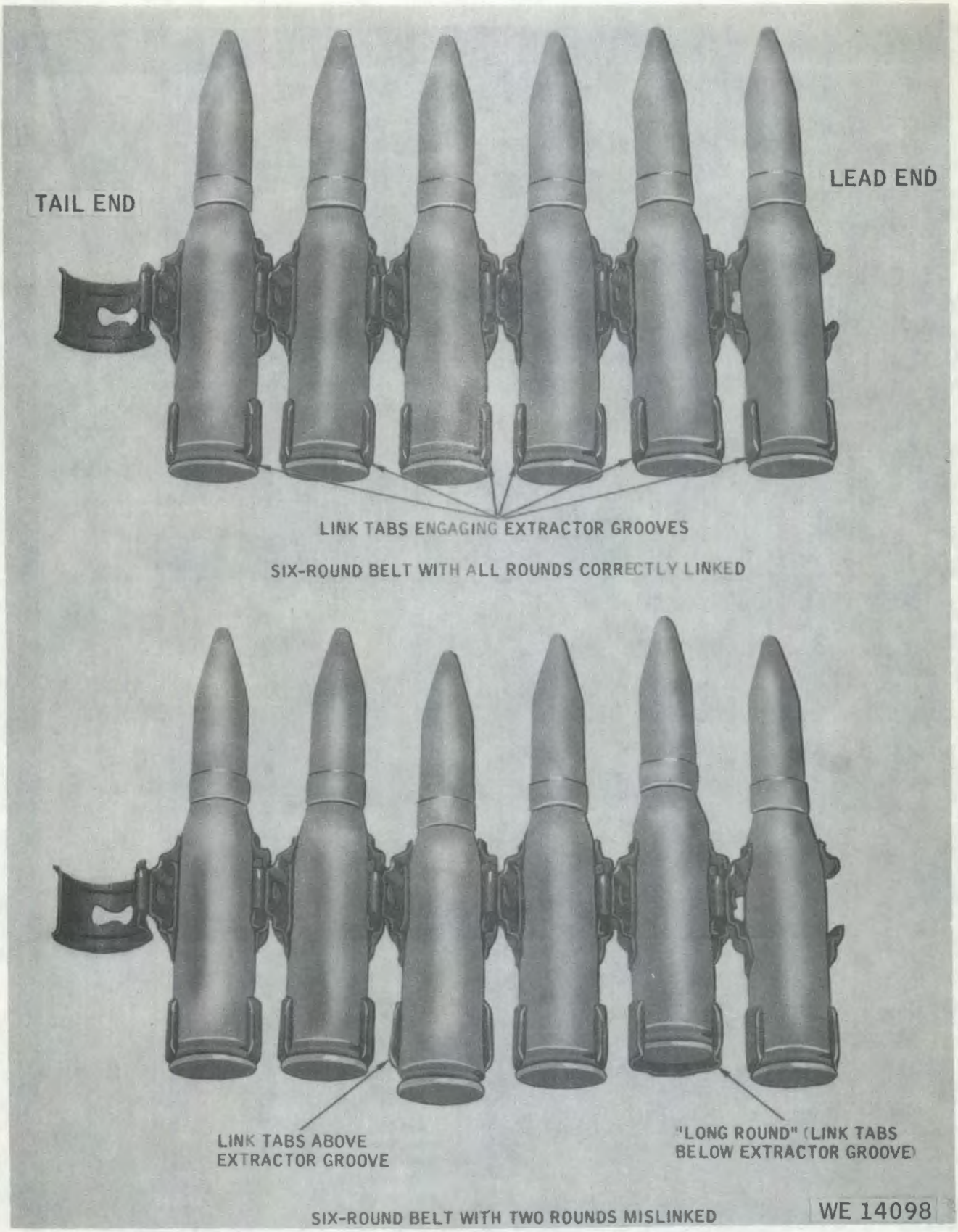


Figure 2-56. Correctly and incorrectly linked ammunition.

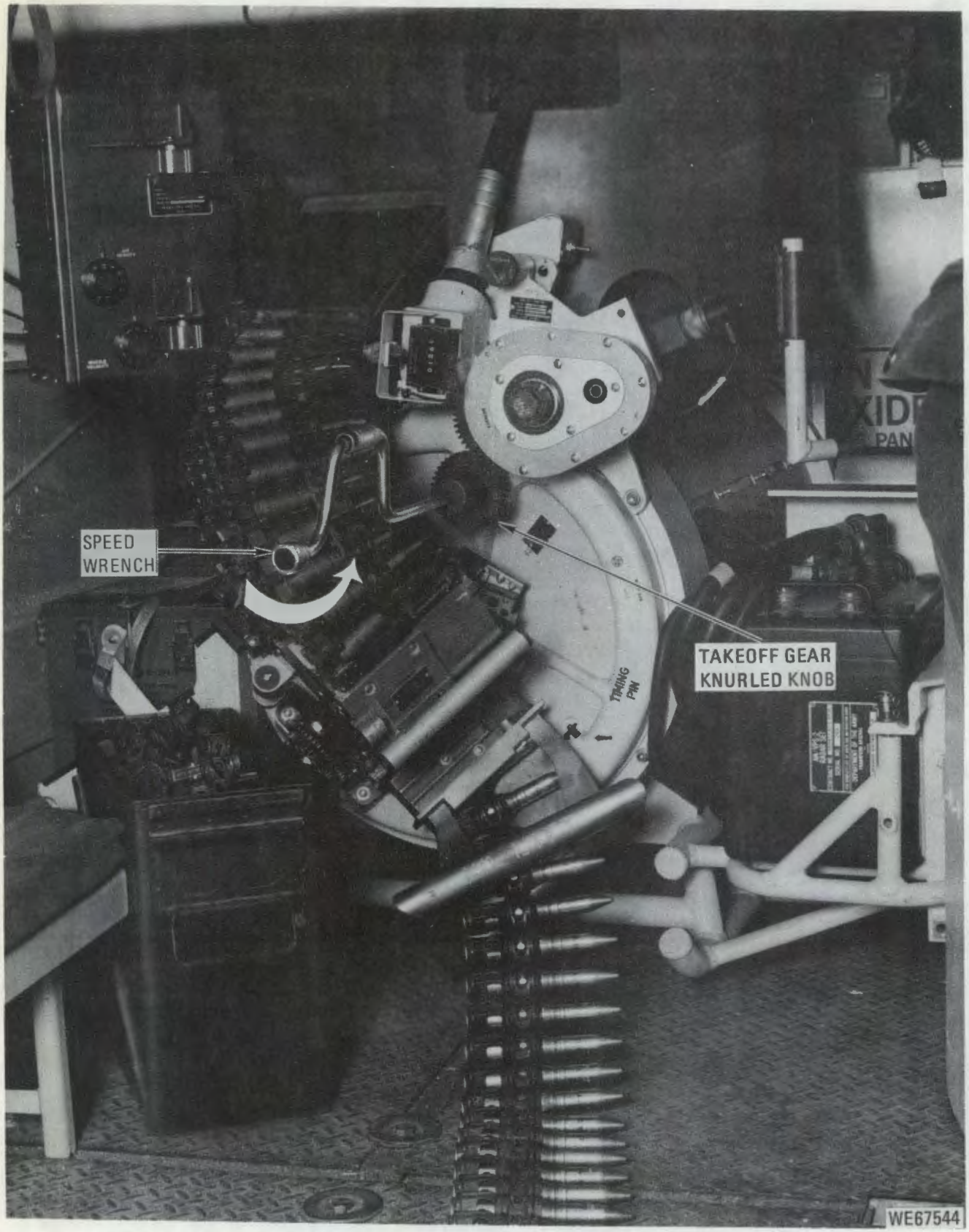


Figure 2-57. XM157 mount-loading.

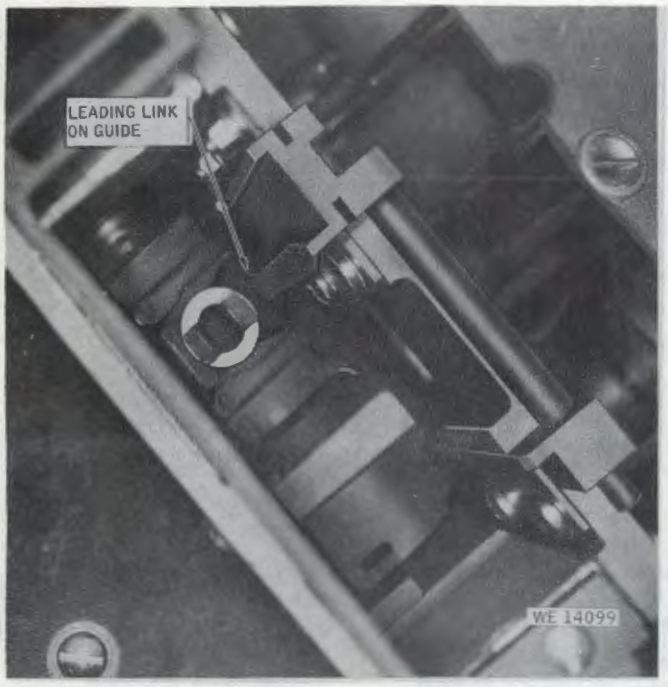


Figure 2-58. Leading link on "T" rail guide.

(d) Proceed to step (23).

(22) Load long belt of ammunition as follows:

(a) Momentarily hold load switch to MOMENTARY ON position. Release switch after 5 to 10 rounds have been loaded to check free flow of ammunition.

(b) Recover leading link.

(c) Set load switch to ON.

(d) Continuously check for free flow of ammunition into loading chute assembly.

NOTE

Loading will continue uninterrupted until drum is completely full and the loading motor is automatically deenergized.

(23) Set drum drive assembly shift pin handle (fig. 1–14) to N position.

(24) Remove remaining links from exit unit assembly. Recover the tail link if applicable. Remove and dispose of the stripped links.

(25) If linked ammunition remains in exit unit assembly, insert socket wrench handle into takeoff gear knurled knob. Rotate slowly in clockwise direction until remaining linked ammunition can be removed from the loading chute assembly. Remove handcrank.

(26) Momentarily pull out double link-stripping guide locking pin; pull double link-stripping guide until stripping guide is fully out and locking pin is engaged (fig. 2–55).

(27) Depress round positioning pin (fig. 2–54); turn takeoff gear in feed direction (clockwise) until round is against pin. Apply and maintain slight pressure on takeoff gear in clockwise direction to hold positioning pin in.

(28) Apply pressure to drum timing pin and slowly turn takeoff gear counterclockwise until round positioning pin is released and timing pin can be depressed (fig. 1–14). Release take-off gear knurled knob, then the timing pin. Assure that timing pin is released.

(29) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the unlocked (up) position.

(30) Push the conveyor unit assembly in all the way.

(31) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the locked (down) position. Conveyor unit is now in fire position.

NOTE

The slack point of the feed system is that point above which all element joints are extended and below which all element joints are compressed. Figure 2–59 illustrates the acceptable feed system slack point zone. When the slack point is positioned correctly there are 12 complete rounds visible in the exposed portion of the feed chute assembly bracket on the drum mount.

(32) Check that 12 complete rounds are visible in the exposed portion of the feed chute and that the slack point is within the slack point zone. If the slack point is low (less than 12 rounds visible) perform steps (a) and (b) below. If the slack point is high (more than 12 rounds visible) perform steps (c) through (f) below. If the slack point is positioned properly set shift pin handle to F (fire) position and proceed to step (33).

(a) Rotate the takeoff gear knurled handle clockwise (adding rounds to feed chute) until slack point is correctly positioned.

(b) Set the shift pin handle to F (fire) position.

(c) Assure that control assembly GUN POWER switch is OFF and GUN POWER indicator is extinguished.

(d) Hold BRAKE-CLEAR AND BRAKE switch to BRAKE and slowly rotate cannon in direction of ROTATION arrow on cannon until slack point is positioned properly; release switch.

(e) Set shift pin handle to F (fire) position.

(f) Hold the BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position, rotate cannon and clear cannon of all rounds; release switch.

(33) Install the personnel seat (fig. 2–52) and install the safety guard (fig. 2–51).

(34) Install commander's foot rest and lower commander's seat.

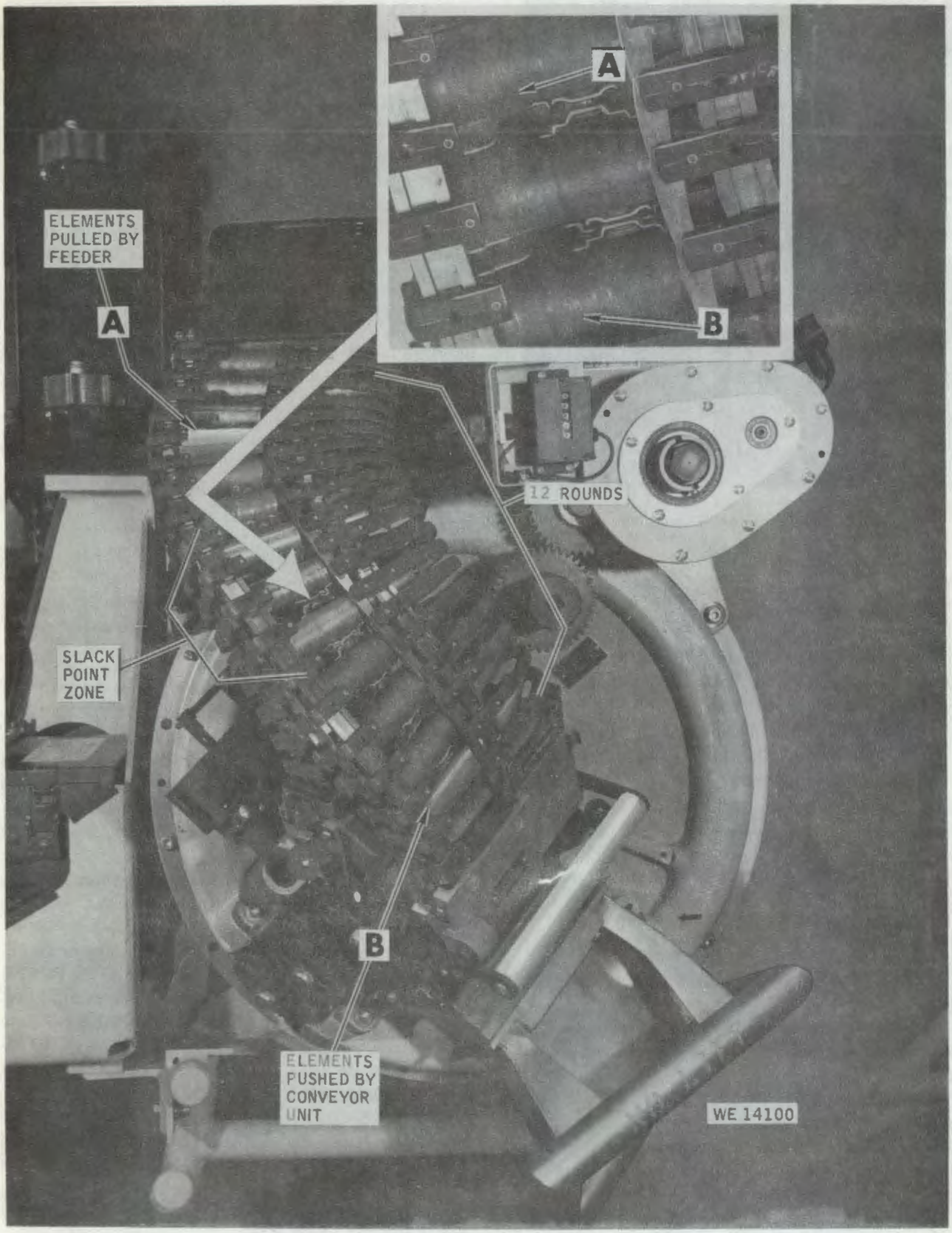


Figure 2-59. Feed system slack point.

(35) Stow the leading and tail links.

(36) Set control assembly ROUNDS REMAINING indicator to indicate quantity of ammunition in drum.

2—17. Loading Ammunition Stowage Rack.

a. Lower personnel seat back rest (fig. 2–52).

b. Release the front web strap and swing personnel seat up toward ramp door.

c. Release the three ammunition stowage tie down straps.

d. Remove ammunition from ammunition box and install tail link on belt.

e. Lay ammunition out on floor of chassis with open side of links up, rounds pointed toward right wall, and tail end of the belt (fig. 2–56) nearest the turret ammunition drum.

f. Check that each round is linked correctly (fig. 2–56).

g. Lift end of belt nearest drum and suspend by resting belt links on support brackets (fig. 2–60) starting with the forward bracket. Suspend so that the lowest of the suspended rounds is approximately three inches above the chassis floor (suspended rounds will number between 23 and 27).

h. Continue until complete belt is suspended.

i. If additional belts are to be stowed, splice new belt to stowed belt (fig. 2–50) and continue as in g. preceding. Install leading link on end of last belt to be suspended.

j. Tie down ammunition using the ammunition stowage tie down straps provided (fig. 2–60).

k. Install ammunition cover as follows:

(1) Remove ammunition cover from oddment bin.

(2) Lay out on chassis floor with tie down loops exposed and edge with notch toward left wall.

(3) Lift and install cover with notch to top. Cover ammunition completely.

(4) Secure cover by engaging metal tie downs (fig. 2–53) provided with ammunition cover loops.

l. Lower personnel seat, secure front web strap, and raise personnel seat back rest.

2—18. Boresighting.

a. General. There are two methods for boresighting the XM163 system: distant aiming point method, and boresight target method. The distant aiming point method for boresighting is the primary method and is used during periods of good visibility for at least 2500 meters. The boresight target method for boresighting is used during periods of restricted visibility such as fog, smoke, or haze. Both methods are similar. The distant aiming point method procedure is contained in b. below, and the boresight target method procedure is contained in c. below.

b. Distant Aiming Point Method.

(1) Set control assembly GUN POWER switch to OFF.

(2) Remove arming connector from mount distribution box and assure that NORM-STATIC-TEST switch is in NORM (up).

(3) Check that the cannon is clear. To clear cannon, hold the BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate the barrels two complete revolutions. Remove any rounds in the case chute.

NOTE

The No. 1 barrel is not marked on the ground role muzzle clamp. When using this clamp, time the cannon per step (4) without regard to No. 1 barrel position and insert the boresight muzzle adapter in the barrel at the 4 o'clock position when viewed from the muzzle end.

(4) Time the cannon in the No. 1 firing position. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE, depress the cannon index pin, and position the No. 1 barrel (marked on the muzzle clamp) in the firing position (4 o'clock position when viewed from the muzzle end). Release the BRAKE-CLEAR AND BRAKE switch and index pin. Check that the index pin has returned to normal.

(5) Set the control assembly SYSTEM POWER switch ON and the MODE switch to RADAR.

(6) Set stow control MAINT switch to ON, set stow control MODE switch to NORMAL.

(7) Select a distant aiming point (at least 2500 meters away) and depress an action switch. Train the cannon to the approximate position for boresighting and position distribution box NORM-STATIC-TEST switch to STATIC (center) position.

(8) Insert the muzzle adapter from the boresight kit into the muzzle of the No. 1 barrel.

(9) Secure boresight telescope (fig. 2–61) in the mandrel assembly (fig. 1–18) with socket head screws on the mandrel assembly.

(10) Insert the mandrel assembly into the muzzle adapter with the eyepiece of the telescope in the horizontal position and press to tighten the adapter and mandrel assembly in the barrel.

(11) Release the two azimuth drive motor brakes and the elevation drive motor brake.

(12) Sight through the boresight telescope at a distinct point. Rotate the mandrel assembly and boresight telescope 180 degrees to the horizontal position on the

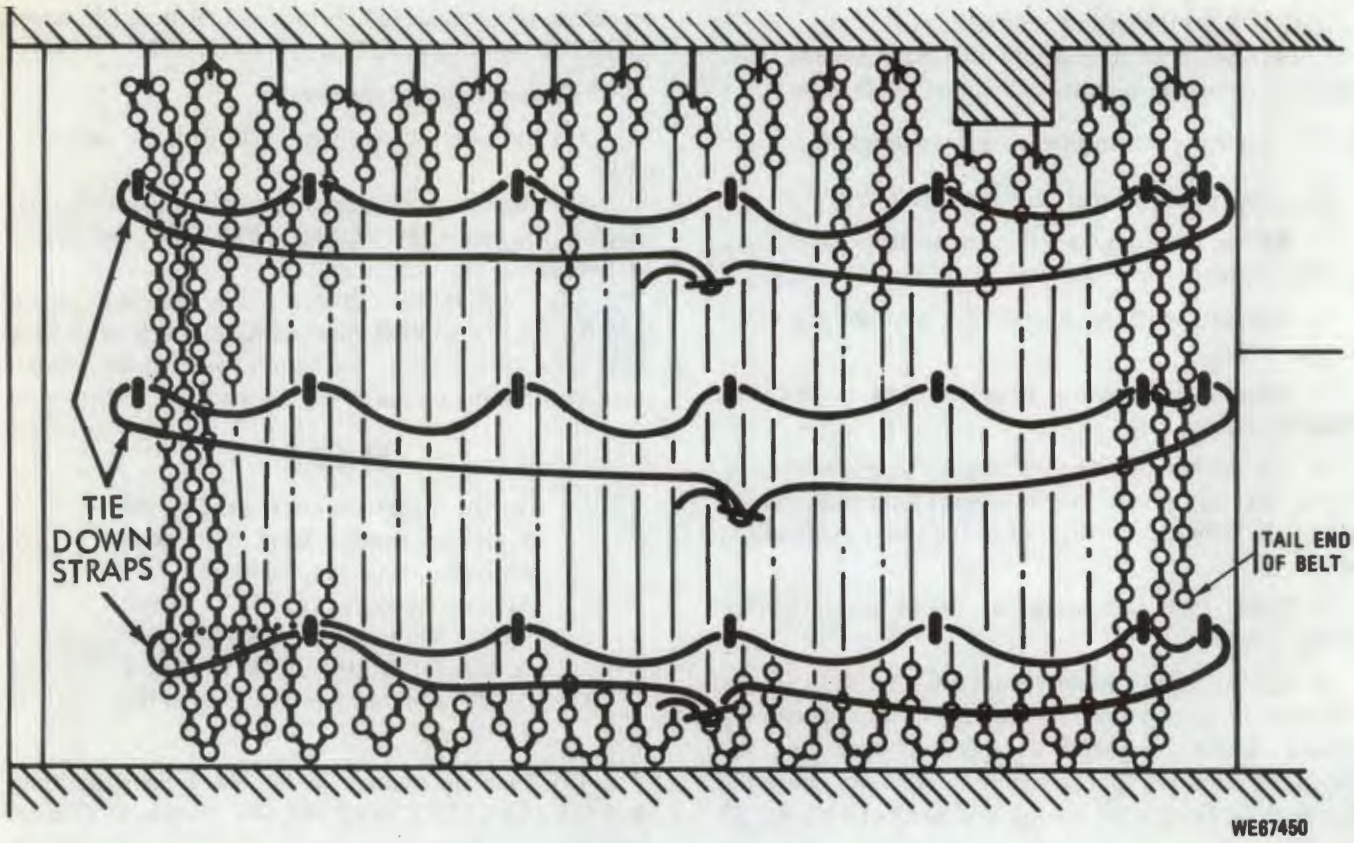


Figure 2-60. Stowing ammunition.

Figure 2-61. Boresight telescope - installed in cannon.

opposite side of the barrel. Sight through the boresight telescope to determine that the point sighted on before is still at the cross hairs. If the point is not on the cross hairs, the boresight kit is defective.

(13) Return boresight telescope to the vertical position, then manually position the cannon so the cross hairs of the boresight telescope are level with and approximately 3.5 mils to the right of the distant aiming point.

(14) Lock the azimuth and elevation drive motor brakes and check that the cannon is still properly aimed.

(15) Manually uncage the sight.

(16) Adjust control assembly SIGHT LAMP knob for a clear reticle in the sight.

(17) Remove only the front and right caps on top of the XM61 sight (fig. 2–37).

NOTE

A second crew member must check through the boresight telescope while the adjustments are being made to assure that the cannon does not move.

(18) While making the following adjustment, move the eye up and down and right and left to find the position that minimizes the apparent shifting of the target. Adjust the socket head bolts on top of the sight to center the inner reticle of the XM61 sight on the distant aiming point. The front adjustment is for elevation and the right adjustment is for azimuth.

(19) Install the caps on the XM61 sight.

NOTE

If the XM134 telescope is to be used, install according to paragraph 2–27h. When boresighting the XM134 telescope, it is necessary to release the clamping screws in front and rear end of the right wall of the XM164 mount (fig. 2–62). Assure that protective lens cover is removed for boresighting.

(20) View through the XM134 telescope and adjust the AZ boresight adjusting screw to bring the cross of the reticle (fig. 2–63) into horizontal alignment with the distant aiming point.

(21) View through the XM134 telescope and adjust the EL boresight adjusting screw to bring the cross of the reticle into vertical alignment with the distant aiming point.

(22) Tighten the clamping screws and install protective lens cover.

NOTE

Check that movable collar on boresight telescope has been secured to the shoulder of the clamping surface, as shown in figure 2–64. If not, notify organizational maintenance.

(23) Remove the boresight telescope, mandrel assembly, and install the boresight telescope in the mount provided in the antenna (fig. 2–64). Remove muzzle adapter from No. 1 barrel.

(24) Loosen the elevation coupling clamp screw (fig. 1–21) which is located on the gun elevation input shaft coupling to the radar antenna. Rotate the radar input shaft

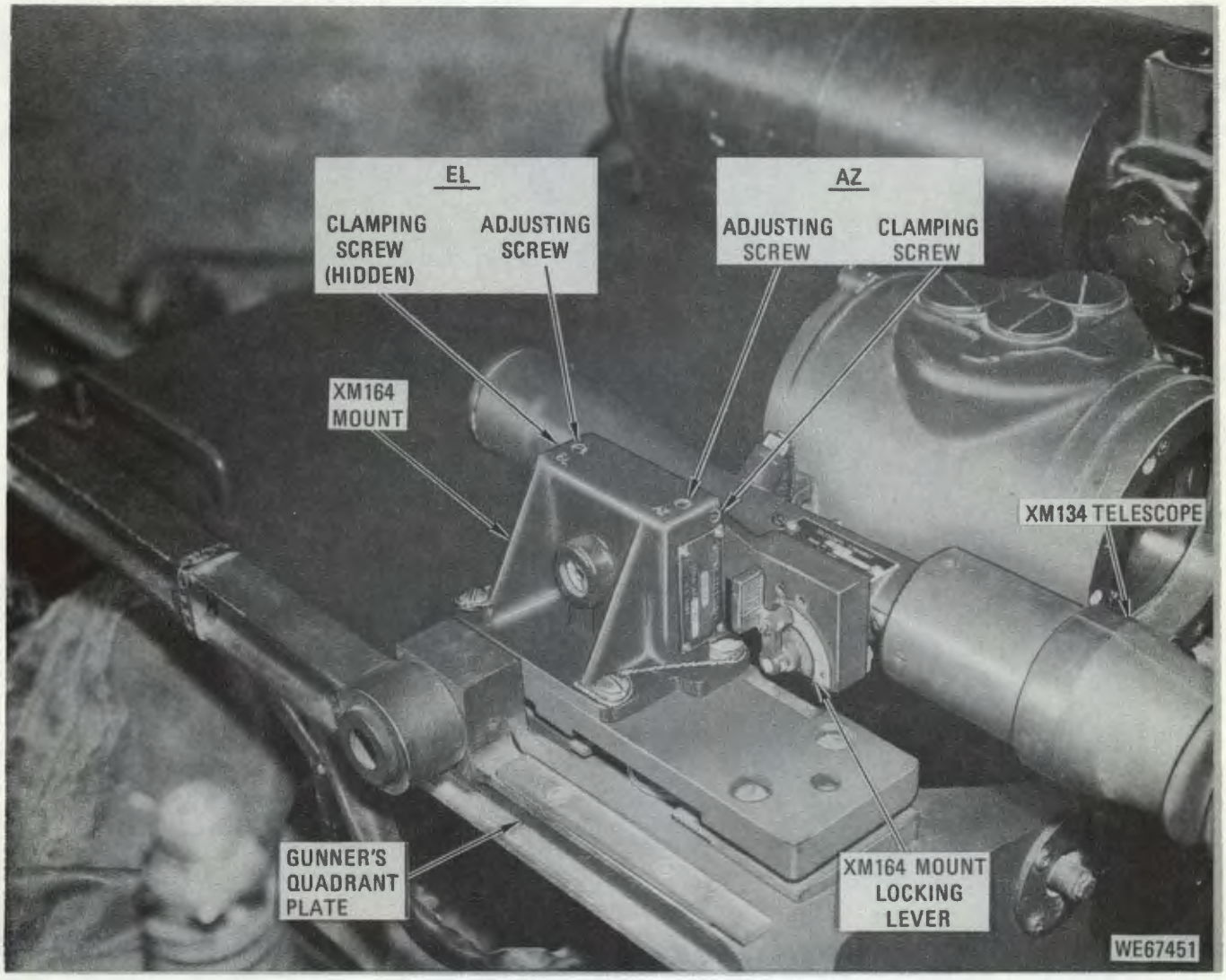


Figure 2-62. XM164 mount controls.

SUPER ELEVATION FOR M56A3
20 MM ELEVATION

RANGE (METERS)	ELEVATION (MILS)
0	0
200	0.96
400	2.12
600	3.57
800	5.41
1000	7.81
1200	11.01
1400	15.37
1600	21.12
1800	28.29
2000	36.95
2200	47.24

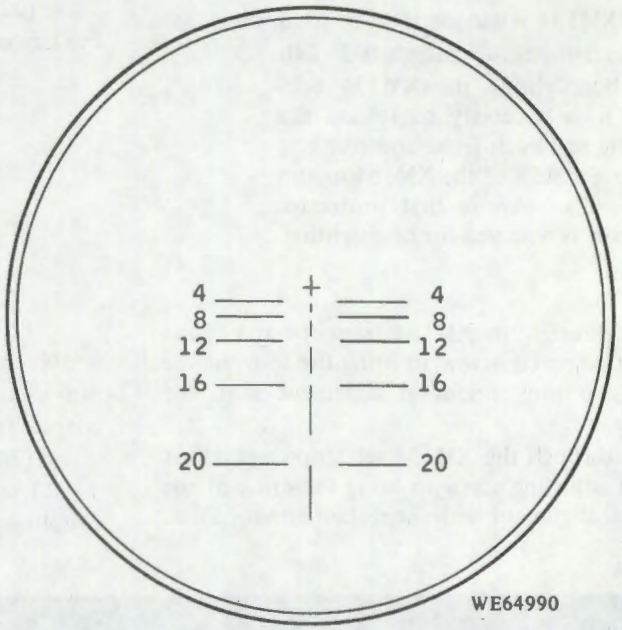


Figure 2-63. XM134 telescope reticle.

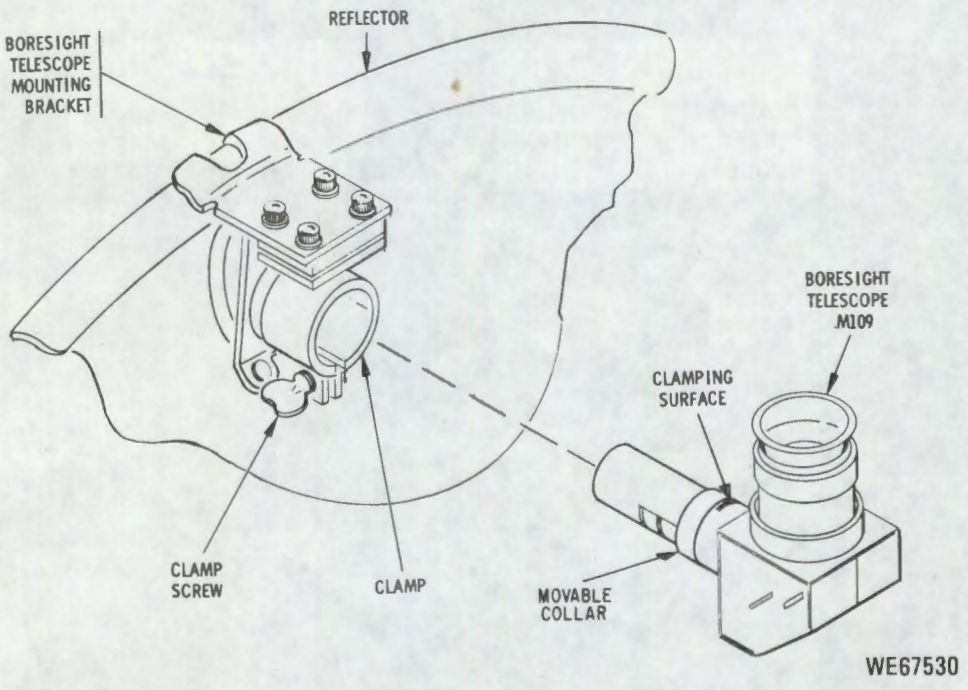


Figure 2-64. Boresight telescope - antenna installation.

to move the horizontal cross hair of the boresight telescope reticle on the distant aiming point. Tighten the screw.

NOTE

A second crew member must check that the XM61 sight reticle is centered on the distant aiming point.

(25) Remove the access cover from the traverse boresight adjustment which is located on the reflector and feed housing assembly. Loosen the traverse clamp screw and turn the adjustment screw (fig. 1–21) until the vertical cross hair on the telescope boresight reticle intersects the distant aiming point; then tighten the clamp screw. Replace access cover.

NOTE

A second crew member must check that the XM61 reticle sight is centered on the distant aiming point.

(26) Repeat steps (24) and (25) if necessary to center the boresight telescope reticle cross hairs.

(27) Set stow control MODE switch to STOW.

(28) Using stow control TRAV switch, drive the antenna to the left approximately 10 degrees.

(29) Place stow control MODE switch to NORMAL.

(30) At the boresight telescope mounted on the antenna, observe that the cross hairs within the reticle are positioned on the distant aiming point.

(31) Repeat steps (27) through (30) except in step (28) drive the antenna to the right.

(32) Set stow control MODE switch to STOW.

(33) Using stow control ELEV switch, drive the antenna up approximately 10 degrees.

(34) Place stow control MODE switch to NORMAL.

(35) At the boresight telescope mounted on the antenna, observe that the cross hairs within the reticle are positioned on the distant aiming point.

(36) Repeat steps (32) through (35) except in step (33), drive antenna down approximately 10 degrees.

NOTE

If when performing (27) through (36), the antenna does not reposition on the distant aiming point, a malfunction exists. Notify organizational maintenance.

(37) Set stow control MAINT switch to OFF.

(38) Remove the boresight telescope from the antenna reflector and install cap cover.

(39) Cage the XM61 sight.

(40) Set control assembly SYSTEM POWER switch to OFF.

(41) Recheck that there is nothing in the muzzle.

(42) Reinstall arming connector (if applicable) and place NORM-STATIC-TEST switch to NORM.

CAUTION

Assure that the sun is not shining directly into the AN/TVS-2B Night Vision Sight (night sight). Do not remove the night sight lens cover during daylight hours.

NOTE

If the night sight is to be used on impending mission, install it in accordance with par. 2–27i.(3). Boresight in accordance with steps 43 through 46. After mission completion remove night sight in accordance with par. 2–27i.(4).

(43) Position cannon so that the cross on the XM134 telescope is on a distant aiming point.

(44) Turn night sight reticle power on.

(45) Open the small aperture of the night sight lens cover.

(46) View through the night sight and adjust the azimuth and elevation boresight adjusting screws of the night sight until the distant aiming point is centered on the top dot of the night sight reticle.

c. Boresight Target Method.

NOTE

Prepare a boresight target as shown in figure 2–65, in accordance with TM 9-6920-210-14. Target materials are listed in TM 9-6920-210-24P.

(1) Choose a level unobstructed area to boresight.

(2) Set control assembly GUN POWER switch OFF.

(3) Remove arming connector from mount distribution box (fig. 1–12).

(4) Check that the cannon is clear. To clear the cannon, hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate the barrels two complete revolutions. Remove any rounds remaining in the case chute.

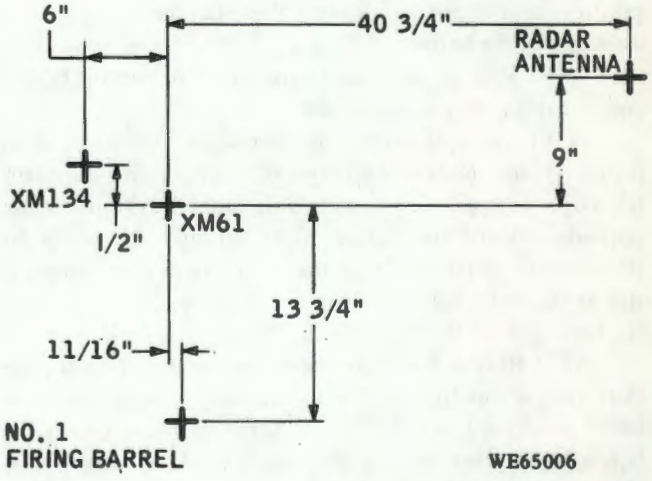


Figure 2-65. Boresight target.

NOTE

The No. 1 barrel is not marked on the ground role muzzle clamp. Time the cannon per step (5) without regard to No. 1 barrel position and insert the boresight muzzle adapter in the barrel at the 4 o'clock position when viewed from the muzzle end.

(5) Time the cannon in the No. 1 firing position. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE. Depress the cannon index pin, and position the No. 1 barrel (marked on the muzzle clamp) in the firing position (4 o'clock position when viewed from the muzzle). Release the BRAKE-CLEAR AND BRAKE switch and index pin. Check that the index pin has returned to normal.

(6) Set control assembly SYSTEM POWER switch to ON and MODE switch to RADAR.

(7) Position the boresight target approximately 1000 inches from the muzzle of the cannon (34 paces).

(8) Depress the action switch and train the cannon to the approximate target location.

(9) Position the cannon at approximately 0 mils elevation using the gunner's quadrant.

(10) Set mount distribution box NORM-STATIC-TEST switch to STATIC.

(11) Set stow control MODE switch to NORMAL. Set stow control MAINT switch to ON.

(12) Insert the muzzle adapter from the boresight kit into the muzzle of the No. 1 barrel.

(13) Secure the boresight telescope (fig. 2–61) in the mandrel assembly (fig. 1–18) and secure with socket head screws on the mandrel assembly.

(14) Insert the mandrel assembly into the muzzle adapter with the eyepiece of the telescope in the horizontal position and press to tighten the adapter and mandrel assembly in the barrel.

(15) Release the two azimuth drive motor brakes and elevation drive motor brake.

(16) Sight through the boresight telescope at a distinct point. Rotate the mandrel assembly and boresight telescope 180 degrees to the horizontal position on the opposite side of the barrel. Sight through the boresight telescope to determine that the point sighted on before is still at the cross hairs. If the point is not on the cross hairs, the boresight kit is defective.

(17) Return boresight telescope to the vertical position, then manually position the cannon so that the No. 1 barrel is aligned on the No. 1 firing barrel cross on the boresight target. Check to see that the cannon elevation is at approximately 0 mils. If necessary, reposition the target.

(18) Lock the azimuth and elevation drive motor brakes and check that the cannon is still properly aimed.

(19) Manually uncage the XM61 sight.

(20) Adjust control assembly SIGHT LAMP knob for a clear reticle in the sight.

(21) Remove only the front and right caps on top of the XM61 sight (fig. 2–37).

(22) While making the following adjustment, move the eye up and down and right and left to find the position that minimizes the apparent shifting of the target. Adjust the socket head bolts on top of the sight to center the inner reticle of the XM61 sight on the XM61 sight cross on the boresight target. The front adjustment is for elevation and the right adjustment is for azimuth.

NOTE

A second crew member must check through the boresight telescope while the adjustments are being made to assure that the cannon does not move.

(23) Install the caps on the XM61 sight.

NOTE

When boresighting the XM134 telescope, it is necessary to release the clamping screws in front and rear end of the right wall of the XM164 mount (fig. 2–62). Assure that protective lens cover is removed for boresighting.

(24) View through the XM134 telescope eyepiece and adjust the AZ boresight adjusting screw to bring the cross of the XM134 telescope reticle (fig. 2–63) into horizontal alignment with the XM134 cross on the target.

(25) View through the XM134 telescope eyepiece and adjust the EL boresight adjusting screw to bring the cross of the reticle into vertical alignment with the XM134 cross on the target.

(26) Tighten clamping screws and install protective lens cover.

(27) Remove the boresight telescope, mandrel assembly, and muzzle adapter from No. 1 barrel. Remove boresight telescope from mandrel assembly.

NOTE

Check that movable collar on boresight telescope has been secured to the shoulder of the clamping surface, as shown in figure 2–64. If not, notify organizational maintenance.

(28) Install the boresight telescope in the mount provided in the antenna (fig. 2–64).

WARNING

Check that muzzle adapter was removed from No. 1 barrel.

(29) Loosen the elevation coupling clamp screw located on the gun elevation input shaft coupling to the radar antenna (fig. 1-21). Rotate the radar input shaft to move the horizontal cross hair of the boresight telescope reticle to intersect the center of the radar antenna cross on the target. Tighten the screw.

NOTE

A second crew member must check that the XM61 sight is centered on the XM61 cross on the target.

(30) Remove the access cover from the traverse boresight adjustment which is located on the reflector and feed housing assembly. Loosen the lock and turn adjustment screw (fig. 1-21) until the vertical cross hair of the boresight telescope reticle intersects the center of the radar antenna cross on the target; then tighten the lock. Replace access cover.

NOTE

A second crew member must check that the XM61 sight reticle is centered on the XM61 cross on the target.

(31) Repeat steps (29) and (30) if necessary to center the boresight telescope reticle cross hairs.

(32) Set stow control MODE switch to STOW.

(33) Using stow control TRAV switch, drive the antenna to the left approximately 10 degrees.

(34) Place stow control MODE switch to NORMAL.

(35) At the boresight telescope mounted on the antenna, observe that the cross hairs within the reticle are positioned on the center of the radar antenna cross on the target.

(36) Repeat steps (32) through (35) except in step (33) drive the antenna to the right.

(37) Set stow control MODE switch to STOW.

(38) Using stow control ELEV switch, drive the antenna up approximately 10 degrees.

(39) Place stow control MODE switch to NORMAL.

(40) At the boresight telescope mounted on the antenna, observe that the cross hairs within the reticle are positioned on the center of the radar antenna cross on the target.

(41) Repeat steps (37) through (40) except in step (38) drive the antenna down approximately 10 degrees.

NOTE

If, when performing steps (32) through (41), the antenna does not reposition on the boresight target, a malfunction exists. Notify organizational maintenance.

(42) Set stow control MAINT switch to OFF.

(43) Remove the boresight telescope from the antenna reflector.

(44) Cage the XM61 sight.

(45) Set control assembly SYSTEM POWER switch to OFF.

(46) Assure that there is nothing in the muzzle.

(47) Reinstall arming connector.

2-19. Preparation for Firing

a. Prefire Check List. A list of prefire checks is provided in table 2-6. These prefire checks are not a part of, nor a substitute for, daily system checks in table 3-5. Time permitting, prefire checks should be performed immediately prior to a firing engagement.

b. Preparation.

(1) Check for full drum assembly. If necessary, reload in accordance with the instruction in paragraph 2-16.

(2) Start the chassis engine (para 2-4, 2-5, or 2-6) or the generator set to maintain the batteries at maximum charge. Refer to TM 5-6115-323-15 for generator operating instructions and para 3-13*g* (2) (*c*) for changing batteries.

(3) Check that the elevation and azimuth drive motor brakes (fig. 1-17 and fig. 1-12) are applied.

(4) Assure that the gun drive connector is connected to the gun drive motor and safety wired (fig. 1-17).

(5) Check that the firing voltage connector is connected to the firing contact assembly and safety wired (fig. 2-66).

(6) Check for security of gun shield and recoil adapter quick release pins (fig. 2-66).

(7) Assure that the ammunition is free in the feed chute and that no obstruction appears in the ammunition case chute.

(8) Check that all distribution box circuit breakers are pushed in (fig. 2-28). Assure that dis-

tribution box NORM-STATIC-TEST switch is in the NORM position (up).

(9) Set control assembly SYSTEM POWER switch to ON. Check that SYSTEM POWER indicator lights.

(10) Using grip assemblies, check that the upper and lower limit switches stop cannon travel in elevation before it hits mechanical stops.

(11) Check that the drive brakes stop gun mount and cannon travel in azimuth and elevation.

Table 2-6. Prefire Checklist

Step	Item	Check for
1.	Cannon	Free of travel lock
2.	Distribution Box Circuit Breakers	Pushed in
3.	Distribution Box NORM-STATIC-TEST	As required Up (NORM) Center (STATIC)
4.	Ammunition	Loaded in drum
5.	Conveyor	Down and locked
6.	Drum Drive Shift Pin	In "F" position
7.	Arming Connection	Secure on DB J6
8.	SCG MUZZLE VELOCITY and AIR DENSITY Switches	Properly set
9.	Feed and Return Chutes	Latched
10.	Ammo Slack Point	MIDPOINT
11.	System Power	ON
12.	Cannon	Proper response in azimuth and elevation
13.	GUN POWER Switch	ON
14.	MODE Switch	Proper mode
15.	FIRING RATE Switch	Proper rate/limit
16.	GUN CLEAR Switch	AUTO
17.	RF Indicator	Lit when footswitch pressed (RADAR mode only)
18.	XM61 Sight	Caged (GRD mode) Uncaged (All other modes)

c. Fire Control Circuits.

(1) *General.* Two controls, an AIR DENSITY switch and a MUZZLE VELOCITY switch, are incorporated in the sight current generator (SCG) to provide ballistic corrections to the XM61 sight lead computing circuits. To manipulate these controls, the operator shall obtain altitude and ambient temperature information. A chart affixed to the SCG cover provides the means for determining AIR DENSITY switch settings for M246 ammunition. The chart for M220 ammunition is shown in table 2-7. Another chart (table 2-8) provides MUZZLE VELOCITY switch dial settings to compensate for changes in temperature and barrel wear factors.

(2) *Use of air density chart.* After the altitude and temperature are determined, find the correct air density dial setting for the AIR DENSITY switch. Refer to table 2-7 or AIR DENSITY chart on SCG, as applicable, and select the altitude and temperature columns which most nearly represent the altitude and ambient temperature. Then:

(*a*) Trace up the pertinent temperature column to the proper altitude line.

(*b*) Note the numerical value where the altitude line and temperature column meet.

(*c*) Set the AIR DENSITY dial to the indicated numerical value.

(3) *Use of muzzle velocity chart.* Muzzle velocity is dependent upon three factors: the type of ammunition used, the ambient temperature, and the amount of wear of the barrel cluster.

(*a*) The ballistics correction circuit card assembly A21A12 compensates for different types of ammunition (see (4) following).

NOTE

The muzzle velocity dial setting chart, table 2-8, should be used in lieu of the muzzle velocity setting chart currently affixed to the sight current generator.

(*b*) The MUZZLE VELOCITY switch dial settings compensate for changes in the temperature and barrel cluster rounds fired factors. Refer to table 2-8 to select the proper dial setting. First, refer to system log book and determine rounds fired on barrel cluster. Select the barrel cluster rounds fired category which conforms with the barrel cluster. Then select the dial setting for the temperature which most nearly represents the ambient temperature.

(4) *Use of ballistics correction circuit card assembly A21A12 (fig. 2-31).*

NOTE

The ballistics correction circuit card A21A12 circuitry is locked out when the weapon is used in the ground mode; hence, there is no need to consider the function of the ballistics correction circuit card if you are operating in ground mode.

(*a*) The ballistics correction circuit card assembly A21A12 is a dual-purpose, double-ended, plug-in type board with two separate circuits, each wired to its own connector. When plugged into the

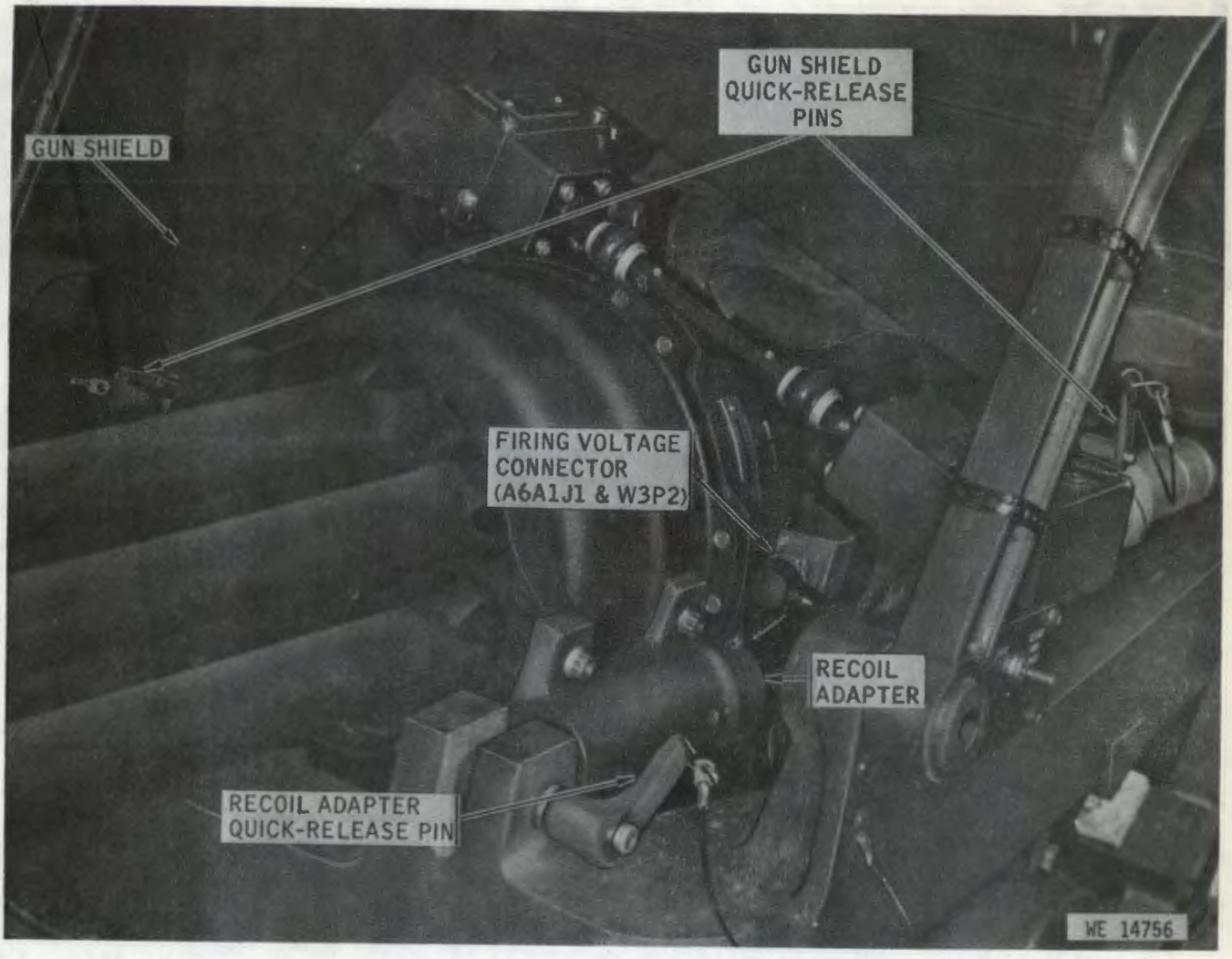


Figure 2-66. XM168 cannon XM157 mount component location.

sight current generator (SCG), the circuit card becomes a part of the SCG circuitry. One end of the circuit card furnishes the power ballistics correction for target practice type ammunition M220 ballistics. The other end furnishes the proper ballistics correction for tactical type ammunition M246 ballistics.

(b) When changeover from one type of ammunition to the other is required, change the circuit card assembly by turning it end for end as follows:

Table 2-7. Air Density Settings for M220 Ballistics

Altitude in feet	Air density dial settings							
10,000	0.9	0.85	0.8	0.75	0.7			
9,000	0.9	0.85	0.8	0.75	0.7			
8,000	0.95	0.9	0.85	0.8	0.75	0.7		
7,000	1.0	0.95	0.9	0.8	0.75	0.7		
6,000	1.0	0.95	0.9	0.85	0.8	0.75	0.7	
5,000	1.05	1.0	0.95	0.9	0.85	0.75	0.7	0.7
4,000	1.1	1.05	1.0	0.9	0.85	0.8	0.75	0.7
3,000	1.15	1.1	1.05	0.95	0.9	0.85	0.8	0.75
2,000	1.2	1.15	1.05	1.0	0.95	0.85	0.8	0.75
1,000	1.2	1.15	1.1	1.05	0.95	0.9	0.85	0.8
0	—	1.2	1.15	1.05	1.0	0.95	0.9	0.85
	−70	−50	−30	0	+30	+70	+90	+130
	Temperature in degrees Fahrenheit							

Table 2-8. Muzzle Velocity Dial Setting Chart

Barrel cluster rounds fired*	Dial setting (muzzle velocity)							
M246 and M220								
0-36,000	8	8	7	7	6	5	5	4
36,000-72,000	9	9	8	8	7	6	6	5
	—70	—50	—30	0	+30	+70	+90	+130
	Temperature in degrees Fahrenheit							

*Refer to system log book.

CAUTION

Assure M61 sight is caged prior to turning SYSTEM POWER switch to OFF.

1. Set control assembly SYSTEM POWER switch to OFF.

2. Remove cover of SCG.

3. Remove ballistics correction circuit card assembly A21A12 from SCG.

4. Remove connector protective cover and install on opposite end.

5. Re-install ballistic correction circuit card assembly in SCG. The arrow corresponding to ballistics to be used must point toward SCG connector.

6. Replace cover of SCG.

7. Turn control assembly SYSTEM POWER switch to ON.

(5) *MODE switch.* Set control assembly MODE switch to TEST.

NOTE

During following step prefire test on fire control system, with MODE switch in TEST position, setting of the AIR DENSITY switch must agree with ballistic data being supplied by ballistics correction circuit card assembly A21A12. The MUZZLE VELOCITY switch dial must be set to 5. The AIR DENSITY switch dial must be set to 0.85 for M220 ballistics and 1.0 for M246 ballistics, as the GOOD WHEN LIT indicator will not remain illuminated at any other AIR DENSITY settings in the TEST MODE. After the test, reset controls for normal operation.

(6) *Action switch.* Press right or left grip assembly action switch. Control assembly GOOD WHEN LIT indicator should light if SYSTEM POWER has been on for at least 10 seconds.

d. M61 Sight.

(1) Set control assemlly MODE switch to MAN.

(2) Uncage the M61 sight by manually rotating the CAGED knob counterclockwise to its stop.

(3) Press right or left grip assembly action switch. Ready-to-fire lamp on the M61 sight should light. Sight reticle lamp should light. Release action switch.

(4) Set control assembly RANGE IN METERS switch to 500.

(5) Set control assembly TARGET SPEED IN KNOTS switch to 0.

(6) Using the right and left grip assembly, position the cannon so that the bottom of the M61 sight inner reticle is centered on a distant point.

(7) Set distribution box NORM-STATIC-TEST switch to STATIC (center).

(8) Press light or left grip assembly action switch. Set control assembly RANGE IN METERS switch to 1500. M61 sight reticle should move down (top of inner circle of reticle approximately on distant point).

(9) Press sight cage switch (left-hand grip assembly thumb pushbutton switch). M61 sight reticle should move up. Release switch.

(10) Set control assembly TARGET SPEED IN KNOTS switch to 600.

(11) Set control assembly RANGE IN METERS switch to 2500. M61 sight reticle should move down (top of inner reticle approximately on distant point).

(12) Set distribution box NORM-STATIC-TEST switch to NORM (up).

(13) Set control assembly RANGE IN METERS switch to 500.

(14) Set control assembly TARGET SPEED IN KNOTS switch to 300.

(15) Using the grip assemblies, rotate gun mount while maintaining a 200 mil lead angle (extreme right or left dot in sight). The time required for the turret to make one revolution should be 16 to 20 seconds.

(16) Mechanically cage M61 sight by turning CAGED knob clockwise.

e. Radar.

(1) *General.* The radar is prepared for firing in accordance with the step-by-step procedures provided in (2) through (8) below. The procedures are arranged in the sequential order in which they must be performed. The normal power condition for the radar prior to a firing mission is standby. In the standby power condition, all radar circuitry is energized except the antenna positioning servo drives, and the transmitter-receiver high-voltage radar radiation circuitry. These functions should be energized only during a firing engagement or for maintenance and prefire checkout purposes. The normal position of the antenna during travel or when not being used is stowed. Six crystal oscillator subassemblies provide a choice of six different radar operating frequencies. The selected crystal oscillator subassembly is inserted into the X-band local oscillator subassembly. The klystron power amplifier is coarse-tuned to the new operating frequency with power removed. The radar is then energized to radiate and the klystron power amplifier is fine-tuned to this new frequency.

(2) *Initial control settings.*

(a) Lower back of gunner's seat.

(b) Set transmitter-receiver CLUTTER LOCKON switch to NORMAL (fig 1-22).

(c) Loosen the four thumbscrew fasteners on the transmitter-receiver and swing down the front panel assembly. Assure SERV RAD CONT switch is in OFF position (fig 2-37). Close front panel assembly and secure with thumbscrew fasteners and raise back of gunner's seat.

(d) Momentarily press power supply circuit breakers CB1 through CB6 (fig 1-25).

(e) Set stow control MODE switch to NORMAL (fig 1-26).

(f) Set stow control MAINT switch to OFF.

(3) *Power energize radar to standby.*

(a) Assure that steps in (2) preceding (initial control settings) have been accomplished.

(b) Set control assembly MODE switch to RADAR or MAN.

(c) Set control assembly SYSTEM POWER switch to ON. Assure that SYSTEM POWER indicator lights.

(d) Allow a two minute warmup period and assure that control assembly READY WHEN LIT indicator lights.

NOTE

If READY WHEN LIT indicator fails to light after warmup period, or if indicator extinguishes during operation, check all power supply circuit breakers and reset if necessary. If circuit breaker trips immediately after resetting, do not attempt to reset; notify organizational maintenance.

(e) Observe that transmitter-receiver HIGH-VOLTAGE POWER SUPPLY OVERLOAD and MODULATOR OVERLOAD indicators are extinguished.

CAUTION

If either transmitter-receiver overload indicator is lit, momentarily set transmitter-receiver OVERLOAD RESET to ON to reset overload sensing circuitry. Do not set OVERLOAD RESET switch to ON when radiate foot switch and action switch are pressed. If overload persists, notify organizational maintenance.

(4) *Power energize antenna servo drives.*

(a) Assure that steps in (2) and (3) preceding have been accomplished to energize the radar to standby.

(b) Set stow control MAINT switch to ON.

NOTE

The method used to energize the antenna servo drives during a firing engagement is to depress the action switch (stow control MAINT switch OFF).

CAUTION

Do not rotate antenna by hand. Forcing antenna gearing without releasing brake electrically can cause brake damage.

(5) *Unstowing antenna.*

(a) Set control assembly MODE switch to MAN or RADAR.

(b) Set SYSTEM POWER switch to ON.

(c) Set stow control MODE switch to NORMAL.

(d) Set stow control MAINT switch to OFF.

(e) Depress grip assembly action switch and observe that antenna drives out of stow and repositions on cannon axis.

(6) *Power energize radar to radiate.*

(a) Assure that steps in (2), (3), (4), and (5) have been accomplished.

(b) Set control assembly MODE switch to RADAR or TEST.

(c) Momentarily press action switch and the radiate foot switch assembly simultaneously and assure that the waveguide RF power indicator lights (fig 1-11).

NOTE

If this indicator fails to light, check transmitter-receiver overload indicators. If either transmitter-receiver overload indicator is lit, momentarily set

OVERLOAD RESET, to ON to reset overload sensing circuitry. If overload persists, notify organizational maintenance.

(7) *Establishing a new radar frequency.*

WARNING

High voltage is present in the transmitter-receiver when the radar is power energized to standby or radiate. Death on contact may result if operating personnel fail to observe safety precautions.

CAUTION

Improper tuning of the klystron power amplifier can shorten the tube life.

CAUTION

Prior to next step, assure that M61 sight is mechanically caged.

(a) Set control assembly SYSTEM POWER switch to OFF.

(b) Lower back of gunner's seat.

(c) Loosen four thumbscrew fasteners and lower the front panel of the transmitter-receiver.

(d) Assure that transmitter-receiver POWER indicator (fig 2-38) is extinguished.

(e) Compress spring clamp on crystal oscillator and remove subassembly presently installed in the X-band local oscillator socket (fig 2-67).

(f) Select the desired crystal oscillator subassembly from those stowed in the transmitter-receiver front panel and listed as follows:

Part number	*Channel no.*	*Radar crystal frequency (MHz)*
10549175	1	9145
10549176	2	9153
10549177	3	9161
10549178	4	9169
10549179	5	9177
10548224	6	9185

NOTE

Each crystal oscillator subassembly is marked with its respective part number, channel number and radar crystal frequency.

(g) Install the selected crystal oscillator in the X-band local oscillator socket observing that the connector on the crystal oscillator is aligned properly with the oscillator socket.

(h) Stow the crystal oscillator subassembly, removed from the X-band local oscillator, in the transmitter-receiver front panel assembly.

(i) Remove the tuning tool from its mounting bracket on the X-band local oscillator by turning the tuning tool counterclockwise (fig 2-68).

NOTE

The five klystron power amplifier tuning adjustments are each identified with a reference number from 1 to 5 (fig 2-69). Klystron tuning adjustment 4 is fixed-tuned and shall not be adjusted.

(j) In reference to step *(k)* following: turn tuning tool clockwise to *increase* channel number; turn tool counterclockwise to *decrease* channel number.

CAUTION

Turning the cavity adjustment screws hard against the stops will damage the klystron.

(k) Readjust klystron tuning adjustments 1, 2, 3 and 5 until the pointer on the dial indicator is positioned to the selected new crystal oscillator channel (fig 2-69).

NOTE

When each klystron tuning adjustment is set properly, the klystron power amplifier is coarse-tuned to the new operating frequency.

WARNING

High voltage is present in the transmitter-receiver when the radar is power energized to radiate. Death on contact may result if operating personnel fail to observe safety precautions.

(l) Turn SYSTEM POWER switch on and set control assembly MODE switch to RADAR.

(m) Pull actuator of transmitter-reciever interlock switch (fig 2-38) forward and out to service position to restore power to transmitter-receiver and wait until READY WHEN LIT light illuminates.

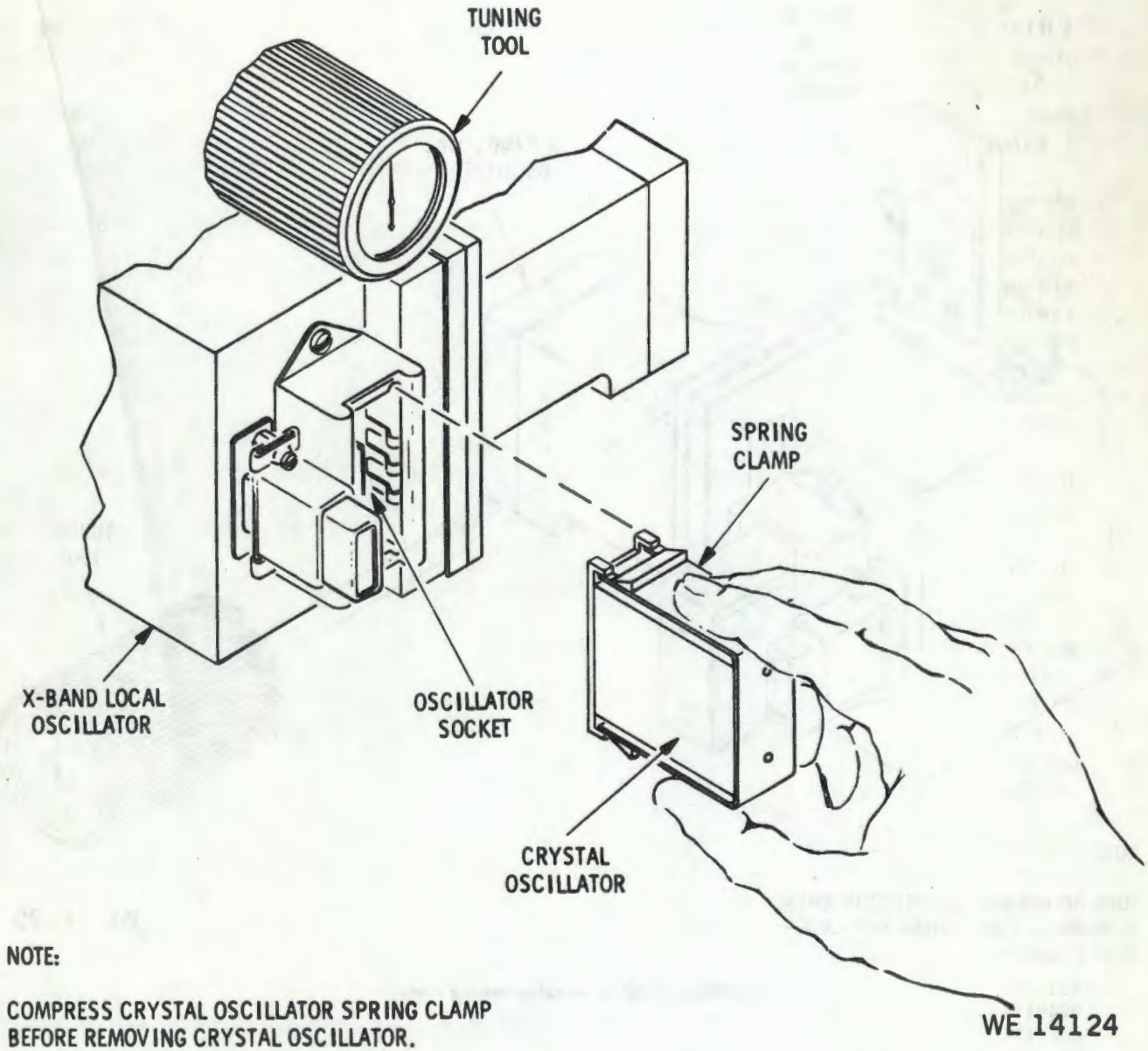


Figure 2-67. Changing crystal oscillator.

NOTE

If READY WHEN LIT indicator fails to light after two minutes, or if indicator extinguishes during operation, check all circuit breakers on the power supply front panel. If a circuit breaker has tripped, as indicated by an exposed white band on extended pushbutton shaft, reset circuit breaker. If circuit breaker trips immediately, do not attempt to reset it again. Notify organizational maintenance.

(*n*) Observe that transmitter-receiver HIGH-VOLTAGE POWER SUPPLY OVERLOAD and MODULATOR OVERLOAD indicators are extinguished.

NOTE

If either transmitter-receiver overload indicator is lit, momentarily set OVERLOAD RESET to ON to reset overload sensing circuitry. If overload persists, notify organizational maintenance.

NOTE

In the following procedure, if the power indicator does not light, test lamp by pressing down on lens. If power indicator remains extinguished, replace lamp.

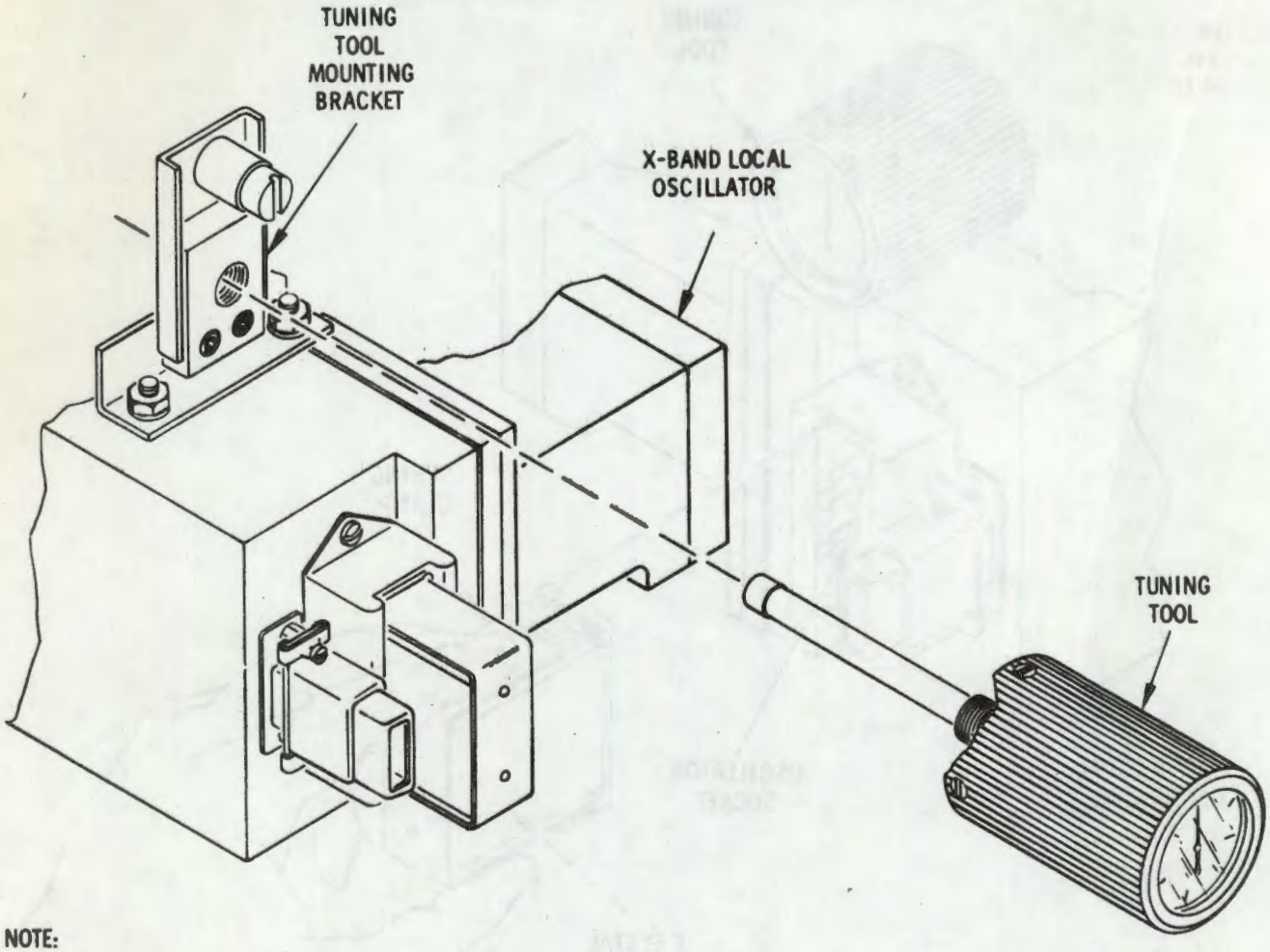


Figure 2-68. Removing tuning tool.

(o) Check that transmitter-receiver power indicator (fig. 2-38) is lit to assure that power is restored to the unit.

WARNING

Potential radiation hazard exists when radar is energized. Personnel should not be within three feet of radiating feedhorn (located in center of dish) in the direction of the transmitted beam.

(p) Set transmitter-receiver SERV RAD CONT switch to ON. Radar should now be energized to radiate.

NOTE

When radar is energized to radiate and either transmitter-receiver overload indicator is lit, momentarily set OVERLOAD RESET to ON (to reset overload sensing circuitry). If overload persists, notify organizational maintenance.

(q) Fine tune the klystron amplifier as follows:

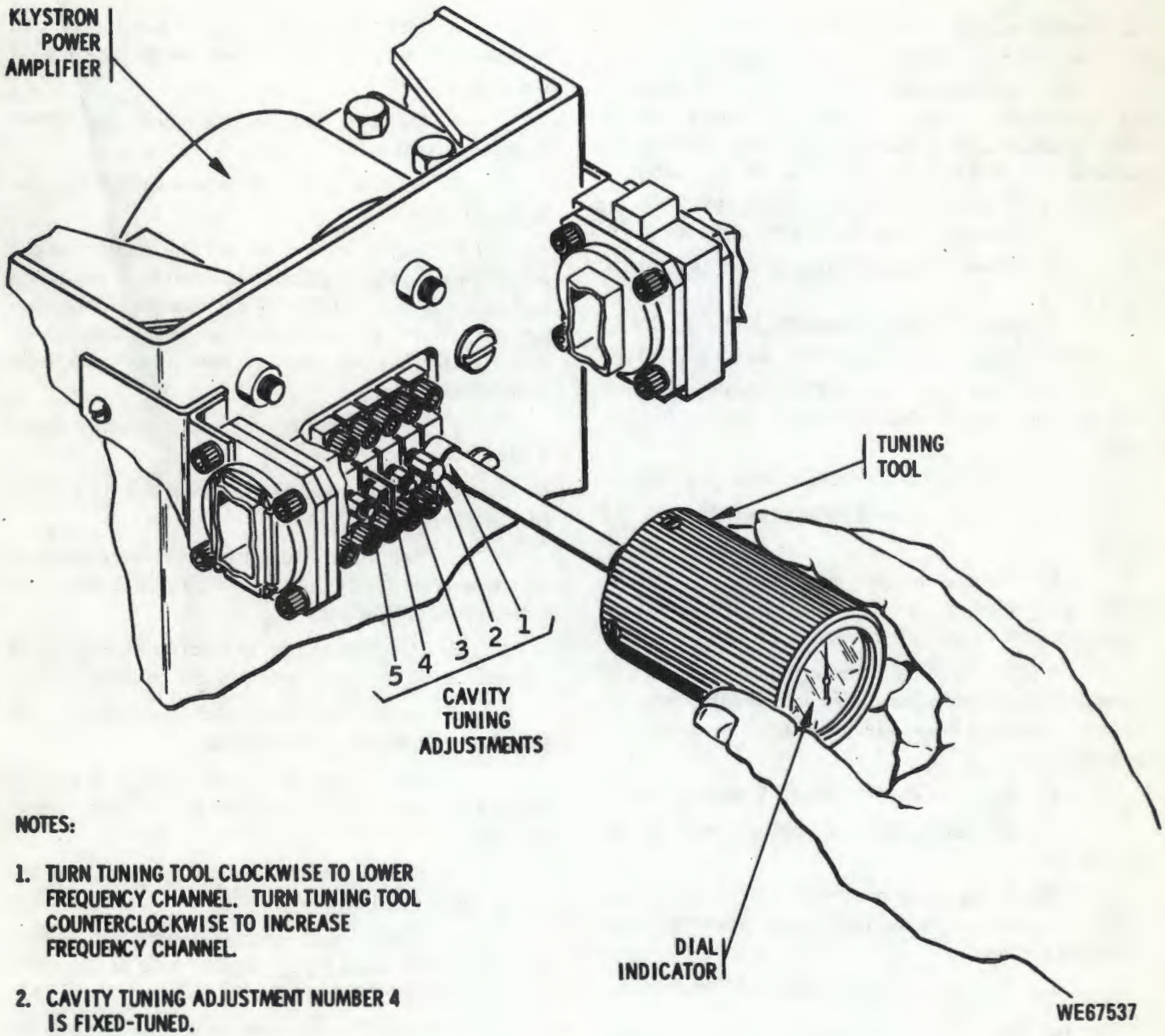
1. Note the reading of microwave chassis RF POWER meter (fig. 2-39).

2. Adjust cavity number 3 to obtain a peak RF POWER meter reading.

3. Detune cavity 3 counterclockwise until the RF POWER meter reading decreases to approximately 50 percent of preceding step 2 peak reading.

4. Peak cavities 1, 2, and 5 respectively to their peak RF POWER meter reading indication.

5. Carefully tune cavity 3 clockwise for a peak RF POWER meter reading indication.



NOTES:

1. TURN TUNING TOOL CLOCKWISE TO LOWER FREQUENCY CHANNEL. TURN TUNING TOOL COUNTERCLOCKWISE TO INCREASE FREQUENCY CHANNEL.
2. CAVITY TUNING ADJUSTMENT NUMBER 4 IS FIXED-TUNED.

Figure 2-69. Tuning klystron power amplifier.

6. Assure that waveguide RF power indicator (fig. 1-11) is illuminated.

NOTE

If the RF power indicator fails to light, check transmitter-receiver overload indicators (fig. 1-22). If either transmitter-receiver overload indicator is lit, momentarily set OVERLOAD RESET switch to ON to reset the overload sensing circuitry. If overload persists, notify organizational maintenance.

(*r*) Set receiver-transmitter SERV RAD CONT switch to OFF.

(*s*) Push in receiver-transmitter actuator of interlock switch to normally open position.

(*t*) Replace tuning tool in mounting bracket on the X-band local oscillator.

(*u*) Raise transmitter-receiver front panel assembly and secure with four thumbscrew fasteners and raise back of gunner's seat and secure.

CAUTION

Assure XM61 sight is mechanically caged prior to next step.

(*v*) Set control assembly SYSTEM POWER switch to OFF.

(8) *Radar checkout.*

(*a*) *General.* The radar checks given in (*b*) through (*e*) following should be performed to verify

radar performance. These checks can be performed in either the radar or test modes of operation.

(b) *Antenna servo drive check.* The following procedures check the antenna servo drives in both normal and stow modes of operation. These procedures are an electrical test only of the antenna positioning circuitry and do not check accuracy.

1. Manually cage the XM61 sight.

2. Power energize radar to standby (para 2-19e (3)).

3. Set stow control MAINT switch to ON.

4. Set stow control MODE switch to STOW.

5. Using stow control ELEV switch, elevate antenna into upper electrical limit (95 to 97 degrees).

6. Set stow control MAINT switch to OFF.

7. Set stow control MODE switch to NORMAL.

8. Depress either grip assembly action switch and observe that the antenna drives out of limit and repositions on the cannon axis.

9. Repeat steps 3 through 8 above with the exception when performing step 5, lower the antenna elevation into the lower electrical limit (—8 to —12 degrees).

10. Set stow control MAINT switch to ON.

11. Set stow control MODE switch to STOW.

12. Using stow control TRAV switch, traverse the antenna into the right-hand electrical limit (24 to 26 degrees).

13. Set stow control MAINT switch to OFF.

14. Set stow control MODE switch to NORMAL.

15. Depress either grip assembly action switch and observe that the antenna drives out of limit and repositions on the cannon axis.

16. Repeat steps 10 through 15 with the exception that, when performing step 12, traverse the antenna into the left-hand electrical limit (24 to 26 degrees).

(c) *RF power check.* The following procedures verify that RF transmit pulse is being coupled to the antenna from the transmitter-receiver.

1. Power energize radar to standby (para 2-19e (3)).

2. Set control assembly MODE switch to RADAR.

3. Depress either grip assembly action switch and energize radar to radiate by pressing on the foot switch.

4. Observe that the waveguide RF power indicator lights.

5. Release both the action switch and the foot switch.

(d) *Clutter lockon check.* The clutter lockon check verifies that the radar is capable of acquiring and locking onto a target. This test should be performed after the antenna has been boresighted (para 2-18). To perform the clutter lockon check, proceed as follows:

1. Power energize radar to standby (para 2-19e (3)).

2. Set transmitter-receiver CLUTTER LOCKON switch to TEST.

3. Remove transmitter-receiver connector J4 cover and connect unbanded plug of combat vehicle crewman's helmet.

4. Position cannon to point to the sky above a fixed target within a range of 250 to 2000 meters.

5. Depress action switch and radiate foot switch to energize radar to radiate.

6. Verify that no clutter lockon is accomplished as evidenced by no tone heard in the headset and ready to fire indicator not lighting.

7. Slowly depress cannon until target appears in sight reticle.

8. Verify that clutter lockon is accomplished as evidenced by an audible tone in the headset and ready to fire indicator lights.

9. Release both the action switch and the foot switch.

10. Remove headset and replace the connector cover on connector J4.

11. Set transmitter receiver CLUTTER LOCKON switch to NORMAL.

(e) *Midrange calibration check.* The midrange calibration check verifies that radar range computations are accurate.

1. Power energize radar to standby (para 2-19e (3)).

NOTE

Range computer MID RANGE CALIBRATION indicator is dimly lit and flashing at the rate of once per second in the off state and brightly lit in the on state.

2. Press and hold range computer PRESS TO TEST pushbutton switch.

3. Observe that MID RANGE CALIBRATION indicator lights brightly within 5 seconds.

NOTE

If MID RANGE CALIBRATION indicator fails to light, notify organizational maintenance.

4. Release the PRESS TO TEST pushbutton switch.

5. Observe that midrange calibration indicator remains lit for approximately 2 seconds after pushbutton has been released.

2-20. Firing

a. General. Four firing modes are available: radar, manual, external and ground. In ground mode either NORM (direct fire) or STATIC (indirect fire) is available. In all modes of firing, the control assembly FIRING RATE switch must be set to the desired rate. If high rate of fire is desired, the FIRE RATE switch is set to one of the four HI-RATE LIMIT positions. If low rate of fire is desired, the Fire RATE switch is set to LO-NO BURST LIMIT.

(1) Immediately before firing in any mode, the GUN POWER switch must be set to ON and the GUN CLEAR switch set to AUTO.

NOTE

When firing in any mode with a remote arm-safe switch assembly connected to A1J6, the remote arm-safe switch assembly pushbutton switch must be depressed and held before the cannon will fire.

NOTE

When slewing gun mount to acquire a target in MAN and EXT modes only, electrically cage the XM61 sight to prevent generation of extreme lead angles (XM61 sight is automatically caged in RADAR mode). Release the sight cage pushbutton switch after smooth tracking begins.

(2) Radar mode is normally used against aircraft. In radar mode the radar set provides the fire control system with range and range rate information automatically.

(3) Manual mode may be used against aircraft and ground targets. In manual mode, estimated target range and speed are set into the system by the gunner.

(4) External mode may be used against either aircraft or ground targets. In external mode, range data is set into the system by means of the external range control operated by an observer.

(5) Ground (NORM) mode is normally used against ground targets. In either ground mode, the lead-computing feature of the sight is not employed.

(6) Ground (STATIC) mode of operation is normally used against a specific ground target or area when the target is obscured by smoke or darkness. In ground (STATIC) mode, the servo drives are deenergized. The cannon cannot be moved in elevation or azimuth during firing.

(7) These procedures should not be construed as defining tactical doctrine.

WARNING

Loss of life and destruction of cannon resulting from a cook-off can occur if an unexpended round remains in a hot barrel. Automatic clearing will be used under all usual conditions. If the gun clear switch should be left in the OFF position, or the gun fail to clear for any other reason the operator must attempt to clear the cannon by holding the GUN CLEAR switch in OPERATOR position and depressing the action switch for approximately 0.5 second.

WARNING

During firing cycle of cannon, a cartridge may not fire until after the clearing cycle starts. This is a hang-fire condition and may result in damage to gun and injury or death to personnel. If ammunition does not fire normally, the firing operation will be immediately terminated and personnel will take cover. Defective ammunition will be disposed of in accordance with the provisions of TM9-1900 and TM9-1300-206.

CAUTION

Under no circumstances attempt to fire a burst of less than 10 rounds. Attempts to do so may cause severe damage to the equipment.

b. Firing in Radar Mode.

(1) Prepare the system for firing (para 2-19)

(2) Set control assembly Mode switch to RA DAR.

(3) After target is observed, slew the cannon to acquire the target in the XM61 sight reticle.

(4) With the target centered in the sight reticle, track smoothly for one second. Depress the foot switch to

energize radar to radiate. When the radar locks on the target, the turret will momentarily speed up and then return to the previous tracking rate.

NOTE

If the READY-TO-FIRE indicator blinks during a firing engagement, the radar is being jammed. Set control assembly MODE switch to MAN and proceed to step c to fire in manual mode.

(5) Track target smoothly for at least one second and when the READY-TO-FIRE indicator lights, commence firing by depressing trigger switch.

(6) If firing in low firing rate, release trigger to stop cannon firing. If firing in high firing rate, release trigger when cannon rotation stops. If more than one burst is desired, depress trigger again.

(7) Release the action switch and foot switch after firing is complete.

c. Firing in Manual Mode.

(1) Prepare the system for firing (para 2-19).

(2) Set control assembly MODE switch to MAN.

NOTE

While in manual mode, the READY-TO-FIRE indicator remains lit whenever the action switch is depressed. It is essential that the radar antenna follows the gun in elevation and azimuth. If the antenna does not follow the gun, disconnect cable connector W7P2 from stow control jack J2 (fig 1-26 and para 2-34).

(3) When target is observed, set control assembly TARGET SPEED IN KNOTS knob to estimated speed of the target.

(4) Set control assembly RANGE IN METERS knob to the estimated range of the target at the time when firing will commence.

(5) Slew mount to obtain smooth target tracking in the M61 sight.

(6) When the target is centered within the inner reticle, continue smooth tracking for a long enough time to enable the correct lead angle to be generated. If target range is 800 meters, track for 1 second, 1500 meters 2 seconds, and 1800 meters 3 seconds. Commence firing at the end of these times when target is centered in the reticle.

(7) If firing in low firing rate, release trigger to stop cannon firing. Observe the warnings on cook-offs and hang-fires in a. preceding. Do not attempt to fire a burst of less than 10 rounds under any circumstances. If firing in high firing rate, keep trigger depressed until burst is completed. If more than one burst is desired, depress trigger again. Repeat steps (4), (5) and (6).

(8) Release action switch when firing is complete.

d. Firing in External Mode.

(1) Prepare the system for firing (para 2-19).

NOTE

Firing in the external mode requires a second man to operate the external range control assembly.

(2) Connect the external range control assembly (fig 1-19) to either the personnel compartment receptacle (fig 2-70) or the outside external range control receptacle (fig 2-71 or 2-71.1).

NOTE

After vehicle serial number C270, the personnel compartment APU receptacle is located on the vehicle exterior (fig 2-71.1).

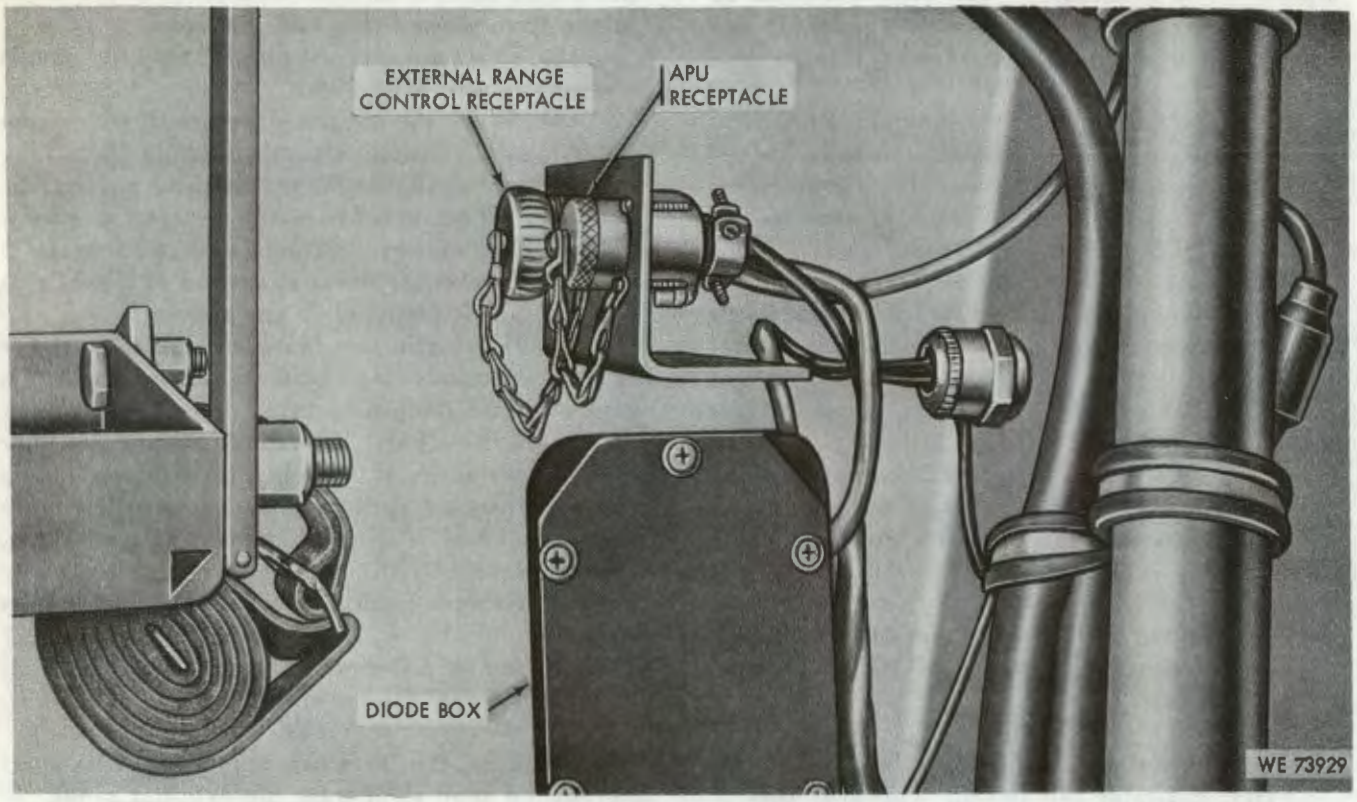


Figure 2-70. Personnel compartment receptacles—up to vehicle serial number C270.

(3) Set control assembly MODE switch to EXT.

(4) When target is observed, the following two steps should be accomplished simultaneously:

(a) External range control operator sets the external range control METERS X100 knob to the estimated range of target and depresses the READY-TO-FIRE push-button. External range control operator continues to change setting of the METERS X100 knob as the range changes.

(b) The gunner presses the action switch and uses the grip assemblies to establish smooth tracking with the target centered in the inner reticle of the M61 sight.

(5) If READY-TO-FIRE lamp is lighted, tracking has been smooth, and the target is centered in the inner reticle, depress trigger to fire cannon.

(6) If firing in low firing rate, release trigger to stop cannon firing. Observe the warnings on cook-offs and hang-fires in a. preceding. Do not attempt to fire a burst of less than 10 rounds. If

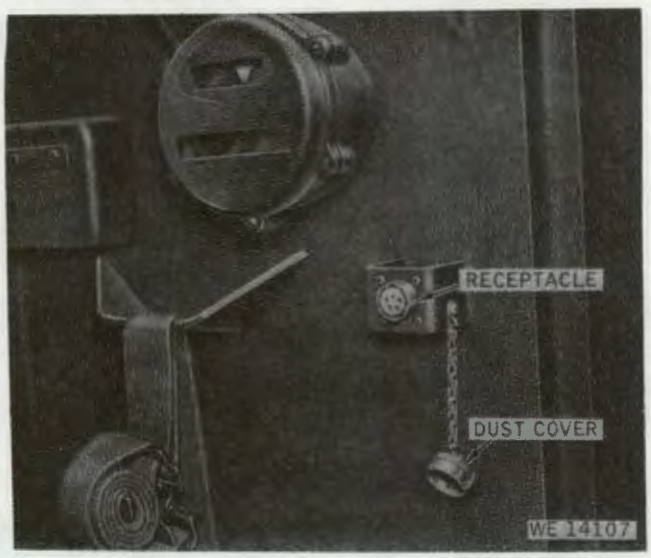


Figure 2-71. External range control external receptacle—up to vehicle serial number C270.

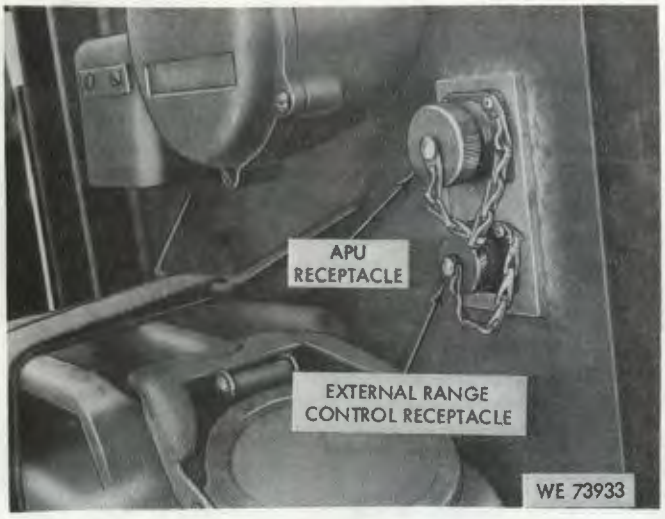


Figure 2-71.1. External range control external receptacle and APU receptacle—after vehicle serial number C270.

firing in high firing rate, keep trigger depressed until burst is completed. If more than one burst is desired, depress trigger again.

(7) Release the action switch after firing is complete.

e. Firing in Ground (NORM) Mode.

(1) Prepare the system for firing (para 2-19).

(2) Manually cage the M61 sight by rotating the CAGED knob clockwise to its stop.

NOTE

When mechanially caged, the sight has a super-elevation of 7.5 mils. Under this condition, a target at 900 meters should be centered in the sight. A target at 1300 meters should be bisected by the bottom of the inner reticle (fig 2-36).

(3) Set control assembly MODE switch to GRD.

(4) Press grip assembly action switch.

(5) Using grip assemblies, position cannon to bear on target in azimuth.

(6) Using grip assemblies, obtain the desired elevation.

(7) Depress trigger switch to fire cannon.

(8) If firing in low firing rate, release trigger to stop cannon firng. Observe the warnings on cook-offs and hang-fires in a. preceding. Do not attempt to fire a burst of less than 10 rounds. If firing in high firing rate, keep trigger depressed until burst is completed. If more than one burst is desired, depress trigger again.

(9) If further movement of the cannon is not desired, release action switch.

f. Firing in Ground (STATIC) Mode.

NOTE

In the ground (STATIC) mode, the servo drives are deenergized. The cannon cannot be moved in elevation or azimuth during firing.

(1) Prepare the system for firing (para 2-19).

(2) Manually cage the M61 sight by rotating CAGED knob clockwise to its stop.

(3) Set control assembly MODE switch to GRD.

(4) Using grip assemblies, press action switch and position cannon to bear on target.

(5) Set distribution box NORM-STATIC-TEST switch to STATIC (center position) to immobilize cannon in correct firing position.

NOTE

If situation permits, fire short burst for zeroing in the cannon. If cannon is on target proceed to step (6) following. If not on target, set distribution box NORM-STATIC-TEST switch to NORM (up position) and repeat steps (4) and (5), moving cannon as indicated by zeroing burst.

(6) When ready to fire, press the action switch and trigger switch.

(7) If firing in low firing rate, release trigger to stop cannon firing. Observe the warnings on cook-offs and hang-fires in *a.* preceding. Do not attempt to fire a burst of less than 10 rounds. If firing in high firing rate, keep trigger depressed until burst is completed. If more than one burst is desired, depress trigger again.

(8) When firing is complete, release action switch.

2-21. Stoppages

WARNING

If cannon cannot be cleared, keep it positioned in a direction such that possible loss of life or damage to property will not result if ammunition cook-off should occur. Due to the danger of ammunition cook-off in an uncleared cannon, personnel should remain either inside chassis or on opposite side of chassis from cannon muzzle until weapon cools (30 minutes).

a. General. A stoppage is any unexpected occurrence that prevents the firing of the cannon on command from the operator.

b. Procedure.

(1) Hold control assembly GUN CLEAR switch to OPERATOR.

(2) Momentarily press the action switch for approximately 0.5 second. If cannon clears, proceed to step (3). If cannon still does not clear, depress distribution box SYS PWR circuit breaker and attempt to clear the cannon again. If the cannon still does not clear, set control assembly SYSTEM POWER switch to OFF and notify organizational maintenance.

(3) Set control assembly GUN CLEAR switch to AUTO. Inspect gun and feed system. Make certain that ammunition is not binding in the feed chute.

(4) Attempt to fire a 10-round burst. If the cannon fires and clears properly, continue operations.

(5) If the cannon can be cleared, but still will not cycle (and no physical obstruction is apparent) check the following:

(a) Rounds expended counter (fig. 1–14) and feed drum for ammunition availability.

(b) The conveyor unit is down and locked.

(c) The firing connector is securely connected.

(d) The shift pin is in the F (fire) hole.

(e) The arm safe cable or arming connector is connected to mount distribution box jack J6.

(f) Cable connector W3P1 is connected to mount distribution box connector J3 and the firing voltage connector W3P2 is connected to the cannon (fig. 2–66).

(6) If cannon still will not fire, notify organizational maintenance.

2-22. Preparation for Travel.

The configuration policy for travel will be dictated by the situation. Perform only those following procedures that are required:

a. Place cannon in travel lock (fig. 2–72) as follows:

(1) Remove the quick release pin from the travel lock base, raise the travel lock and reinstall pin in travel lock.

(2) Loosen hand lock nut and open travel lock clamp.

(3) Release azimuth and elevation brakes.

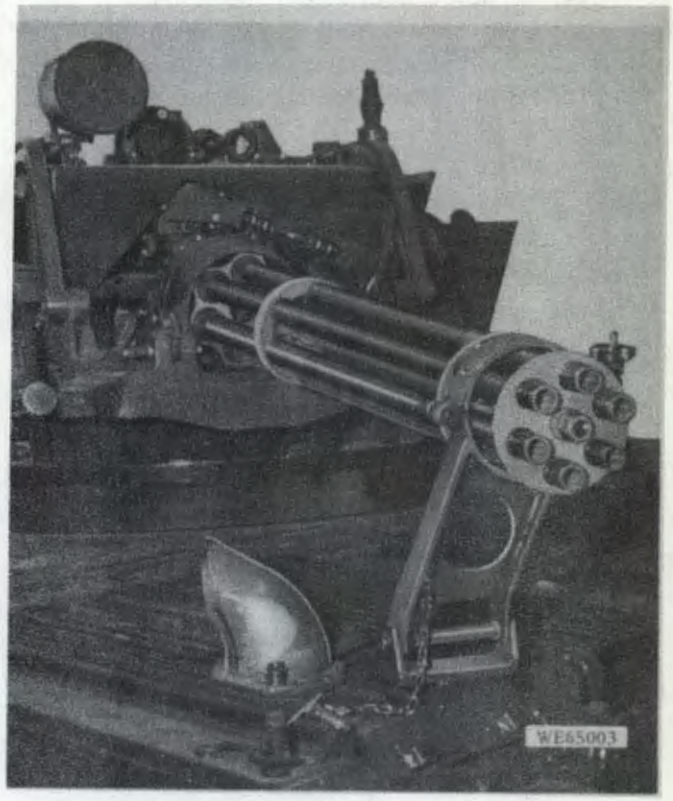


Figure 2-72. Cannon stowed.

(4) Position the mount so that the cannon barrel cluster is in travel lock clamp.

NOTE

It may be necessary to place the BRAKE-BRAKE AND CLEAR switch in the BREAK AND CLEAR position and rotate the barrel cluster slightly in order to close the travel lock clamp.

(5) Close the travel lock clamp and secure with hand lock nut.

(6) Apply azimuth and elevation brakes.

b. Stowing the Antenna. The stow position of the antenna during ground or external firing modes is with the reflector and feed assembly pointed upward. Stowing the antenna in this manner improves the commander's field of view and provides maximum clearance over the commander's hatch. The stow position of the antenna for travel through brush or woodland is with the reflector and feed assembly pointed down and inward to provide maximum protection to the antenna. To stow the antenna proceed as follows:

(1) Set SYSTEM POWER switch to ON.
(2) Set MODE switch to RADAR or MANUAL.
(3) Set stow control MODE switch to STOW.

(4) Set stow control MAINT switch to ON.

(5) Using stow control ELEV switch and TRAV switch, position the antenna to the stow position.

(6) Set stow control MAINT switch to OFF.

NOTE

Leave stow control MODE switch set to STOW.

c. Install Muzzle, Turret, and Antenna Covers.

2-23. Unloading Ammunition from Drum.

a. Prepare system for unloading as follows:

(1) Check that nothing will impede the motion of the turret in azimuth.

(2) Remove turret cover and antenna covers.

(3) Release the cannon from the travel lock and stow the travel lock.

WARNING

Clear cannon before performing the following procedures.

(4) Position the mount approximately 1600 mils to the left of the travel position with approximately 0 mils elevation.

(5) Gain access for unloading by stowing the turret safety guard as follows:

(a) Place commander's seat in up position and remove commander's foot rest.

(b) Release the left latch and 3 gate locks (fig. 2–51), fold the guard against the right wall and stow with the web strap (fig. 2–51).

b. Place conveyor unit in position to unload as follows:

(1) Set the drum drive assembly shift pin handle (fig. 1–14) to N.

(2) With the knurled knob on takeoff gear, rotate the takeoff gear in feed direction (clockwise) until an arrow on a conveyor gear tooth (indexed tooth) is nearly opposite notch in timing lock as shown in figure 2–54.

(3) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the unlocked (up) position.

(4) Pull the conveyor unit assembly out from the exit unit assembly into the load position (fig. 2–54).

(5) Depress the conveyor unit assembly handle lockbutton and rotate handle to locked (down) position. Check that timing lock notch has engaged in indexed tooth (in time). Conveyor unit is now in unload position.

NOTE

If the timing lock notch has not engaged an indexed tooth, manually disengage the timing lock and rotate the conveyor gear until the notch will engage an indexed tooth.

WARNING

Observe normal safety precautions while performing following steps, if live ammunition is being unloaded.

(6) Turn takeoff gear in feed direction (clockwise) using socket wrench handle until all ammunition has been removed from the drum and the exit unit assembly.

(7) Apply pressure to drum timing pin and slowly turn takeoff gear counterclockwise until timing pin can be depressed. Release knurled knob and then the timing pin.

(8) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the unlocked (up) position.

(9) Push the conveyor unit assembly in all the way.

(10) Depress the conveyor unit assembly handle lockbutton and rotate the handle to the locked (down) position. Conveyor unit is now in fire position.

(11) Set shift pin handle to F (fire) position.

(12) Store dummy rounds in the steel ammunition cans provided with the dummy ammunition. Store live ammunition in accordance with the instructions in chapter 5.

CAUTION

Do not cycle rounds through the feed system when the drum is completely empty.

2-24. Unloading Stowed Ammunition.

a. Lower the personnel seat back rest (fig. 2–52).

b. Release the front web strap and swing the personnel seat up towards ramp door.

c. Remove ammunition cover (fig. 2–53).

d. Release web straps securing ammunition to left wall of vehicle and remove ammunition starting at ramp end of stowage rack.

2-25. M19 Periscope.

a. Description and Use. The M19 periscope (fig. 2–73) is used for blackout driving with infrared headlights. When not in use the M19 periscope is stowed on the hull wall to the left of the driver.

CAUTION

Damage to the periscope will occur if the lenses are exposed to direct sunlight. Always remove and stow the periscope before daylight.

b. Installation and Adjustments.

WARNING

The power cable must be connected to the periscope before power is turned on.

(1) Install infrared periscope M19 in accordance with figures 2–74 and 2–75, A through H.

CAUTION

Do not open driver's hatch with M19 periscope installed.

(2) Adjust the headrest, azimuth, elevation, and focus in accordance with I through L, figure 2–75.

c. Removal.

WARNING

Injury to personnel or damage to equipment may occur if the main light switch lever and the infrared power switch are not turned OFF before power cable is disconnected.

(1) Set instrument panel light switch assembly (2, fig. 2–3) to OFF.

(2) Set instrument panel I.R. POWER switch (1, fig. 2–3) to OFF.

(3) Set MASTER SWITCH (fig. 2–6) to OFF and wait one minute.

WARNING

Before disconnecting power cable from periscope, wait one minute until residual charge in system has drained off and then remove cable from periscope and immediately connect to stowage receptacle on master switch panel. Do not under any circumstances touch end of cable when moving from periscope to stowage receptacle because voltage of power pack exceeds 16,000 volts.

(4) Remove power cable connector and immediately connect to stowage receptacle on master switch panel (fig. 2–6).

(5) The remaining removal procedures are the reverse of the installation procedures. Refer to G through A, figures 2–74 and 2–75 to remove the M19 periscope.

2-26. M17 Periscope.

Four M17 periscopes are mounted around the driver's hatch. The periscopes are mounted in positions to allow maximum view of terrain and conditions by the driver when the hatch is closed.

2-27. Materiel Used in Conjunction with Major Item.

a. Communication System.

(1) *Scope.* The following paragraphs contain information for the guidance of personnel responsible for operation of the communication system. They contain only the information necessary for using personnel to properly identify, connect, and protect this equipment while being used or transported with the vehicle.

CAUTION

Turn communications equipment off before starting or stopping engine.

(2) *Description.*

(a) General. The communication equipment installed in XM163 system consists of crew interphone equipment and a radio set for voice communication between other vehicles, aircraft, and infantry or field units. Maximum reliable operating distance, depending on units installed, is 50 miles.

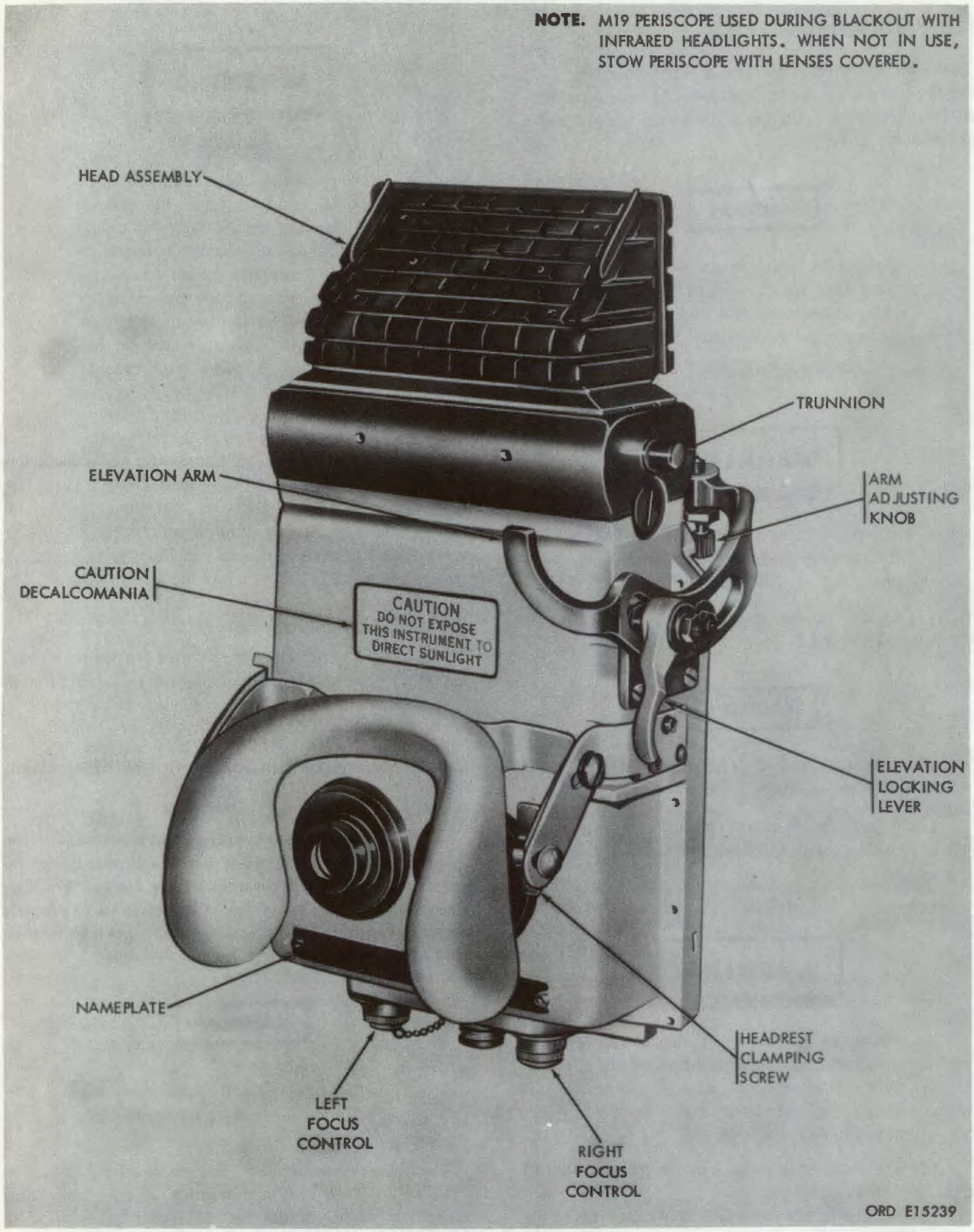
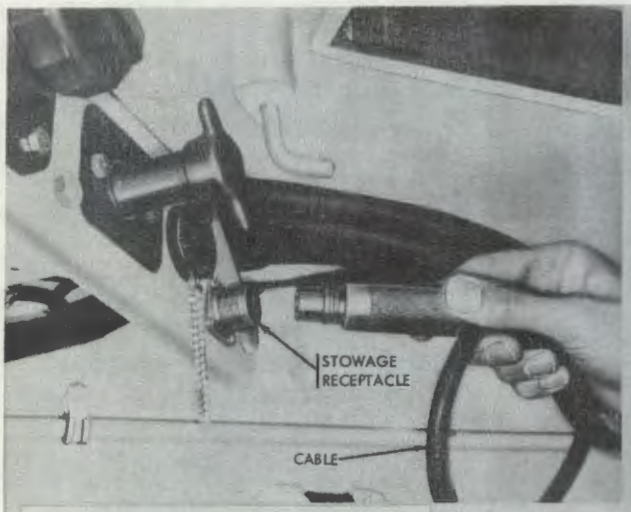
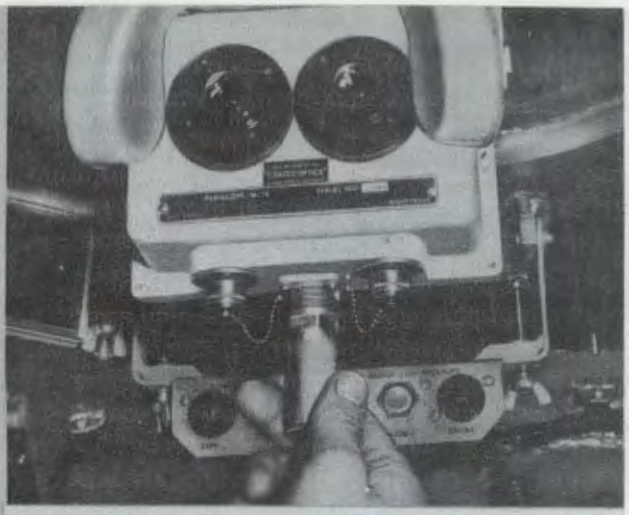


Figure 2-73. M19 periscope.

Figure 2-74. Installation of M19 periscope.



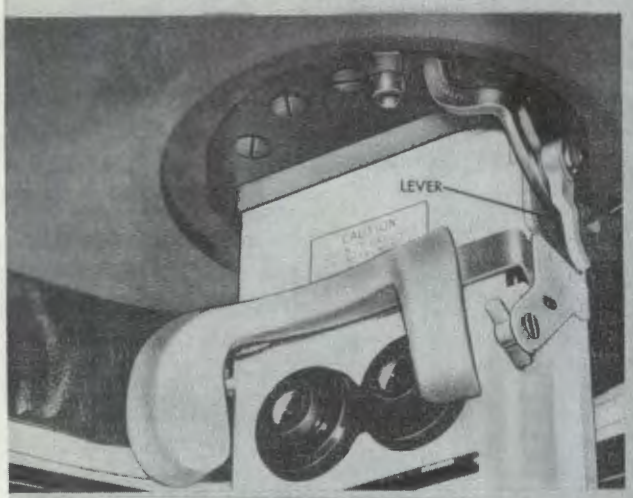
G. Remove periscope power cable from stowed position.



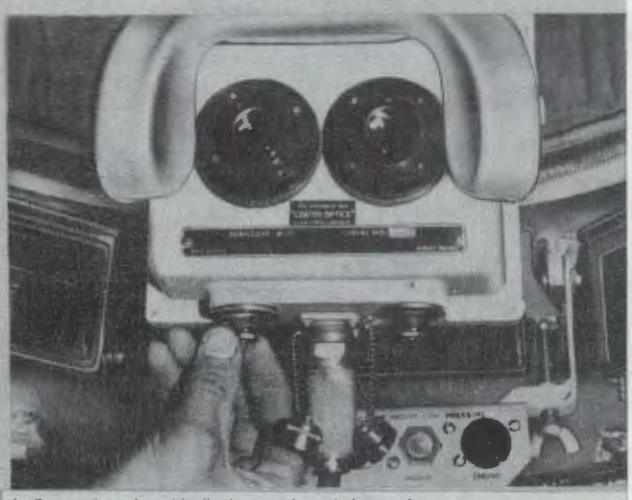
H. Connect cable to periscope. Turn master switch ON, IR power switch ON and light switch assembly to BO DRIVE.

I. Loosen clamping screw and adjust headrest.

J. Adjust periscope in azimuth and tighten azimuth locking knob.



K. Adjust periscope in elevation and tighten locking lever.



L. Focus each eyepiece with adjusting screw; loosen lock nut as shown, use screwdriver to adjust screw, and retighten lock nut.

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Figure 2-75. Installation and adjustments of M19 periscope.

(b) Radio set AN/VRC-47. The radio set consists of mountings, auxiliary radio receiver, and receiver-transmitter. Refer to TM 11-5820-401-10, supplied with the equipment, for operating and maintenance instructions for the radio set.

(c) Intercommunication set AN/VIC-1 (V). The intercommunication set provides voice communication among members of the crew. It is composed of audio frequency amplifier AM-1780/VRC and three intercommunication control sets C-2298/VRC. These components are connected by special purpose cable assemblies and are powered by the vehicle batteries. The auto frequency amplifier is the main junction box for the intercommunication control sets. The control sets provide connections between the audio frequency amplifier and the crew positions. The three intercom stations, when used in conjunction with the amplifier, and with the MONITOR switches set to ALL, can provide two-way conversations. All controls and connectors are mounted on the outside of the equipment. Refer to TM 11-5830-340-12 for operating and maintenance instructions on the intercommunication set.

(d) Teleposts. Four feed-through teleposts (fig. 1-3) are located on the chassis hull rear wall between the ramp and the right taillight. The teleposts, in conjunction with amplifier AM-1780/VRC, provide internal-external telephone or radio communication when the system is combat locked.

(3) *Removal and installation.* Notify organizational maintenance for all removal and installation of communications equipment.

(4) *Radio interference suppression.* Radio interference suppression is the elimination or minimizing of electrical disturbances that interfere with radio reception or disclose the system location to sensitive electrical detectors. It is important that vehicles, without radios as well as with radios, be properly suppressed to prevent interference with radio reception in neighboring vehicles and to avoid detection. Suppression in the XM163 system is accomplished by braided bond strap ground cables, toothed washers, resistor suppressors, and coaxial capacitors in circuits and components. Shielding is used on some primary and all secondary high-voltage circuits in the power plant electrical system. If excessive noise or interference is encountered during operation of the radio equipment, notify organizational maintenance.

CAUTION

Do not transmit with radio RT-524 receiver-transmitter during active target tracking or engagement (see para (5) following).

(5) *Radar/mount servo-radio interference.* Operation of the AN/VRC-47 radio interferes with and degrades radar transmission [and mount servo operation if a target is being tracked or is engaged. Consequently, the radio RT-524 receiver-transmitter should not be used to transmit during active target tracking or engagement. This prohibition applies to operation in all modes except the ground (static) mode.

b. Personnel Compartment Heater.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of the personnel compartment heater. The heater, part of the XM163 system winterization kit, is authorized for issue when temperature ranges require additional protection for the crew and passengers.

(2) *Description.*

(a) General. The personnel compartment heater (fig. 2-76) provides heat during cold weather operation by circulating warm air within the personnel and driver's compartments from a fresh air type heater assembly.

(b) Heater assembly. The multifuel burning fresh air type heater assembly is a cylindrical unit with a rectangular control box (fig. 2-77) mounted on the ceiling to the left and rear of the driver. Vertically mounted in the right front corner of the personnel compartment, the heater assembly heats and circulates the air.

(c) Fuel system. Fuel for the heater assembly (fig. 2-76) is fed from the vehicle fuel compartment through a hose to an electric fuel pump and then through a fuel tube to the heater assembly. The fuel pump is located under the rear floor plate in the left rear corner of the personnel compartment.

(d) Exhaust system. The heater assembly exhaust outlet is located in the chassis roof above the heater. The exhaust pipes run from the front of the heater into the power plant compartment, back into the personnel compartment, and out the opening in the roof.

(e) Electrical system. The heater control box, located in the driver's compartment, connects the heater assembly and the fuel pump through a wiring harness to the vehicle electrical system.

(f) Air circulating system. The heater assembly blower draws cool air in through the top of the heater assembly and circulates warm air within the driver's compartment through a plenum, flexible tube, and duct assembly. The duct assembly, located on the side and across the front of the personnel compartment, is connected to the heater by the flexible tube and plenum. Openings in the duct assembly direct the warm air into the compartments.

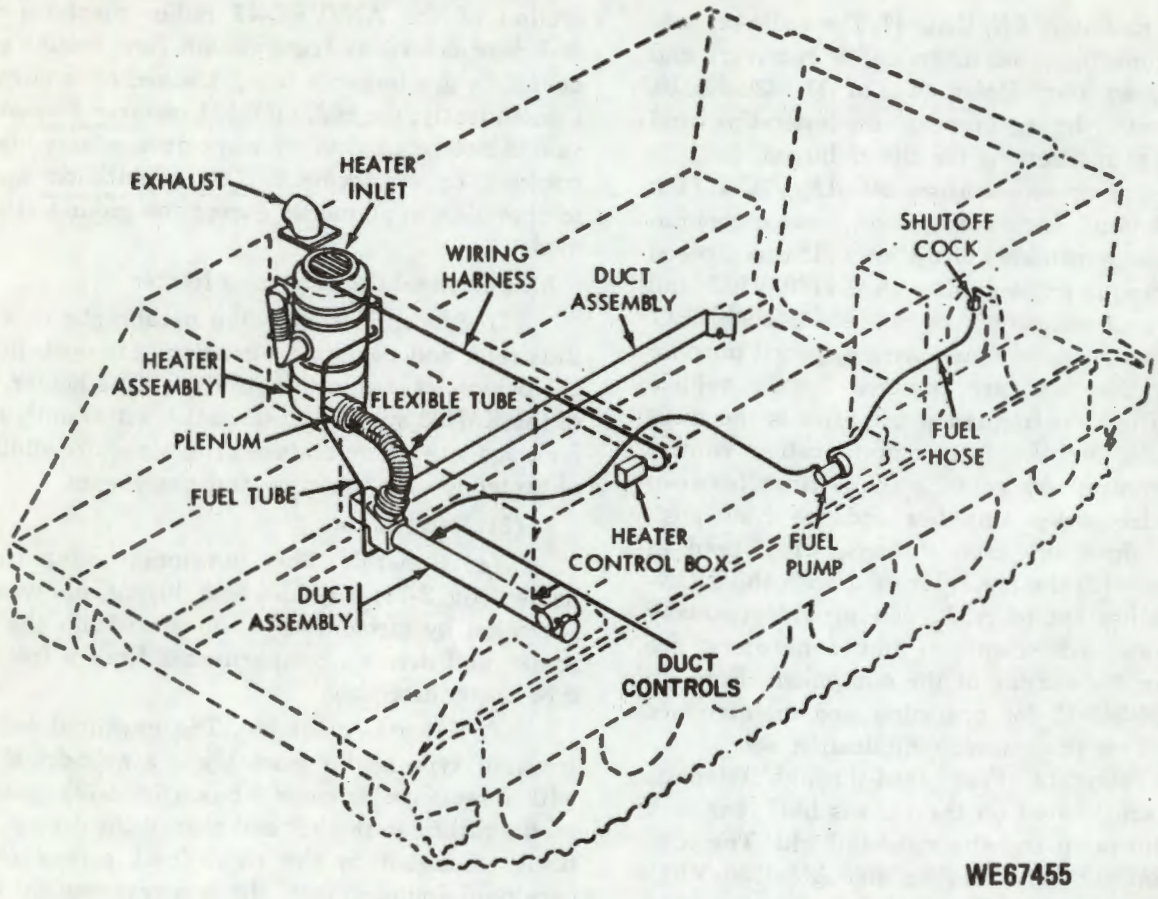


Figure 2-76. Personnel compartment heater—schematic.

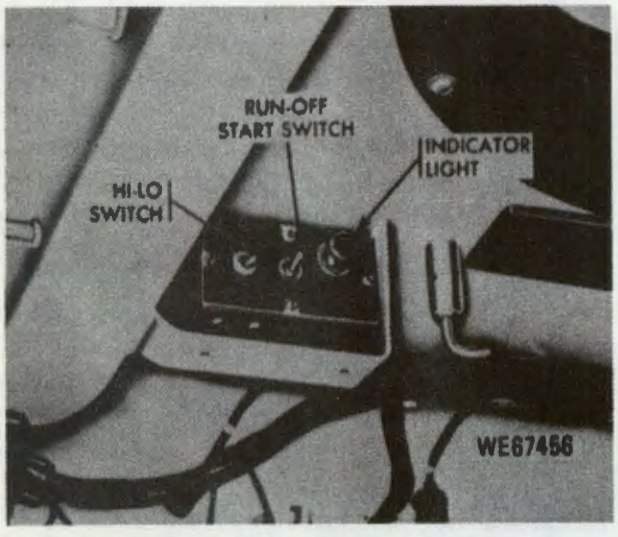


Figure 2-77. Personnel compartment heater control box.

(3) *Controls and instruments.* This paragraph provides information pertaining to the controls and instruments for the operation of the personnel compartment heater. The heater controls and instruments are listed and functionally described in table 2-9.

(4) *Operating instructions.*

(a) General. This paragraph contains instructions for the mechanical steps necessary to operate the personnel compartment heater.

NOTE

The RUN-OFF-START switch must be held in START position until the PERSONNEL HEATER indicator lights.

Table 2-9. Personnel Compartment Heater Controls and Instruments

Control	Function	Reference
HI-LO switch	Used to regulate the temperature output of the heater assembly. Set to HI for high heat. Set to LO for low heat.	Fig. 2-77
RUN-OFF-START switch	Used to start, run, and turn off the heater. Spring loaded for return to OFF when released from START. Hold in START to start heater. Set to RUN to run heater. Set to OFF to turn off heater.	Fig. 2-77
PERSONNEL HEATER indicator	When indicator is lit, heater is running. Lens cover rotated clockwise, dims the light. Lens cover rotated counterclockwise brightens the light. Push in on lens cover and light will light if voltage is at the control box.	Fig. 2-77
Duct assembly controls	Used to direct warm air to the personnel and driver's compartments. To open, slide pin toward center of vehicle; to close, slide pin toward outside of vehicle.	Fig. 2-76
Fuel shutoff cock (same shutoff cock is used for engine coolant heater)	Used to turn on or shut off the supply of fuel to the heater. To open cock, turn handle counterclockwise to close cock, turn handle clockwise to stop.	Fig. 2-78

(b) Starting personnel heater.

WARNING

MONOXIDE POISONING CAN BE DEADLY.
DO NOT operate heater in an enclosed area unless it is ADEQUATELY VENTILATED.
DO NOT operate heater for long periods without maintaining ADEQUATE VENTILATION in driver's and personnel compartments.
BE ALERT at all times during heater operation for monoxide exposure symptoms.

1. Perform before operation preventive-maintenance (table 4–1) before starting heater.
2. Open heater fuel shutoff cock (fig. 2–78).
3. Set vehicle MASTER SWITCH to ON.
4. Set heater control box HI-LO switch to HI or to LO according to heat requirement.

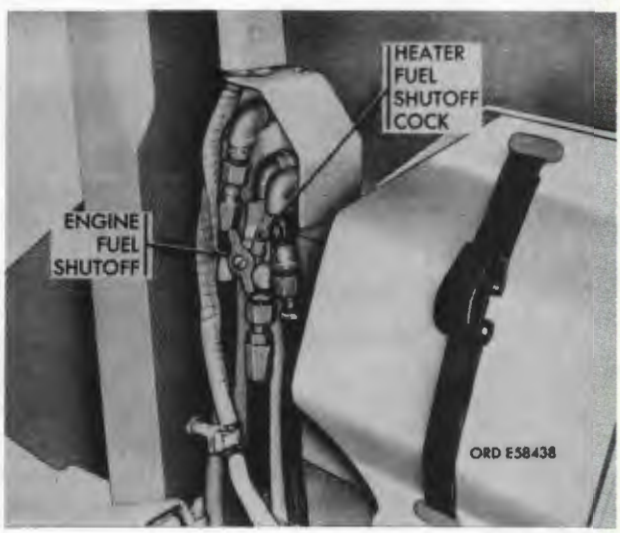


Figure 2-78. Heater fuel shutoff cock.

NOTE

The heater will automatically start on low heat regardless of the HI-LO switch setting. If the switch is set on HI, the heater will go to high heat after the heater starts.

5. Hold heater control box RUN-OFF-START switch to START. Wait until after the heater has ignited, the blower speed has increased and the PERSONNEL HEATER indicator lights, and then set RUN-OFF-START switch from START to RUN without stopping in the OFF position.

6. If heater fails to start, set heater control box RUN-OFF-START switch to OFF.

7. Check PERSONNEL HEATER indicator lamp by pressing indicator lens cover. If the indicator lights, repeat steps 4 through 6 above. If heater does not start on third attempt, refer to fault isolation procedures (table 4–2).

NOTE

If heater becomes overheated during operation, it will shut down automatically and must be restarted (b. preceding); wait at least 5 minutes before attempting restarting.

(c) During-operation services. Perform during-operation preventive-maintenance as prescribed in table 4–1.

(d) Operating heater unattended.

1. Set heater control box HI-LO switch to HI or to LO depending on heat requirements.

2. Open personnel compartment air inlet ventilator.

(e) Stopping heater.

WARNING

Do not turn off vehicle MASTER SWITCH until heater has been turned off and has purged itself.

1. Set heater control box RUN-OFF-START switch to OFF.

NOTE

The PERSONNEL HEATER indicator will remain lit and the blower will continue to run until the heater has purged itself.

2. After the heater is purged and has turned off, set chassis MASTER SWITCH to OFF.

3. Close heater fuel shutoff cock.

4. Perform after-operation preventive-maintenance (table 4–1).

c. Driver's Windshield.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for use of the driver's windshield. It is part of the XM163 system winterization kit, authorized for issue when temperature ranges require additional protection for the driver. The windshield is usually issued with the personnel compartment heater.

(2) *Description.* The driver's windshield (fig. 2–79) is a removable shield with five vinyl plastic windows, mounted across the front of the driver's hatch opening, to protect the driver from the effects of arctic windchill during cold weather operation. Wire supports sewed into the canvas, between the windows and along the upper edge, retain the windshield in a vertical position. When installed, five clips and a strap assembly attach the windshield to the driver's hatch. When not in use, the windshield is folded, placed into a stowage bag, and stowed inside the vehicle.

(3) *Installation.*

CAUTION

Use care in handling windshield to avoid damage and scratches to the vinyl plastic windows.

(a) Perform before-operation preventive-maintenance (table 4–1).

(b) Position windshield between periscopes and driver's hatch (fig. 2–79).

(c) Attach five metal clips on windshield to M17 periscope guards.

NOTE

There is no clip on right end of windshield.

(d) Install strap assembly on windshield and around rear of driver's hatch; tighten strap assembly to secure.

(4) *Removal (fig. 2–79).*

(a) Loosen strap assembly securing windshield to driver's hatch.

(b) Disconnect five metal clips from periscope guards.

(c) Perform after-operation preventive-maintenance (table 4–1).

(d) Fold windshield, place in stowage bag, and stow inside vehicle.

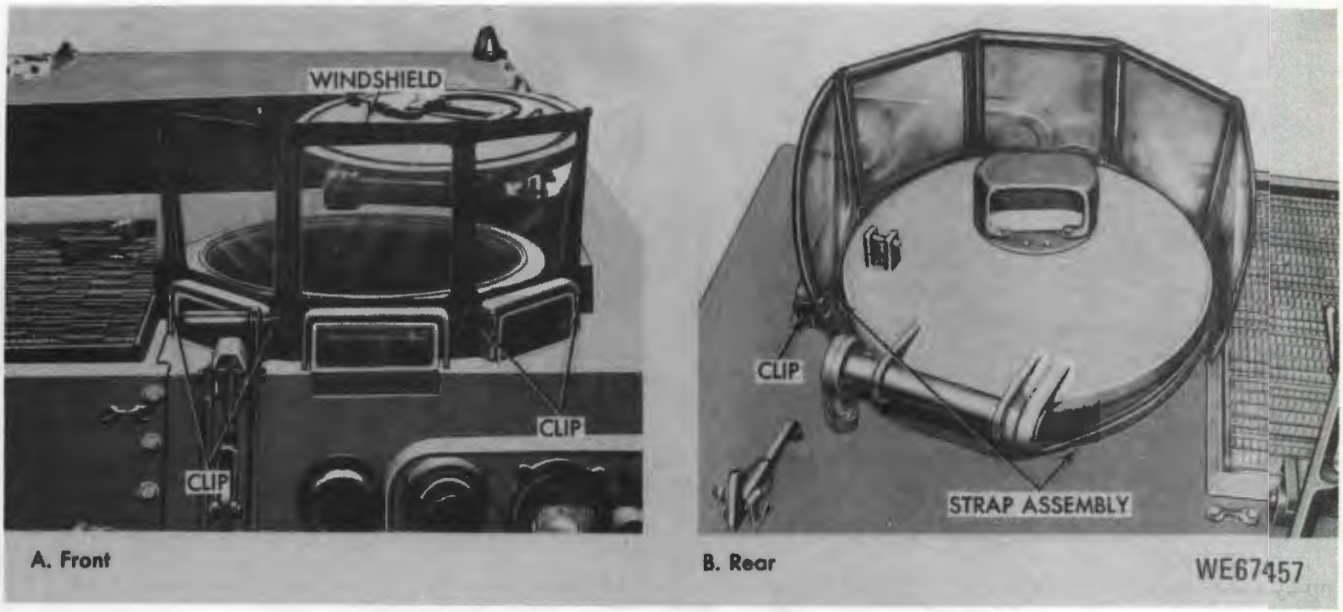


Figure 2-79. Driver's windshield.

d. Engine Coolant Heater.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of the engine coolant heater. It is part of the system winterization kit, authorized for issue for starting the vehicle where temperatures range between minus 25 degrees and minus 65 degrees Fahrenheit.

(2) *Description.*

(a) General. The engine coolant heater (fig. 2–80) heats and circulates coolant through the engine and a heat exchanger in the battery box. When the engine is not in use, the coolant heater is used to maintain warm lubricating oil, engine block, and battery electrolyte by circulating warm coolant through the engine and battery box heat exchanger. The heater is not intended for use as a quick preheat heater. After stopping a warm engine, the heater is started to keep the lubricating oil, engine block, and battery electrolyte warm for a 12-hour period and to permit restarting the engine from the vehicle batteries.

(b) Coolant heater. The multifuel burning coolant heater is a cylindrical unit with a coolant hose, fuel line, and electrical connections attached on top. Horizontally mounted in the right front corner of the power plant compartment, the heater heats the engine coolant and circulates it throughout the system.

(c) Fuel system. Fuel for the coolant heater is fed from the chassis fuel compartment to an electrical fuel pump and then through tubes to the heater. The fuel pump is located under the left floor plate in the personnel compartment. The fuel shutoff cock for the personnel compartment heater is also used for the coolant heater.

(d) Exhaust system. Combustion air for the heater is drawn in the left end of the heater, by a blower on the right end. The exhaust fumes are forced out the bottom of the heater and piped into the vehicle exhaust air chamber above the radiator.

(e) Electrical system. A heater control box, located below the personnel compartment heater control box in the driver's compartment, connects the heater, coolant pump, and fuel pump through a wiring harness to the vehicle electrical system.

(f) Coolant circulating system. An electrical coolant pump, located in front of the coolant heater, circulates the coolant through the heater, engine, battery box heat exchanger, and back to the heater. When the coolant heater is not in use, two shutoff cocks restrict the flow of coolant through the heater (figs. 2–81 and 2–82). A vent hose connects the system to the top of the vehicle radiator.

(3) *Controls and instruments.* This paragraph provides sufficient information pertaining to the controls and instruments for proper operation of the engine coolant heater. The engine coolant heater controls and instruments are listed and functionally described in table 2–10.

(4) *Operating instructions.*

(a) General. This paragraph contains instructions for the mechanical steps necessary to operate the engine coolant heater.

NOTE

The RUN-OFF-START switch must be held in START position until the HEATER CONTROL indicator lights.

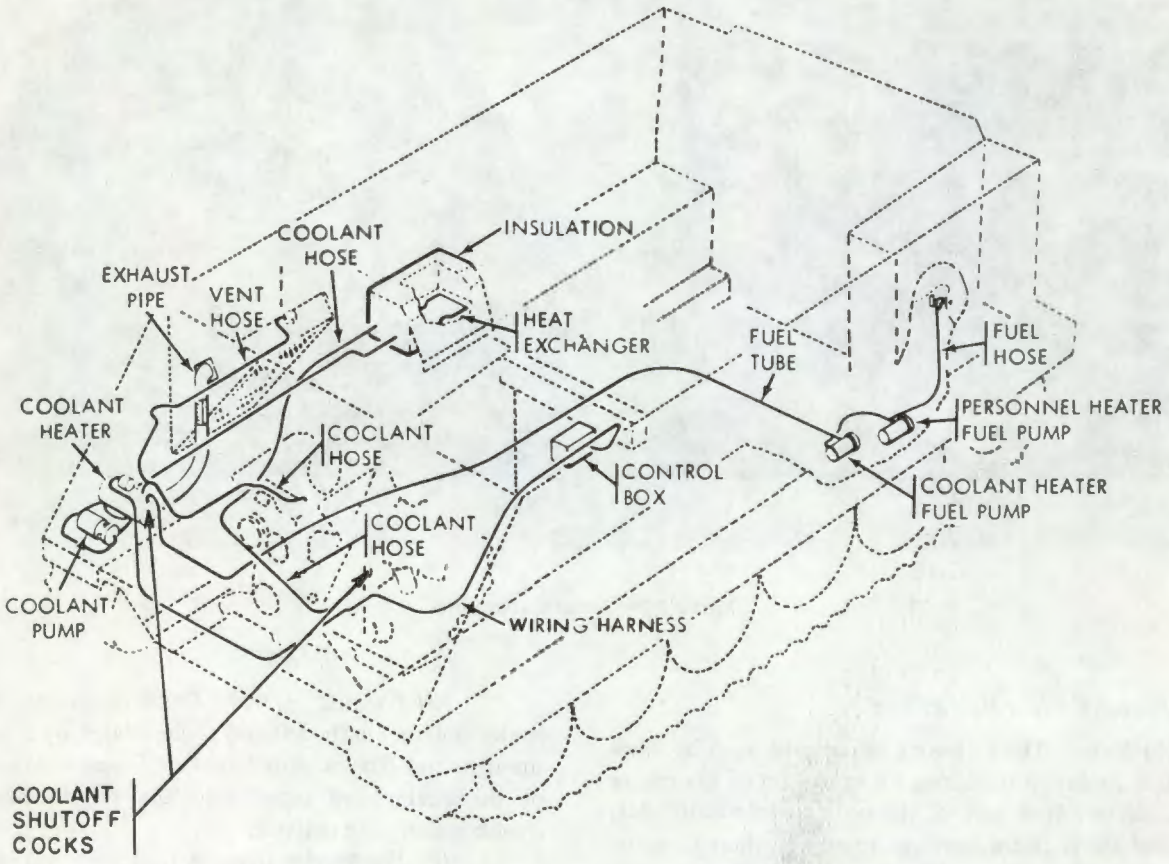


Figure 2-80. Engine coolant heater - schematic.

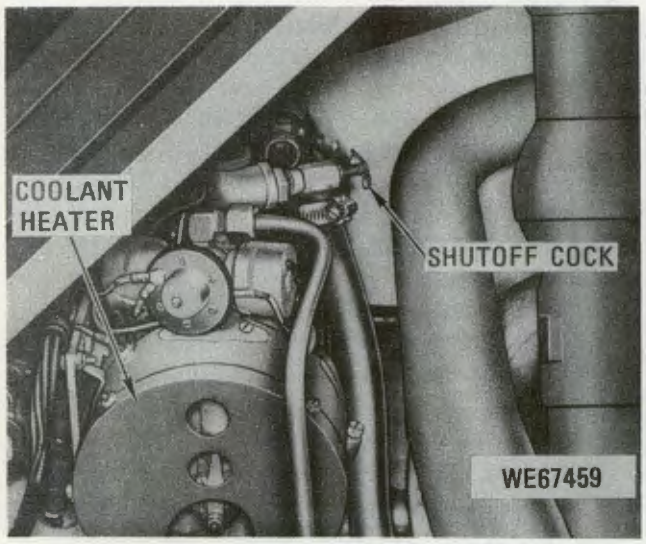


Figure 2-81. Heater coolant shutoff cock.

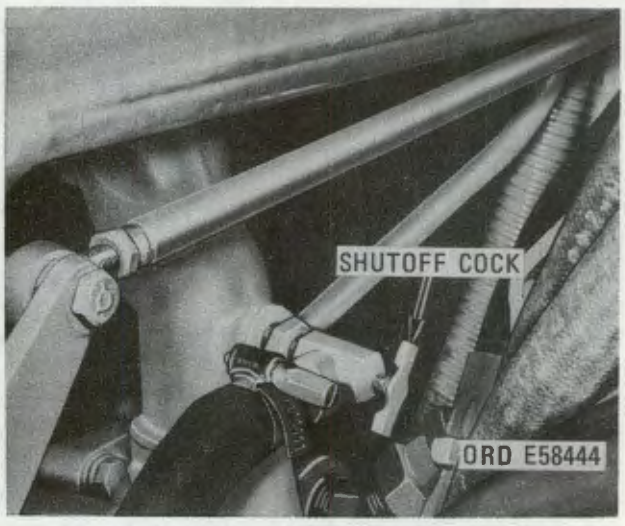


Figure 2-82. Engine coolant shutoff cock.

Table 2-10. Engine Coolant Heater Controls and Instruments

Control	Function	Reference
HI-LO switch	Used to regulate the temperature output of the heater. Set to HI for high heat. Set to LO for low heat.	Fig 2-83
RUN-OFF-START switch	Used to start, run, and turn off the heater. Spring loaded for return to OFF when released from START. Hold in START to start heater. Set to RUN to run heater. Set to OFF to turn off heater.	Fig 2-83
HEATER CONTROL indicator light	When indicator is lit, heater is running. Lens cover rotated clockwise, dims the light. Lens cover rotated counterclockwise brightens the light. Push in on lens cover and light will light if voltage is at the control box.	Fig 2-83
Coolant shutoff cocks	Used to bypass the heater when heater is not in use. Open cocks by turning handle counterclockwise to stop. Close cocks by turning handle clockwise until seated.	Figs 2-81 and 2-82
Fuel shutoff cock (same shutoff cock as personnel compartment heater shutoff cock)	Used to turn on or shut off the supply of fuel to the heater. Open cock by turning handle counterclockwise to stop. Close cock by turning handle clockwise until seated.	Fig 2-78

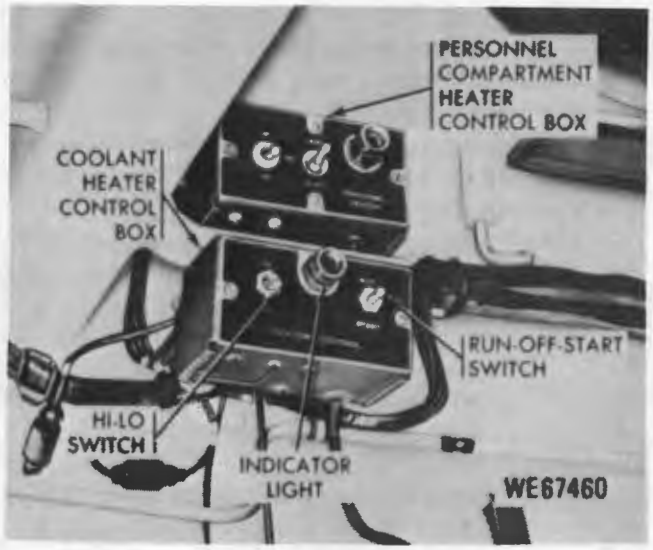


Figure 2-83. Engine coolant heater control box.

(b) Starting engine coolant heater.

NOTE

DO NOT operate lights or other vehicle electrical equipment while coolant heater is operating, or operate engine for extended periods of time with coolant heater operating.

1. Perform before-operating preventive maintenance (table 4-1) before starting heater.

2. Open heater fuel shutoff cock (fig 2-78).

3. Open both coolant shutoff cocks (figs 2-81 and 2-82).

4. Set vehicle MASTER SWITCH to ON.

5. Set heater control box HI-LO switch to HI or to LO according to heat requirement.

NOTE

If the switch is set to HI, the heater will automatically switch to low heat when the coolant temperature gets high and will switch back to high heat when the coolant temperature drops. If set on LO, the heater will remain on low heat.

6. Hold heater control box RUN-OFF-START switch to START until HEATER CONTROL indicator lights and then set RUN-OFF-START switch from START to RUN without stopping in the OFF position.

7. If heater fails to start, set RUN-OFF-START switch to OFF. Press HEATER CONTROL indicator lens cover. If indicator lights, repeat step 6 to start heater. If heater does not start on third attempt, refer to fault isolation procedures (table 4-2).

(c) During-operation service. Perform during-operation preventive-maintenance checks and services as prescribed in table 4-1.

(d) Operating coolant heater. Stop coolant heater (*e* following), and start engine at least every 12 hours to recharge vehicle batteries.

NOTE

If heater becomes overheated, it will shut down automatically and must be restarted (*b* preceding); wait at least 5 minutes before attempting restart.

(e) Stopping coolant heater.

WARNING

Do not turn off vehicle MASTER

SWITCH until heater has been purged and turned off.

1. Set heater control box RUN-OFF-START switch to OFF.

NOTE

The HEATER CONTROL indicator will remain lit and heater will continue to run until the heater is purged.

2. After heater has purged and turned off, set vehicle MASTER SWITCH to OFF.

3. Close both coolant shutoff cocks.

4. Close heater fuel shutoff cock.

5. Perform after-operation preventive maintenance (table 4-1).

e. Portable Fire Extinguisher.

(1) *Description.* The portable fire extinguisher (fig 1-5B) is a carbon dioxide (CO_2) extinguisher with a capacity of 5 pounds. The extinguisher is stowed in a bracket below the generator set in the right rear corner of the personnel compartment. The extinguisher can be used to put out electrical fires and burning liquids.

(2) *Operation.*

(a) Remove the fires extinguisher from stowed position.

(b) Remove safety pin from handle.

(c) Point nozzle at base of fire and pull trigger to discharge extinguisher.

f. Arm-Safe Switch. The arm-safe switch (fig 2-84) enables an external operator to control the firing of the cannon from a remote location. The arm-safe switch replaces the arming connector on jack J6 of the distribution box. The arm-safe switch cable is 63 feet long and the switch must be held depressed before the cannon can be fired. Perform the before-and after-operation checks listed in table 4-1.

g. Generator Set.

(1) *Description and Use.* The generator set is a self-contained, aircooled, gasoline-engine driven, auxiliary power unit (APU) that can be used to supply all electrical loads in conjunction with the system batteries. The APU maintains all system electrical functions during both operation and standby and charges all chassis and mount batteries. If the APU LOAD CURRENT percent meter indicates 100 percent load before the voltmeter on the distribution box reads 29 volts, as the APU voltage is increased, the total connected load exceeds the capacity of the APU. It may be necessary to initially accept a voltage less than 29 volts. As the batteries charge, the load on the APU will decrease and cause the voltage at the distribution box to increase above 30 volts. The APU must be readjusted to keep the operating voltage between 29 and 30 volts to prevent damage to the batteries. The generator set is designed to operate at elevations up to 8000 feet above sea level without special services or adjustment. For operation above 8000 feet, refer to TM 5-6115-323-15.

(2) *Operation.* Refer to TM 5-6115-323-15 for generator set general operating procedures.

(3) *Setting up and stowing the generator set.* The generator set is stowed in the right rear of the personnel compartment. Refer to figure 2-85 to set up or stow the generator set.

(4) *Charging the batteries.* Refer to para 3-13 *g* (2) *(c).*

g.1. Turn Signal Kit.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of the turn signal kit.

(2) *Description.* The turn signal kit (fig 2-83.1) is installed to comply with local highway driving laws where required. Principal components of the kit consist of a signal control assembly and flasher unit, mounted in the driver's compartment; two lamp assemblies, one mounted on each side of the front slope of the vehicle; and two stoplight-taillight assemblies containing flasher circuits, one mounted on each rear corner of the vehicle. A safety reflector is mounted inboard of each stoplight-taillight assembly.

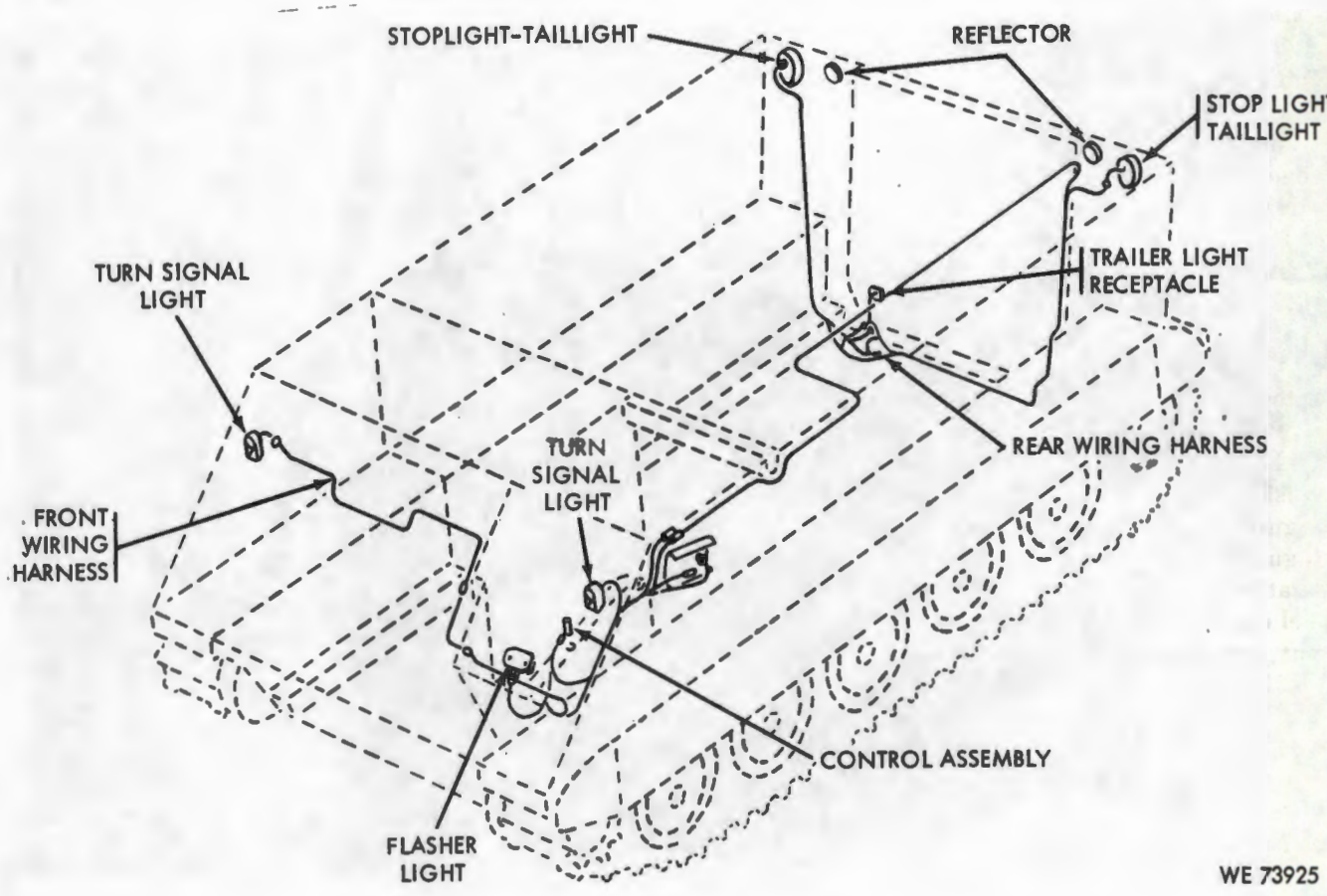


Figure 2-83.1. Turn signal kit—schematic.

(a) Signal Control Assembly. The signal control assembly (fig 2-83.2), located on the driver's left, next to the instrument panel, is used to activate the vehicle turn signals. The control lever is moved to the right to signal a right turn and to the left to signal a left turn. When a stop on the control lever is lifted and the lever moved to the extreme left, to the hazard warning position, all four signal lights will flash intermittently. A light located on the end of the control lever, when intermittently illuminated, indicates a properly functioning electrical system.

(b) Flasher Uint. The flasher unit (fig 2-83.2), located to the right of the signal control assembly, when activated by the signal control assembly, emits 24 volts intermittently to the signal lights and trailer receptacle.

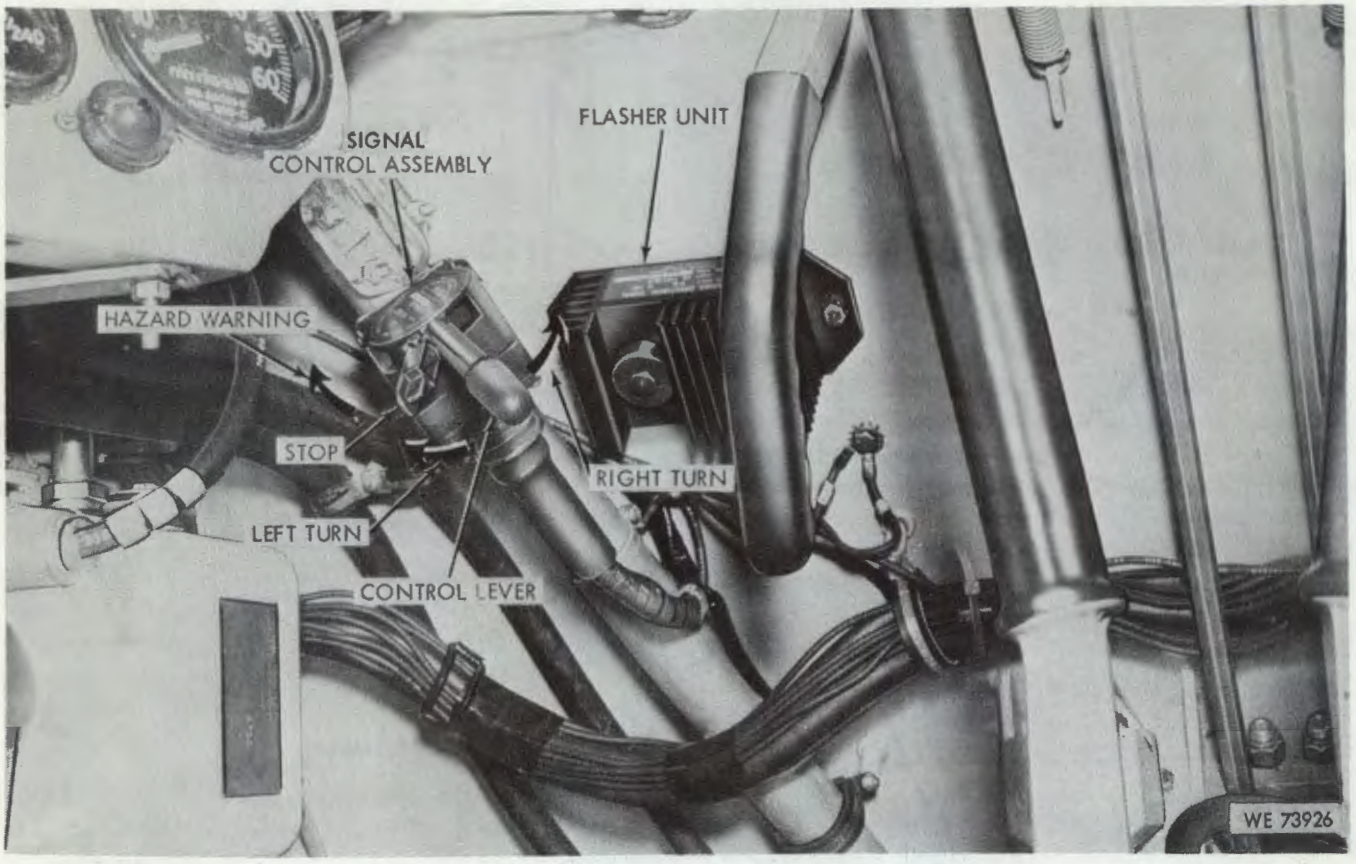


Figure 2-83.2. Signal control assembly and flasher.

(3) *Operating instructions.* Operating instructions for the turn signals are as follows:

NOTE

All instructions are subject to applicable tactical situation. Turn signals will not operate when light selector switch is in B.O. DRIVE position.

(a) Turn master switch ON and place driving light selector switch (fig 2-3 and 2-4) in STOP LIGHT or SER. DRIVE position.

(b) Move lever on signal control assembly to desired direction prior to turning vehicle. After turn has been completed, return control lever to neutral position.

(c) During halt, lift stop on control lever and move lever extreme left position, to indicate hazard warning. Return lever to neutral position before moving vehicle.

NOTE

Trailer lights will correspond to those of the vehicle when connected to the trailer lights receptacle.

h. M134 Straight Telescope and M164 Mount.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of the M134 telescope.

(2) *Description.* The M134 telescope (fig 1-16) is a straight telescope which provides spotting capability for

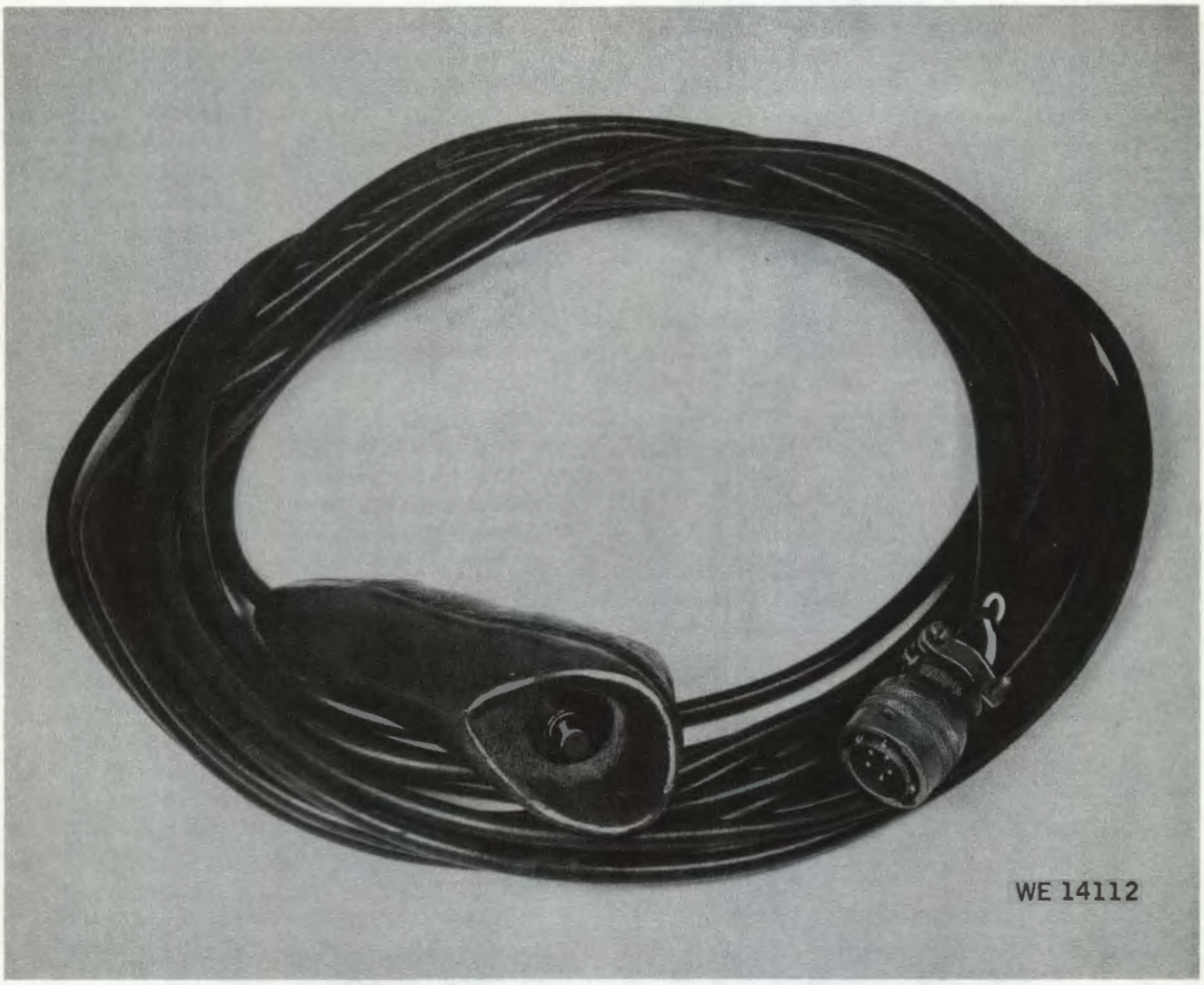


Figure 2-84. Arm-safe switch.

improved accuracy and effectiveness against ground targets. The XM134 telescope is mounted on the XM164 mount on the sight support assembly to the left of the XM61 sight. The XM134 telescope may be installed on or removed from the XM164 mount by operating personnel.

(3) *Installation.*

(a) Remove XM134 straight telescope from its case stowed on the right sponson of the vehicle.

(b) Raise XM164 mount thumb operated locking lever to its upper detent (fig. 2–62).

(c) Align female dovetail on left side of XM134 straight telescope with male dovetail on right side of XM164 mount and slide sight forward to the stop.

(d) Secure in place by lowering thumb operated locking lever to its lower detent.

(4) *Removal.*

(a) Raise thumb operated locking lever to its upper detent.

(b) Slide XM134 off of male dovetail.

(c) Assure that lens cover is in place.

(d) Stow XM134 in its case on right sponson of vehicle.

i. Night Vision Sight.

WARNING

The image intensifier assembly phosphor screens contain toxic materials.

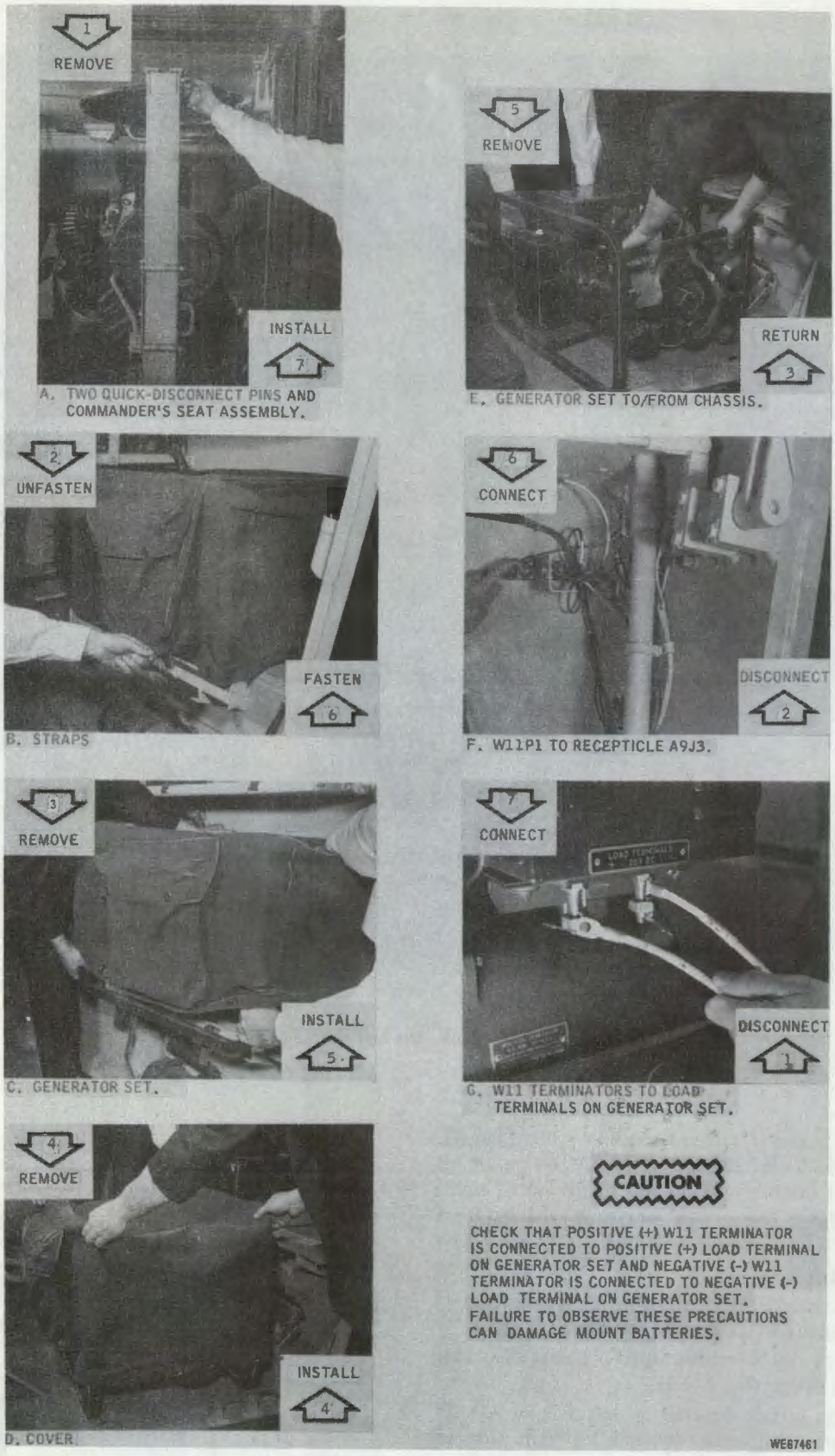


Figure 2-85. Setting up and stowing generator set (APU).

WARNING

If an assembly becomes broken, use extreme care to avoid inhaltion of the phosphor screen material or allowing it to come in contact with the mouth or open skin wounds.

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of Night Vision Sight: Crew Served Weapons, AN / TVS-2B (night sight). The night sight is used for improved accuracy and effectivenss of the M163 system when employed against ground targets. Detailed instructions on operation and maintenance for this equipment are contained in TM 11-5855-202-13.

(2) *Description.* The night sight (fig 1-16) is a crew-served weapons sight which permits observation of ground targets at night. The sight is mounted on the sight support assembly to the right of the M61 sight and may be installed on or removed from the mount by operating personnel.

(3) *Installation.*

WARNING

Before releasing the carrying case latches, open the PRESSURE EQUALIZER in accordance with instructions on the warning plate.

CAUTION

The night sight is a precision electro-optical device. Handle with care. Do not remove the night sight lens cover during daylight.

(a) Remove night sight from its case stowed on the right sponson of vehicle.

(b) Assure that small aperature of the night sight lens cover is closed and lens cover is installed.

(c) Install night sight on the dovetail mount to the right of the M61 sight and push forward to the stop.

(d) Secure sight by tightening the wing nut thumbscrew on the right and the lock lever on the left of the mounting.

(4) *Removal.*

CAUTION

The night sight is a precision electro-optical device. Handle with care. Assure that lens cover is properly installed and small aperture in lens cover is closed.

(a) Unlock and remove night sight from its dovetail mount.

CAUTION

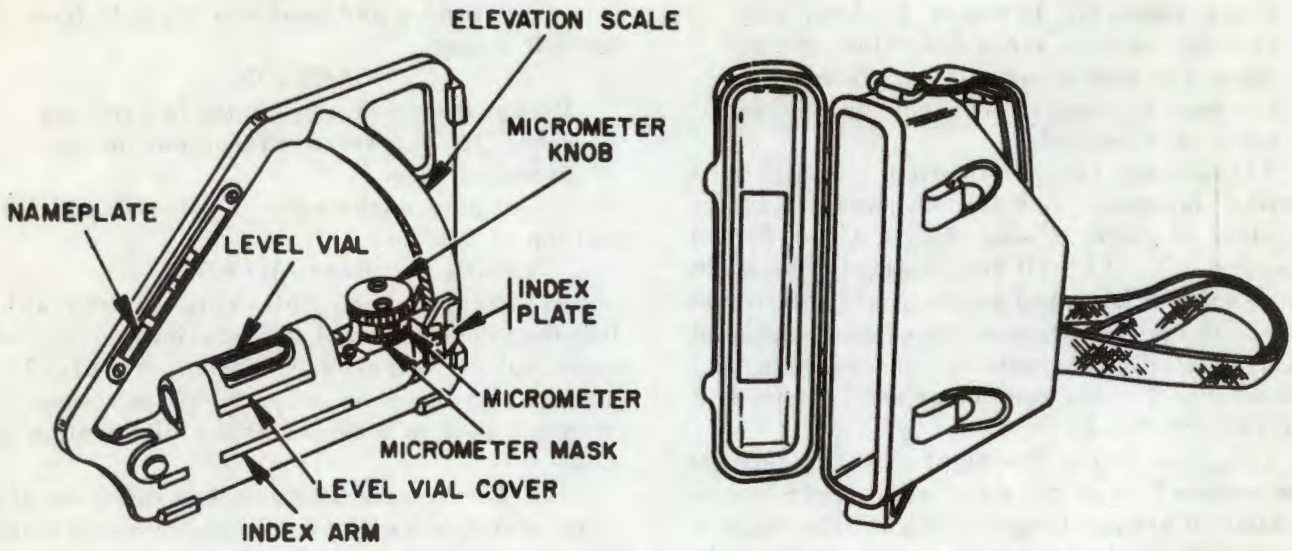
Do not store wet equipment in carrying case. Do not store equipment in wet carrying case.

(b) Stow night sight in its case on right sponson of vehicle.

j. Gunner's Quadrant (M1A1).

(1) *Scope.* The following paragraphs describe, illustrate, and contain instructions for operation of Gunner's Quadrant M1A1. The gunner's quadrant is a portable, precision instrument used to measure angles of elevation in mils.

(2) *Description.* The gunner's quadrant (fig 2-86) is equipped with two coarse graduated scales for opposite sides of the frame. One side is graduated from 0 to 800 mils, the opposite side from 800 to 1600 mils. Both scales are graduated in 10 mil increments and numbered every 50 mils. Each is used with a scale of corresponding color on a micrometer knob mounted to the index arm. A direction arrow, LINE OF FIRE, located on each side of the quadrant, indicates the correct reference surface for the scale in use, as well as the direction for positioning the quadrant on the gunner's quadrant plate (fig 2-62). The index arm is used to lay off elevations on the coarse elevation scales. The arm pivots at one end and has an index plate mounted on each side of its free end. A spring-loaded plunger in the free end of the arm meshes with notches in the quadrant frame to permit rapid setting of the arm in coarse steps. Knurled sections on the index plates are finger grips used to depress the spring-loaded arm and to move the arm to desired readings on the elevation scales. A level vial on the index arm provides the horizontal reference necessary in determining elevation. A knurled, sleeve-type cover protects the glass level vial when the quadrant is not in use. The micrometer knob on the index arm has a knurled portion for the operator's fingers and a portion with a micrometer. The micrometer has line graduations from 0 to 10 mils in 0.2 mil increments, and upper and lower



A. Gunner's quadrant M1A1.

B. Carrying case M82.

WE67533

Figure 2-86. Gunner's quadrant.

sets of figure graduations, both numbered from 0 to 10 in 1-mil intervals. The figures are used with the line graduations on the micrometer to obtain fine adjustments of elevation readings on the coarse elevation scales. A micrometer mask ensures that the correct micrometer scale is used during operation. Elevation is read as the sum of the coarse and fine scale readings when the level vial bubble is centered.

(3) *Installation.* No installation instructions are required. The gunner's quadrant is removed from its case. The gunner's quadrant plate (fig 2-62) and the pads on the quadrant shall be wiped clean prior to holding the quadrant on its plate for use.

(4) *Operation.* Refer to TM 9-1527 for operation of the gunner's quadrant.

k. Stowage of Loose Items. Refer to figures 2-86.1 and 2-86.2 for a guide to stowage of loose items.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

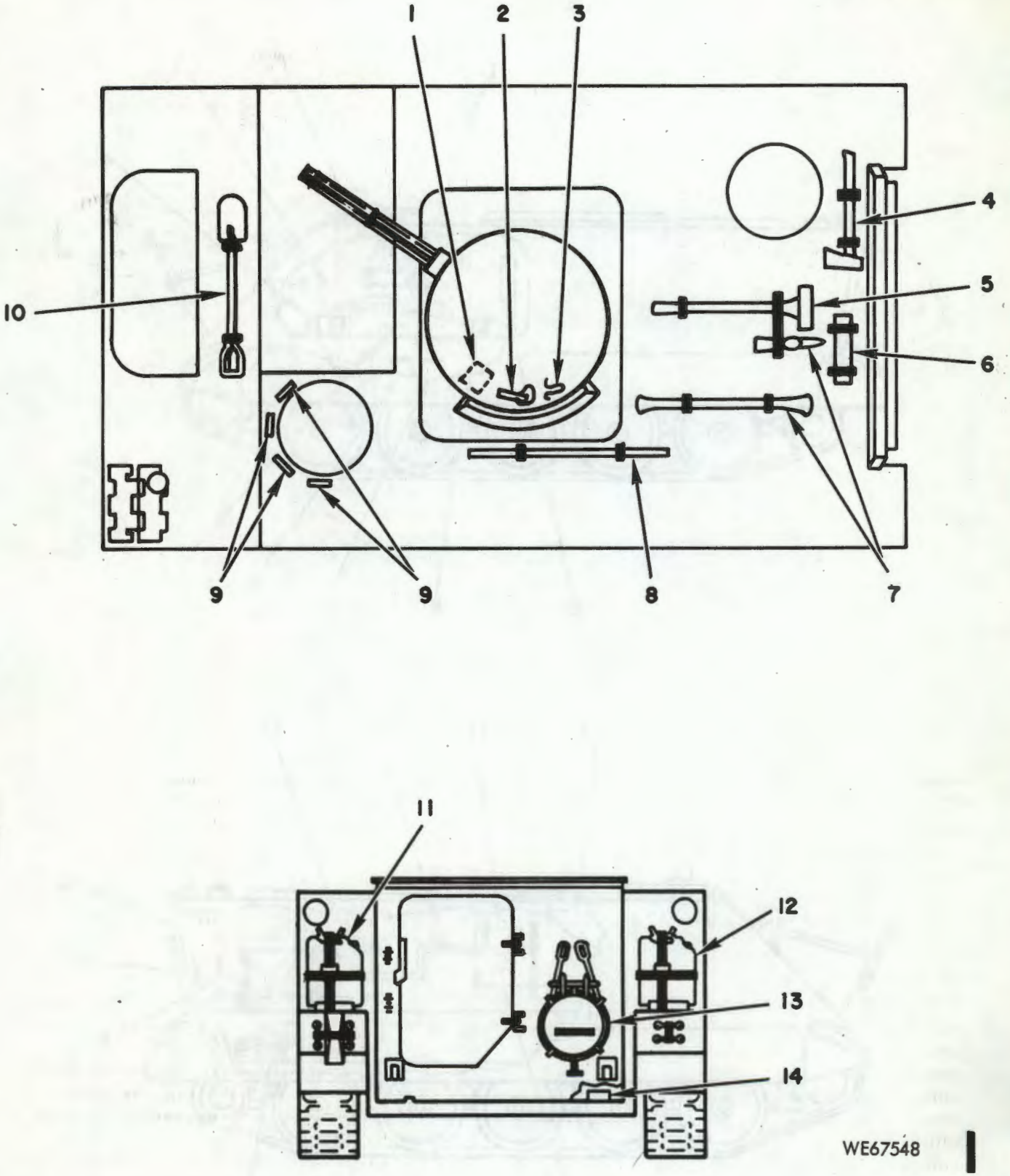
2-28. General

This section contains special instruction for operating and servicing the M163 system under unusual conditions. In addition to the normal preventive-maintenance service, special care in cleaning and lubrication must be observed where extremes of temperature, humidity, and terrain conditions are present or anticipated. Proper cleaning, lubrication, and storage and handling of fuels and lubricants insure proper operation of the M163 system and guard against excessive wear of the working parts and deterioration of the materiel. TM 21-301 contains instructions on driver selection, training, and supervision, and TM 21-306 prescribes special driving instructions for operating full-tracked vehicles under unusual conditions.

CAUTION

It is imperative that the practices prescribed in the following paragraphs be followed when operating under unusual condition.

Refer to LO 9-2350-300-10 for lubrication under unusual conditions and to chapter 3 for maintenance procedures to be performed by the crew. When failure of material results from subjection to extreme conditions, report of the condition should be made.



1 Rifle ammunition pocket (2)
2 Fire control quadrant
3 Rifle
4 Axe
5 Hand hammer
6 Track connecting fixture
7 Mattock
8 Crow bar
9 M17 periscope
10 Hand shovel
11 Gas can
12 Water can (2)
13 Wire rope
14 Rifle brackets (2 rifle)

Figure 2-86.1. Stowage guide.

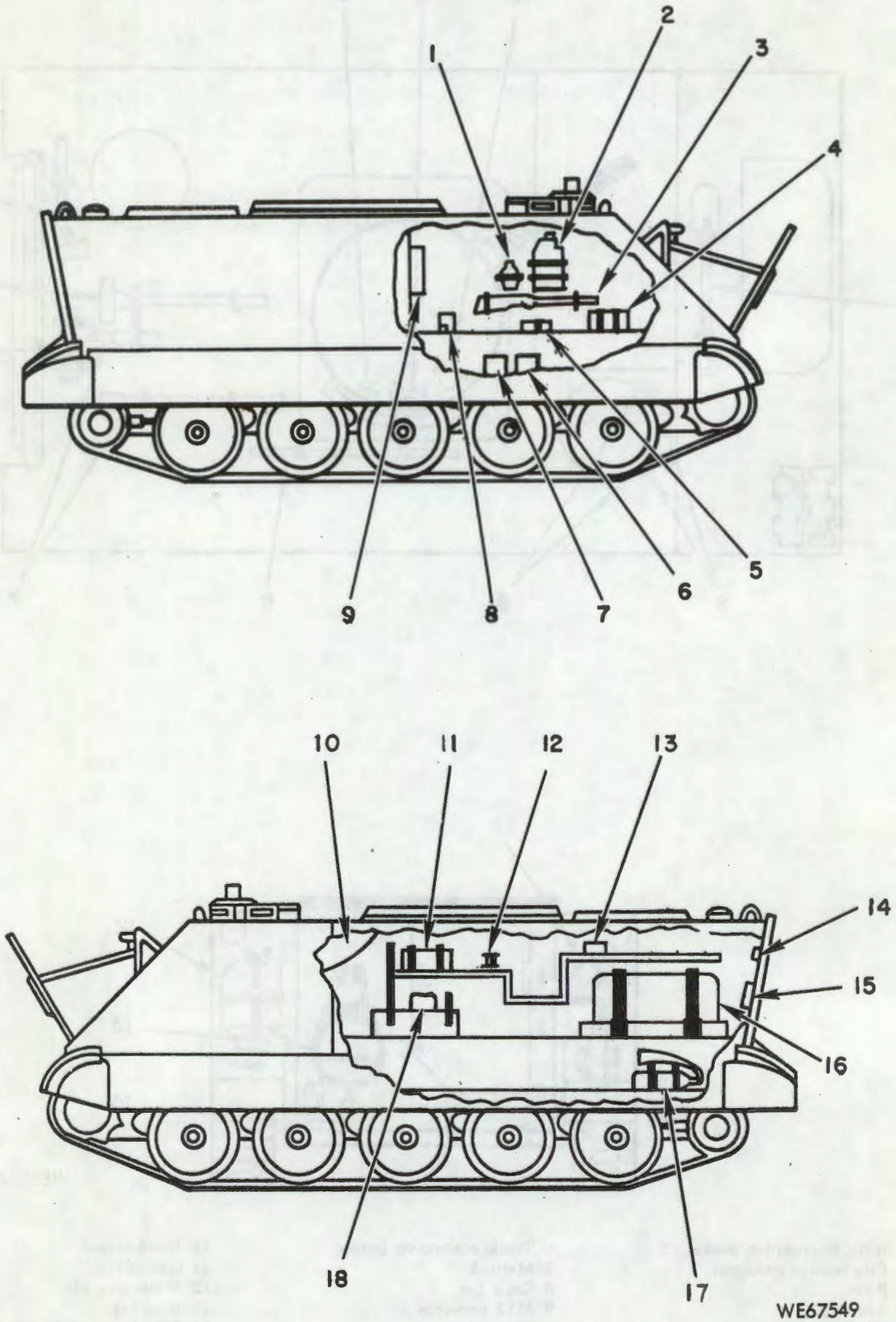


Figure 2-86.2. Stowage guide.

Key to fig. 2-86.2.

1 Canteen
2 M19 periscope
3 Rifle
4 Rifle ammunition
5 First aid kit
6 M19 periscope head
7 M17 periscope head
8 Flashlight
9 Pamphlet bag
10 Air grille curtain
11 AN / TVS-2B sight
12 Muzzle clamp
13 M134 telescope
14 Flashlight
15 External range control
16 Generator
17 Fire extinguisher
18 Tool bag

2-29. Operation in Extreme Cold.

a. General. Extensive preparation of materiel scheduled for operation in extreme cold weather is necessary. Generally, extreme cold will cause lubricants to thicken or congeal, freeze batteries or prevent them from furnishing sufficient current, will crack insulation and cause electrical short circuits, prevent fuel from vaporizing and properly combining with air to form a combustible mixture for starting, and will cause the various construction materials to become hard, brittle, and easily damaged or broken. The cooling system should be prepared and protected for temperatures below 32°F in accordance with instructions given in TM 9-207 on draining and cleaning the system, and on the selection, application, and checking of antifreeze compounds to suit the anticipated conditions. TM 9-207 also describes the method of correcting specific gravity readings for vehicle batteries exposed to extreme cold. XM163 systems scheduled for extreme-cold operation must be checked for proper lubrication, the low rate mount battery taps must be repositioned (check with organizational maintenance), and the battery heater connectors (fig. 1–12) must be connected. The APU or vehicle engine must be operated for a minimum of 2 hours at -65°F in order to heat the mount batteries before system can be operated. Between 32°F and -40°F it is necessary to preheat the batteries for 1 hour. In extreme cold the fire control system requires a warmup period. Operate the system in standby for 15 minutes between 32°F and -40°F, and for 30 minutes between -40°F and -65°F before attempting to operate or perform prefire checks. Sighting and fire-control instruments should not be transferred suddenly from cold to warm temperatures or vice versa. Condensation induced by this action may cause clouding of optics and rusting of internal parts. Abnormal strains may also be set up in parts and cause breakage.

b. Winterization Equipment. Special equipment is provided for the vehicle when protection against extreme cold weather (0° to -65°F) is required. This equipment is issued as specific kits. Each kit also contains data that provides information on description, installation instructions, and methods of use. TM 9-207 contains general information on winterization equipment and processing.

c. Operation. The driver or operator must always be on the alert for indications of the effect of cold weather on the vehicle. Be very cautious when placing the vehicle in motion after a shutdown. Congealed lubricants may cause failure of parts. Tracks may be frozen to the ground. Install air grille cover in accordance with figure 2–87 and adjust for conditions. Engine starting procedures should be in accordance with paragraph 2–5 or 2–6. After warming up the engine thoroughly, place shift lever in 1 range and drive vehicle slowly about 100 yards. This should heat lubricant in gears and free the tracks to a point where normal operation can be expected.

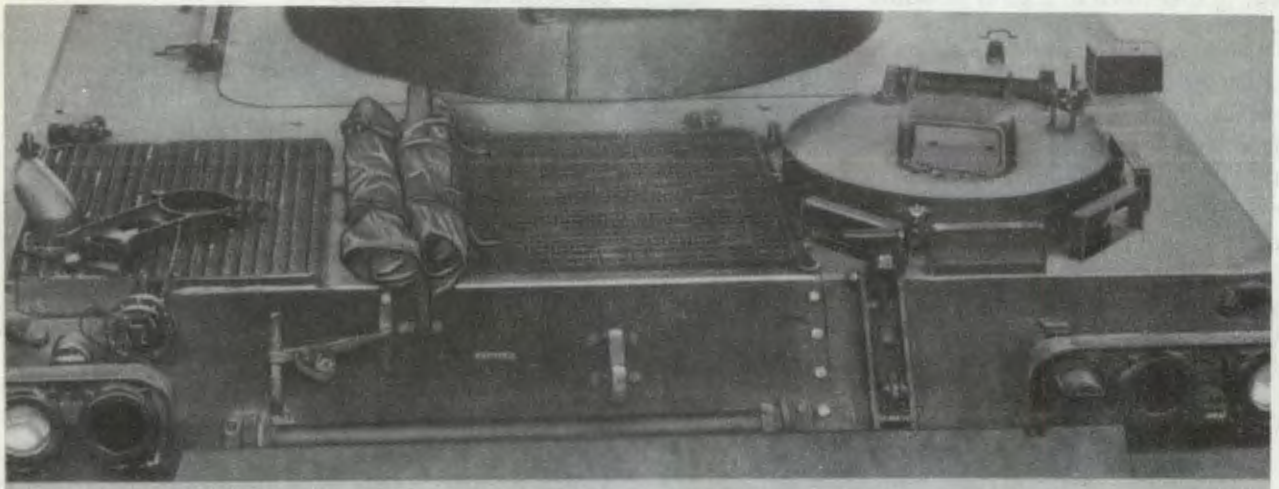
d. At-Halt or Parking. When halted for short shutdown periods, park the vehicle in a sheltered spot out of the wind. If no shelter is available, park so that the vehicle does not face into the wind. For long shutdown periods, if high dry ground is not available, prepare a footing of planks or brush. Chock in place if necessary. It is essential that the hull drain pipe plugs (fig. 2–45) be removed in order that any water in the hull drains out before it freezes. Clean all parts of the vehicle of snow, ice, and mud as soon as possible after operation. Refer to table 3–2 for detailed after-operation procedures. Protect all parts of engine and engine accessories against entrance of loose, drifting snow during the halt by installing the air grille cover. Snow penetrating the power plant compartment may enter various components and cause malfunction. Refuel immediately in order to reduce condensation in the fuel compartment. Immediately after engine shutdown, start the engine coolant heater and check to be sure that it is operating effectively. This heater precludes the necessity of removing the batteries to warm storage. The heater is designed to operate unattended during overnight stops. Instructions for operation of engine coolant heater are found in paragraph 2–27d. Draining an engine cooling system to prevent freezing will be done only when no approved antifreeze solution is available. When drain plugs have been removed or drain cocks opened to remove liquid from the cooling system of any equipment, the drains will be inspected to be sure none are obstructed. If the drain hole has become obstructed by foreign material, a soft wire should be used to clear the hole of the obstruction. This is particularly important before leaving a vehicle that has had the engine drained to protect the block from freezing.

e. Armament. The cannon should be covered when not in use. Breech bolt assemblies must be clean and lubricated. Do not over-lubricate.

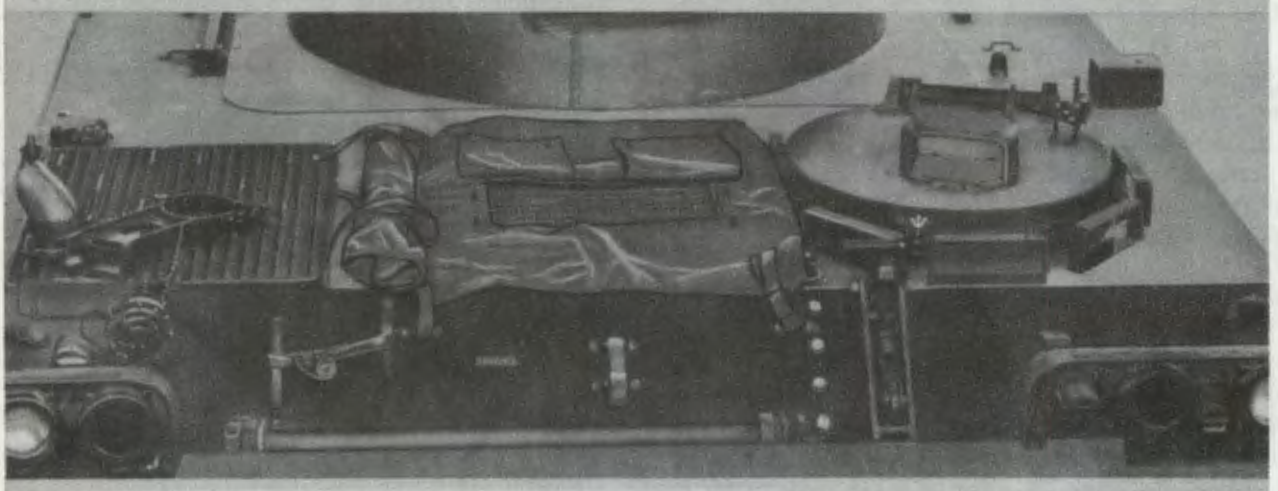
f. Fire-Control Materiel. Avoid breathing on exposed optical surfaces and causing condensation which might freeze. Cover ends of periscope when not in use to prevent accumulation of snow or ice. Avoid sudden temperature changes from warm room to low temperature outdoors.

g. Snow. It may be possible for the vehicle to ride heavily crusted snow with occasional breakthrough. To climb back onto the crust, reduce engine speed and shift into 1 range to achieve very low track speed for forward movement without slippage. Where grades must be taken, drive as nearly straight up and down as possible to equalize track load. Avoid sharp turns. For soft or fine snow, select the transmission range which gives the best traction.

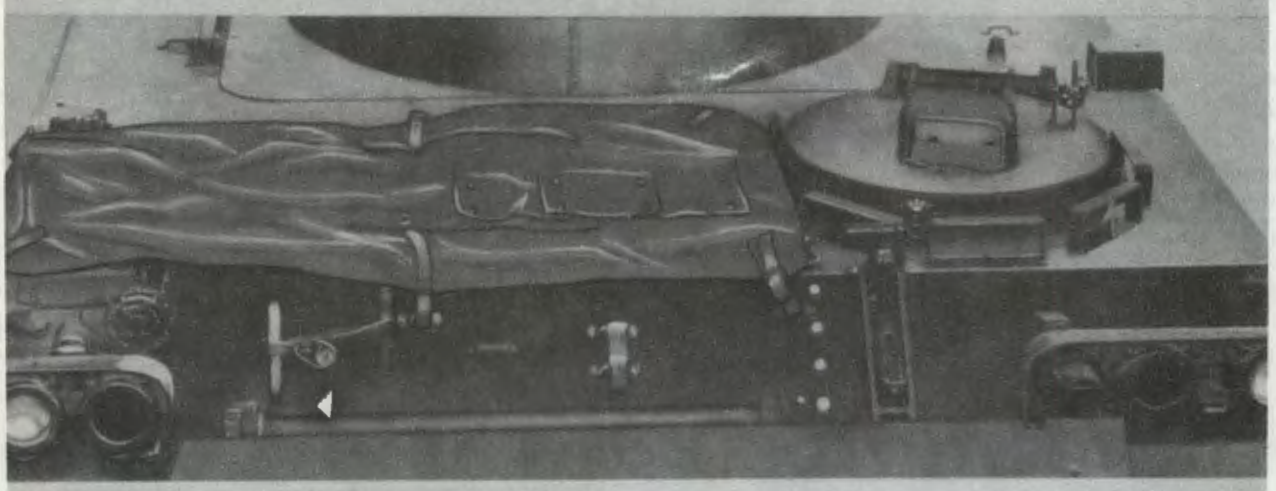
h. Ice. Skidding is the general hazard encountered on ice. Select the proper transmission range to move the vehicle steadily, without imposing undue strain on engine.



A. AIR GRILLE COVER STOWED.



B. AIR GRILLE COVER INSTALLED FOR COLD WEATHER OPERATION.



C. AIR GRILLE COVER INSTALLED FOR PARKING. WE 14114

Figure 2-87. Operation of air grille cover.

When skidding occurs, decelerate the engine and proceed with caution.

i. Maintenance Problems.

(1) *General.* The importance of maintenance must be impressed on all concerned. Maintenance of mechanical equipment in extreme cold is exceptionally difficult in the field. Even shop maintenance cannot be completed with normal speed, because the equipment must be allowed to thaw out and warm up before the mechanic can make satisfactory repairs. In the field, maintenance must be undertaken under the most adverse of conditions. Bare hands stick to cold metal. Fuel in contact with the hands results in supercooling due to evaporation, and the hands can be painfully frozen in a matter of minutes. Engine Oils, except subzero grade, are unpourable at temperatures below -40°F. Ordinary greases become as solid as cold butter. These difficulties increase the time required to perform maintenance. At temperatures below -40°F, maintenance requires up to five times the normal amount of time. The time required to warm up the vehicle so it is operable at temperatures as low as -50°F may approach 2 hours. Vehicles in poor mechanical condition probably will not start at all, or only after many hours of laborious maintenance and heating. Complete winterization, diligent maintenance, and well-trained crews are the key to efficient arctic-winter operations. Refer to TM 9-207 for general information on extreme cold-weather maintenance procedures.

(2) *Extreme cold-weather maintenance – chassis.* When the chassis has been serviced with arctic fuel, purge fuel in air box heater system as follows:

(a) Set vehicle MASTER SWITCH on master switch panel to OFF.

(b) Purge the fuel from the accumulator by loosening the line at the pressure indicator (fig. 2–17). When pressure indicator shows no pressure, tighten line.

(c) Fill accumulator with fuel by unlocking hand fuel pump (push in and rotate 90 degrees counterclockwise) and operating pump until pressure indicator reads in center of yellow area (55 to 65 psi).

(d) Lock hand fuel pump.

(e) Place fuel cut off control (9, fig. 2–1) in out position.

(f) Crank engine, and operate air box heater switch (8, fig. 2–3) for 5 cycles of 2 seconds on and 2 seconds off to fill solenoid valve and nozzle with arctic fuel.

(3) *Extreme cold-weather maintenance – fire control.* In cold weather, optical surfaces should be cleaned with lens tissue paper moistened with alcohol. If alcohol is not available, use dry lens tissue paper. Wipe gently to avoid scratching or removing the coated surface.

j. Generator Set. The generator set can operate in temperatures as low as –60° F. Store and operate unit in a sheltered area to prevent wind chill and exposure to snow. Refer to TM 5-6115-323-15.

2-30. Operation in Extreme Heat.

a. XM741 Chassis.

(1) *General.* Continuous operation of the vehicle at high speeds or long hard pull may cause overheating. Avoid continual use of low-gear ratios whenever possible.

(2) *At-halt or parking.* Do not park the vehicle in the sun for long periods of time. When practical, park vehicle under cover to protect it from sun, sand, and dust. Cover inactive vehicle with tarpaulins if no other suitable shelter is available. Where entire vehicle cannot be covered, protect periscopes and other items against etching by sand and protect power plant compartment against entry of sand. Vehicles inactive for long periods in hot, humid weather are subjected to rapid rusting and accumulation of fungus growth. Make frequent inspections and clean and lubricate to prevent excessive deterioration.

(3) *Fire-control materiel.* This materiel should be shielded as much as possible from the direct rays of the sun.

(4) *Extreme hot-weather maintenance – chassis.*

(a) Cooling system. Keep system filled to within 3 inches of the top of the filler pipe with coolant when operating in extremely high temperatures. Formation of scale and rust in the cooling system occurs more rapidly during operation in extremely high temperatures. Therefore, corrosion inhibitor compound should always be added to the cooling liquid. Avoid use of water that contains alkali or other substances which may cause scale and rust formations.

(b) Chassis batteries.

1. Electrolyte level. Check level of electrolyte in cells daily and, if necessary, replenish with pure distilled water. If this is not available, rain or drinking water may be used. Use of water with high mineral content will eventually cause damage to batteries and should be avoided.

2. Maintenance. Refer to TM 9-6140-200-15 for care and maintenance of chassis batteries.

NOTE

Check with organizational maintenence for maintenance of mount batteries.

b. Generator Set. The generator set is designed to operate in extreme high temperatures. Store and operate unit in a shaded location. Do not block free flow of air (refer to TM 5-6115-323-15).

c. XM61 Sight. Shield the XM61 sight from the direct rays of the sun as much as possible.

2-31. Operation in Dusty or Sandy Areas.

a. XM741 Chassis.

(1) *Driving.* Avoid spinning the tracks when driving in sand. Reduce speed and use a range low enough to move the vehicle steadily. Do not allow the engine to labor.

(2) *Maintenance.* Clean power plant and power plant compartment. Touch up all painted surfaces damaged by blowing sand. Lubricate completely to force out lubricants contaminated by sand or dust. Air cleaners and fuel and oil filters must be cleaned at least daily. Radiator fins should be cleaned with compressed air daily when operating in dusty terrain. Power plant grilles and other exposed vents should be covered with cloth at all times when not in operation.

b. Generator Set. Keep area around unit free of dust or sand. If possible, wet area down. Provide wind shields to prevent windborne dust or sand from entering unit. Refer to TM 5-6115-323-15.

c. Fire Control. Keep optical surfaces protected from etching by sand.

d. Armament. Avoid excessive lubrication. Remove all but a thin film of oil from the breech, breech bolts and breech bolt tracks. Use muzzle cover whenever possible to prevent dust from collecting in gun barrels.

2-32. Operation Under Rainy or Humid Conditions.

a. XM741 Chassis.

(1) *Driving in mud.* Select transmission low range to move vehicle steadily without digging in. If the chassis becomes mired, attempt to back out; if unsuccessful, arrange to be towed.

(2) *Maintenance.* In hot, damp climates, corrosive action will occur on all parts of the materiel and will be accelerated during the rainy season. Evidence will appear in the form of rust, corrosion and paint blisters on metal surfaces, and mildew, mold or fungus growth on woods, fabrics, leather, and glass. Protect all exposed unfinished metal surfaces with a film of general purpose oil (PL medium). Cables and terminals should be kept clean and dry. Make frequent inspection of idle, inactive vehicles. Remove corrosion from metal surfaces with abrasive paper or cloth, and apply a protective coating of paint, oil, or suitable rust preventive.

(3) *Mud.* Thorough cleaning and lubrication of all parts affected must be accomplished as soon as possible after operation in mud. Clean all suspension components and lubricate as specified in lubrication order LO 9-2350-300-10.

b. Generator Set.

(1) *General.* When the generator set is operated outdoors, erect a shelter, if possible, to protect the unit. If erection of a shelter is not possible, keep the generator set, when inoperative, covered with canvas or other waterproof material. Remove the cover during dry periods to allow the unit to dry out. Keep the fuel tanks full to prevent the forming of condensation.

(2) *Painting.* Paint all exposed nonpolished surfaces. Refer to TM 9-213. Coat all exposed polished surfaces with standard-issue rust-proofing material, if available, or cover parts with a light coat of general purpose oil (PL-M).

c. Armament. Thoroughly lubricate all unpainted exposed metal surfaces. Coat cannon barrel cluster, muzzle clamp, and declutching feeder assembly with a thin coat of general purpose oil (PL medium). Coat conveyor elements with a thin coat of LSA-T.

2-33. Operation in Salt Water Areas.

a. Materiel should be inspected frequently when being operated in salt water areas.

b. When the materiel is in active use, clean and relubricate the XM163 system more frequently than is prescribed for normal service.

c. Moist and salty atmospheres have a tendency to emulsify oils and greases and destroy their rust-preventive qualities. Inspect parts frequently for corrosion. Keep covers in place as much as conditions permit.

d. Canvas covers, leather straps, or other items which are subject to deterioration from mildew, or attack by insects or vermin, must be shaken out and aired for several hours as often as possible. Mildewed canvas or leather is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it must not be used until mildew has been removed. If mildew is present, examine material carefully by stretching and pulling for evidence of rotting or weakening. If fabric of canvas shows weakness, it is probably not worth retreatment. If not damaged, retreat canvas as outlined in TM 9-247. Do not fold wet canvas.

NOTE

At no time is mineral spirits paint thinner to be used to remove oil or grease spots from canvas. Only water and a scrubbing brush with issue soap may be used to remove oil or grease.

e. When the materiel is not in active use, the unpainted parts should be covered with a film of artillery and automotive grease (GAA). All covers should be in place.

2-34. Operation During Partial Failure.

a. General. The primary function of manual mode is to provide a backup mode of operation in case the radar should fail. When operating in manual mode, the range and target speed are manually set into the system by the gunner. The radar antenna normally will still continue to

supply proper lead angle correction signals to the SCG. A radar partial failure which does not affect the antenna positioning circuits will not affect operation in manual mode. An inoperative radar antenna, if not physically damaged, will generally be noticed during sight traverse and elevation lead angle daily system checks. An inoperative antenna will not be noticed in test mode unless the antenna is considerably off center.

b. Disconnecting Radar Antenna.

(1) If the radar antenna is at the zero degree azimuth and zero degree elevation position and does not move with the cannon, it is not necessary to remove W7P2 from the stow control.

(2) If the radar antenna is offset from the zero degree azimuth or zero degree elevation position and does not move with the cannon, remove W7P2 from the stow control and leave it open ended.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. BASIC ISSUE ITEMS

3-1. General

Tools, equipment and repair parts are issued to the operator / crew for operation and maintenance of the M163 system. Tools and equipment shall not be used for purposes other than prescribed and should be properly stored when not in use (storage locations are given in appendix B).

3-2. Tools and Equipment

Tools and equipment issued for use with the materiel are listed and illustrated in appendix B, which is the authority for requisitioning replacements.

3-3. Repair Parts

Repair parts are issued for replacement of those parts that become unserviceable. Providing replacement parts is within the scope of operator and crew maintenance functions. Operator / crew repair parts supplied for the M163 system are listed in appendix B, which is the authority for requisitioning replacements.

Section II. LUBRICATION INSTRUCTIONS

3-4. Lubricant Chart.

The lubricant chart (table 3-1) prescribes cleaning and lubrication materials for this system. Lubrication to be performed by operator / crew personnel is listed in lubrication order LO 9-2350-300-10. This order is issued with each vehicle and is to be carried with it at all times. In the event the vehicle is received without a copy, the using organization shall requisition one immediately.

Table 3-1. Lubricant Chart

Lubricant	Mil desig.	FSN	(Pkg data)
Grease, automotive and artilley	GAA	9150-190-0905	(5 lb can)
Grease, graphite	XP190	9150-921-7084	(5 lb can)
Grease, instrument aircraft	G1A	9150-985-7245	(8 oz tube)
Hydraulic fluid, petroleum base	OHA	9150-935-9807	(1 qt can)
		9150-935-9808	(1 gal can)
		9150-935-9809	(5 gal pail)
		9150-935-9810	(55 gal drum)
Lubricant, solid film	SFD	9150-142-9309	(12 oz can)
		9150-834-5608	(1 pt can)
		9150-142-9361	(1 gal can)
Lubricant, weapons, semifluid (high load-carrying capacity)	LSA-T	9150-949-0323	(8 oz tube)
Lubricating oil, chain	CW-IIA	9150-234-5197	(5 lb can)
		9150-261-7891	(35 lb pail)
		9150-530-7293	(120 lb drum)
	CW-IIB	9150-234-5199	(5 lb can)
		9150-246-3276	(35 lb pail)
		9150-530-7371	(120 lb drum)
Lubricating oil, gear, sub-zero	GOS	9150-261-7904	(1 qt can)
		9150-257-5440	(5 gal pail)
		9150-257-5443	(55 gal drum)
Lubricating oil, general purpose, preservative	PLS	9150-231-6689	(1 qt can)
Lubricating oil, internal combustion engine	OE / HDO-10	9150-111-3199	(5 gal pail)
		9150-111-3200	(55 gal drum)
	OE / HDO-30	9150-111-0209	(5 gal pail)
		9150-111-0210	(55 gal drum)
Lubricating oil, internal combustion engine, subzero	OES	9150-242-7603	(5 gal drum)
		9150-242-7604	(55 gal drum)

Table 3-1. Lubricant Chart—Continued

Lubricant	Mil desig.	FSN	(Pkg data)
Lubricating oil, preservative, medium	PL-M	9150-231-2361	(1 qt can)
Lubricating oil, semifluid (automatic weapons)	LSA	9150-889-3522	(4 oz bottle)
Solvent, dry cleaning	SD-2	6850-597-9765	(1 gal)
		6850-582-1647	(5 gal)

Section II. PREVENTIVE MAINTENANCE INSTRUCTIONS

3-5. General.

Preventive maintenance is the systematic care, inspection and servicing of equipment to maintain it in serviceable condition, prevent stoppages and assure maximum operation readiness. The operator's duties in the performance of preventive maintenance are:

a. Perform daily maintenance each day the system is used (table 3-2).

b. Perform weekly maintenance when the system has not been used for one week (table 3-2).

c. Assist organizational maintenance in the performance of any maintenance.

d. Maintain an up-to-date record of the number of rounds cycled through the system, rounds fired, and the armament components whose replacement and maintenance are dependent on quantity of rounds cycled or fired. These components are listed in table 3-3.

e. Perform the maintenance listed in table 3-3 at the specified intervals and notify organizational maintenance when any component of the system requires organizational maintenance.

f. Insure that before-operation preventive maintenance in table 3-2 is performed prior to performing armament system daily checks in table 3-5 (see para 3-9).

3-6. Intervals of Maintenance Services.

a. Daily Service. Each system will be inspected each day that it is operated and never at an interval greater than weekly. This service is divided into three parts, as indicated in (1) through (3) below.

(1) *Before-operation service.* This is a brief service to ascertain that the system is ready for operation; it is mainly a check to see if conditions affecting the system's readiness have changed since the last after-operation service.

(2) *During-operation service.* This service consists of detecting unsatisfactory performance. While operating the system, be alert for any unusual noises, odors, abnormal instrument readings or any other indications of malfunction of any part of the system.

(3) *After-operation service.* This is the basic daily service which consists of correcting, insofar as possible, any operating deficiencies. Thus, the system is prepared to operate at a moment's notice.

b. Weekly Service. The weekly service is similar to the daily service except as noted in tables 3–2 and 3–3 and is performed only if seven days have elapsed since the last daily service was performed.

c. Checks Performed on a Rounds Interval Basis. Table 3–3 lists the checks to be performed based on the number of rounds cycled/fired through the system.

3-7. General Procedures.

a. The following general procedures apply to operator and crew preventive maintenance services and to all inspections and are just as important as the specific procedures.

b. Inspection to see if items are in good condition, correctly assembled or stored, secure, not excessively worn, not leaking, and adequately lubricated applies to most items in the preventive maintenance and inspection procedures. Any or all of these checks that are pertinent to any item (including supporting, attaching or connecting members) will be performed automatically as general procedures in addition to any specific procedures given.

(1) Inspection for good condition is usually a visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. Good condition means that a component or part is not bent or twisted, chafed or burred, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, or not deteriorated.

(2) Inspection of an item to see that it is correctly assembled or stowed is usually a visual inspection to see if the item is in its normal position in the vehicle and if all its parts are present and in their correct relative position.

(3) Inspection of an item to determine if it is secure is usually a visual examination or a check by hand, wrench, or prybar for looseness. Such an inspection must include any brackets, lockwashers, locknuts, locking wires, or cotter pins as well as any connecting tubes, hoses, or wires.

(4) Excessively worn means worn beyond serviceable limits or to a point likely to result in failure if the item is not replaced before the next scheduled inspection. Excessive wear of mating parts or linkage connections is usually evidenced by too much play (lash or lost motion). It includes illegibility as applied to markings, data, caution plates, and printed matter.

(5) Where the instruction "tighten" appears in the procedure, it means tighten with a wrench, even if the item appears to be secure.

c. Any special cleaning instructions required for specific components or parts are contained in the pertinent section. General cleaning instructions are as follows:

WARNING

Dry cleaning solvent or mineral spirits paint thinner is flammable and should not be used near an open flame. Fire extinguishers should be provided nearby when these materials are used. Use only in well-ventilated places.

(1) Use dry cleaning solvent or mineral spirits paint thinner to clean all metal parts.

CAUTION

Do not clean interior of hull with steam, water or air under pressure. Such cleaning will cause the XM157 mount to become inoperative because of entrance of moisture. The mount equipment is sealed to withstand dust, dampness and variations of atmospheric conditions; however, the equipment is not protected to resist steam, air or water under high pressure.

CAUTION

Water entering the exhaust system when the vehicle is being washed can harm the engine. To prevent this, operate engine or tape exhaust outlets before washing. Also tape personnel heater exhaust outlets to prevent water entering heat exhaust system.

NOTE

The use of diesel fuel oil, gasoline, or benzine (benzol) is prohibited for cleaning purposes.

(2) A solution of one part grease-cleaning compound to four parts of dry cleaning solvent or mineral spirits paint thinner may be used for dissolving grease and oil from engine castings, components and engine compartment. After cleaning, use cold water to rinse off any solution remaining on the item being cleaned.

(3) After parts are cleaned, rinse and dry them thoroughly. Apply light grade of oil to all unprotected metal surfaces (other than optical instruments) to prevent rusting.

(4) When authorized to install new parts, remove any preservative materials such as rust-preventive compound, grease, etc., and prepare parts as required; for those parts requiring lubrication, apply lubricant prescribed in Lubrication Order LO 9-2350-300-10.

d. General precautions in cleaning are as follows:

(1) Dry cleaning solvents and mineral spirits paint thinners evaporate quickly and have a drying effect on the skin. If these cleaners are used frequently without gloves, cracks in the skin and a mild irritation or inflammation of the skin may result.

(2) Avoid getting petroleum products, such as dry cleaning solvent and mineral spirits paint thinner, or engine fuels and lubricants, on rubber parts because they will deteriorate rubber that is not resistant to petroleum.

e. To prevent formation of mildew, shake out and air the canvas covers for several hours at frequent intervals. Have any loose grommets or rips in the canvas repaired without delay. Failure to make immediate repairs may allow a minor defect to develop into major damage. Mildewed canvas is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it must not be used until all mildew has been removed. If mildew is present, examine fabric carefully for evidence of rotting or weakening of fabric. If fabric shows indication of loss of tensile strength, it is probably not worth retreatment. If not damaged, notify organization maintenance so steps can be taken to have the canvas retreated. Oil and grease can be removed by scrubbing with soap and warm water. Rinse well with clear water and dry.

f. Steel name plates, caution plates and instruction plates may rust very rapidly. When they are found to be in a rusty condition, they should be thoroughly cleaned and coated with preservative oil.

g. When the materiel is not in use, the proper covers must be used.

h. Use only tools that are provided and see that they fit properly. Tools that do not fit may slip and cause damage to parts.

i. No alteration or modification will be made by the crew, except as officially authorized.

3-8. Specific Procedures.

Specific preventive maintenance to be performed on the system is listed in tables 3–2 and 3–3. When performing these services, the operator must enter the item number and the malfunction, which is beyond his scope to repair, in accordance with requirements of TM38-750.

3-9. Daily System Checks.

a. Daily system checks are performed to make certain that the armament is operating correctly. If a normal indication is not obtained when performing the daily system checks as listed, make certain that the correct procedure is being used before using the fault isolation procedures.

b. Operator personnel must be able to recognize less-than-optimum performance during normal operation and the performance of operator checks. When the fault isolation procedure is beyond operator capability or no procedure is listed, the operator will notify organizational maintenance. Necessary adjustments, including those listed in the fault isolation table, are a normal part of the daily system checks and do not necessarily indicate equipment malfunctions.

c. Table 3–4 lists the position of controls before daily system checks. Controls not listed in table 3–4 may be left in any position.

d. The before-operation preventive maintenance on armament in table 3–2 must be completed before the daily system checks in table 3–5 are performed. To maintain the mount batteries at a maximum charge, either the vehicle engine or the generator set (par. 2–27g) must be operated during checks. If vehicle engine is used, before-operation preventive maintenance on chassis XM741 in table 3–2 must be completed.

e. The daily system checks in table 3–5 will be performed each day before the system is operated or weekly when the system has not been operated. Selected portions of these checks may be performed more frequently at the discretion of the operator when he desires to make certain a particular function is operating correctly.

Table 3-2. Preventive Maintenance

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily						
B	D	A	W	Item to be inspected	Procedure	Reference
					M163 SYSTEM	
1.0				System log book	Check log book prior to operation of equipment to determine status of the system.	
					CHASSIS M741	
1		32		Suspension system	Inspect tracks, road wheels, idler wheels, track shrouds, sprockets, and shock absorbers for damage. Check for broken torsion bars. If torsion bars are broken, chassis will list or sag to one side. Check road wheel and idler wheel hub oil levels. Oil should be visible halfway up sight indicator. Bubbles in oil indicate water contamination. Visually inspect under hull for evidence of leaks. Check that access covers and drain plugs are secure.	Fig 3-1
		32.1		Track shoes	Check track shoe bushings and grousers for excessive wear.	Para 3-13 *b*
1.1		33		Track tension	Check track tension of both tracks.	Para 3-13 *c*
		34		Hull	Check towing pintle and latch for proper operation or damage. Operate trim vane and check for debris damage. Check flotation pods for deformation damage. Check the flotation pods for structural damage in or near the pod mounting flange area. If damage is present, notify organizational maintenance.	
2		35		External fire extinguisher handle	Check that lead wire seal is not broken.	Fig 2-2
3		36		Power plant compartment	Check for fuel, lubricant and coolant leaks. Check that engine, transmission, differential, hydraulic tank, transfer gear case, fan gearbox, hydraulic tank and final drives have sufficient oil or fluid for operation. (Servicing procedures are on driver's access power plant panel.) Check that engine disconnect control handle is in the engaged position (fig 2-18).	
4		37		Coolant level	Check that coolant level is not lower than approximately 3 inches below the top of the filler tube.	Fig 2-19
4.1		38		Driver's compartment	Check instrument panels for cracks, broken or missing meters, indicator glass faces, lamp covers or other damage. Check installed and stowed periscopes for cleanliness, general condition and completeness.	
5		39		Fire extinguishers	Inspect interior fire extinguishers (fixed, fig 2-2; portable, fig 1-5) for broken seals and serviceable condition. Check inspection tags for current inspection date.	

Table 3-2. Preventive Maintenance—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily			W	Item to be inspected	Procedure	Reference
B	D	A				
6		40		Fuel system	Check fuel filler screen for cleanliness. Fill fuel compartment, allowing approximately 3 inches in neck for expansion. Check fuel gage for proper indication. (MASTER SWITCH must be ON.)	
7	31			Steering, braking, accelerator, and shifting controls	Start engine in accordance with para 2-4, 2-5, or 2-6. Then check steering and braking action, shifting and accelerator controls for binding, grabbing, or excessive play in linkage. Continuously check instrument and warning lights while engine is running.	
8		41		Suspension lockout system	With engine running at 1500 RPM, place the suspension lockout control to EXTEND SUSP LOCKED OUT light on warning lights panel lights when cylinders are extended. Visually inspect to see that all cylinders are extended to lockout the road wheels. Check for leaks. Place the suspension lockout control to RETRACT. Observe that SUSP LOCKED OUT light extinguishes. Visually check that all cylinders fully retract.	6, fig 2-1 and fig 2-5
8.1		42		Bilge pumps	Set BILGE PUMPS switch on instrument panel to ON. If bilge is dry, air should be felt at the outlets.	15, fig 2-3, para 3-13*f*
8.2		43		Lights	Check operation of vehicle lights. Check for broken or discolored lenses. To check infrared lights, turn on and place hand on lens; heat will be felt if light is operating.	Fig 2-4
9		44		Oil levels **NOTE** Bring transmission and differential to normal operating temperature (160° to 180° F) before checking oil levels.	**TRANSMISSION** Check transmission oil level with engine operating at 1500 RPM, transmission shift lever in N. Check that level is within the operating range (between the ADD and FULL lines).	LO 9-2350-300-10
					DIFFERENTIAL With engine idling, check that oil level is within the operating range (between the ADD and FULL lines).	LO 9-2350-300-10
					FINAL DRIVES Check that oil level is within the operating range (between the ADD and FULL lines). Stop engine (para 2-13).	LO 9-2350-300-10
					FAN GEAR BOX Check that oil level is within the operating range (between the ADD and FULL lines).	LO 9-2350-300-10

Table 3-2. Preventive Maintenance—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily			W	Item to be inspected	Procedure	Reference
B	D	A				
					TRANSFER GEAR CASE	
					Check that oil level is within operating range (between the ADD and FULL lines).	LO 9-2350-300-10
					ENGINE	
					Check that oil level is within operating range (between the L and F dots).	LO 9-2350-300-10
		45		Cleaning	Clean exterior, removing dirt, mud, and excess grease. Wipe oil or grease drippings from power plant and personnel compartments. Remove hull drain plugs (fig 2-45) to drain water from hull. Reinstall drain plugs.	Para 3-13*h*
		46		Air cleaner	Clean and inspect air cleaner element.	Para 3-13*e* Para 3-13*g*
		47		Batteries	Inspect and service chassis batteries.	
		48		Deleted.		
					ARMAMENT	
		49		Muzzle and turret covers	Check that covers are free of tears, farying and dirt and grease.	
10		50		M157 mount	Check that nothing will interfere with movement of mount and cannon. Clean and inspect the mount components.	Para 3-16
10.1		51		Hatch safety switches	Check that nothing obstructs movement of switch plungers and that switches are securely mounted.	Fig 1-6
11		52		Feed and return chutes	Check that feed and return chutes are secured to declutching feeder and that chuting is not damaged.	Fig 1-14
12		53		Recoil adapters	Check that the two quick-release pins holding the recoil adapters to the mount are in place and that the four bolts attaching each recoil adapter to the cannon are installed. Check that the two lengths of safety wire securing knurled nuts are not broken.	Fig 1-13
13		53.1		Muzzle clamp and centering clamp	Check that muzzle clamp is in proper position on barrels, and triangular locking plate is in barrel grooves. Check that centering clamp is in proper position on barrels and is locked with cotter pin installed.	
14		54		Gun drive motor and elevation drive motor	Check that the connector is properly installed and safety wire is intact. Check that both gun drive motor brake levers and the elevation drive motor brake lever are in on position.	Fig 1-17
15		55		Declutching feeder solenoid	Check that connector is installed.	Fig 2-32
16		56		Gun shield assembly	Check that the notch in each rear support engages the pins on the mount and the two quick-release pins are in place.	Fig 2-66
17		57		Conveyor unit assembly	Check that conveyor unit assembly is in fire position, down and locked.	Fig 2-57

Table 3-2. Preventive Maintenance—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily						
B	D	A	W	Item to be inspected	Procedure	Reference
18		58		Shift pin handle	Check that shift pin handle is set to F (fire) position.	Fig 1-14
19				Ammunition	Check for sufficient ammunition.	Fig 1-20
20		59		Azimuth drive motor	Check that both azimuth drive motor brake release levers are in on position.	Fig 1-20
21		60		Feed and return chutes below deck	Rotate mount to load position. Check that feed and return chutes are secured to conveyor unit assembly. Check that nothing protrudes into feed or return chutes to obstruct the free flow of ammunition and conveyor elements.	Fig 1-13, 1-14
			74	Conveyor elements	Check for corrosion, cracking, or chipping of elements.	LO 9-2350-300-10
22				Feed system slack point	Check that feed system slack point is positioned properly and each visible conveyor element contains a round.	Fig 2-59
23		61		Electrical cables and connectors	Check that all cable connectors are connected and secure. Check the cables for kinks and cut or abraded insulation.	
24				Cannon, declutching feeder, and feed system	*a.* Remove arming connector from distribution box.	Fig 1-12
					b. Set BRAKE-CLEAR AND BRAKE switch to BRAKE; rotate cannon by hand and cycle 6 to 12 dummy rounds through cannon.	Fig 2-27
					c. Set BRAKE-CLEAR AND BRAKE switch to the CLEAR AND BRAKE position and rotate cannon by hand until cannon is clear.	Fig 2-27
					d. Set BRAKE-CLEAR AND BRAKE switch to the BRAKE position and rotate cannon by hand until feeder is engaged.	Fig 2-27
					e. Remove cleared dummy rounds from case chute.	
					f. Install arming connector on distribution box (J6).	Fig 1-12
25		62		M61 sight	Clean and inspect.	Para 3-14
26		63		M134 telescope	Clean and inspect.	Para 4-9
27		64		AN / TVS-2B sight	Clean and inspect.	Para 4-8
28		65		Control panel illuminating and azimuth indicator lights	Check for operation.	
		66		Deleted.		
		67		M168 cannon	Clean and inspect.	Para 3-15
29		68		Radar interconnecting cables	Check all external flexible cables for signs of excessive wear, damage, kinks or mutilation. Check interconnecting waveguide for cracks and proper fastening at flanges. Check that rf power indicator lamp is clean.	Fig 1-11 1-21

Table 3-2. Preventive Maintenance—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily						
B	D	A	W	Item to be inspected	Procedure	Reference
		69		Antenna	Check reflector and feed assembly. Check reflector for bends or holes. Check feed for cracks or loose hardware. Check boresight clamps for loose hardware. Check waveguide for cracks and proper fastening at flanges. Check that covers are secure on elevation and traverse servo drive assemblies. Check that gun elevation input coupling is not loose. Check stops and bumpers for damage or looseness.	Para 3-17*b* Fig 1-21
			75	Transmitter-receiver	Check inside of unit for broken leads and components. Check that tuning tool is snug-tight in bracket. Check that spare crystal oscillator subassemblies are secured properly. Check that ventilators are unobstructed and permit free passage of air. **CAUTION** **Any obstruction to free air flow through unit may cause component failure.**	
		70		Transmitter-receiver	Check that all thumbscrews are snug-tight when front panel is closed. Check exterior for damage (broken parts).	Fig 1-22
			76	Transmitter-receiver air filter	Clean air filter. **NOTE** **Air filter should be cleaned daily when in dusty or sandy areas.**	Para 3-17*d*
		71		Receiver and range computer	Check exterior for damage. Check that thumbscrews are snug-tight.	Figs 1-23 and 1-24
		72		Power supply	Check exterior for damage. Check that air intake and exhaust ports are unobstructed and permit free passage of air. Check that thumbscrews are snug-tight. **CAUTION** **Any obstruction to free air flow through unit may cause component failure.**	Fig 1-25
			77	Power supply air filter	Clean air filter. **NOTE** **Air filter should be cleaned daily when in dusty or sandy areas.**	Para 3-17*d*
		73		Stow control	Check exterior for damage. Check for deterioration of switch boots.	Fig 1-16

Table 3-2. Preventive Maintenance—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily			W	Item to be inspected	Procedure	Reference
B	D	A				
30				Boresight	**NOTE** In those instances in which a weapon system has not been relocated and the radar set and the M61 sight are not being readied for operation, boresighting should be accomplished on a monthly basis.	
					Boresight M168 cannon, M61 sight, M134 telescope, AN / TVS-2B sight and radar antenna.	Para 2-18
					M163 SYSTEM	
		78		System log book	Record required entries as prescribed by TM 38-750.	

Table 3-3. Preventive Maintenance—Round Interval

Sequence no.	Item to be inspected	System rounds cycled / fired x 1000 specified in system log book					Procedure or reference
		12 60 84 132	24 48 96 120	36 108	72	144	
*1	Muzzle clamp bolt	X	X	X	X	—	Torque muzzle clamp bolt to 650 in-lb
2	Declutching feeder	X	X	X	X	—	Notify organizational maintenance to replace feeder.
3	Gun drive motor brake	—	X	—	X	—	Torque the muzzle bolt to 650 in-lb; the barrel cluster should not rotate. If barrel cluster rotates, notify organizational maintenance.
4	Bolt assembly components	—	—	X	—	—	Notify organizational maintenance to replace bolt assembly components.
5	Linkless feed drum assembly	—	—	X	X	—	Notify organizational maintenance.
*6	Barrel cluster	—	—	—	X	—	Notify organizational maintenance to replace barrels.
*7	Recoil adapters	—	—	—	X	—	Notify organizational maintenance to replace recoil adapters.
8	Bolt assemblies	—	—	—	X	—	Notify organizational maintenance to replace bolt assemblies.
9	Conveyor elements	—	—	—	X	—	Notify organizational maintenance to replace elements.
10	Feeder lock pins	—	—	—	X	—	Notify organizational maintenance to replace feeder lock pins.
11	Guide bar	—	—	—	X	—	Notify organizational maintenance to replace guide bar pin.
12	Cannon unlocking cams	—	—	—	X	—	Notify organizational maintenance for replacement of cams.
13	Cannon M168	—	—	—	—	X	Notify organizational maintenance to replace Cannon M168.

*Schedule based on rounds fired only.

Table 3-4. Positions of Controls Before Armament System Daily Checks

Reference	Item	Position
Figs 2-9, 2-13	Driver's and commander's hatches	Closed and latched
Fig 1-12	Arming connector	Removed
Fig 2-35	M61 sight caged knob	CAGED
8, Fig 2-24	SYSTEM POWER switch	OFF
9, Fig 2-24	GUN POWER switch	OFF
5, Fig 2-24	RANGE IN METERS knob	500
10, Fig 2-24	TARGET SPEED IN KNOTS knob	300
16, Fig 2-24	MODE switch	MAN
4,. Fig 2-24	GUN CLEAR switch	AUTO
Fig 1-26	Stow control MODE switch	NORM
Fig 1-26	Stow control MAINT switch	OFF
Fig 2-28	NORM-STATIC-TEST switch	NORM (up)
Fig 2-28	Distribution box circuit breakers (4)	Reset (pressed in)
	Cannon	Over front of chassis
Fig 1-17	Azimuth and elevation drive motor brakes	Applied
Para 2-4, 2-5, 2-6, or 2-27*g*	Chassis engine or APU	Running

Table 3-5. Armament System Daily Checks

Step	Procedure	Normal indication	Reference for abnormal indication
	SYSTEM POWER CHECK		
1.	*a.* Set control panel SYSTEM POWER switch to ON.	*a*-1. SYSTEM POWER indicator lights.	*a*-1. Step 63, table 3-6.
		a-2. M61 sight reticle lights after approximately 10 seconds.	*a*-2. Perform step 1*b* following.
	b. Rotate SIGHT LAMP knob both ways from OFF.	*b.* Reticle intensity increases in both directions.	*b.* Step 90, table 3-6.
	HATCH PROTECTIVE CIRCUITS CHECK		
2.	**WARNING** **Alert all personnel in and around the vehicle before traversing in the following procedures.**		
	a. Position cannon to 0 degrees elevation and slowly slew the mount one revolution (360°) in both directions.	*a.* Mount completes revolution smoothly in each direction, and cannon moves freely over driver's and commander's hatches.	*a.* N / A
	b. Open and latch driver's and commander's hatches and (with cannon at 0 degrees elevation) attempt to traverse over open hatches.	*b.* With hatches open, the mount will stop (from either direction) before the cannon reaches a hatch.	*b.* N / A
	c. Elevate the cannon as required to allow traversing over open hatches.	*c.* Cannon should not move over open hatch from either direction unless elevated above the horizontal approximately 20 degrees.	*c.* Notify organizational maintenance.
	d. Elevate cannon approximately 60 degrees over open hatches, in turn, hold action switch pressed, and rapidly depress cannon.	*d.* Cannon should not depress below the 20 degrees above horizontal level established in *c* preceding.	*d.* Notify organizational maintenance.
	e. Close and latch both hatches.	*e.* None.	*e.* N / A

Table 3-5. Armament System Daily Checks—Continued

Step	Procedure	Normal indication	Reference for abnormal indication
	ELEVATION DRIVE MOTOR CUT-OUT CHECK		
3.	*a.* Press the action switch and slowly rotate the grip assembly to drive the cannon to maximum elevation.	*a.* Cannon drives up in elevation smoothly and stops before the mechanical stop is reached; drive motor stops running.	*a.* Notify organizational maintenance.
	b. With the action switch pressed, slowly rotate the grip assembly to the down position to drive the cannon to minimum elevation.	*b.* Cannon drives down in elevation smoothly and stops before the mechanical stop is reached; drive motor stops running.	*b.* Notify organizational maintenance.
	SIGHT TRAVERSE LEAD ANGLE CHECK		
4.	*a.* Uncage the M61 sight.	*a.* None	*a.* N/A
	b. Verify that cannon is approximately horizontal.	*b.* None	*b.* N/A
	c. Traverse to the right and adjust the traverse rate until the left 200 mil dot (lead angle mark) stabilizes at the white indicator arrow (lead angle index). When a stable rotation rate is reached, time one complete rotation of the mount.	*c.* Time for one revolution is between 16 and 20 seconds.	*c.* Notify organizational maintenance.
	d. Continue to traverse and press the sight caged switch on left grip assembly.	*d.* Sight reticle moves toward the center.	*d.* Notify organizational maintenance.
	SIGHT SUPERELEVATION CHECK FOR MANUAL AND EXTERNAL MODE		
5.	*a.* Connect external range control to its receptacle on right rear of M741 chassis.	*a.* None	*a.* N/A
	b. Set TARGET SPEED knob to 0.	*b.* None	*b.* N/A
	c. Position cannon so that the bottom of the inner circle of the M61 sight reticle is on a fixed target (distant aiming point) about zero degrees elevation (0° mark on the linkage arm).	*c.* None	*c.* N/A
	d. Set the NORM-STATIC-TEST switch to STATIC (center position).	*d.* None	*d.* N/A
	e. Set the RANGE knob to 1700 and press the action switch.	*e.* The top of the M61 sight inner circle repositions on the target.	*e.* Notify organizational maintenance.
	f. Release the action switch. Set MODE switch to EXT and press that action switch.	*f.* The READY WHEN LIT indicator goes out; the top of the M61 sight inner circle is on the target.	*f.* Notify organizational maintenance.
	g. Release the action switch and set MODE switch to MAN.	*g.* READY WHEN LIT indicator lights.	*g.* Notify organizational maintenance.
	h. Set RANGE knob midway between 2000 and 2500; set TARGET SPEED knob to 600 and press the action switch.	*h.* The top of the M61 sight inner circle remains on the target.	*h.* Notify organizational maintenance.
	i. Release the action switch and set MODE switch to EXT.	*i.* READY WHEN LIT indicator goes out.	*i.* Notify organizational maintenance.
	j. Set the METERS X100 knob on external range control to 20.	*j.* The top of the M61 sight inner circle remains on the target.	*j.* Notify organizational maintenance.
	k. Press and hold the grip assembly action switch and the pushbutton on the external range control.	*k.* Ready-to-fire indicator lights.	*k.* Notify organizational maintenance.
	l. Release action switch and the pushbutton on external range control.	*l.* Ready-to-fire indicator goes out.	*l.* Notify organizational maintenance.

Table 3-5. Armament System Daily Checks—Continued

Step	Procedure	Normal indication	Reference for abnormal indication
	m. Set MODE switch to MAN, set the RANGE knob fully counterclockwise, and set the TARGET SPEED knob to 0.	*m.* None	*m.* N / A
	n. Set NORM-STATIC-TEST switch to NORM and position cannon so that the bottom of the inner circle of the M61 sight reticle is on the target.	*n.* None	*n.* N / A
	o. Manually cage the sight.	*o.* The target is approximately in the center of the inner circle.	*o.* Notify organizational maintenance.
	p. Disconnect and stow the external range control.	*p.* None	*p.* N / A
	SIGHT CURRENT GENERATOR CHECK		
6.	*a.* Record the setting of the MUZZLE VELOCITY switch on the sight current generator, then set dial to position 5.	*a.* None	*a.* N / A
	b. Record the setting of the AIR DENSITY switch, then set dial to 0.85 for M220 ballistics or 1.0 for M246 ballistics.	*b.* None	*b.* N / A
	c. Set MODE switch to TEST.	*c.* None	*c.* N / A
	d. Press and hold the action switch.	*d.* GOOD WHEN LIT indicator lights after approximately 2 seconds and stays on as long as pressure is applied to the right or left action switch. **NOTE** If step *d* fails to give the proper indication, change the AIR DENSITY switch setting to 1.0 or 0.85, whichever setting was *not* used to conduct the original check (see *b* preceding), and repeat the step.	*d.* Step 89, table 3-6.
	e. Release action switch.	*e.* None	*e.* N / A
	f. Set the MUZZLE VELOCITY and AIR DENSITY switches back to original settings recorded in steps 6*a* and 6*b* preceding.	*f.* None	*f.* N / A
	RADAR CHECK		
7.	*a.* Set control panel MODE switch to RADAR and wait two (2) minutes ±15 seconds (system warmup). **NOTE** Make sure all six (6) circuit breakers, on the radar power supply (Unit 5) are in their set (pressed in) position.	*a.* READY WHEN LIT indicator lights. Radar is now in standby.	*a.* Notify organizational maintenance.
	b. Verify the following radar control positions: (1) CLUTTER LOCKON switch on transmitter-receiver is set to NORMAL. (2) MODE switch on stow control is set to NORM. (3) MAINT switch on stow control is set to OFF.	*b.* Assure that transmitter-receiver HIGH-VOLTAGE POWER SUPPLY OVERLOAD indicator and MODULATOR OVERLOAD indicator are *not* lit	*b.* Step 84, table 3-6.

Table 3-5. Armament System Daily Checks—Continued

Step	Procedure	Normal indication	Reference for abnormal indication
	WARNING **A potential health hazard exists to personnel within 3 feet in front of the antenna dish while radar is radiating.**		
	CAUTION **Do not radiate antenna at targets within a range less than 250 meters, as damage to receiver (Unit 3) may result.**		
c.	Depress right or left action switch and reposition cannon in both elevation and azimuth.	*c.* Antenna repositions to align with the axis of the cannon.	*c.* Step 81, table 3-6.
d.	Hold action switch pressed and depress the foot switch.	*d.* Waveguide RF power indicator lights.	*d.* Step 83, table 3-6.
e.	Release foot switch and action switch.	*e.* None	*e.* N/A
f.	Set transmitter-receiver CLUTTER LOCKON switch to TEST. Connect headset connector to J4 connector on the transmitter-receiver.	*f.* None	*f.* N/A
g.	Aim at a fixed target 250 to 2000 meters away.	*g.* None	*g.* N/A
h.	Hold action switch pressed and depress the foot switch.	*h.* Ready-to-fire indicator lights, and at the same time a high-pitched doppler tone is heard in the headset.	*h.* Notify organizational maintenance.
	NOTE The following steps must be performed by two crewmen. **WARNING** **Make sure all personnel are clear of cannon travel above deck and of the mount travel below deck before performing steps *i* and *j* following.**		
i.	Press action switches separately and rotate the mount slowly left and right.	*i.* Mount rotates following grip assembly movement smoothly.	*i.* Notify organizational maintenance.
	WARNING **After push button is pressed in the following step *j*, remove hand quickly from components, as mount will slew rapidly in direction of travel.**		
j.	Press MID RANGE CALIBRATION push button on range computer (Unit 4) while mount is rotating.	*j.* (1) Mount speeds up in direction of travel. (2) M61 sight reticle and radar antenna move in direction opposite to mount movement and in elevation with the apparent target. (3) Ready-to-fire light on M61 sight lights. (4) MID RANGE CALIBRATION indicator lights brightly within five seconds, remains lit for a period of two seconds, then resumes blinking.	*j.* Notify organizational maintenance.

Table 3-5. Armament System Dail hecks—Continued

Step	Procedure	Normal indication	Refefence for abnormal indication
		GROUND MODE CHECK	
8.	*a.* Set the MODE switch to GRD.	*a.* M61 sight reticle remains lit.	*a.* Notify organizational maintenance.
	b. Verify that the NORM-STATIC-TEST switch is set to NORM.	*b.* None	*b.* N / A
	c. Traverse mount, and elevate and depress the cannon.	*c.* Mount traverses smoothly, and cannon elevates and depresses smoothly.	*c.* Step 67, 68, 69, 70 or 71, table 3-6.
	d. Set all controls as indicated in table 3-4.	*d.* None	*d.* N / A

Section IV. FAULT ISOLATION

3-10. General.

This section provides information useful to the operator / crew in diagnosing and correcting unsatisfactory operation or failure of the system.

3-11. Procedures.

Table 3-6 lists possible malfunctions, probable causes and corrective actions that can be performed by the operator / crew. Wherever applicable, probable causes are listed in their order of probability and should be checked in that order during fault isolation.

NOTE

Prior to taking corrective action on any electrical component, assure that the batteries are charged (3-13 *g* (2) *(c)*), all circuit breakers are reset (figs 1-25 and 2-28) and all cable connectors are tight.

Table 3-6. Fault Isolation

Malfunction	Probable cause	Corrective action
	ENGINE AND THROTTLE CONTROLS	
1. Engine fails to crank when starter switch is held on.	a. MASTER SWITCH not turned on.	a. Turn MASTER SWITCH on (fig. 2-6).
	b. Shift lever not in N.	b. Place shift lever in N (fig. 2-40).
	c. Chassis batteries dead.	c. Charge batteries using APU (par. 3-13g(2)(c).
	d. Other malfunction.	d. Notify organizational maintenance.
2. Engine cranks but fails to start.	a. Fuel flow control valve not turned on.	a. Turn on fuel flow control valve (fig. 2-10).
	b. No fuel in fuel compartment.	b. Fill fuel compartment (fig. 2-20).
	c. Fuel cutoff control pulled out.	c. Push in fuel cutoff control (9, fig. 2-1).
	d. Extremely cold engine.	d. Operate air box heater (par. 2-5).
	e. Restricted air cleaner.	e. Service air cleaner element (par. 3-13e).
	f. Engine disconnect engaged (cold weather).	f. Disengage engine disconnect (fig. 2-18).
	g. Improper or contaminated fuel.	g. Service engine primary fuel filter; refer to LO 9-2350-300-10. If fuel is contaminated or improper, notify organizational maintenance.
	h. Other malfunction.	h. Notify organizational maintenance.
3. Engine oil HI TEMP LO PRESS indicator lights.	a. Low engine oil level.	a. Add oil if necessary; refer to LO 9-2350-300-10, for correct oil level.
CAUTION Do not operate engine with indicator light on.	b. Engine idling below 550 to 600 rpm when warm.	b. Idle engine at 550 to 600 rpm.
	c. External oil leaks.	c. Check engine for evidence of oil leakage. If leaks cannot be stopped by tightening, notify organizational maintenance.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
	d. Other malfunction.	d. Notify organizational maintenance.
4. Engine overheats as indicated by TEMP F indicator.	a. Low coolant level.	a. Fill radiator with coolant (fig. 2-19).
	b. Radiator core clogged.	b. Notify organizational maintenance.
	c. Restricted air intake grille.	c. Clean air intake grille.
	d. Hull drain plugs or access plates not installed.	d. Install hull drain plugs or access plates (fig. 2-45).
	e. Engine disconnect disengaged.	e. Engage engine disconnect (fig. 2-18).
	f. Other malfunction.	f. Notify organizational maintenance.
5. Engine overcools as indicated by TEMP F indicator.	a. Intake and exhaust grille cover not installed (cold weather only).	a. Install intake and exhaust grille cover, and adjust flaps (fig. 2-87).
	b. Other malfunction.	b. Notify organizational maintenance.
6. Engine does not develop full power.	a. Engine oil level too high (hot weather only).	a. Refer to LO 9-2350-300-10 for correct oil level.
	b. Restricted air cleaner.	b. Service air cleaner element (par. 3-13e).
	c. Other malfunction.	c. Notify organizational maintenance.
7. Engine runs unevenly or stalls frequently.	a. Engine disconnect disengaged.	a. Engage engine disconnect (fig. 2-18).
	b. Internal engine malfunction or defective fuel system.	b. Notify organizational maintenance.
8. Engine oil consumption abnormal.	a. Leaking oil lines or connection.	a. Check engine for external oil leaks. If leaks cannot be stopped by tightening, notify organizational maintenance.
	b. Other malfunction.	b. Notify organizational maintenance.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
	FUEL AND AIR INTAKE SYSTEMS	
9. Fuel consumption abnormal.	Leaking fuel line, connections or fuel compartment.	Check fuel system for evidence of fuel leakage. If leaks cannot be stopped by tightening, notify organizational maintenance.
10. Engine cranks but fails to start when air box heater is operated and temperature is below 40°F.	a. Accumulator fuel pressure low.	a. Pump up accumulator fuel pressure (par. 2-5b).
	b. Leaking air box fuel lines or connections.	b. Check air box fuel system for evidence of fuel leakage. If leaks cannot be stopped by tightening, notify organizational maintenance.
	EXHAUST SYSTEM	
	WARNING Exhaust fumes are dangerous. Notify organizational maintenance immediately if fumes are indicated.	
11. Exhaust fumes in vehicle.	Leak at exhaust crossover pipes, exhaust manifold or muffler connection and proper plant access panels not properly installed.	Check engine exhaust system for leakage. Properly install power plant access panels. If leaks exist, notify organizational maintenance.
	ELECTRICAL SYSTEM	
12. MASTER SWITCH ON indicator fails to light when vehicle MASTER SWITCH is turned ON.	a. Defective chassis batteries, lamp or electrical circuit.	a. Notify organizational maintenance.
	b. Chassis batteries dead.	b. Charge batteries using APU (par. 3-13g(2)(c)4).
13. All instrument panel and vehicle electrical components inoperative with vehicle MASTER SWITCH ON.	Defective switch or electrical circuit.	Notify organizational maintenance.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
14. ENGINE OIL-HI TEMP LO PRESS indicator fails to light. **NOTE** With MASTER SWITCH ON, engine oil HI TEMP-LO PRESS indicator should light until engine starts.	Defective indicator lamp or electrical circuit.	Notify organizational maintenance.
15. BATTERY-GENERATOR indicator fails to operate with MASTER SWITCH ON.	Defective or dead chassis batteries or defective electrical circuit.	Notify organizational maintenance.
16. FUEL indicator fails to register when MASTER SWITCH is turned ON, although fuel compartment holds a known quantity of fuel.	Defective fuel quantity transmitter, indicator or electrical circuit.	Notify organizational maintenance.
17. No generator output as indicated by BATTERY-GENERATOR indicator.	a. Low engine fuel pressure.	a. Assure fuel flow control valve is fully open (fig. 2-10).
	b. Loose or defective generator drive belt, or defective generator, regulator, indicator or battery-generator electrical circuit.	b. Notify organizational maintenance.
18. Continuous high or low battery charging rate as indicated by BATTERY-GENERATOR indicator.	a. Low electrolyte level in chassis batteries.	a. Service batteries (par. 3-13g).
	b. Generator-regulator out of adjustment.	b. Notify organizational maintenance.
19. Chassis batteries discharged.	a. Excessive operation of electrical equipment without running engine.	a. Run engine or APU with vehicle MASTER SWITCH ON during extended operation of electrical equipment.
	b. Low electrolyte level.	b. Service batteries (par. 3-13g).

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
	c. Generator-regulator out of adjustment.	c. Notify organizational maintenance.
20. Chassis batteries overheating.	Generator-regulator out of adjustment.	Notify organizational maintenance.
21. Engine TEMP F indicator fails to register.	Defective coolant temperature transmitter, indicator or electrical circuit.	Notify organizational maintenance.
22. Horn fails to sound.	Defective horn, switch or electrical circuit.	Notify organizational maintenance.
23. Any external vehicle light, internal dome light or chassis instrument panel light fails to operate.	Defective light, selector switch or electrical circuit.	Notify organizational maintenance.
24. Auxiliary power-receptacle inoperative.	Defective receptacle or electrical circuit.	Notify organizational maintenance.
25. Utility outlet inoperative.	Defective receptacle or electrical circuit.	Notify organizational maintenance.
26. M19 periscope inoperative.	a. M19 periscope not properly installed.	a. Install per figs. 2-74 and 2-75.
	b. Defective M19 periscope, infrared-blackout switch, infrared power supply, main light selector switch or electrical circuit.	b. Notify organizational maintenance.
27. BILGE PUMPS ON indicator light(s) fail to operate with BILGE PUMPS switch ON.	Defective indicator or electrical circuit.	Notify organizational maintenance.
28. Trailer lights receptacle inoperative.	Defective receptacles or electrical circuit.	Notify organizational maintenance.
29. Radio or intercommunication systems inoperative.	Defective communications equipment or electrical circuit.	Notify organizational maintenance.
TRANSMISSION		
30. TRANS OIL HI TEMP indicator lights.	a. Incorrect transmission oil level.	a. Refer to LO 9-2350-300-10 for correct oil level.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
CAUTION Operation of chassis must not be continued with indicator light on.	b. Improper driving practice.	b. Observe driving precautions (par. 2-10).
	c. Defective temperature transmitter, indicator light bulb, transmission, coolant system or electrical circuit.	c. Notify organizational maintenance.
31. Engine operates properly but chassis fails to move with shift lever in any position.	a. Engine disconnect not engaged.	a. Engage engine disconnect (fig. 2-18).
	b. Transmission oil level low.	b. Add oil if necessary; refer to LO 9-2350-300-10 for correct oil level.
NOTE Notify organizational maintenance of any unusual noises, odors or malfunctions of the transmission.	c. Transmission shift linkage broken, defective control differential, or internal transmission malfunction.	c. Notify organizational maintenance.
32. Vehicle moves in neutral.	Internal transmission malfunction or controls out of adjustment.	Notify organizational maintenance.
33. Oil leaks at output shaft.	Leaking output shaft seal or gasket.	Notify organizational maintenance.
	TRANSFER GEARCASE	
34. No power transmitted through transfer gearcase although engine is running.	a. Engine disconnect not engaged.	a. Engage engine disconnect (fig. 2-18).
	b. Internal malfunction of gearcase.	b. Notify organizational maintenance.
35. Transfer gearcase overheating.	a. Low gearcase oil level.	a. Refer to LO 9-2350-300-10 for correct oil level.
	b. Internal gearcase malfunction.	b. Notify organizational maintenance.
36. Transfer gearcase excessively noisy.	a. Low gearcase oil level.	a. Refer to LO 9-2350-300-10 for correct oil level.
	b. Internal gearcase malfunction.	b. Notify organizational maintenance.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
CONTROL DIFFERENTIAL AND FINAL DRIVES		
37. DIF OIL HI TEMP indicator light comes on. **CAUTION** **Operation of vehicle must not be continued with indicator light on.**	*a.* Differential oil level low or restricted breather.	*a.* Refer to LO 9-2350-300-10 for correct oil level and service of breather.
	b. Brake bands out of adjustment.	*b.* Notify organizational maintenance.
	c. Defective transmitter, indicator light or oil coolant system.	*c.* Notify organizational maintenance.
	d. Internal differential malfunction.	*d.* Notify organizational maintenance.
38. Vehicle difficult to steer, steers abruptly, one or both brakes grab or brakes do not hold properly.	*a.* Brakes out of adjustment.	*a.* Notify organizational maintenance.
	b. Brake linkage out of adjustment.	*b.* Notify organizational maintenance.
	c. Internal differential malfunction.	*c.* Notify organizational maintenance.
39. Engine and transmission operate properly but vehicle fails to move with shift lever in any range.	*a.* Internal differential malfunction.	*a.* Notify organizational maintenance.
	b. Propeller shaft broken.	*b.* Notify organizational maintenance.
40. Oil leaking from final drive.	*a.* Defective oil seal(s) or final drive.	*a.* Notify organizational maintenance.
	b. Restricted breathers.	*b.* Notify organizational maintenance.
41. Water in final drive.	Defective output seal.	Notify organizational maintenance.
42. Power train noisy during operation.	*a.* Lack of lubricant.	*a.* Refer to LO 9-2350-300-10 for lubrication of drive shafts.
	b. Worn or loose universal joints.	*b.* Notify organizational maintenance.
	c. Worn or defective power plant or differential mounts.	*c.* Notify organizational maintenance.
TRACKS AND SUSPENSION		
43. Vehicle leans to one side. **NOTE** **Vehicle normally pulls to low side of crowned road or sloping terrain.**	*a.* Unequal track tension.	*a.* Check and adjust track tension (par. 3-13 *c).*
	b. Buildup of mud or dirt on one track.	*b.* Clean tracks.
	c. Worn or damaged track components.	*c.* Check and replace worn or damaged track shoes. Check for worn bushings by running chassis slowly and observing track shoes as they pass over road wheels one and two. Track shoes with worn bushings hang lower than other shoes (para 3-13 *b).*
44. Vehicle throws track.	*a.* Foreign material lodged in track or between sets of road wheels or idler wheels.	*a.* Clean suspension system of foreign material.
	b. Improper drive habits.	*b.* Observe driving precautions (para 2-10).
	c. Excessively loose or worn track.	*c.* Check and replace worn or damaged track shoes; refer to item 43 *c.* Check and adjust track tension (para 3-13 *c).*
45. Vehicle sags to one side.	Broken torsion bar anchor screw or torsion bar.	Notify organizational maintenance.
46. Thumping noise heard during chassis operation.	*a.* Worn bushing in one or more track shoes.	*a.* Check (para 3-13 *b)* and replace (para 3-13 *d)* worn or damaged track shoes.
	b. One or more track pads not properly assembled.	*b.* Check (para 3-13 *b)* and replace para 3-13 *d)* worn or damaged track shoes.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
	c. Chunking of road wheels.	c. Notify organizational maintenance.
47. Excessive noise in tracks or suspension during vehicle operation.	a. Worn or seized road wheel hub bearings.	a. Check hubs for excessive heat immediately after vehicle operation. If hub feels excessively hot, notify organizational maintenance. **NOTE** Excessive heat can be determined by comparative check of hubs.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
	b. Worn sprocket cushion or drive sprockets.	b. Check sprockets and sprocket cushions for wear. If sprockets or cushions are worn, notify organizational maintenance.
	c. Worn track bushings.	c. Refer to item 46.
48. Track does not maintain proper tension.	Defective track adjuster.	Notify organizational maintenance.
49. Leaking road wheel or idler wheel hub.	Damaged or defective hub seals, sight glass or gasket.	Notify organizational maintenance.
50. Leaking road wheel support arm housing.	Damaged or defective housing inner or outer seal.	Notify organizational maintenance.
	PIVOT STEER CONTROLS	
51. Pivot steer brake inoperative when control lever is applied.	a. No fluid in master cylinders.	a. Refer to LO 9-2350-300-10 for correct fluid level.
	b. Leaking hydraulic lines or connections.	b. Check hydraulic lines for leaks. If leaks cannot be stopped by tightening, notify organizational maintenance.
	c. Controls out of adjustment.	c. Notify organizational maintenance.
	d. Defective pivot steer hydraulic system or component.	d. Notify organizational maintenance.
52. Pivot steer brakes do not release.	a. Restricted master cylinder breather.	a. Check and clean breather hole in master cylinder filler cap (two master cylinders) (fig. 2-16).
	b. Controls out of adjustment.	b. Notify organizational maintenance.
	c. Defective pivot steer hydraulic system or components.	c. Notify organizational maintenance.
	d. Foreign matter on brake discs.	d. Notify organizational maintenance.

Table 3-6. Fault Isolation - Continued

Malfunction	Probable cause	Corrective action
	SHOCK ABSORBERS	
53. Vehicle rides excessively hard.	a. Suspension locked out.	a. Release suspension lockout (par. 2-9b).
	b. One or more defective shock absorbers.	b. Check shock absorbers after operation. If shock absorbers are defective, notify organizational maintenance.
	c. One or both road wheel arm bumpers defective.	c. Check condition of road wheel arm bumpers. If bumpers are defective, notify organizational maintenance.
	RAMP HYDRAULIC SYSTEM	
54. Ramp fails to rise.	a. Low hydraulic tank fluid level.	a. Refer to LO 9-2350-300-10 for correct fluid level.
	b. Leaking hydraulic lines or connection.	b. Check hydraulic lines for leakage. If leak cannot be stopped by tightening, notify organizational maintenance.
	c. Defective ramp hydraulic system or components.	c. Notify organizational maintenance.
	d. Broken ramp wire rope.	d. Notify organizational maintenance.
55. Ramp operation slow or sluggish.	a. Low vehicle engine speed.	a. Increase vehicle engine speed.
	b. Low ramp hydraulic tank fluid level.	b. Refer to LO 9-2350-300-10 for correct fluid level.
	c. Leaking hydraulic lines or connections.	c. Check hydraulic lines for leakage. If leaks cannot be stopped by tightening, notify organizational maintenance.
	d. Defective ramp hydraulic system.	d. Notify organizational maintenance.
56. Ramp fails to lower.	a. Defective ramp hydraulic control valve.	a. Notify organizational maintenance.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
	b. Ramp linkage out of adjustment.	*b.* Notify organizational maintenance.
	c. Ramp frozen shut (cold weather).	*c.* Thaw.
TRIM VANE ASSEMBLY		
57. Trim vane will not stay extended during water operation.	Linkage out of adjustment or defective.	Notify organizational maintenance.
BILGE PUMPS		
58. Bilge pumps fail to operate. 59. Bilge pumps run but fail to pump water.	Defective pump or electrical circuit. *a.* Pump air locked.	Notify organizational maintenance. *a.* Turn BILGE PUMPS switch on and off to clear (fig 2-3).
	b. Restricted pump inlet screen.	*b.* Clean bilge pump inlet screen (fig 1-9).
	c. Restricted discharge line.	*c.* Clean bilge pump outlet tubes (fig 1-9).
	d. Defective pump.	*d.* Notify organizational maintenance.
INSTRUMENTS		
60. Speedometer fails to register.	Defective speedometer, adapter or flexible shaft assembly.	Notify organizational maintenance.
61. Tachometer fails to register.	Defective tachometer, adapter or flexible shaft assembly.	Notify organizational maintenance.
62. SUSP LOCKED OUT light does not light.	*a.* Low hydraulic tank level.	*a.* Refer to LO 9-2350-300-10.
	b. Defective lamp.	*b.* Notify organizational maintenance.
MOUNT		
	NOTE One of the most common causes of improper mount operation is dead mount batteries. After any malfunction of the mount, check the control panel indicator lights; if they are illuminated very dimly or not at all, the batteries are discharged. Recharge mount batteries (para 3-13*g* (2) *(c)*).	
63. Control panel SYSTEM POWER indicator fails to light when SYSTEM POWER switch is set to ON position.	*a.* Defective lamp (press to test).	*a.* Replace lamp (para 3-16*c*).
	b. Blackout shutter closed.	*b.* Open blackout shutter.
	CAUTION Do not reset circuit breaker more than once. If circuit breaker fails to reset, notify organizational maintenance.	
	c. SYS PWR circuit breaker on distribution box open.	*c.* Press circuit breaker to reset (fig 2-28).
	d. Cables disconnected or loose.	*d.* Reconnect and / or tighten cable connections.
	e. No battery power	*e.* Recharge mount batteries (para 3-13*g* (2) *(c)*.
	f. Other malfunction.	*f.* Notify organizational maintenance.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
64. Loading motor is not energized when loading switch is set to either ON or MOMENTARY ON position.	*a.* Drum is full.	*a.* Check visually.
	b. Conveyor unit in fire position.	*b.* Lock conveyor unit in LOAD (out) position (fig 2-54).
	c. Shift pin handle in F position.	*c.* Set shift pin handle (fig 1-14) in L position.
	d. Cable connection loose.	*d.* Tighten cable connection.
	e. Other malfunction.	*e.* Notify organizational maintenance.
65. Loading motor energizes but drum fails to load.	*a.* Ammunition jammed.	*a.* Remove ammunition from loading chute. Detect and release jam. Insure rounds are correctly linked and proper loading procedures followed (para 2-16).
	b. Shift pin handle not in L position.	*b.* Set shift pin handle (fig 1-14) in L position.
	c. Other malfunction.	*c.* Notify organizational maintenance.
66. Conveyor unit assembly cannot be set to fire position (in toward exit unit assembly).	*a.* Double link stripping guide not fully out.	*a.* Slide double link stripping guide (fig 2-55) out to lock position.
	b. Conveyor unit not timed.	*b.* Time conveyor unit (para 2-16).
	c. Round not timed in exit unit.	*c.* Time round in exit unit (para 2-16).
	d. Other malfunction.	*d.* Notify organizational maintenance.
67. Both azimuth and elevation drives fail to respond when action switch is depressed and elevation and azimuth controls are rotated.	*a.* NORM-STATIC-TEST switch not set to NORM position.	*a.* Set switch to NORM (up position (fig 2-28).
	b. Control panel SYSTEM POWER switch set to OFF position.	*b.* Set switch to ON position. (If SYSTEM POWER indicator fails to light, refer to step 63.)
	c. Conveyor unit not in fire position.	*c.* Place conveyor unit in fire position (down and locked) (fig 2-29).
	d. Shift pin not in F position.	*d.* Set shift pin (fig 1-14) in F position.
	e. Other malfunction.	*e.* Notify organizational maintenance.
68. Elevation drive responds when action switch is depressed but azimuth drive does not respond.	Azimuth servo amplifier A15A1 defective.	Disconnect W8P3 and W8P2 from A15A1 and A15A2 (fig 1-12). Connect W8P3 to A15A2 for operation at reduced slew speed. Notify organizational maintenance.
69. Elevation drive responds when action switch is depressed but azimuth drive has uncontrolled response.	Either azimuth servo amplifier A15A1 or A15A2 defective.	Disconnect W8P2 from A15A2 (fig 1-12). If malfunction still exists, disconnect W8P3 from A15A1 and connect W8P3 to A15A2. Notify organizational maintenance.
70. Azimuth slew speeds low.	Servo amplifier A15A2 defective.	Notify organizational maintenance.
71. Azimuth drive responds when action switch is depressed but elevation drive does not respond or has uncontrolled response.	Elevation servo amplifier assembly A15A3 defective.	Disconnect W8P2 and W8P4 from A15A2 and A15A3 (fig 1-12). Connect W8P4 to A15A2 for operation at reduced azimuth slew speed. Notify organizational maintenance.
72. GUN POWER indicator fails to light when GUN POWER switch is set on ON.	*a.* Control panel SYSTEM POWER switch set to OFF position.	*a.* Set SYSTEM POWER switch to ON. If indicator fails to light, refer to step 63.
	b. Defective lamp (press to test).	*b.* Replace lamp (para 3-16*c*).
	c. Blackout shutter closed.	*c.* Open blackout shutter.
	d. Other malfunction.	*d.* Notify organizational maintenance.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
73. Cannon cannot be rotated with BRAKE-CLEAR AND BRAKE switch set to CLEAR AND BRAKE position.	*a.* Shift pin not in F position.	*a.* Adjust slack point in feed chute (para 2-16*b* (32)) and place shift pin in F position.
	b. Two breech bolt assemblies on one track.	*b.* Remove extra breech bolt assembly (para 3-15*b* (5)).
	c. Indexing pin on cannon is engaged.	*c.* Free indexing pin (fig 2-23).
	d. Indexing pin in feeder engaged.	*d.* Free indexing pin (fig 2-32).
	e. SYS PWR circuit breaker on distribution box open.	*e.* Press circuit breaker to reset (fig 2-28)
	f. Cable W3 connectors loose or disconnected.	*f.* Connect and / or tighten cable W3 connectors (fig 2-66).
	g. Other malfunction.	*g.* Notify organizational maintenance.
74. SYSTEM POWER and GUN POWER indicators light but cannon does not rotate.	*a.* Drum assembly empty.	*a.* Load drum assembly (para 2-16).
	b. Arming connector or arm-safe switch missing from distribution box.	*b.* Connect arming connector or arm-safe switch to J6 on distribution box (fig 1-12).
	c. Arm-safe switch not closed (when used).	*c.* Depress arm-safe switch (fig 2-84).
	d. Shift pin not in F position.	*d.* Set shift pin (fig 1-14) to F position.
	e. Conveyor not locked in fire position.	*e.* Set conveyor in fire position (down and locked) (fig 2-29).
	f. Cable W3 not connected to gun drive assembly or distribution box.	*f.* Connect cable W3 to gun drive assembly (fig 1-17) and distribution box jack J3.
	g. Other malfunction.	*g.* Notify organizational maintenance.
75. Cannon rotates, rounds fed through cannon but are not fired.	*a.* Connector W3P2 not connected to firing contact assembly.	*a.* Connect W3P2 to firing contact assembly (fig 2-66).
	b. Other malfunction.	*b.* Notify organizational maintenance.
76. Cannon fires normally but does not clear with GUN CLEAR switch in AUTO or OPERATOR position.	*a.* Connector W3P4 not connected to feeder.	*a.* Connect W3P4 to feeder connector J1 (fig 2-32).
	b. Other malfunction.	*b.* Notify organizational maintenance.
77. Cannon misfires.	*a.* Dirty breech bolt assembly(s).	*a.* Clean and lubricate breech bolt assemblies (para 3-7).
	b. Other malfunction.	*b.* Notify organizational maintenance.
77.1. Slow or erratic rate of fire.	*a.* Cannon not lubricated.	*a.* Clean and lubricate cannon (para 3-15)
	b. Mount batteries low.	*b.* Recharge mount batteries (para 3-13*g* (2) *(c)*.

SIGHTING AND FIRE CONTROL

	NOTE One of the most common causes of improper mount operation is dead mount batteries. After any malfunction of the mount, check the control panel indicator lights; if they are illuminated very dimly or not at all, the batteries are discharged. Recharge mount batteries (para 3-13*g* (2) *(c)*).	
78. Operation is normal in ground mode but no lead angle is developed in manual mode.	*a.* Sight mechanically caged.	*a.* Uncage sight.
	b. Other malfunction.	*b.* Notify organizational maintenance.
	c. SCG PWR circuit breaker on distribution box open.	*c.* Press circuit breaker to reset.

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
79. Improper lead angle developed in manual mode.	*a.* MODE switch on stow control set to STOW.	*a.* Set MODE switch to NORMAL (fig 1-26). **CAUTION** **Do not reset circuit breaker more than once. If circuit breaker fails to reset, notify organizational maintenance.**
	b. SCG PWR circuit breaker on distribution box open.	*b.* Press circuit breaker to reset (fig 2-28).
	c. SIGHT GYRO PWR circuit breaker on distribution box open.	*c.* Press circuit breaker to reset.
	d. INVERTER PWR circuit breaker on distribution box open.	*d.* Press circuit breaker to reset.
	e. Other malfunction.	*e.* Notify organizational maintenance.
80. In radar mode, READY WHEN LIT indicator fails to light within 2 minutes after SYSTEM POWER switch is set to ON.	*a.* Cover on radar receiver-transmitter not securely closed.	*a.* Close cover and tighten thumbscrews.
	b. Defective lamp.	*b.* Replace lamp (para 3-16*c*). **CAUTION** **Do not attempt to reset circuit breakers more than once. If a circuit breaker fails to reset, notify organizational maintenance.**
	c. CONVERTER circuit breaker on radar power supply open.	*c.* Press circuit breaker to reset (fig 1-25).
	d. CONTROL CKT circuit breaker on radar power supply open.	*d.* Press circuit breaker to reset (fig 1-25).
	e. Other malfunction.	*e.* Notify organizational maintenance.
81. Antenna does not respond to positioning commands.	*a.* MODE switch on stow control set to STOW.	*a.* Set MODE switch to NORMAL (fig 1-26). **CAUTION** **Do not attempt to reset circuit breakers more than once. If a circuit breaker fails to reset, notify organizational maintenance.**
	b. TRAV circuit breaker on radar power supply open.	*b.* Press circuit breaker to reset (fig 1-25).
	c. ELEV circuit breaker on radar power supply open.	*c.* Press circuit breaker to reset (fig 1-25).
	d. Cable W7P2 disconnected from stow control jack J2.	*d.* Connect cable (fig 1-26).
	e. INVERTER PWR circuit breaker open.	*e.* Press circuit breaker to reset (fig 2-28).
	f. Other malfunction.	*f.* Notify organizational maintenance.
82. Antenna cannot be boresighted.	Same as 81.	Same as 81.
83. Rf power indicator lamp fails to light when footswitch is pressed in RADAR mode.	*a.* Defective lamp. **CAUTION** **Do not attempt to reset OVERLOAD RESET switch with foot switch depressed; damage to radar will result.**	*a.* Replace lamp (fig 3-19). **CAUTION** **Do not attempt to reset circuit breakers or overload resets more than once. If a circuit breaker or overload circuitry will not reset, notify organizational maintenance.**
	b. One or more circuit breakers on radar power supply open.	*b.* Press circuit breakers to reset (fig 1-25).

Table 3-6. Fault Isolation—Continued

Malfunction	Probable Cause	Corrective Action
	c. High-voltage power supply overload or modulator overload sensing circuitry in radar transmitter-receiver is tripped.	c. Reset overload sensing circuitry with OVERLOAD RESET switch (fig 1-22).
	d. Defective crystal oscillator subassembly.	d. Change radar frequency channel if situation permits (para 2-19*e*(7)).
	e. Other malfunction.	e. Notify organizational maintenance. **CAUTION** **Do not attempt to reset OVERLOAD RESET switch with foot switch depressed; damage to radar will result.**
84. HIGH-VOLTAGE POWER SUPPLY OVERLOAD or MODULATOR OVERLOAD indicators light.	a. High-voltage power supply overload or modulator overload sensing circuitry in radar transmitter-receiver is tripped.	a. Reset overload sensing circuitry with OVERLOAD RESET switch (fig 1-22).
	b. Other malfunction.	b. Notify organizational maintenance.
85. Power indicator lamp does not illuminate when radar is energized to standby and interlock switch is placed in service position.	a. Defective lamp.	a. Replace lamp (para 3-17*c*(1) *(b)*).
	b. Other malfunction.	b. Notify organizational maintenance.
86. Abnormal idication of rf power meter during tuning of klystron power amplifier.	a. Defective crystal oscillator-subassembly.	a. Change radar frequency if situation permits (para 2-19*e*(7)).
	b. Other malfunction.	b. Notify organizational maintenance.
87. Unable to obtain audio tone during clutter lockon test.	a. Defective headset, or test failed.	a. Replace headset and retest.
	b. Defective radar unit.	b. Notify organizational maintenance.
88. MID RANGE CALIBRATION indicator lamp does not illuminate during midrange calibration test.		Notify organizational maintenance.
89. GOOD WHEN LIT indicator fails to light during sight current generator test.	a. AIR DENSITY or MUZZLE VELOCITY knob set wrong.	a. Check settings on AIR DENSITY or MUZZLE VELOCITY knobs.
	b. Radar antenna not aligned with cannon.	b. Set stow control MODE switch to NORMAL (fig 1-26).
	c. Defective lamp.	c. Replace lamp (para 3-16*c*).
	d. Other malfunction.	d. Notify organizational maintenance.
90. Sight reticle lamp does not light.	a. Defective lamp.	a. Replace lamp (para 3-14*b*).
	b. Loose cable connection.	b. Tighten cable connector.
	c. INVERTER PWR circuit breaker open.	c. Reset circuit breaker (fig 2-28).
	d. Other malfunction.	d. Notify organizational maintenance.

Section V. CORRECTIVE MAINTENANCE

3-12. General.

This section contains maintenance and service instructions that can be performed by the operator / crew.

3-13. M741 Chassis.

a. General. Maintenance services performed by the driver or crew include adjustment of track tension and replacement of worn or damaged track shoes. See figure 3-1 for suspension points to inspect during regular preventive maintenance services. Services performed also include cleaning the air cleaner filter, cleaning the vent holes and screens in the bilge pumps, and maintenance of vehicle after water operation.

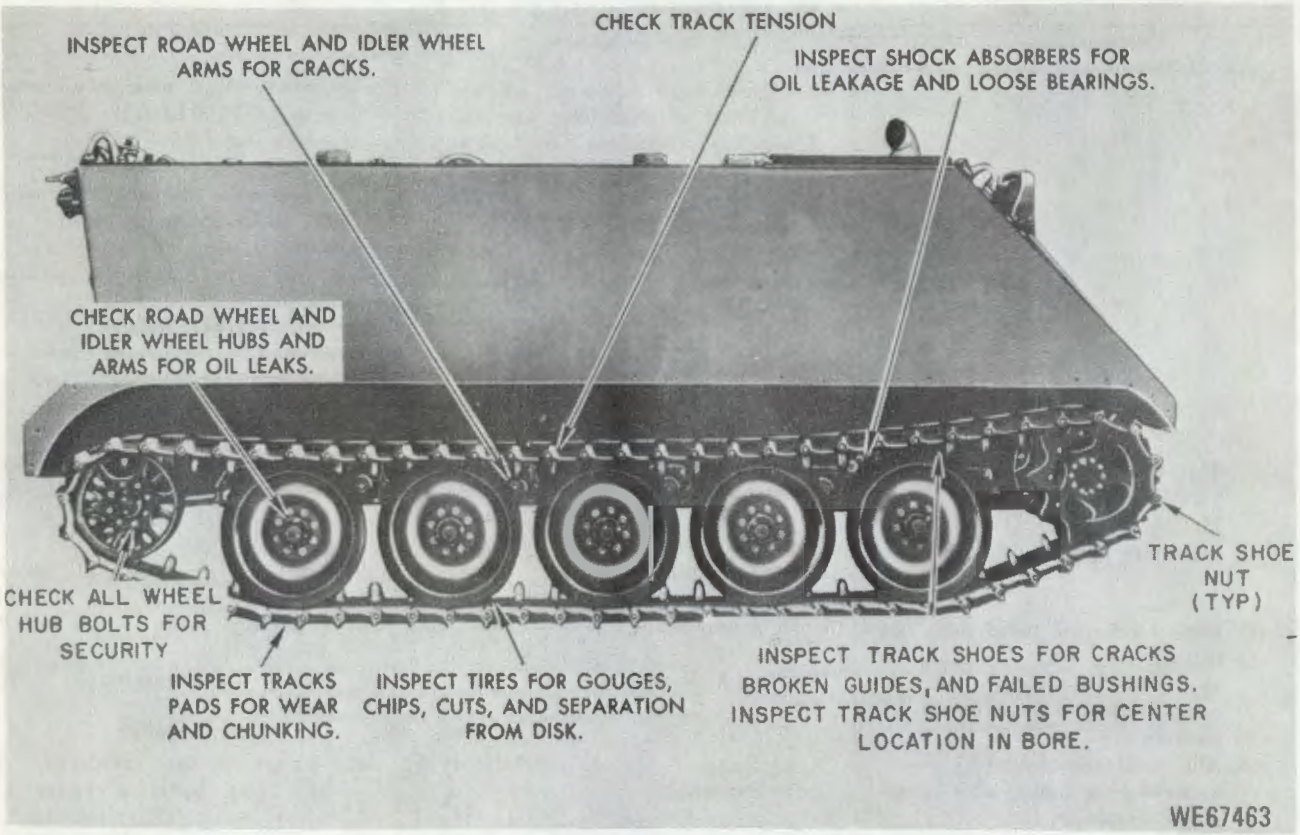


Figure 3-1. Suspension inspection points.

b. Checking Track Shoe Wear.

(1) *Bushing wear* (A, fig 3-1.1).

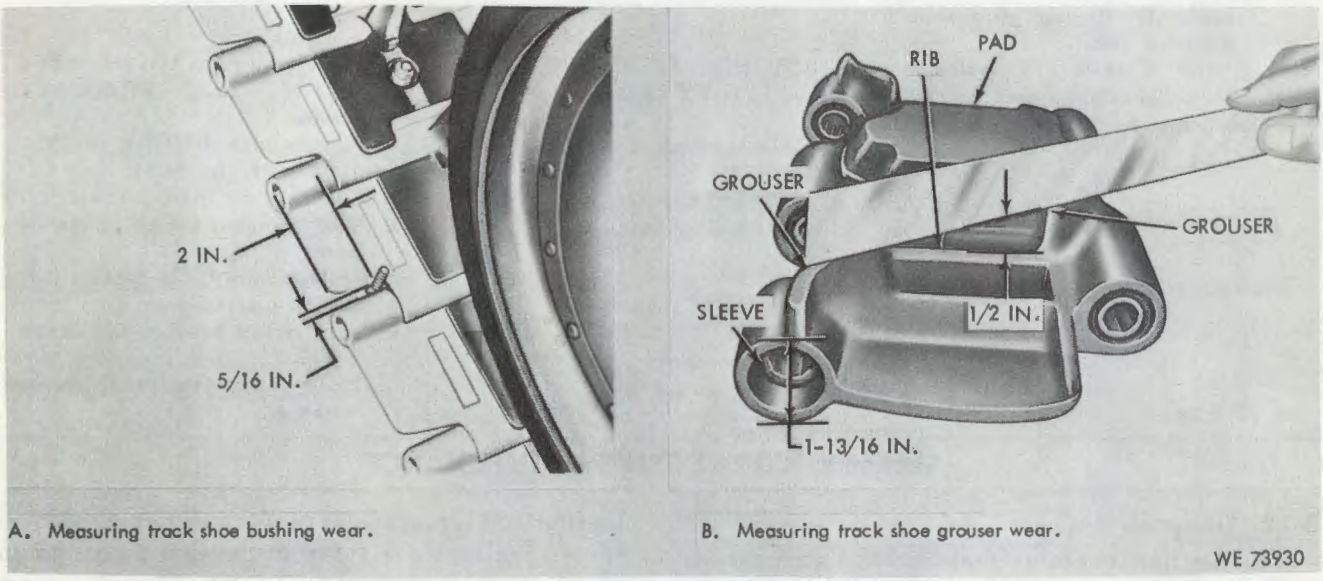


Figure 3-1.1. Measuring wear of track shoe bushing and grouser.

(a) Track shoe bushing wear check must be made with track under normal tension (*c* following).

(b) Measure distance between track shoes, 2 inches in from outer edge of shoes. Distance between shoes should be 5 / 16 inch or less. If

distance is more than 5 / 16 inch, or bushing metal sleeve is 1 / 16 inch off center of shoe bore, shoe is unserviceable and must be replaced (*d* following).

NOTE

A 5 / 16-inch cap screw or 5 / 16-inch diameter rod may be used to measure bushing wear.

(2) *Grouser wear* (B, fig 3-1.1).

(a) Measure height of grouser from raised ribs on each side of track shoe pad (preferred method). Height should be ½ inch or more. If height is less than ½ inch, shoe is unserviceable and must be replaced (*d* following).

(b) Measure height of grouser from bottom of three-bushing end of track shoe (optional method). Height should be 1-13 / 16 inches or more. If height is less than 1-13 / 16 inches, shoe is unserviceable and must be replaced (*d* following).

c. Track Tension.

(1) Checking track tension (fig 3-1 and 3-2).

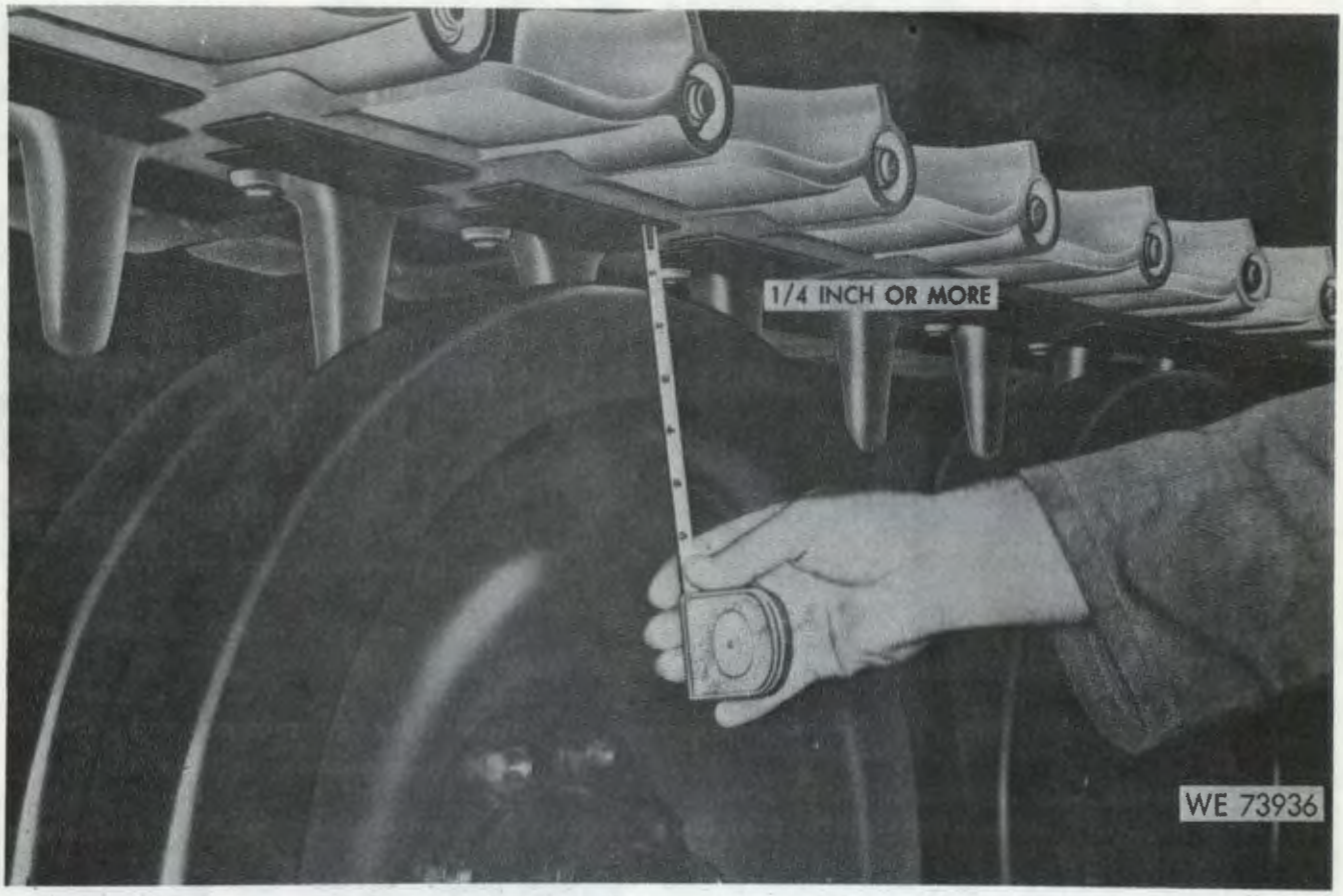


Figure 3-2. Checking track tension.

(a) Select an area that has a firm level surface and, with the transmission in 2-3 range, accelerate vehicle to approximately 8 mph. Shift transmission to neutral while power is being applied and coast to a stop. Do not apply brakes.

(b) Measure distance between top of second road wheel and bottom of track. Distance must be ¼ inch or more with track resting on third road wheel.

(c) Loosen or tighten track ((2) or (3) following) to obtain measurement in *(b)* preceding.

(2) *Tightening track tension* (fig 3-3).

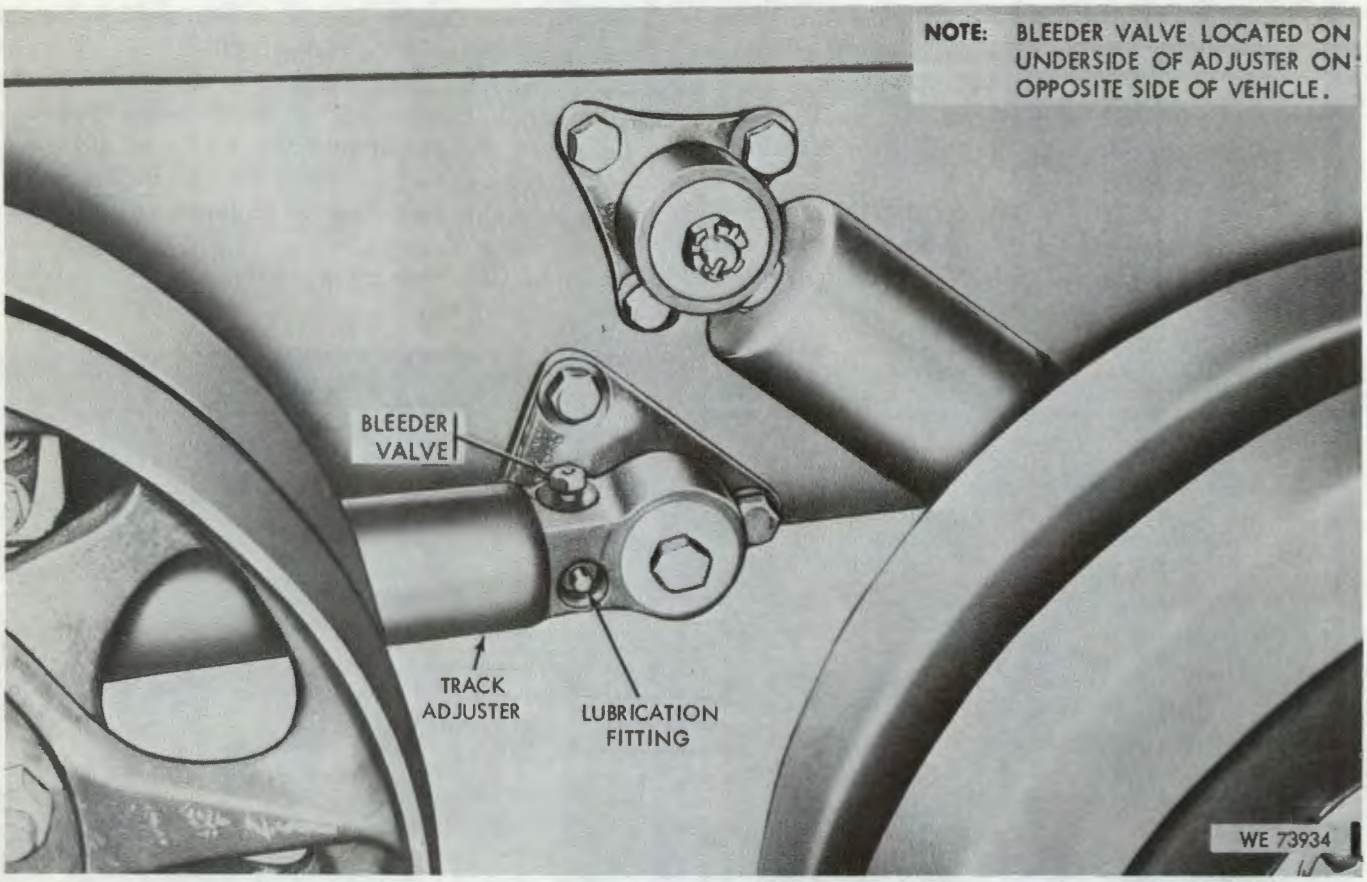


Figure 3-3. Adjusting track tension.

(a) Check track tension ((1) preceding).

(b) Using grease gun, add GAA grease to track adjuster through lubrication fitting.

(c) Check track tension ((1) preceding).

(d) If track tension is still loose and track adjuster is fully extended, remove one track shoe from track (*d* following).

NOTE

Maximum extended length of track adjuster is 17 inches between bearing centers. After vehicle is operated for a time with a new track, the track will stretch sufficiently to permit full extension of the track adjuster.

(3) *Loosening track tension* (fig 3-3).

(a) Check track tension ((1) preceding).

(b) Turn relief valve counterclockwise, and allow grease to escape from track adjuster.

(c) Turn relief valve clockwise to close.

(d) Check track tension ((1) preceding).

(e) If track tension is still tight and track adjuster is fully retracted, add one track shoe to track (*d* following).

NOTE

Minimum retracted length of track adjuster is 13½ inches between bearing centers.

d. Replacement of Track Shoes.

(1) *Disconnecting track* (fig 3-4).

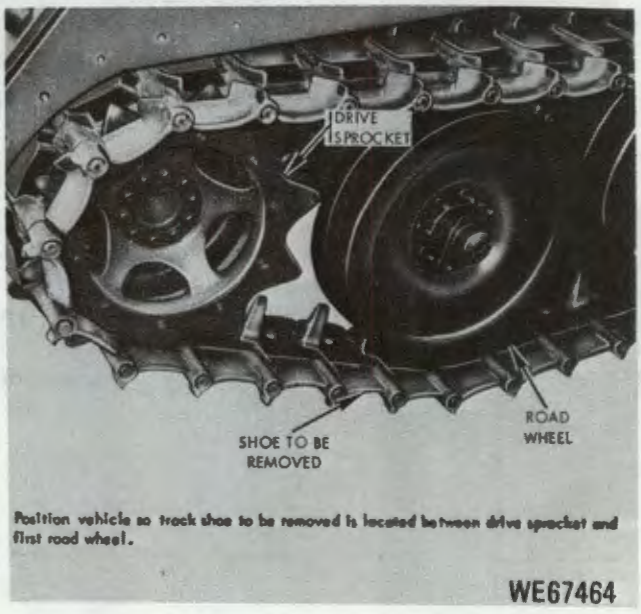


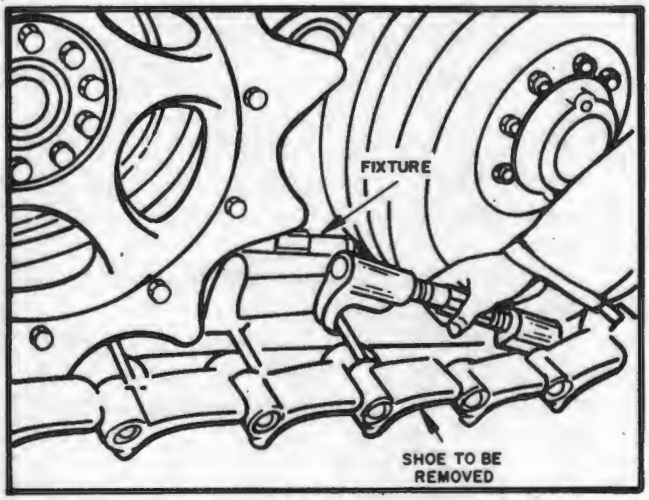
Figure 3-4. Position of track shoe for removal.

(a) Drive vehicle onto level, hard-surfaced ground, and position track shoe to be removed midway between sprocket and first road wheel, or midway between idler and fifth road wheel.

(b) Block opposite track to prevent vehicle movement. Do not lock vehicle brakes.

(c) Turn relief valve counterclockwise on track adjuster, and relieve track tension. Turn relief valve clockwise to close (fig 3-3).

(d) Attach two track connecting fixtures across track shoe to be removed, and tighten fixtures equally to relieve tension on track pin (fig 3-5).



Attach track connecting fixtures across track shoe to be removed and tighten fixtures to relieve tension on track pins.

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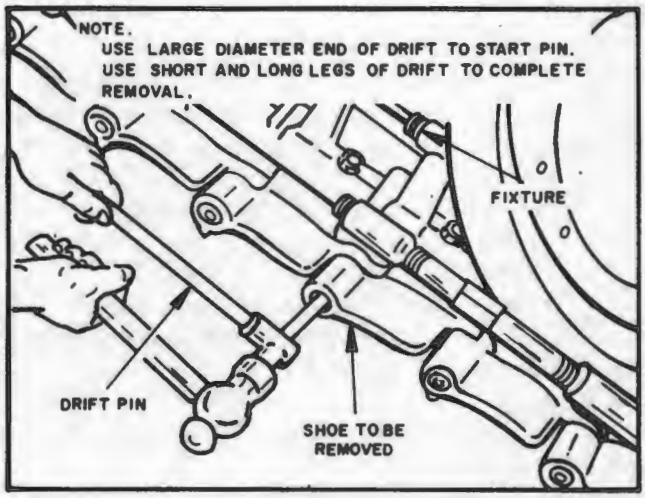
Figure 3-5. Installing track connecting fixtures.

(e) Remove track pin nut from outer end of track pin.

(f) Start track pin, using short leg of drift pin, and remove track pin with long leg of drift pin (fig 3-6).



Remove track pin nuts from outer end of pins and drive one pin out, using drift and hammer.

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Figure 3-6. Driving track shoe pin with drift.

(g) Loosen and remove two track fixtures from track.

(2) *Removing track shoes* (A, fig 3-7).

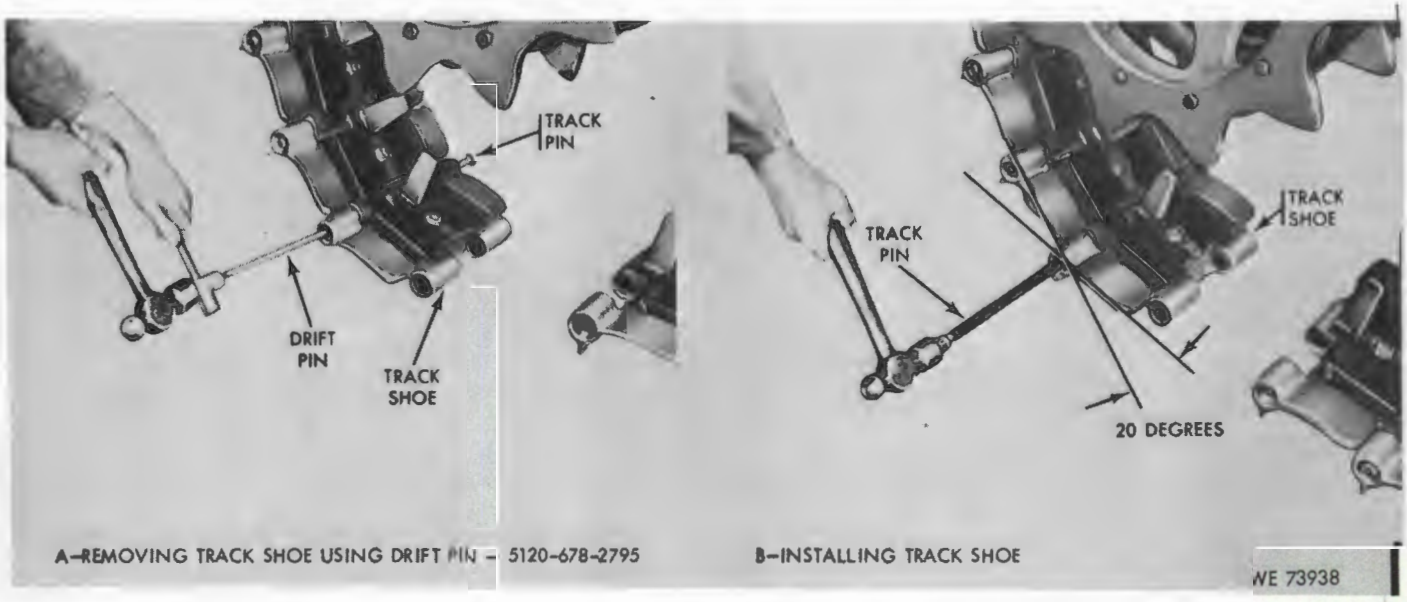


Figure 3-7. Removing and installing track shoe.

(a) Disconnect track ((1) preceding).

(b) Remove track pin nut from outer end of track pin.

(c) Start track pin, using short leg of drift pin, and remove track pin with long leg of drift pin (fig 3-6).

(d) Remove track shoe from track.

(e) If removed track shoe is serviceable, install removed track pin and two nuts on track shoe, and stow track shoe in position provided on vehicle (fig 1-2).

(f) Connect track ((4) following).

(g) Adjust track tension (*c* preceding).

(3) *Installing track shoe* (B, fig 3-7).

(a) Disconnect track ((1) preceding).

(b) Remove track shoe from stowed position on vehicle, and remove track pin and two track pin nuts from shoe.

(c) Install nut on one end of track pin, flush with end of pin.

(d) Position track shoe on track, align track pin holes with 20-degree angle between shoes, and install track pin.

(e) Install inner track pin nut, and tighten both track pin nuts.

NOTE

A minimum of ⅛ inch of track pin must extend through both track pin nuts.

(f) Connect track ((4) following).

(g) Adjust track tension (*c* preceding).

(4) *Connecting track* (fig 3-8).

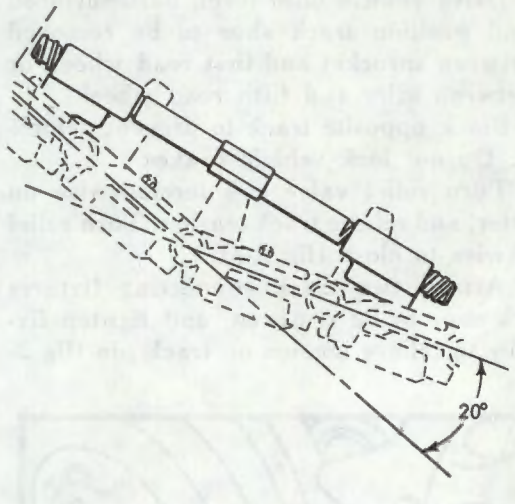


Figure 3-8. Track shoe angle for pin installation.

(a) Pull track ends together, and install two track connecting fixtures across track shoes to be connected.

(b) Install track pin nut on one end of track pin, flush with end.

(c) Align track shoe bushings, tighten track connecting fixtures to obtain 20-degree angle between track shoes with track pin holes alinged, and install track pin.

NOTE

Use crowbar to obtain correct angle.

(d) Install inner track pin nut, and tighten both track pin nuts.

NOTE

A minimum of ⅛ inch of track pin must extend through both track pin must extend through both track pin nuts.

(e) Loosen and remove two track connecting fixtures from track.

(f) Adjust track tension (para 3-13 c).

e. Air Cleaner Filter (fig 3-9 and 3-9.1).

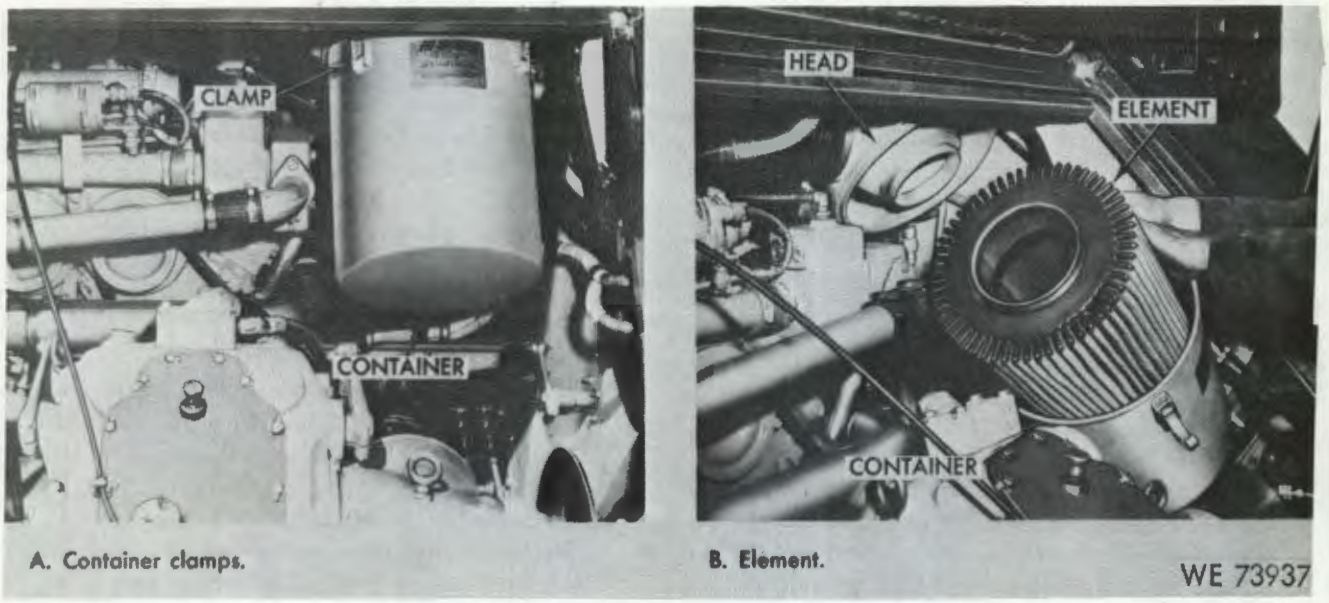


Figure 3-9. Servicing old type air cleaner.

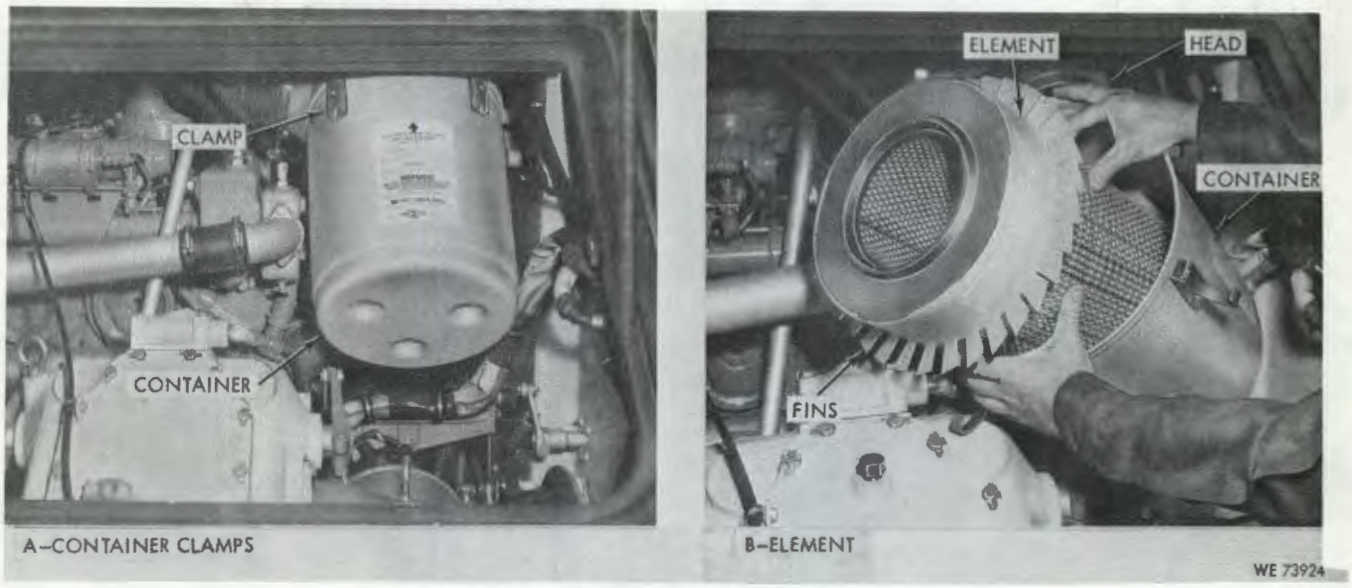


Figure 3-9.1. Servicing new type air cleaner.

e. Air Cleaner Filter (fig 3-9).

(1) *General.* The air cleaner element can be cleaned by one of three methods, listed in following steps (3) through (5) in preferred-use sequence. The method used depends upon the length of time the vehicle can be shut down and the availability of equipment and supplies.

(2) *Removing air cleaner element.*

(a) Unfasten four clamps securing element container to air cleaner head. While unfastening clamps, hold container so it does not drop.

(b) Remove container, then remove element.

CAUTION

To avoid damage to element, do not hold air nozzle against element.

(3) *Cleaning element with compressed air.* Direct approximately 100 psi of compressed air against inside of element, then against fins on outside of element, and again against inside of element.

(4) *Cleaning element by washing.*

(a) Wash element in soap and water, and rinse thoroughly.

(b) Dry element thoroughly before reinstalling in container.

NOTE

Do not strike end of element.

(5) *Cleaning element by jarring.* Gently tap with hands on sides of fins so dirt will fall from element.

(6) *Install air cleaner element.*

NOTE

Two types of noninterchangeable air cleaner elements and containers are in use. When servicing air cleaner element, make certain element being installed is same type as one removed.

(a) Place new type element in air cleaner container with slots in bottom baffle of element located over stops in container housing. Rotate element to lock into position.

(b) Position container on cleaner head and fasten four clamps.

f. Bilge Pumps (fig 1-9).

(1) If openings in screen are clogged, clean until free of debris.

(2) Run a wire in and out of the vent hole in pump to ensure that hole is open.

g. Batteries (fig 3-10).

WARNING

Do not handle ammunition in vehicle while chassis batteries are being serviced. Rounds will discharge if dropped onto the batteries.

WARNING

Vapor from the battery electrolyte can be explosive. Do not permit smoking or open flames in the vicinity while servicing chassis batteries.

WARNING

Do not drop tools onto the batteries. Severe arcing will result, with possible injury to personnel and damage to the batteries.

WARNING

Do not wear rings, metal watchbands or identification bracelets when servicing chassis batteries.

CAUTION

Mount batteries will be serviced by organizational maintenance only.

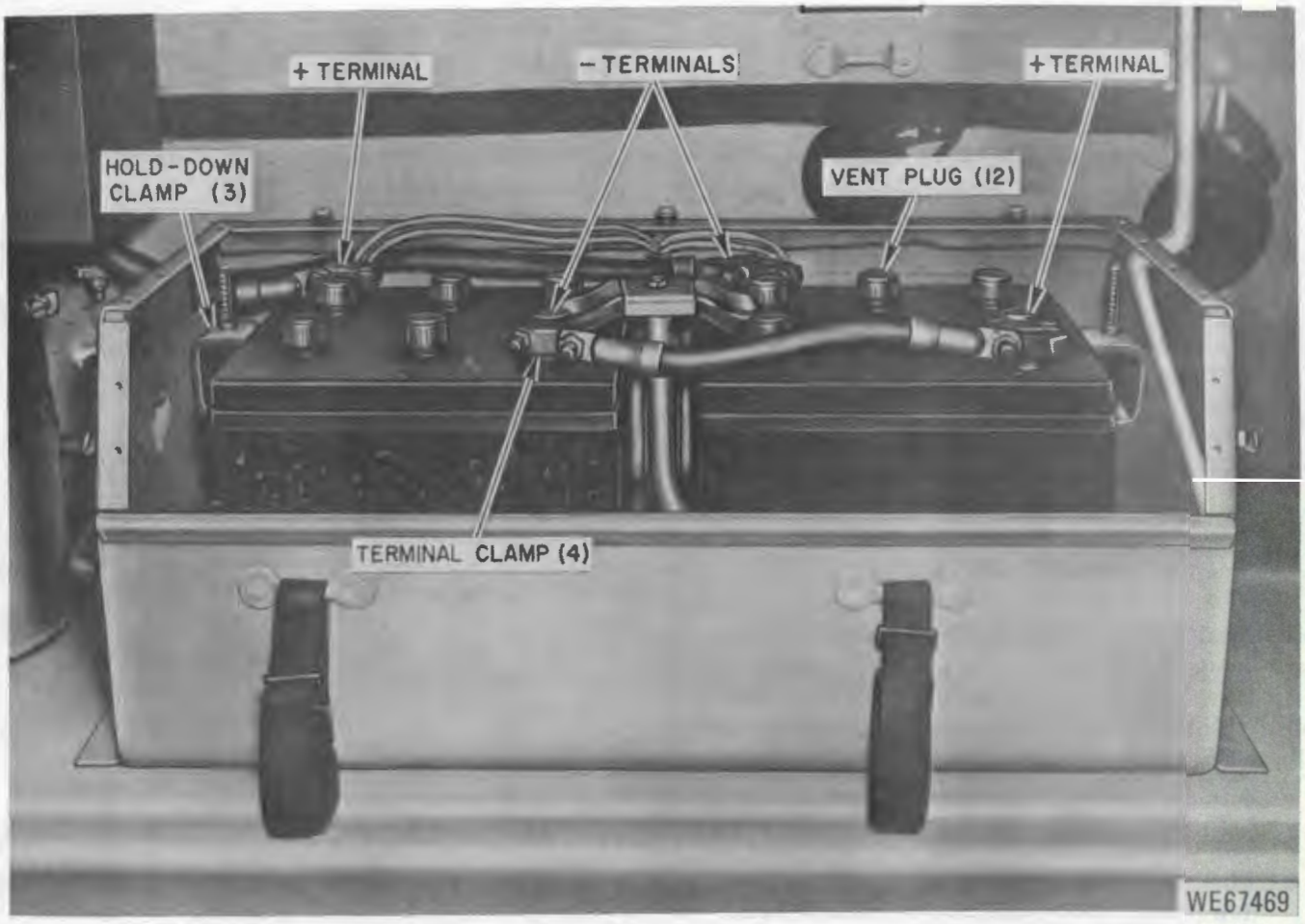


Figure 3-10. M741 chassis batteries.

(1) *Inspection.* Inspect chassis batteries for correct electrolyte level, presence of acid on outside, and loose vent plugs and terminal clamps. Check for cracked cases, corroded battery terminals and hold-down clamps; service and clean batteries.

(2) *Servicing chassis batteries.*

CAUTION

Mount batteries will be serviced by organizational maintenance only.

(a) Adding water. Battery electrolyte level should normally be checked weekly. At ambient temperatures above 100°F, the electrolyte level should be checked daily if the APU or vehicle generator is in continuous use for battery charging. Remove vent plugs and add distilled water or rain water from a nonmetallic container to bring electrolyte to split-ring level. Do not overfill. Reinstall vent plugs.

CAUTION

Keep batteries clean and do not overfill. In cold weather, charge battery immediately after adding water so water will combine with electrolyte and not freeze.

CAUTION

Syringes used to add water to gun mount batteries and chassis batteries must not be interchanged. Intermixing electrolytes will contaminate batteries and result in irreversible battery damage.

(b) Cleaning chassis battery.

CAUTION

Do not use wire brush. Wire brush will cause short-circuiting and damage to the battery cases, vent plugs or battery terminals.

The top of the battery must be kept clean. Tighten vent plugs, and clean batteries with a plastic brush dipped in alkaline solution of bicarbonate of soda and water. after foaming stops, flush top of battery with clean water, and wipe dry with clean cloth. Clean battery terminals, cable terminal clamps and battery hold-down clamps in same manner. Tighten clamps, then coat clamps and terminals with grease (GAA). Refer to TM 9-6140-200-15 for additional information on care of batteries.

(c) Charging batteries.

WARNING

Nickel cadmium batteries use potassium hydroxide electrolyte which is very corrosive. If electrolyte comes into contact with skin, clothing, or materiel, flood area affected with water. Consult medical personnel if electrolyte gets into eyes.

CAUTION

Gun mount batteries will be serviced by organizational maintenance personnel only.

(c) Charging batteries.

1. Charging mount batteries. Using vehicle engine generator:

(a) Start the vehicle engine and set it to run at approximately 1000 rpm.

(b) Observe AMPS meter on distribution box for indication to see that batteries are being charged.

(c) Continue to operate vehicle engine until the AMPS meter indicates 10 amperes or less. Batteries are now charged.

(d) Turn off vehicle engine.

2. Charging mount batteries using APU.

WARNING

The generator set (APU) produces dangerous electrical power which can cause bodily injury or equipment damage if normal safety precautions are not observed.

CAUTION

Insure that both the vehicle MASTER SWITCH and the APU circuit breaker are in the OFF position before connecting or disconnecting the auxiliary power cable. Do not operate the APU until you are familiar with operating procedures set forth in TM 5-6115-323-15.

NOTE

After vehicle serial number C270, the APU receptacle is on the exterior of the vehicle. Connect APU to receptacle near right rear taillight (fig 2-71.1).

(a) Set up the APU as indicated in figure 2-85.

CAUTION

During the charging process do not permit the distribution box VOLTS meter indication to exceed 30 volts, as mount battery damage may result.

(b) Start the APU and set the charging voltage (refer to TM 5-6115-323-15) until the distribution box VOLTS meter indicates 29-30 volts. Continue to monitor VOLTS meter and adjust APU output to maintain this indication.

NOTE

It may be necessary to initially accept a VOLTS meter indication less than 29-30 volts to prevent overloading the APU (load current percent meter indicaton APU in excess of 100).

(c) Continue to charge the batteries until the VOLTS meter indicates 29-30 volts and the AMPS meter indicates 10 amperes or less. Mount batteries are now charged.

(d) Stop the APU (refer to TM 5-6115-323-15).

(e) Stow the APU (refer to fig 2-85).

3. Charging chassis batteries using vehicle engine generator.

(a) Start the vehicle engine (para 2-4, 2-5 or 2-6) and set it to run at approximately 1000 rpm.

(b) Continue to operate vehicle engine until the BATTERY GENERATOR indicator has indicated in the green for 2 hours (less time for partially charged batteries).

(c) Turn off vehicle engine.

4. Charging chassis batteries using APU.

(a) Set up the APU as outlined in 2. (a) and (b) preceding.

(b) Set vehicle MASTER SWITCH to ON.

CAUTION

During the charging process do not permit the distribution box VOLTS meter indication to exceed 30 volts, as mount battery damage may result.

(c) Continue to charge batteries until BATTERY-GENERATOR indicator has indicated in the green for 2 hours (less time for partially charged batteries).

(d) Set vehicle MASTER SWITCH to OFF.

(e) Stop the APU (refer to TM 5-6115-323-15).

(f) Stow the APU (fig 2-85).

h. Maintenance of Vehicle After Water Operation.

(1) *General.* After any short-duration, routine water operation, perform *(a)* and *(b)* following; these precautions should be taken as soon as possible to halt deterioration and avoid damage, before vehicle is driven extensively in regular service. After flooding of chassis interior, or submersion, perform *(b)* and *(c)* following; these precautions should halt deterioration and avoid damage to the vehicle and all components. Regardless of temporary measures taken, the

vehicle must be delivered to organizational maintenance as soon as practicable following flooding or submersion.

(a) Lubricate all exterior chassis points in accordance with LO 9-2350-300-10.

(b) Drain and clean out hull. After each salt water operation, vehicle should also be flushed to ensure salt deposits are washed away.

1. Remove front hull drain plug and final drive hull drain plugs (fig 2-45).

NOTE

Hull drain pipe plugs have a ¾-inch square recess; do not confuse the hull drain pipe plugs with the adjacent final drive oil drain plugs which have a ⅜-inch square recess. Location of the plugs is pinpointed by figure 2-45A.

2. Slope front of vehicle downward and slightly to its right side. Open power plant access door and flush all components in the power plant compartment.

NOTE

Exercise care so that electrical components are not saturated, and pay particular attention to flushing unpainted surfaces.

3. Slope front of vehicle downward and slightly to left. Flush final drive and hull plates. Inspect final drive hull drain recess to ensure all water is drained.

4. Install hull and final drive hull drain plugs. Close power plant access door.

5. Elevate front of vehicle. Remove rear hull drain plug (fig 2-45) located under vehicle, and drain any accumulated water from rear of vehicle.

6. Lower vehicle ramp, remove three personnel compartment floor plates and flush hull bottom plates.

7. Install three personnel compartment floor plates and rear hull drain plug.

(c) Perform a complete lubrication service in accordance with LO 9-2350-300-10 regardless of time interval.

1. If water or sludge is present in lubricants as they are drained, flush with proper type and grade of lubricant and then refill.

2. All road wheel, idler wheel, and support arm bearings that have lubrication fittings installed must be disassembled, cleaned, and repacked.

i. M17 Periscopes.

(1) *General.* A spare M17 periscope, stowed on the left wall behind driver, can be used to replace any one of the four periscopes mounted around the driver's hatch.

(2) *Removing M17 periscope.*

(a) Remove M17 periscope from over warning lights panel as follows:

1. Stretch springs and position periscope cover under warning lights panel.

2. Loosen the two thumbscrew clamps.

3. While pressing upward, support periscope with one hand and swing warning lights panel forward.

4. Lower periscope and remove from its porthole.

(b) Remove M17 periscopes from right, front, and left side of driver's hatch as follows:

1. Support periscope with one hand and loosen the two thumbscrew clamps.

2. Swing thumbscrew clamp assemblies inward.

3. While supporting periscope with one hand, stretch periscope cover springs downward to allow space for periscope removal.

4. Lower periscope and remove from its porthole.

(3) *Installing M17 periscope.*

(a) Install M17 periscope over warning lights panel as follows (fig 3-11):

1. Swing warning lights panel forward.

2. Position periscope up through the porthole, assuring that the clamping flange on the periscope is inside the vehicle.

3. Support periscope with one hand and swing warning lights panel rearward.

4. Align shaft of thumbscrews with detent in bottom of periscope clamping flange.

5. Tighten thumbscrew clamps and place cover on periscope.

(b) Install M-17 periscope on right, front, and left side of driver's hatch as follows:

1. Swing the two thumbscrew clamps away from driver's position.

2. Support periscope with one hand and stretch cover springs downward to allow access.

3. Position periscope up through porthole, assuring that clamping flange on periscope is inside the vehicle.

4. Position cover on periscope.

5. Swing thumbscrew clamps toward driver's position and align shaft point of thumbscrew clamps with detent in bottom of periscope clamping flanges.

6. Tighten thumbscrew clamps.

3-14. M61 Sight.

a. General. The reticle lamp housing is sealed to the sight case, permitting replacement of the reticle lamp without breaking the sight's seal.

b. Reticle Lamp Replacement (fig 3-12).

(1) Unscrew the reticle lamp assembly cover (fig 3-12) to gain access to the reticle lamp holder (fig 3-13).

(2) Unplug the connector (fig 3-13) and remove the reticle lamp holder (fig 3-12) from the housing.

CAUTION

Do not touch clear portion of lamp with bare hands.

(3) Replace the reticle lamp, making sure that the clear portion of the bulb will face the gunner when the holder is installed.

(4) Install the reticle lamp holder in the housing.

NOTE

A guide pin is provided on the lamp housing to properly align the reticle lamp holder in the housing (fig 3-13).

(5) Connect the connector to the reticle lamp holder (fig 3-13).

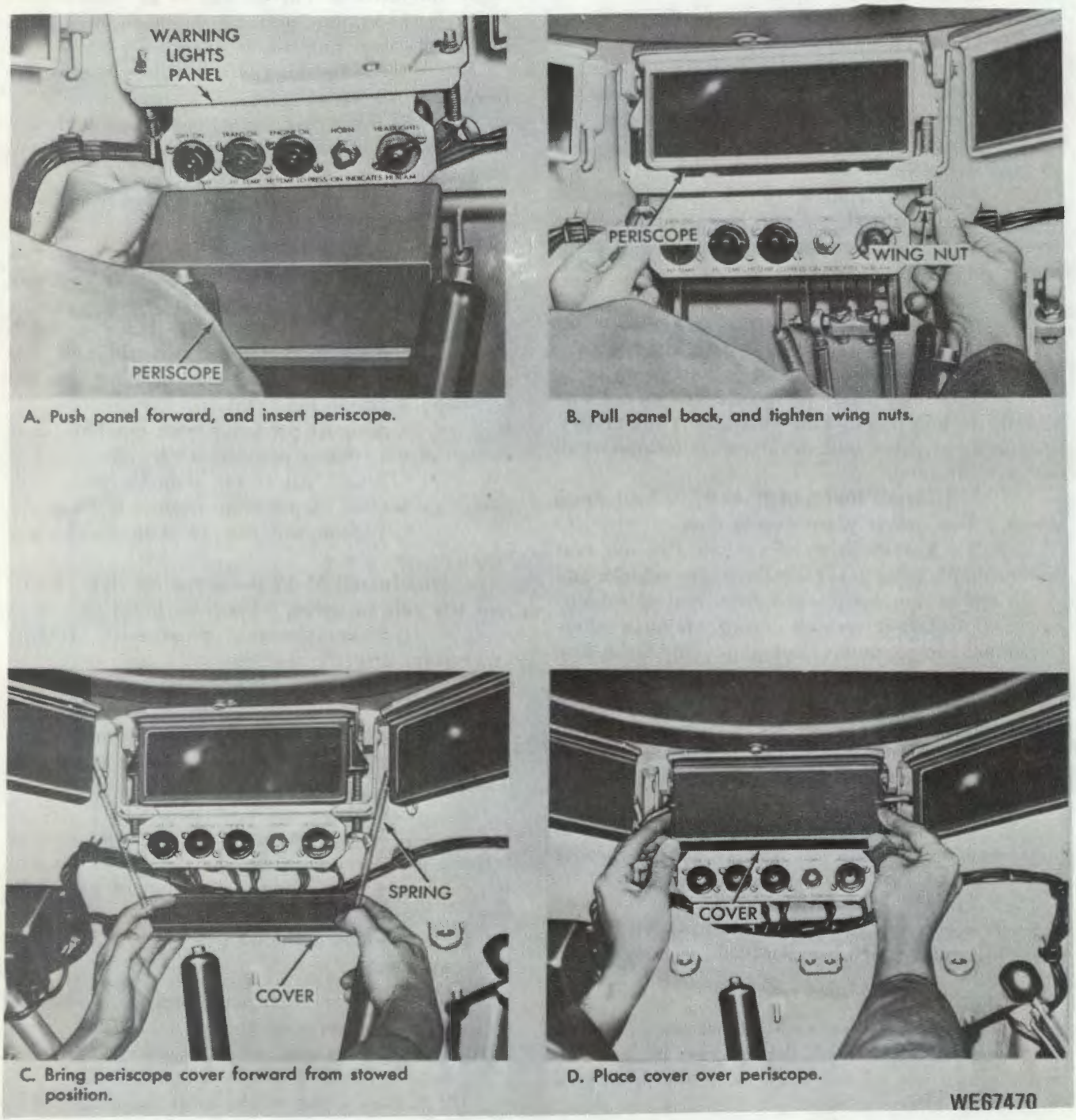


Figure 3-11. Installation of M17 periscope over warning lights panel.

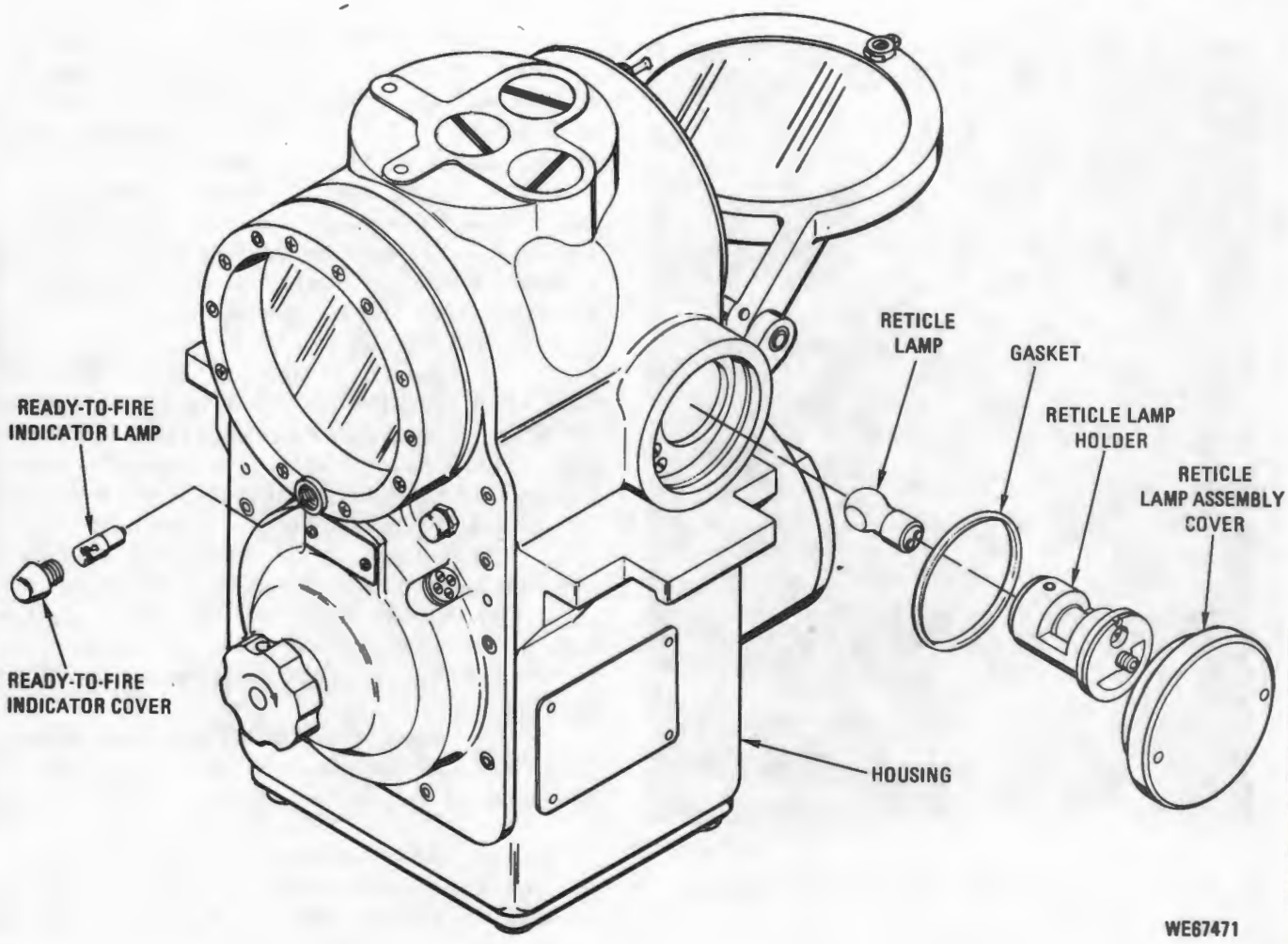


Figure 3-12. M61 sight reticle lamp removal.

(6) Check that the gasket (fig 3-12) is in place and install the reticle lamp assembly cover.

c. Ready-to-Fire Indicator Light Replacement. Refer to figure 3-12.

d. Cleaning. All glass surfaces on the sight should be cleaned with cotton and water. Dry cleaning solvent or paint thinner may be used to clean grease and oil from metal parts.

3-15. M168 Cannon.

a. Cleaning. Clean the cannon as instructed in paragraph 3-7. When cleaning barrels, use cleaning staff and bore brush saturated in lubricating oil (PL-M). After cleaning, wipe off excess oil.

b. Muzzle Clamp Assembly and Center Clamp Assembly.

(1) *Removal.*

(a) Verify that GUN POWER and SYSTEM POWER switches (fig 2-24) are in their OFF psotions.

WARNING

Check that the cannon is clear: To clear cannon, hold the BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate the barrels two complete revolutions in the firing direction.

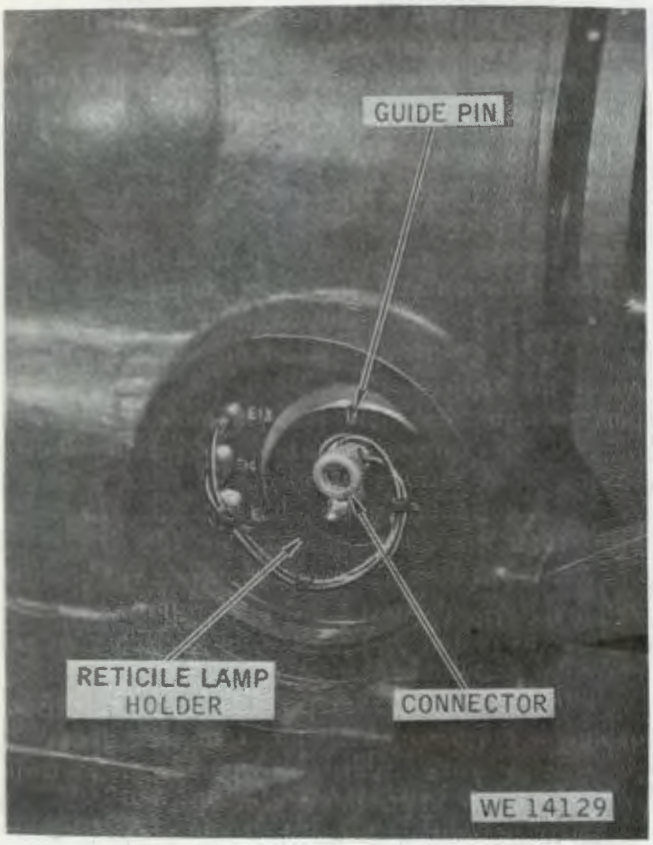


Figure 3-13. M61 sight reticle lamp holder installed.

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position for longer than 10 seconds during any given 1-minute interval.

(b) Place distribution box NORM-STATIC-TEST switch at STATIC position, and verify that arming connector is disconnected from A1J6 connector on distribution box.

(c) Remove cotter pin from center clamp and rotate locking disk in UNLOCK (clockwise) direction (as seen from muzzle) until it disengages barrels.

(d) Use soft-faced hammer to drive center clamp one to two inches toward muzzle.

(e) Loosen muzzle clamp locking bolt by turning it counterclockwise, and disengage locating pin on triangular locking plate from hole in front plate.

(f) Rotate triangular locking plate counterclockwise (as seen from muzzle) until it is free of barrels, and remove muzzle clamp, using soft-faced hammer if required.

(g) Remove center clamp.

(2) *Inspection.*

(a) Inspection of muzzle clamp assembly. Check for damaged clamp, broken weld, damaged threads on bolts or lugs on locking plate, bent or missing pin on locking plate, and defective self-locking feature of locking plate.

(b) Inspection of center clamp assembly. Check for bent or damaged barrel locking lugs, cracked or distorted locking disk, missing or damaged spring pin or retaining ring, and defective locking feature of locking disk.

(3) *Installation.*

(a) Time the cannon: Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE: depress the cannon index pin. Rotate the barrels until cannon index pin engages; release BRAKE-CLEAR AND BRAKE switch and index pin. Check that the index pin is disengaged.

(b) Position center clamp approximately one inch forward of its normal location on barrels.

(c) Position muzzle clamp with triangular locking plate in counterclockwise position on barrels and slide or drive it rearward until it hits a positive stop.

(d) Rotate muzzle clamp triangular locking plate clockwise until pin on locking plate is aligned with locating hole in front plate of muzzle clamp.

CAUTION

In step *(e)* following, torque against the gun drive motor brake only. Do not use any auxiliary means of retaining cannon to reach torque requirement.

(e) Torque muzzle clamp bolt to 650 inch-pounds.

(f) Use soft-faced hammer to position center clamp in its normal location on barrels, and secure center clamp in position by turning locking disk in LOCK (counterclockwise) direction (as seen from muzzle) until it reaches the locked position (holes in locking disk and clamp body aligned).

(g) Replace cotter pin.

c. Barrels.

(1) *Removal.*

(a) Remove muzzle clamp and center clamp as instructed in paragraph 3-15 *b* (1) preceding.

(b) Twist each barrel approximately 60 degrees in either direction and pull out of cannon rotor.

(2) *Inspection.* Inspect barrels for the following conditions:

(a) Damaged locking lugs or flanges.

(b) Cranks or bulges.

(3) *Installation.*

(a) Install barrels in reverse of removal.

(b) Install muzzle clamp and center clamp as instructed in paragraph 3-15 *b* (3).

d. Safety wire. Check that all safety wire is unbroken.

e. Breech bolt assemblies.

WARNING

Make sure cannon is clear before performing the following procedure.

(1) *Removal.*

(a) Remove gun shield, then elevate cannon to maximum elevation.

(b) Pull two bolt access cover pins and remove bolt access cover (A, fig 314).

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position for longer than 10 seconds during any given 1-minute interval.

(c) Depress and hold sector clearing cam on cannon, and hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE position. Rotate cannon until bolt is in cover area (A, fig 3-14), release BRAKE-CLEAR AND BRAKE switch, then move bolt forward to clear removable track (B).

(d) Using bolt access cover pin, release removable track by depressing the track lock pin (C); move track to the rear and out (D). Slide bolt to the rear and lift out (E). Replace removable track with large diameter hole toward the front of the cannon, and slide track forward until locking pin snaps into place (F).

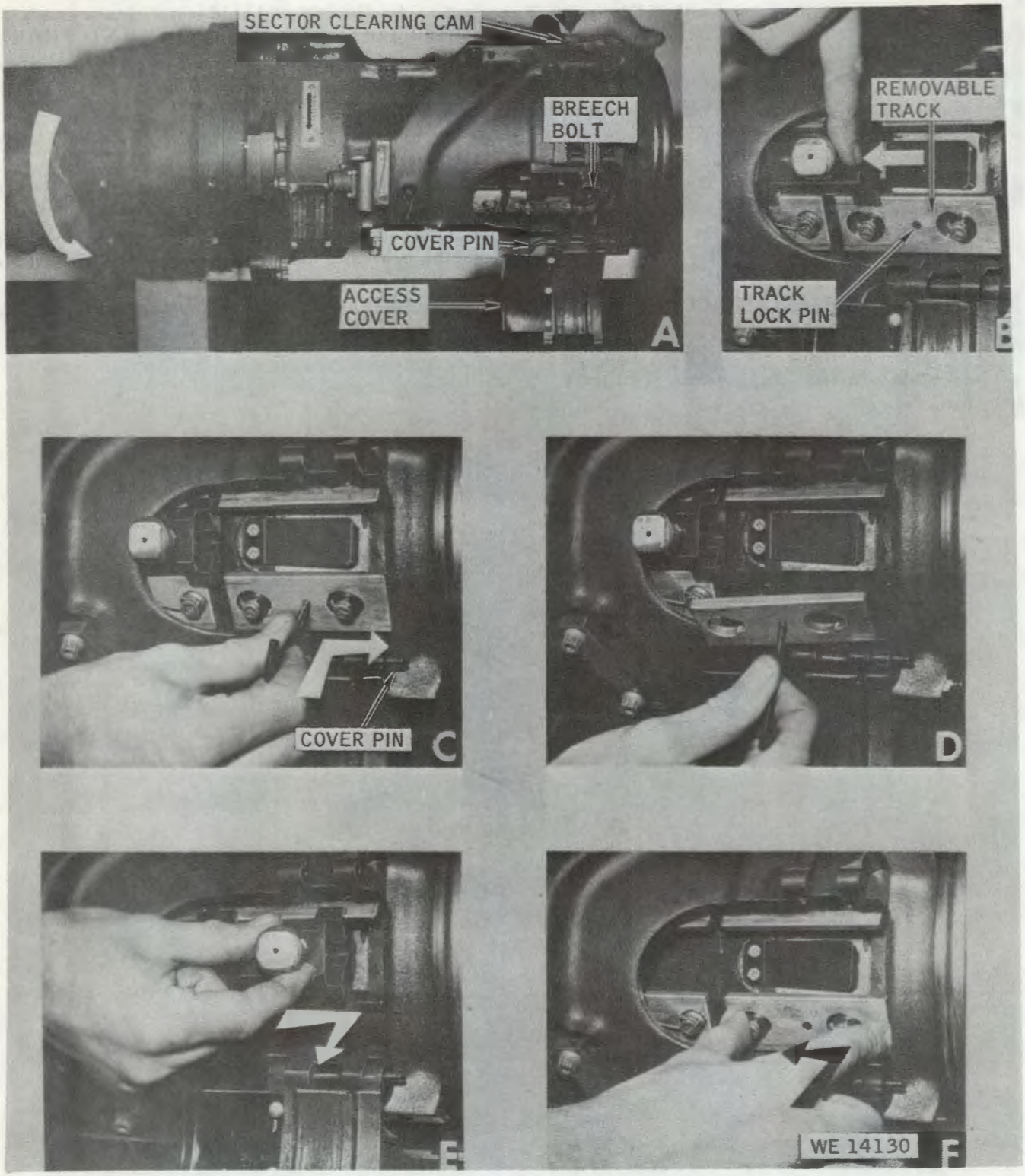


Figure 3-14. Removal and installation of breech bolt assemblies.

(e) Remove the remaining bolts in the same manner without replacing tracks.

NOTE

Leave last track on rotor after last bolt is removed.

(2) *Checks.*

(a) Check roller on bolt shaft for free movement.

(b) Check visible portion of firing cam pin insulator for cracks.

(c) Check bolt shaft for grooves, nicks, burrs and cracks.

(d) Check bolt shaft, locking block, and firing cam pin for freedom of movement.

(3) *Installation of breech bolt assemblies.*

(a) Install one side of cover using lower pin hole.

(b) Locate the one track left on rotor during the removal procedure.

(c) Install bolt on track and replace next track.

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position longer than 10 seconds during any 1-minute interval.

(d) Hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position; hold cover closed and rotate cannon to next bolt position. Release switch and open cover.

(e) Repeat steps 3 and 4 for remaining bolts.

(f) After installation of the fifth bolt, rotate cannon to position for the installation of the sixth bolt. Remove next track, install sixth bolt, and reinstall track.

(g) Close cover and install remaining pin.

(h) Lower cannon and install gun shield.

f. Rotor assembly. Remove case chute so that rotor tracks can be observed through case chute adapter.

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position longer than 10 seconds during any 1-minute interval.

Hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position. Rotate cannon in firing direction and check that safety wiring on track bolts and screws is undamaged. After check, install case chute.

3-16. M157 Mount

a. Cleaning. Clean the mount components as instructed in paragraph 3-7.

b. Inspection.

(1) *Control assembly.* Check all switches for freedom of movement and smoothness of operation. Check that guards over SYSTEM POWER and GUN POWER switches pivot smoothly over the switches. Check for chipped or flaking paint. Check markings for legibility.

(2) *Declutching feeder assembly.* Check all visible gears for burrs, nicks, defective or missing teeth. Check for elongation of pin holes, alignment, freedom of movement. Check assembly for security of mounting. Disconnect cable and check connector receptacle and plug for corrosion, alignment and cracked inserts. Check cable for abraded insulation. Reconnect cable. Check for broken safety wiring.

(3) *Distribution box.* Check for cracked or broken glass on the ammeter and voltmeter. Check assembly for security of mounting.

c. Lamp Replacement Procedures.

The control assembly contains four front panel indicator lamps. These are the READY WHEN LIT, GOOD WHEN LIT, GUN POWER, and SYSTEM POWER indicator lamps. When any of these lamps requires replacement, proceed as shown in figure 3-15.

3-17. AN/VPS-2 Radar Set

a. General. Operator corrective maintenance is limited to lamp replacement. Paragraph *c.* following provides lamp replacement procedures. Operator preventive maintenance is given in table 3-2. Paragraph *d.* following provides the detailed procedures to clean the air filter in the transmitter-receiver and power supply. These procedures are part of the weekly operator services.

b. Reflector and Feed Assembly Inspection. Inspect reflector and feed assembly (fig 1-21) as follows:

NOTE

Notify organizational maintenance if a misalignment or other defect is indicated in the following inspection.

(1) Check reflector for dents, bends or holes. Check for distortion of reflector parabolic shape.

(2) Check that feed and reflector are attached securely to reflector and feed assembly housing.

(3) Check that feed protective brackets are attached securely to reflector. Check for any distortion of feed protective brackets on reflector rim.

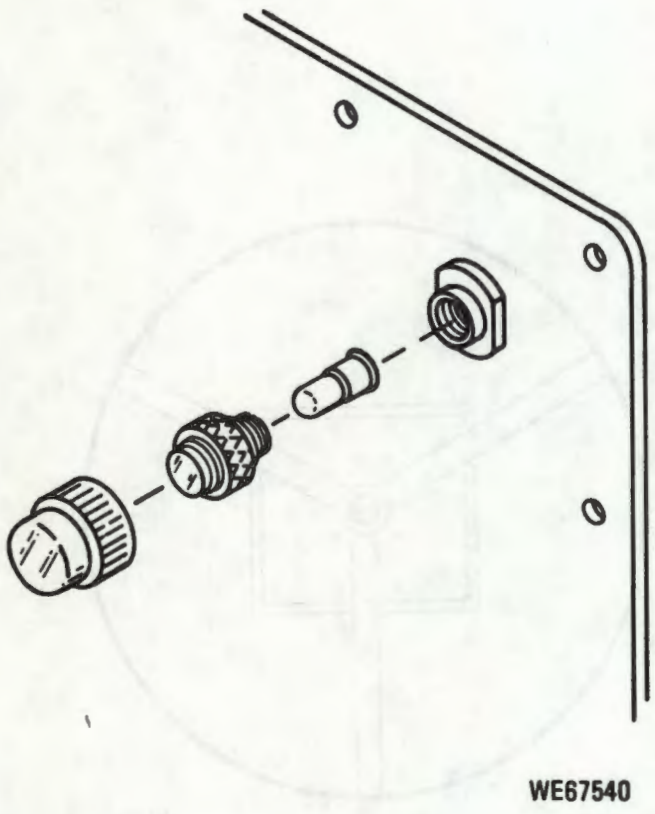


Figure 3-15. Control assembly front panel lamp replacement.

(4) Check alignment of feed to reflector by observing visually that alignment mark (white dot) on feedhorn is centered in hole provided at junction of feed protective brackets (fig. 3–16). Be sure your line of sight is centered in the hole when making this check.

c. Lamp Replacement Procedures.

(1) *Transmitter-receiver lamp replacement.*

(a) Front panel lamps. Two indicators are located on the front panel of the transmitter-receiver. These are the MODULATOR OVERLOAD indicator lamp and the HIGH-VOLTAGE POWER SUPPLY OVERLOAD indicator lamp. When either lamp requires replacement, proceed as shown in figure 3–17.

(b) Power indicator lamp replacement. The power indicator lamp is located on the inside of the transmitter-receiver front panel. When the lamp requires replacement, proceed as follows (fig. 3–18):

WARNING

High voltage is used in operation of this equipment. High voltage is present in transmitter-receiver when radar is energized to radiate. Death on contact may result if operating personnel fail to observe safety precautions.

1. Set control assembly SYSTEM POWER switch to OFF.

2. Lower transmitter-receiver front panel by turning four thumbscrews in counterclockwise direction.

3. Remove and replace lamp as shown in figure 3–18.

4. Secure transmitter-receiver front panel utilizing four thumbscrews.

(2) *Rf power indicator lamp replacement* (fig. 3–19). The rf power indicator lamp is located on the radar interconnecting waveguide. When the lamp requires replacement, proceed as shown in figure 3–19.

d. Air Filter Cleaning Procedures.

(1) *Cleaning instructions.* The air filters are washed in clear water or a solution of water and mild detergent. When filters are dipped in water to clean, they should be held vertically to avoid damage to the internal media. Procedures to remove the two air filters in the radar for cleaning are provided in (2) and (3) following.

(2) *Transmitter-receiver, air filter removal* (fig. 3–20). The air filter is located on the interior right wall of the transmitter-receiver. To remove the filter for cleaning, proceed as follows:

WARNING

High voltage is used in operation of transmitter-receiver. High voltage is present in transmitter-receiver when radar is energized to radiate. Death on contact may result if operating personnel fail to observe safety precautions.

(a) Set control assembly SYSTEM POWER switch to OFF.

(b) Lower transmitter-receiver front panel by turning four thumbscrews in counterclockwise direction.

(c) Disengage upper and lower scissor clips and open cover.

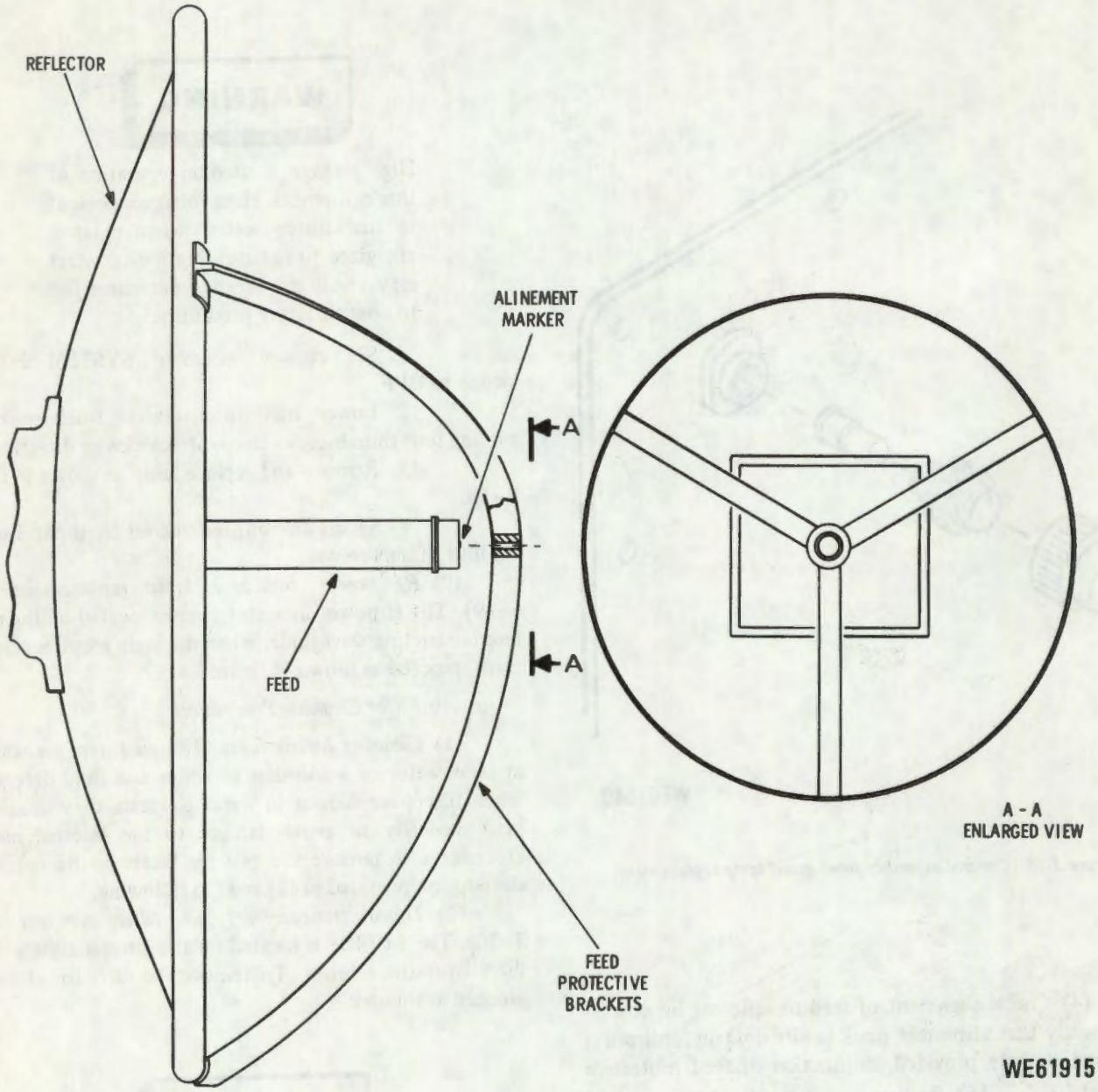


Figure 3-16. Reflector and feed assembly.

(d) Remove air filter and clean in accordance with procedure given in a preceding.

(e) Install air filter.

(f) Close cover and engage upper and lower scissor clips.

(g) Secure transmitter-receiver front panel, utilizing four thumbscrews.

(3) *Power supply air filter removal* (fig. 3–21). The air filter is located on the front of the power supply front panel assembly. To remove the air filter for cleaning, proceed as follows:

(a) Using screwdriver, turn four captive screws (1) counterclockwise to remove air filter access plate (2) and gasket (3).

(b) Remove air filter (4) by pushing filter gently, using screwdriver through louvers.

(c) Clean in accordance with procedures given in a preceding.

(d) Install air filter (4).

(e) Install gasket (3) and air filter access plate (2) by turning four captive screws (1) clockwise.

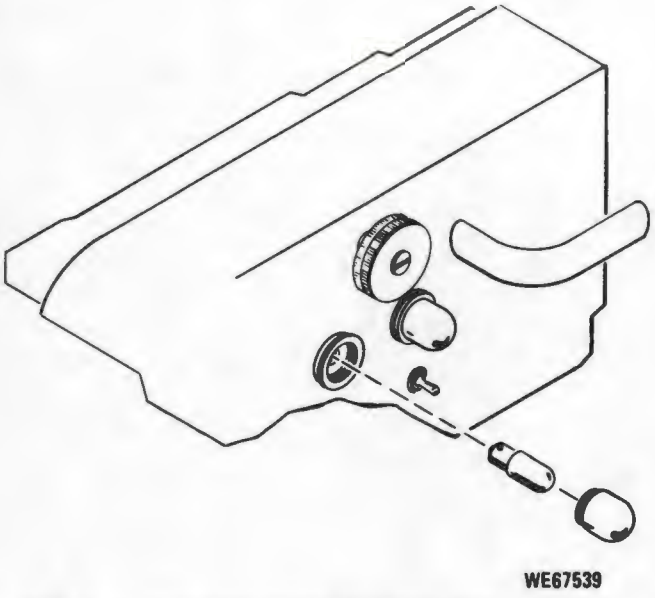


Figure 3-17. Transmitter-receiver front panel lamp replacement.

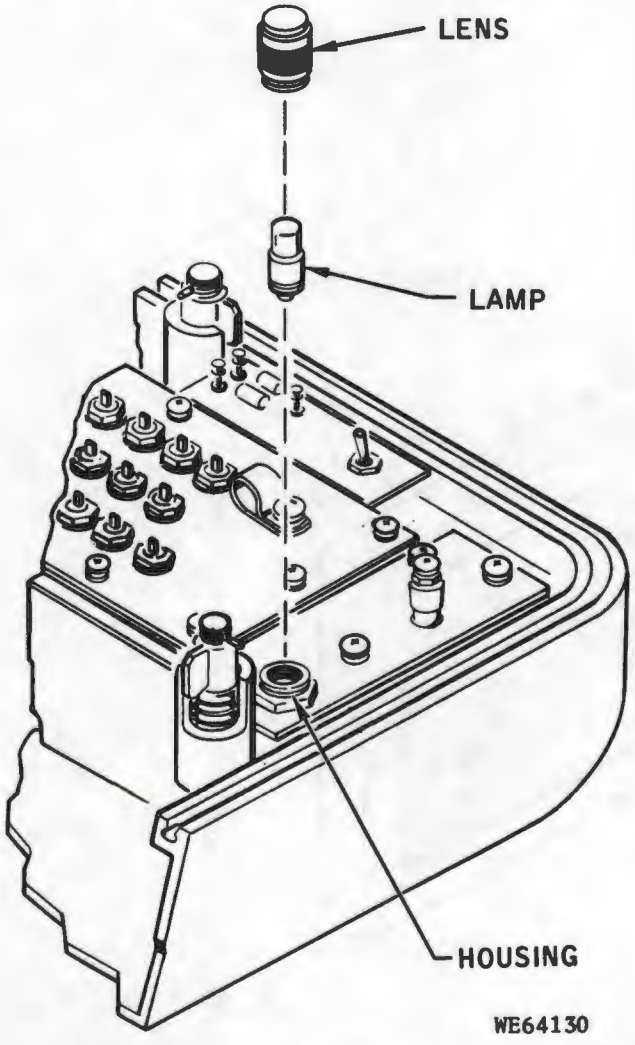


Figure 3-18. Transmitter-receiver power indicator lamp replacement.

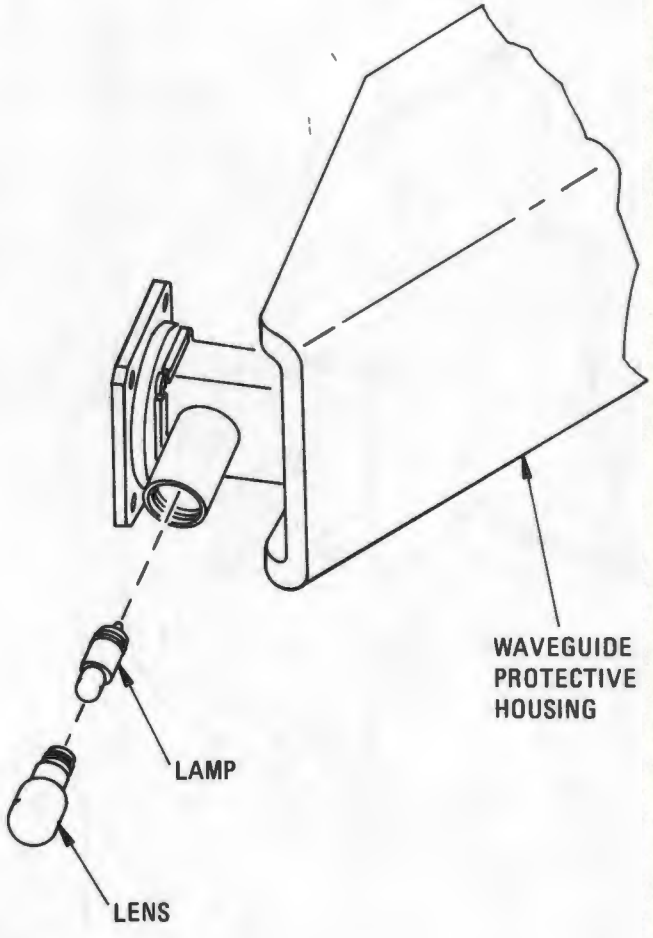


Figure 3-19. RF power indicator lamp replacement.

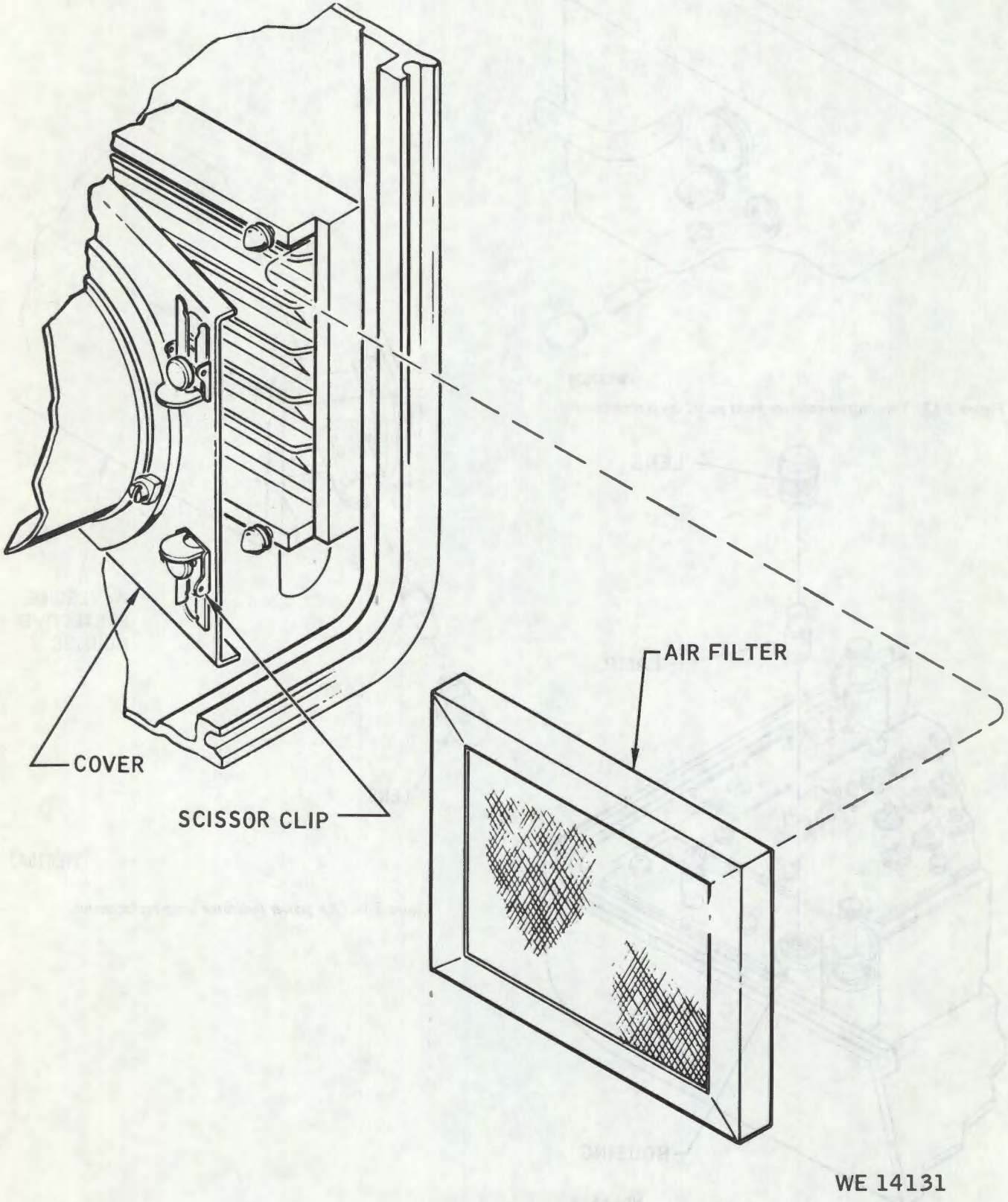


Figure 3-20. Transmitter-receiver air filter removal.

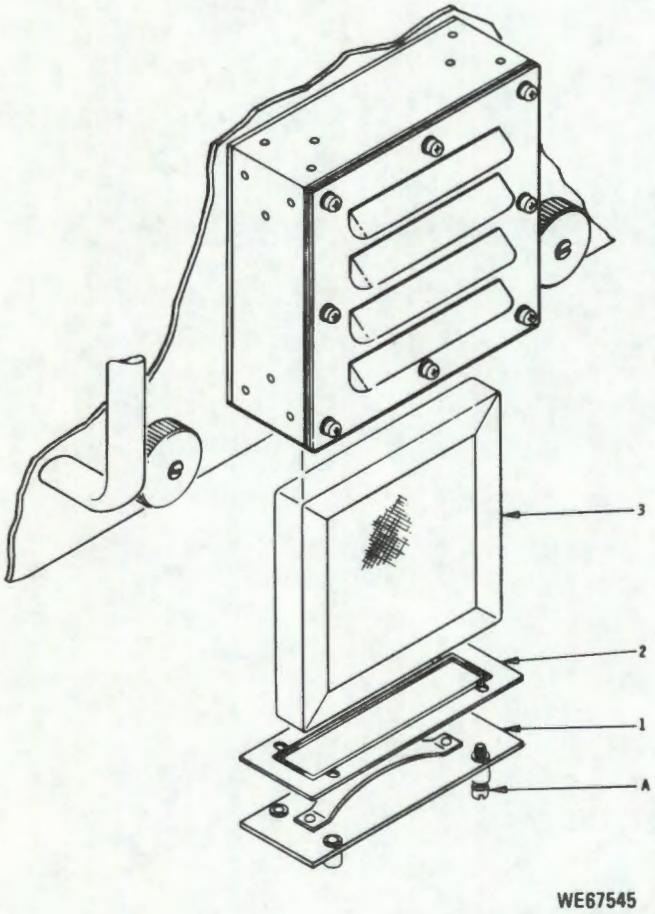


Figure 3-21. Power supply air filter removal.

CHAPTER 4

MAINTENANCE OF MATERIEL USED IN CONJUNCTION WITH MAJOR ITEM

Section I. PREVENTIVE MAINTENANCE

4-1. Communication System

Refer to TM 11-5830-340-12 for operation and maintenance of Intercommunication Set AN/VIC-1(V). Refer to TM 11-5820-401-10 for operating and maintenance instructions on communication equipment.

4-2. Personnel Compartment Heater.

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Specific preventive maintenance to be performed on the personnel compartment heater is listed in table 4-1. When performing preventive maintenance, the operator must record the sequence number and the malfunction, which is beyond his scope to repair, in accordance with requirements of TM 38-750. The preventive maintenance listed in table 4-1 should be performed in conjunction with the preventive maintenance in table 3-2.

4-3. Driver's Windshield

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. The before and after-operation preventive maintenance to be performed on the driver's windshield are listed in table 4-1. When performing these services, the operator must record the item number and the malfunction, which is beyond his scope to repair, in accordance with the requirements of TM 38-750. The preventive maintenance listed in table 4-1 should be performed in conjunction with the preventive maintenance in table 3-2.

4-4. Engine Coolant Heater

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Specific preventive maintenance to be performed on the engine coolant heater is listed in table 4-1. When performing these services, the operator must record the sequence number and the malfunction, which is beyond his scope to repair, in accordance with the requirements of TM 38-750. The preventive maintenance listed on table 4-1 should be performed in conjunction with the preventive maintenance in table 3-2.

4-4.1. Turn Signal Kit

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Specific preventive maintenance to be performed on the turn signal kit is listed in table 4-1. When performing preventive maintenance, the operator must record the sequence number and the malfunction, which is beyond his scope to repair, in accordance with requirements of TM 38-570. The preventive maintenance listed in table 4-1 should be performed in conjunction with the preventive maintenance in table 3-2.

4-5. Portable Fire Extinguisher

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Refer to table 3-2 for specific preventive maintenance procedures to be performed on the fire extinguishers.

4-6. Arm Safe Switch

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Specific preventive maintenance to be performed on the arm safe switch is listed in table 4-1. When performing these services, the operator must record the sequence number and the malfunction, which is beyond his scope to repair, in accordance with the requirements of TM 38-750. The preventive-maintenance listed in table 4-1 should be performed in conjunction with the preventive maintenance checks and services in table 3-2.

4-7. Auxiliary Power Unit (APU)

Refer to TM 5-6115-323-15 and TM 5-2805-208-14 for generator set operation and maintenance instructions.

4-8. Crew Served Weapons Night Vision Sight

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

b. Specific Procedures. Refer to TM 11-5855-202-13 for specific preventive maintenance instructions.

4-9. M164 Mount and M134 Straight Telescope

a. General Procedure. Refer to paragraph 3-7 for general preventive maintenance instructions.

Table 4-1. Preventive Maintenance of Materiel Used in Conjunction With Major Item

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily						
B	D	A	W	Item to be inspected	Procedure	Reference
					PERSONNEL COMPARTMENT HEATER	
1		..	..	Electrical system.	Check electrical circuit to heater by depressing control box PERSONNEL HEATER indicator. Indicator lamp should light (fig 2-74).	Table 2-9
..	..	16	..	Personnel heater.	Check that heater indicator lamp remains lit and blower continues to run after stopping heater, until heater is purged. **WARNING** **Do not turn off vehicle MASTER SWITCH until heater has been turned off, has purged itself, and the blower has stopped.**	Para 2-27*b* (4) *(e)*
2	..	17	..	Fuel system.	Check exposed fuel lines and connections for leaks. Before operation, open fuel shutoff cock. After operation, close fuel shutoff cock.	Fig 2-78
3	12	..	..	Personnel heater.	Start and run heater. The indicator on the control box should light when heater starts and remain lit when heater is running. Observe heater operation and quantity of exhaust smoke. Report unusual conditions to organizational maintenance.	Para 2-27*b* (4) *(b)*
4	13	18	..	Air intake, exhaust outlet, and duct assembly outlets.	Check heater air intake, exhaust outlet, and warm air duct outlets for obstructions. Openings should be free of any restrictions.	Fig 2-73
					DRIVER'S WINDSHIELD	
5	..	19	..	Windshield.	Check windshield for worn or torn canvas and strap assembly, scratched or cracked window, and broken or bent clips and supports. Make certain windshield is properly secured or stowed.	Fig 2-79
					ENGINE COOLANT HEATER	
6	..	..	..	Electrical system.	Check electrical circuit to heater with master switch on by depressing control box HEATER CONTROL indicator. Indicator lamp should light.	Table 2-10
..	..	20	..	Coolant heater.	Check that heater indicator lamp remains lit and blower continues to run after stopping, until heater is purged. **WARNING** **Do not turn off vehicle MASTER SWITCH until heater has been turned off and has purged itself.**	Para 2-27*d* (4) *(e)*

Table 4-1. Preventive Maintenance of Materiel Used in Conjunction With Major Item—Continued

Interval and sequence no.				B—Before operation D—During operation		A—After operation W—Weekly
Daily						
B	D	A	W	Item to be inspected	Procedure	Reference
7	..	21	..	Fuel system.	Check fuel lines and connections for leaks. Before operation, open shutoff cock. After operation, close shutoff cock.	Fig 2-78
8	14	..	..	Coolant heater.	Start and run coolant heater. Indicator lamp should light after heater starts and remain lit when heater is running.	Para 2-27*d*(4) *(b)*
..	15	..	..	Battery box.	Check vehicle battery box to see that box is properly closed and batteries do not overheat.	Fig 1-5B
9	..	22	..	Coolant circulating system.	Check coolant hoses and connections for leaks. Before operation, open coolant shutoff cocks (one between engine and transmission and one on coolant heater). After operation, close coolant shutoff cocks.	Figs 2-81 and 2-82
					TURN SIGNAL KIT	
9.1				Lights	Check operation of lights (if tactical situation permits) in all three operating positions.	Para 2-27*g*1
		22.1		Reflectors	Inspect reflectors for cracked, missing, or broken glass.	Fig 2-83.1
					ARM-SAFE SWITCH	
10	..	23	..	Arm-safe switch, cable and connector.	Check the cable for kinks, and cut or abraded insulation. Check connector for bent pins. Check for free operation of switch.	Fig. 2-84
					M134 STRAIGHT TELESCOPE	
11	..	24	..	M134 telescope.	Clean lens with cotton and water. Dry cleaning solvent may be used to clean grease and oil from metal parts.	

b. Specific Procedures. Specific preventive maintenance to be performed on the straight telescope M134 and M164 mount is listed in table 4-1. When performing preventive maintenance the operator must record the sequence number and the malfunction, which is beyond his scope to repair, in accordance with the requirements of TM 38-750. The preventive maintenance listed in table 4-1 should be performed in conjunction with the preventive maintenance in table 3-2.

4-10. Gunner's Quadrant.

a. General Procedures. Refer to paragraph 3-7 for general maintenance instructions.

b. Specific Procedures. Refer to TM 9-1527 for specific preventive maintenance instructions.

Section II. CORRECTIVE MAINTENANCE

4-11. General.

This section provides information useful to the operator / crew in diagnosing and correcting unsatisfactory operation or failure of the personnel compartment heater, the engine coolant heater, and the turn signal kit. If other materiel used in conjunction with the major item fails, refer to applicable TM.

4-12. Procedure.

Table 4-2 lists possible malfunctions, probable causes, and corrective actions that can be performed by the operator / crew. Wherever applicable, probable causes are listed in their order of probability and should be checked in that order during fault isolation.

NOTE

Prior to taking corrective action on any electrical component, assure that the chassis batteries are charged (para 3-13 *g* (2) *(c)*) and all cable connectors are tight.

Table 4-2. Fault Isolation of Personnel Compartment Heater, Engine Coolant Heater, and Turn Signal Kit.

Malfunction	Probable Cause	Corrective Action
PERSONNEL COMPARTMENT HEATER		
1. Personnel heater fails to start with RUN-OFF-START switch held in START position.	*a.* MASTER SWITCH turned off. *b.* Fuel shutoff cock turned off. *c.* Other malfunction.	*a.* Turn MASTER SWITCH on. *b.* Open fuel shutoff cock. *c.* Notify organizational maintenance.
2. Personnel heater overheats and stops burning.	*a.* Restricted air circulating system.	*a.* Check heater air inlet, heater exhaust outlet, and duct assembly outlets for restrictions.
	b. Other malfunction.	*b.* Notify organizational maintenance.
3. Personnel heater overheats and continues to burn.	Defective heater assembly.	Turn fuel shutoff cock off, and notify organizational maintenance.
4. Personnel heater output too low.	*a.* Heater HI-LO switch in LO position.	*a.* Move switch to HI position.
	b. Other malfunction.	*b.* Notify organizational maintenance.
5. Personnel heater smokes excessively or "bangs" when starting. **NOTE** If ignition is delayed, the exhaust may be smoky immediately after ignition, but should clear after a few minutes of operation.	Defective heater assembly.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
6. Personnel heater-blower does not stop when RUN-OF-START switch is placed in OFF position. **NOTE** Heater will continue to run a minute or so until purged of fuel under normal conditions.	Defective heater assembly.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
7. Odor of fuel in air circulating system.	Defective heater assembly.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
8. Personnel heater-blower runs, but heater fails to ignite.	*a.* Fuel shutoff cock turned off. *b.* Other malfunction.	*a.* Open fuel shutoff cock. *b.* Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.

Table 4-2. Fault Isolation of Personnel Compartment Heater, Engine Coolant Heater, and Turn Signal Kit—Continued

Malfunction	Probable Cause	Corrective Action
ENGINE COOLANT HEATER		
9. Coolant heater fails to start when RUN-OFF-START switch is in START position.	*a.* MASTER SWITCH turned off. *b.* Fuel shutoff cock turned off. *c.* Other malfunction.	*a.* Turn MASTER SWITCH on. *b.* Open fuel shutoff cock. *c.* Notify organizational maintenance.
10. Coolant heater blower runs when RUN-OFF-START switch is in START position but heater does not ignite.	*a.* Fuel shutoff cock turned off. *b.* Other malfunction.	*a.* Open fuel shutoff cock. *b.* Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
11. Coolant heater blower runs when RUN-OFF-START switch is in START position and heater ignites, but indicator does not light.	Defective indicator lamp.	Notify organizational maintenance.
12. Coolant heater starts and runs but goes out later.	*a.* Restricted fuel supply. *b.* Restricted coolant circulating system. *c.* Other malfunction.	*a.* Open fuel shutoff cock. *b.* Open shutoff cocks on engine and at heater. *c.* Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
13. Coolant heater overheats.	Restricted coolant circulating system.	Open shutoff cocks on engine and heater. If heater still overheats, stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
14. Coolant heater output low.	*a.* HI-LO switch in LO position. *b.* Other malfunction.	*a.* Set HI-LO switch to HI. *b.* Notify organizational maintenance.
15. Coolant heater smokes excessively. **NOTE** If ignition is delayed, the exhaust may be smoky immediately after ignition, but should clear up after a few minutes of operation.	Defective heater.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
16. Coolant heater blower does not stop when RUN-OFF-START switch is in OFF position. **NOTE** Heater will continue to run a minute or so until purged of fuel under normal conditions.	Defective heater.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
17. Vehicle batteries overheat during heater operation.	*a.* Air temperature too high for heater operation. *b.* Engine operating. *c.* Other malfunction.	*a.* Heater operation not required above -25° F. *b.* Do not operate engine for extended periods of time with coolant heater operating. *c.* Notify organizational maintenance.
TURN SIGNAL KIT		
18. Lights do not flash with control lever in operating position.	*a.* Master switch not turned to ON position. *b.* Driving light selector switch not in STOP or SER DRIVE. *c.* Defective signal control assembly, flasher, or electrical circuit.	*a.* Turn master switch to ON position. *b.* Position driving light selector switch in STOP or SER DRIVE position. *c.* Notify organizational maintenance personnel.
19. Front turn signal light or rear stoplight-taillight does not flash with control lever in operating position.	Defective lamp or electrical circuit.	Notify organizational maintenance personnel.

CHAPTER 5
AMMUNITION

5-1. General.

This chapter contains a description of 20MM ammunition intended for use with the gun. Federal stock numbers and pertinent data for the standard ammunition are listed in SC-1305/30 IL.

5-2. Ammunition Types.

WARNING

Rechambering of cartridges is prohibited. Rechambering of unfired cartridges can result in premature discharge or detonation of projectile, or in a misfire condition that can damage equipment or cause injury or death of personnel. Any cartridges that have been chambered and later extracted unfired will be disposed of in accordance with TM 9-1900 and TM 9-1300-206.

a. High-Explosive Incendiary With Tracer Self-destroying (HEIT-SD), M246 (fig. 5–1). This cartridge is assembled with an M505A3 point detonating (PD) fuze. The projectile, in addition to the M505A3 fuze, consists of an HEI charge, self-destruct relay charge, and a tracer charge. These charges form the self-destruct chain. The tracer burns for about 3 to 7 seconds, whereupon the relay charge is ignited which detonates the HEI charge at low order. If impact with a target occurs, prior to self-destruction, the M505A3 fuze causes the HEI charge to detonate high order. This cartridge is for use against aerial targets.

b. High-Explosive Incendiary (HEI), M56A3 (fig. 5–2). This cartridge is for use against ground targets, including lightly armored vehicles, functioning with both explosive and incendiary effect. The projectile consists of an HEI charge and is assembled with the M505A3 fuze. The M505A3 fuze is a point-detonating, single-action fuze intended to function on impact with the target.

c. Target Practice-Tracer (TP-T), M220 (fig. 5–3). This cartridge is for practice and training. The projectile is similar to the M56A3 projectile, but has no HEI charge and

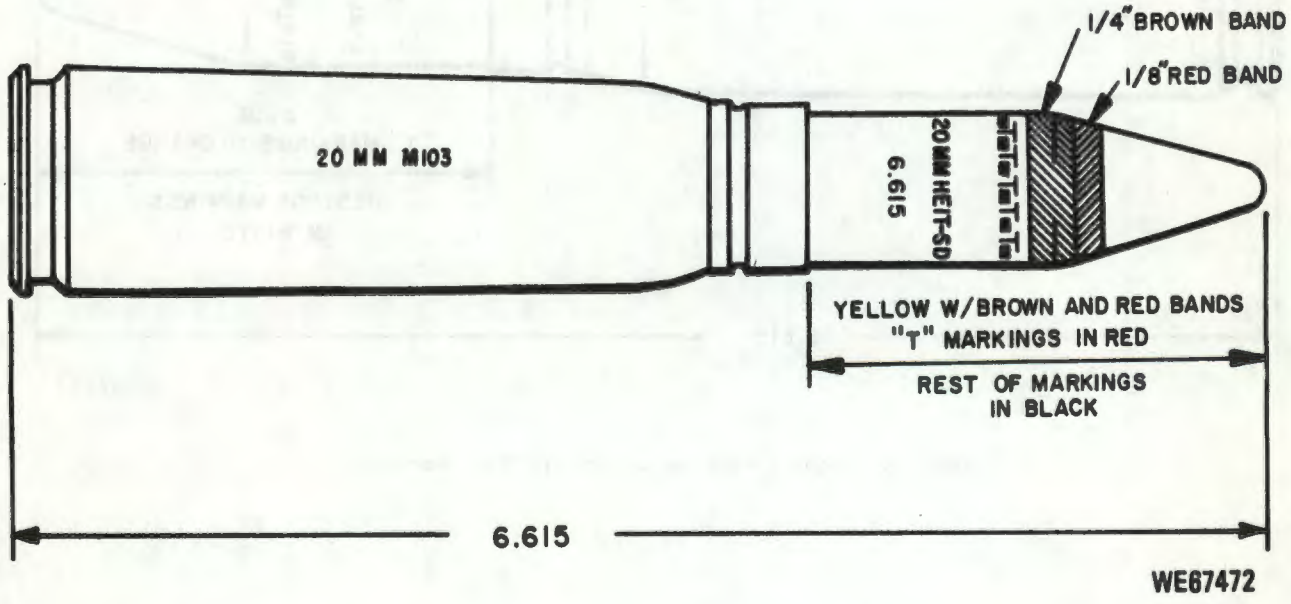


Figure 5-1. Marking of high-explosive, incendiary with tracer, self-destroying (HEIT-SD) M246 cartridge.

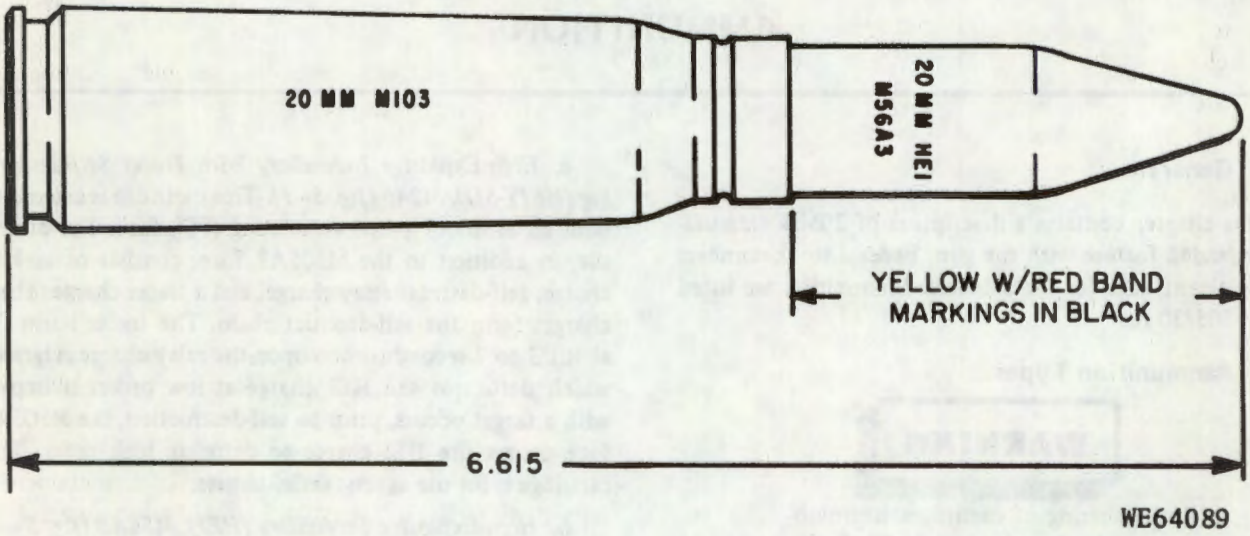


Figure 5-2. Marking of high-explosive, incendiary (HEI) M56A3 cartridge.

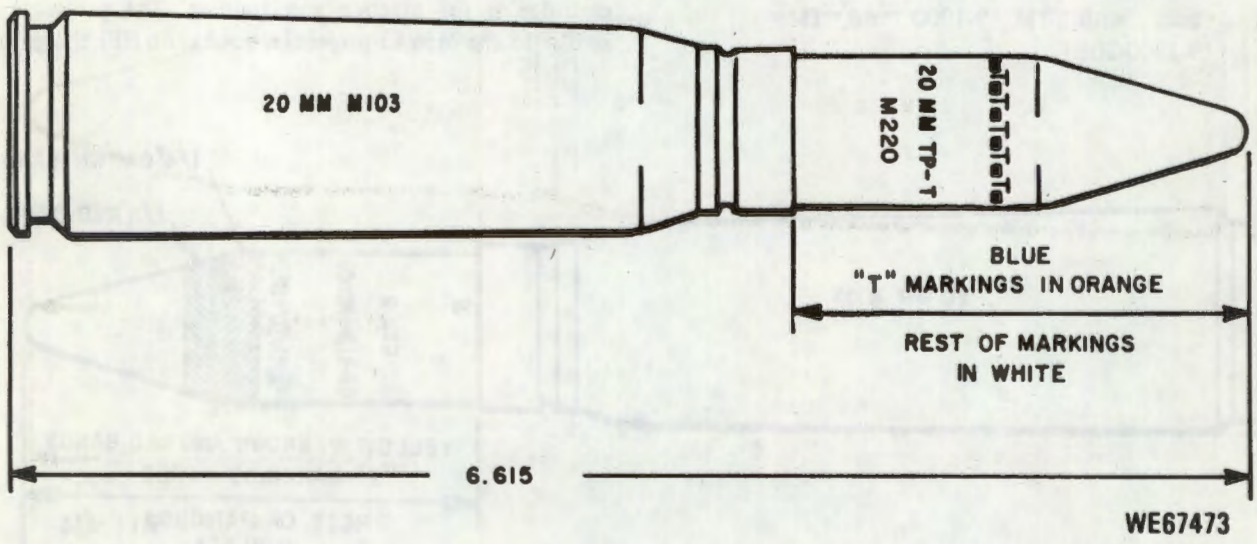


Figure 5-3. Marking of target practice-tracer (TP-T) M220 cartridge.

is assembled with a dummy fuze. The projectile does contain a tracer composition which burns visibly for a minimum of 1.9 seconds.

d. Target Practice (TP), M55A2 (fig. 5–4). This cartridge is for practice and proof-firings. The projectile is similar to the M56A3 projectile, but is hollow and contains no HEI charge or tracer.

e. Dummy, M51A1B1 (fig. 5–5). The dummy is a completely inert assembly used for filling the conveyor system during shipment or storage and for nonfiring system checkout.

5-3. Identification of Ammunition.

a. Color Code. The ammunition is painted as shown in figures 5–1 through 5–5 to provide a ready means of identification. The color codes used are listed in table 5–1.

b. Marking. The caliber, type, model, and lot number are marked on the projectile.

5-4. Preparation for Firing.

Ammunition will be visually inspected to assure that it is clean, free of grease, and free of dents, scratches, or corrosion. Ammunition with dents, burrs, or other deformities will not be used.

5—5. Care, Handling, and Preservation.

a. Explosive ammunition must be handled with appropriate care at all times. Explosive elements such as primers and fuzes are sensitive to excessive shock, electrical discharge, and temperature.

b. Keep ammunition in a serviceable condition and ready for immediate use as follows:

(1) Store ammunition in original containers in a dry, well-ventilated place protected from rays of sun and other sources of excessive heat.

(2) Keep ammunition and its container clean and dry and protected from possible damage.

(3) Disassembly of components of ammunition, such as fuzes and primers, is strictly prohibited. Any alteration of ammunition is hazardous and shall not be undertaken. Relinking of ammunition is permitted.

(4) Do not open sealed ammunition containers or remove protective or safety devices until just before use.

(5) Return ammunition, prepared for firing but not fired, to its original packing and mark it appropriately. Use such ammunition first in subsequent firings in order to keep stocks of opened packages at a minimum.

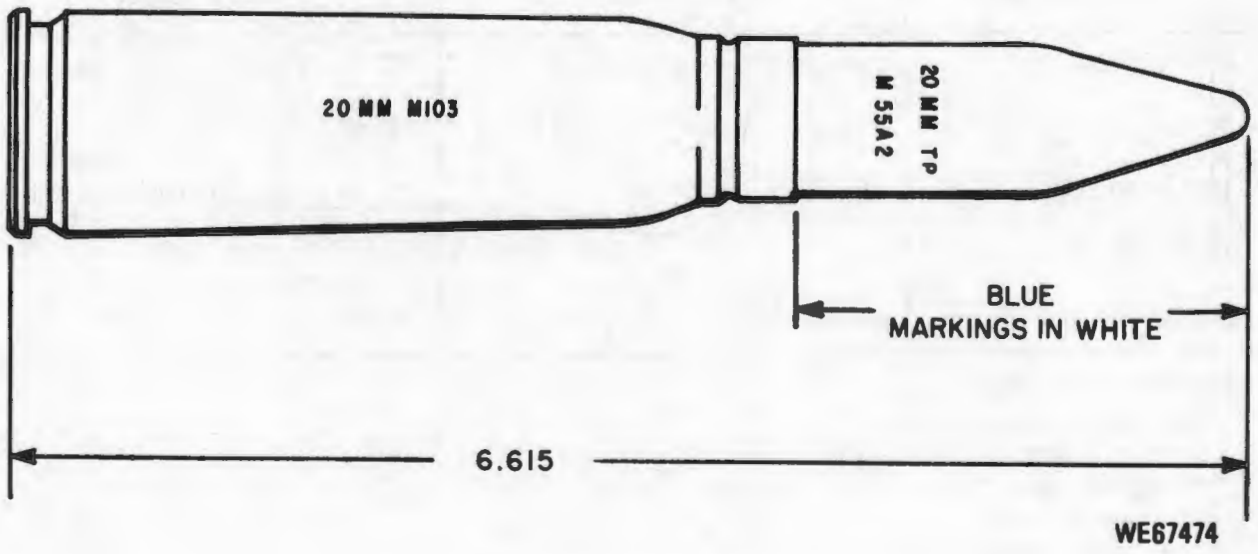


Figure 5-4. Marking of target practice (TP) M55A2 cartridge.

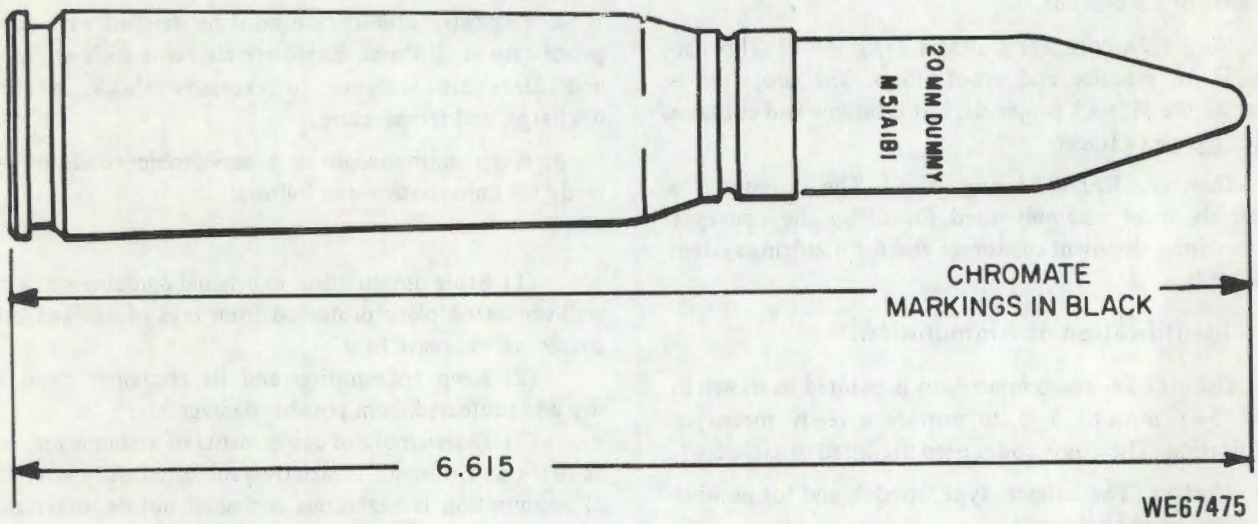


Figure 5-5. Marking of dummy M51A1B1 cartridge.

Table 5-1. Color Codes of Ammunition

Kind of ammunition	Color of projectile	Color of marking
HEIT-SD M246	Yellow w/brown and red bands	"T" in red, rest of markings black
HEI, M56A3	Yellow w/red band	Black
TP-T, M220	Blue	"T" in orange, rest of markings white
TP, M55A2	Blue	White
Dummy, M51A1B1	Chromate	Black

Explanation of symbols:

HEI – high-explosive incendiary
HEIT – high-explosive incendiary tracer
SD – self-destruct
TP – target practice
TP-T – target practice-tracer

APPENDIX A
REFERENCES

A-1. Publication Indexes

The following indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this manual.

Military Publications:

Index of Blank Forms	DA Pam 310-2
Index of Doctrinal, Training, and Organizational Publications (Field Manuals, Reserve Officers' Training Corps Manuals, Training Circulars, Army Training Programs, Army Subject Schedules, Army Training Tests, Firing Tables and Trajectory Charts, Tables of Organization and Equipment, Type Tables of Distribution and Tables of Allowances)	DA Pam 310-3
Index of Modification Work Orders	DA Pam 310-7
Index of Supply Catalogs and Supply Manuals (Excluding Types 7, 8, and 9)	DA Pam 310-6
Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9) Supply Bulletins and Lubrication Orders	DA Pam 310-4

A-2. Supply Catalogs

FSC Group 13 Ammunition and Explosives (Class 1305)	SC 1305/30 IL
FSC Group 13 Ammunition and Explosives (Class 1305)	SC 1305/30 ML

A-3. Other Publications

a. Camouflage.

Camouflage, Basic Principles and Field Camouflage	FM 5-20

b. Decontamination.

Chemical, Biological, and Nuclear Defense	FM 21-40
Chemical, Biological, and Radiological (CBR) Decontamination	TM 3-220

c. Destruction to Prevent Enemy Use.

Demolition Materiels and Methods	TM 5-220
Explosives and Demolitions	FM 5-25

d. General.

Ammunition, General	TM 9-1900
Army Equipment Record Procedures	TM 38-750
Basic Cold Weather Manual	FM 31-70
Care, Handling, Preservation and Destruction of Ammunition	TM 9-1300-206
Cleaning of Ordnance Materiel	TM 9-208-1
Color and Marking: Military Vehicles	TB 746-93-1
Driver Selection, Training, and Supervision, Full Tracked Vehicle	TM 21-301
Lubrication of Ordnance Materiel	TM 9-273
Manual for the Tracked Combat Vehicle Driver	TM 21-306

Northern Operations	FM 31-71
Operation and Maintenance of Army Materiel in Extreme Cold Weather 0° to -65°	TM 9-207
Painting Instructions for Field Use	TM 9-213
20MM and 30MM Ammunition: Rechambering of Cartridges Prohibited	TB ORD 612

e. Maintenance.

Lubrication Order, Gun, Antiaircraft Artillery, Self-Propelled: 20-mm, XM163	LO 9-2350-300-10
ESC, Gun, Antiaircraft Artillery, Self-propelled: 20-mm, XM163	TM 9-2350-300-ESC
Operation and Organizational, Field, and Depot Maintenance: Storage Batteries, Lead-Acid Type	TM 9-6140-200-15
Operator and Organizational Maintenance Manual Intercommuniation Set AN/VIC-1 (V)	TM 11-5830-340-12
Operator and Organizational Maintenance Manual Nickel-Cadmium Storage Batteries	TM 11-6140-203-12
Operator, Organizational, DS, GS, and Depot Maintenance Manual: Engine, Gasoline, 3 HP, Military Standard Models (Model 2A016-1, FSN 2805-601-5127); (Model 2A016-2, FSN 2805-714-8553); (Model 2A016-3, FSN 2805-072-4871). (TO 38G2-103-2; TM 03521A-14)	TM 5-2805-208-14
Operator, Organizational and DS Maintenance Manual (Including Repair Parts and Special Tool Lists): Night Vision Sight, Crew Served Weapons, AN/TVS-2	TM 11-5855-202-13
Operator, Organizational, Direct and General Support, and Depot Maintenance Manual Including Repair Parts List: Generator Set, Gasoline Engine Driven: Air-cooled, Skid Shock-Mounted, Tubular Frame (Less Engine) Military Design: 1.5 KW AC, 60 HZ (DOD Model MEP-015A) FSN 6115-889-1446 and Military Design; 1.5 KW, DC, 28 Volt (DOD Model MEP-025A) FSN 6115-017-8236	TM 5-6115-323-15
Operator, Organizational, Direct and General Support Maintenance Manual Including BIIL and Repair Parts / Special Tools List: Small Arms Targets and Target Material	TM 9-6920-210-14
Operator's Manual, Radio Sets AN/VRC-12 and AN/VRC-43, -44, -45, -46, -47, -48, and -49	TM 11-5820-401-10
Gunner's Quadrants M1 and M1918 and Machine Gun Clinometer M1917	TM 9-1527

APPENDIX B

BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Section I. INTRODUCTION

B-1. Scope

This appendix lists basic issue items and items troop installed or authorized required by the crew / operator for operation of the M163 system.

B-2. General

This basic issue items and items troop installed or authorized list is divided into the following sections:

a. Basic Issue Items List—Section II. A list, in alphabetical sequence, of items absolutely essential for operation of the end item, which are furnished with and must be turned in with the end item.

b. Items Troop Installed or Authorized List—Section III. A list, in alphabetical sequence, of items required by the operator for sustained operation of the end item. These discretionary items will be requisitioned by the unit in accordance with its mission requirements. They may accompany the end item, but are not subject to be turned in with it.

B-3. Explanation of Columns

The following provides an explanation of columns found in the tabular listings.

a. Federal Stock Number. Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

b. Description. Indicates the Federal item name and a minimum description required to identify the item. The last line indicates the reference number followed by the applicable Federal Supply Code for Manufacturer (FSCM) in parentheses. The FSCM is used as an element in item identification to designate manufacturer or distributor or Government agency, etc., and is identified in SB 708-42.

c. Unit of Measure (U / M). Indicates the standard or basic quantity by which the listed item is used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, e.g., ea, in., pr, etc, and is the basis used to indicate quantities and allowances in subsequent columns.

d. Quantity Furnished with Equipment (Basic Issue Items Only). Indicates the quantity of the item furnished with the equipment.

e. Quantity Authorized (Items Troop Installed or Authorized Only). Indicates the quantity of the item authorized to be used with the equipment.

f. Illustrations (Basic Issue Items Only). This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration on which the item is shown.

(2) *Item number.* Indicates the callout number used to reference the item on the illustration.

Section II. BASIC ISSUE ITEMS LIST

(1) Federal Stock No.	(2) DESCRIPTION Reference Number & Mfr. Code Usable on Code	(3) Unit of Meas	(4) Qty Furn With Equip	(5) ILLUSTRATION (a) Fig No.	(b) Item No.
4931-997-4568	BORESIGHT KIT ASSEMBLY: 10545540 (19200) Composed of: 1—ADAPTER, MUZZLE 1—CASE, BORESIGHT KIT 4—KEY, SOCKET HEAD SCREW 1—MANDREL ASSEMBLY, MATCHED 1—TELESCOPE, ELBOW, M109	EA	1	1-18 and B-1	9
1005-936-5387	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL, BRANCHED: 8437142 (19204)	EA	1	B-1	12
1305-157-4616	CARTRIDGE, 20-MM DUMMY, M51A1B1: (100 CTG / MTL BOX) 11075758 (19201)	BX	200	B-1	1
1240-782-9652	CASE, CARRYING: TELESCOPE 10553971 (19200)	EA	1	B-1	7
1005-754-5291	CLAMP ASSEMBLY, MUZZLE: (FOR GROUND MODE USE) 11010336 (19204)	EA	1	B-1	5
1005-888-3999	COVER, ANTENNA: 8437624 (19204)	EA	1	B-1	11
1005-226-2663	COVER, TURRET: 8437623 (19204)	EA	1	B-1	10
4210-270-4512	EXTINGUISHER, FIRE, CARBON DIOXIDE: MILE468, Type 1, Class 1 (81349)	EA	1	B-1	14
6545-922-1200	FIRST AID KIT, GENERAL PURPOSE: 57K340-12 (80244)	EA	1	B-1	16
6115-017-8236	GENERATOR SET, GASOLINE ENGINE: 13213E2700 (73239)	EA	1	B-1	18
1005-936-5385	LINK, LOADING, LEADING: 8437138 (19204)	EA	6	B-1	2
1005-936-5386	LINK, LOADING, TAIL: 8437139 (19204)	EA	6	B-1	3
4925-787-9803	LINKER-DELINKER, HAND: M25 7790853 (19204)	EA	1	B-1	13
8415-266-8843	MITTEN, CLOTH: ASBESTOS MILM11199 (81349)	EA	2	B-1	15
1290-891-9999	QUADRANT, FIRE CONTROL: M1A1 7197156 (19200)	EA	1	B-1	4
1265-997-4569	RANGE CONTROL ASSEMBLY, EXTERNAL: 10545548 (19200)	EA	1	B-1	8
5120-010-7915	SCREWDRIVER, FLAT TIP: CB416-6 (11728)	EA	1	B-1	17
1005-824-4485	SWITCH AND LEAD ASSEMBLY: ARM-SAFE 8437361 (19204)	EA	1	B-1	6

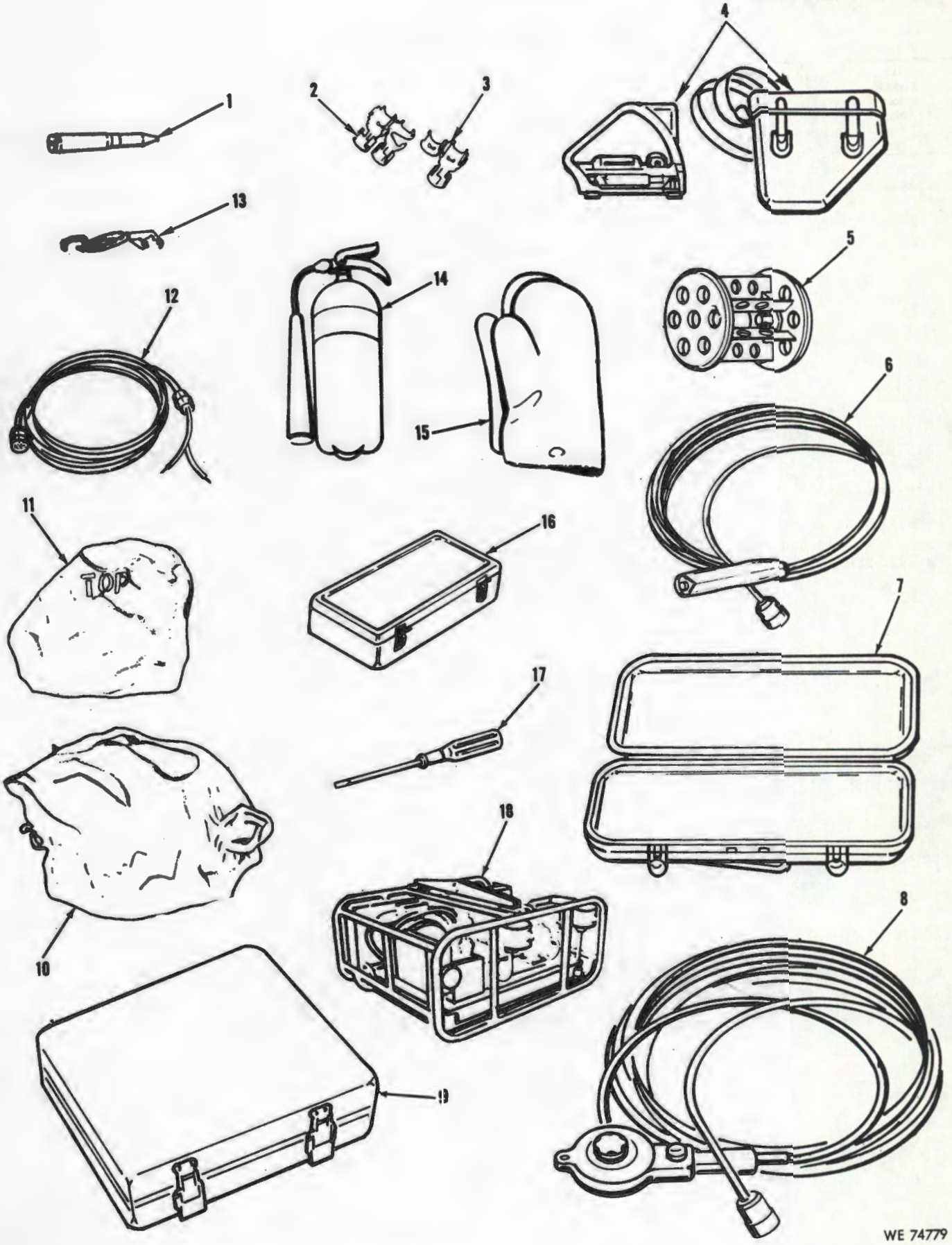


Figure B-1. Basic issue items.

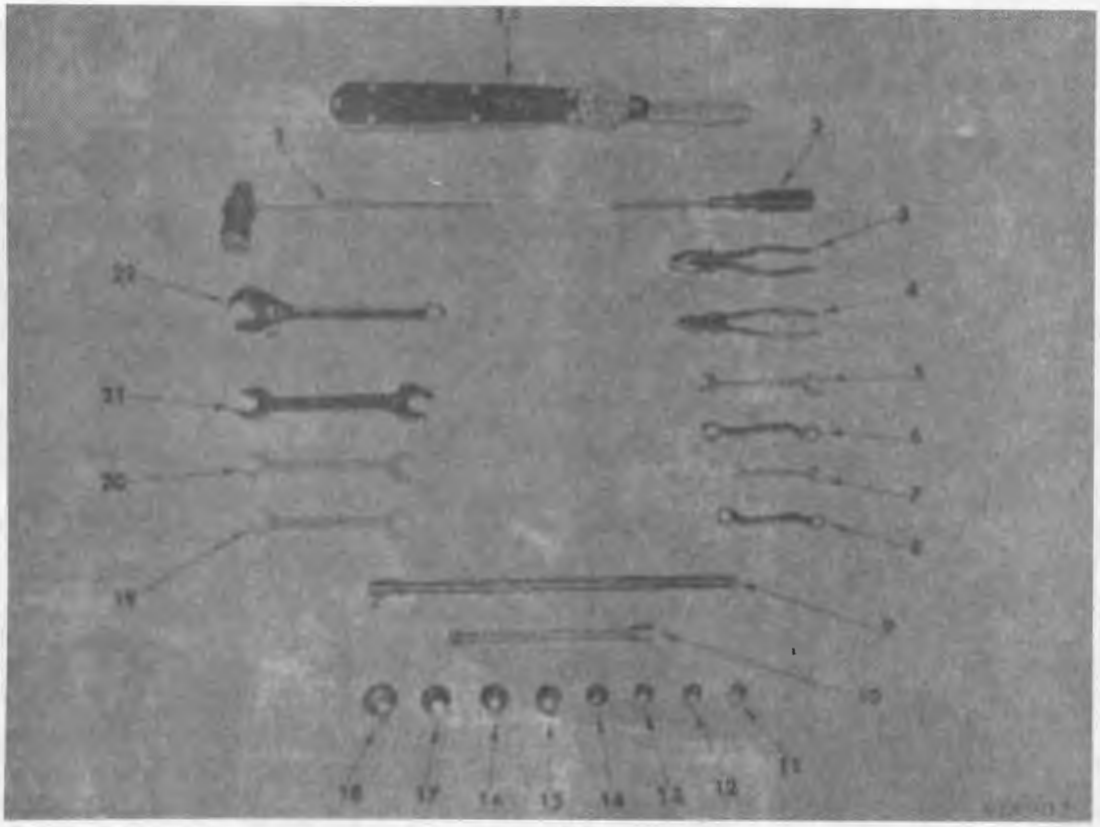


Figure B-2. Stowed items.

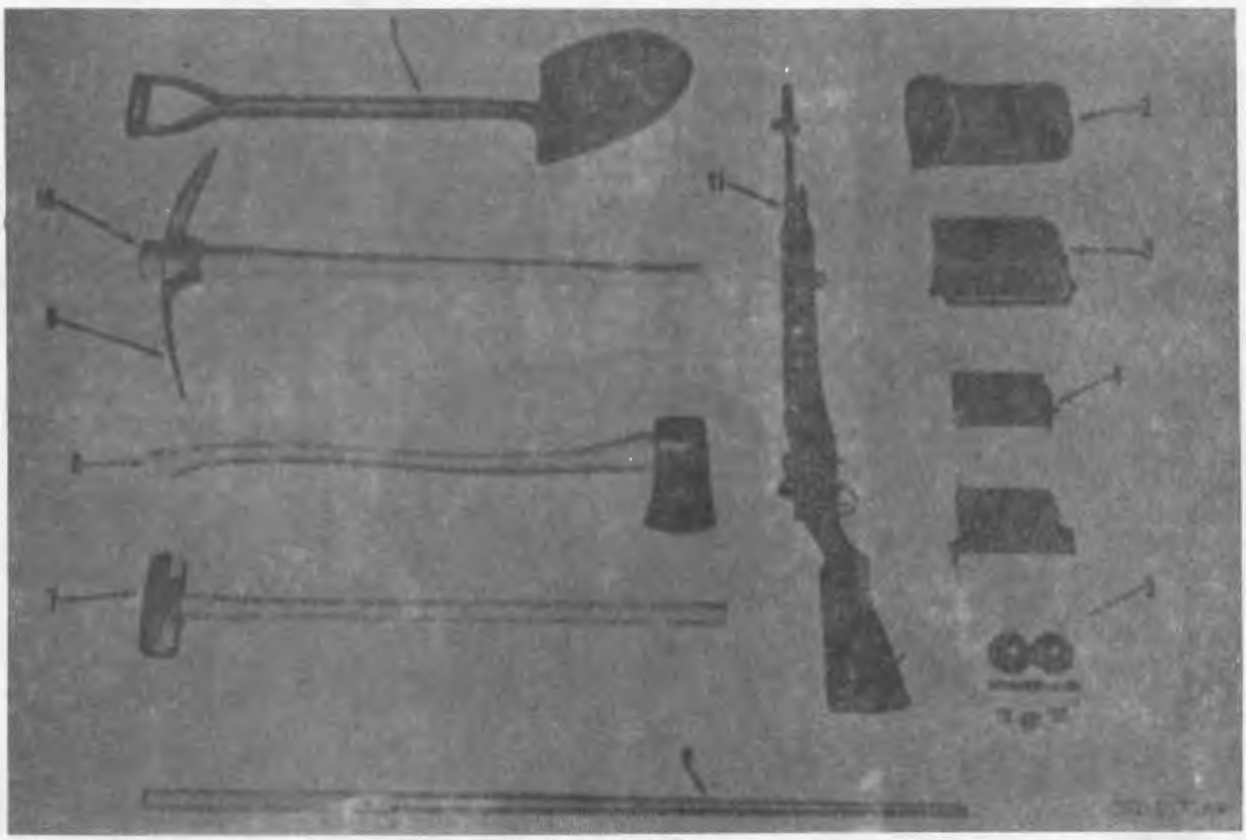


Figure B-3. Stowed items.

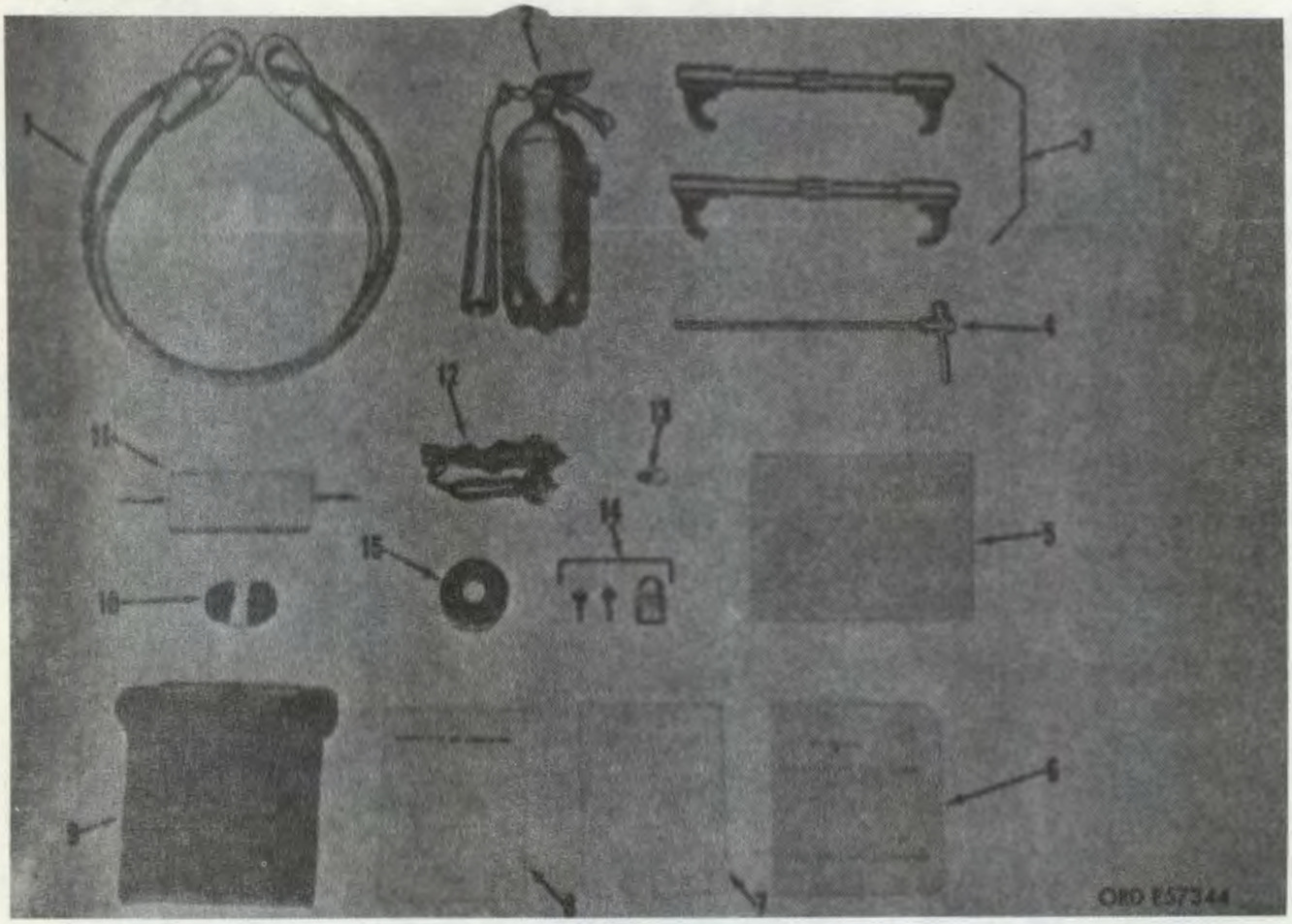


Figure B-4. Stowed items.

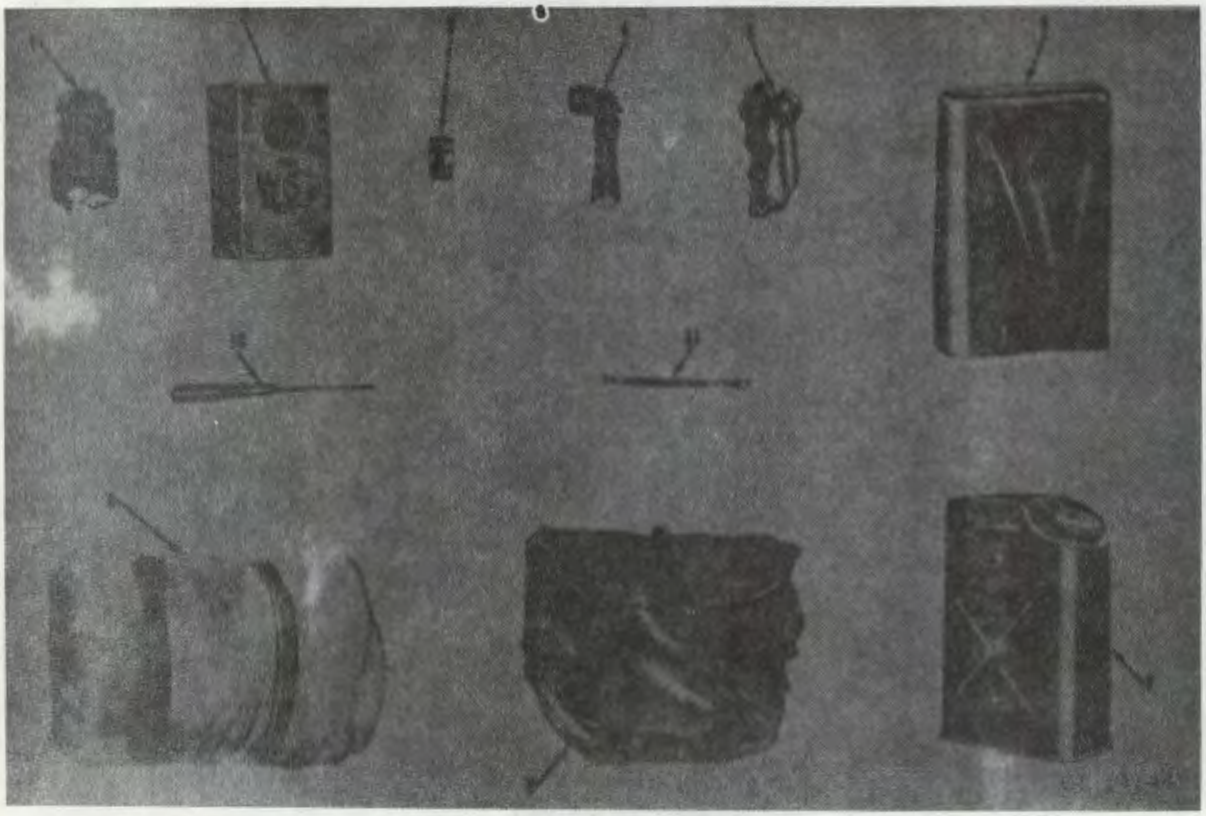


Figure B-5. Stowed items.

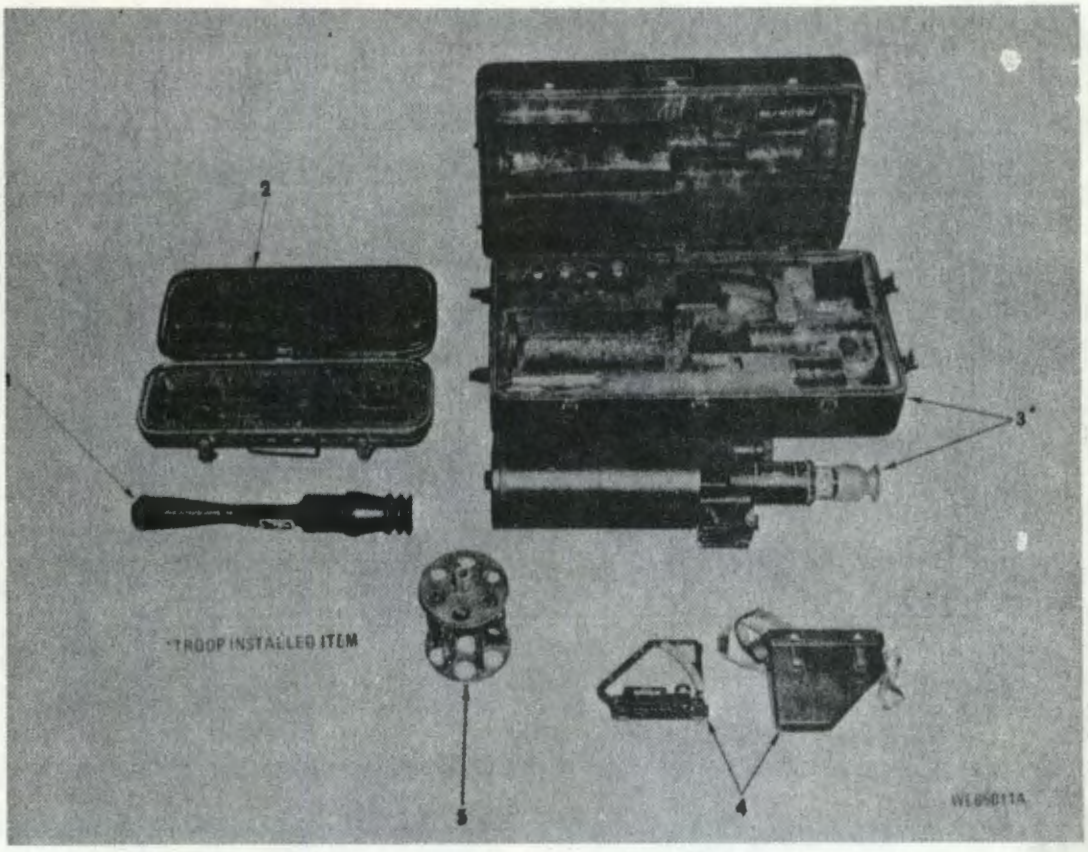
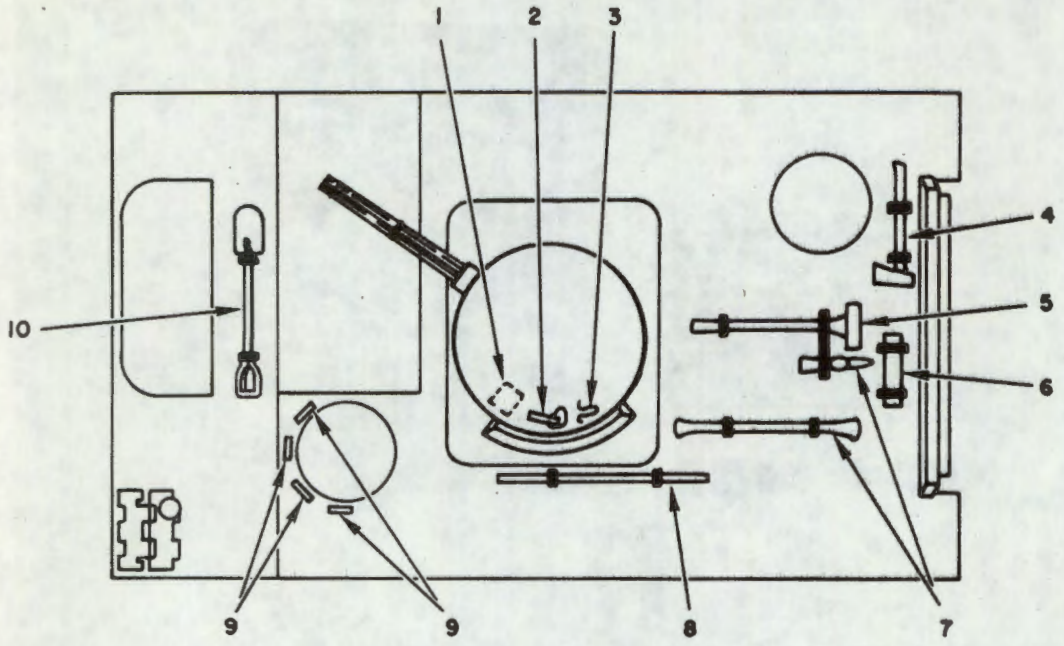
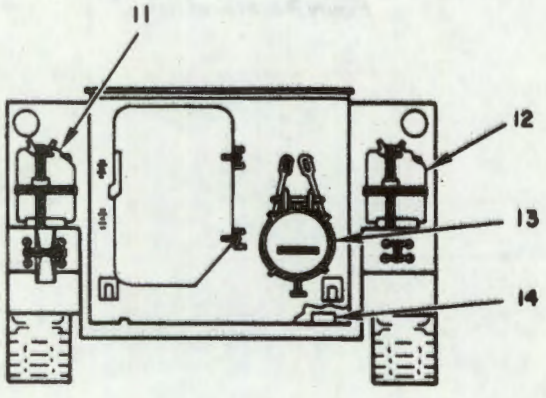


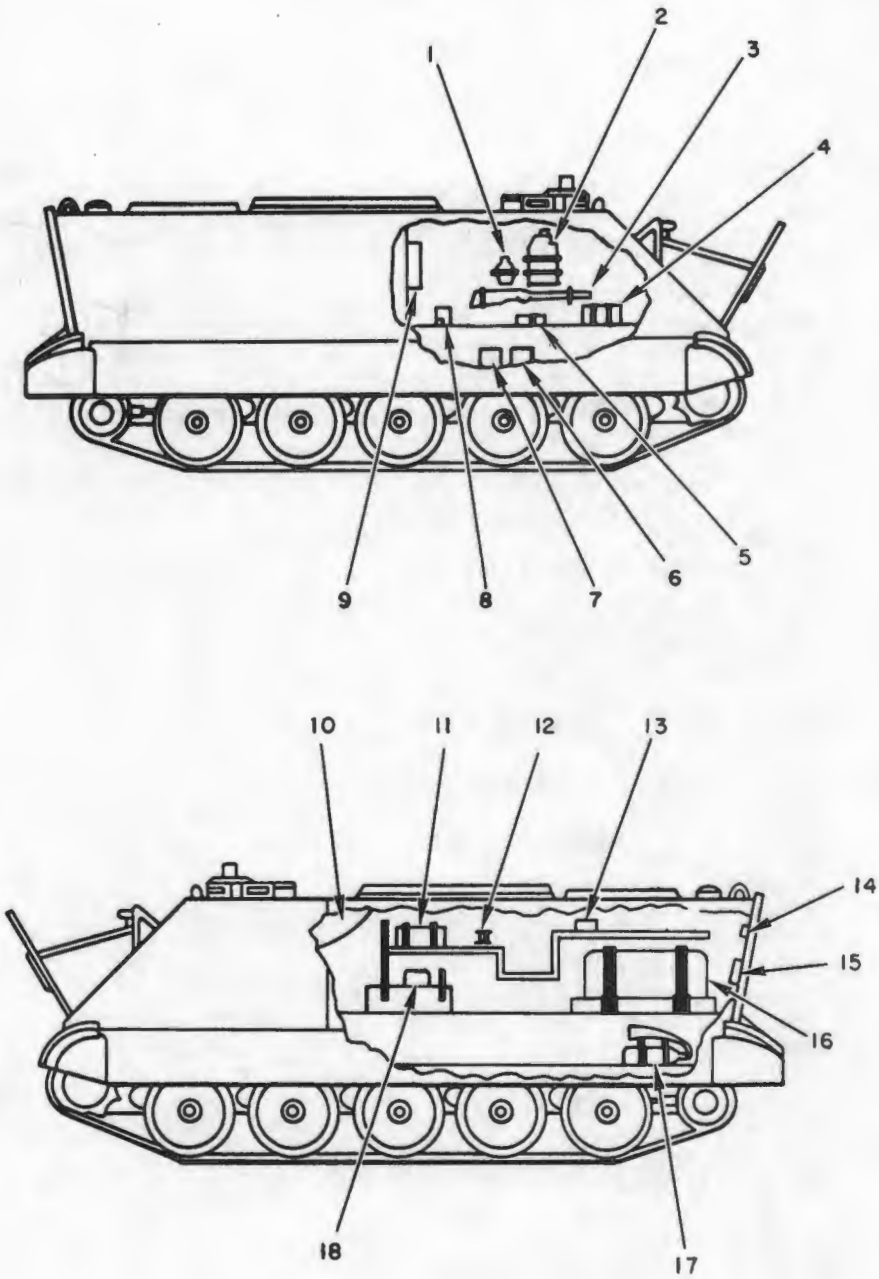
Figure B-6. Stowed items.





1 Rifle ammunition pocket (2)
2 Fire control quadrant
3 Rifle
4 Axe
5 Hand hammer
6 Track connecting fixture
7 Mattock
8 Crow bar
9 M17 periscope
10 Hand shovel
11 Water can
12 Water can (1) and gasoline can (1)
13 Wire rope
14 Rifle brackets (2 rifle)

Figure B-7. Stowage guide.



1 Canteen
2 M19 periscope
3 Rifle
4 Rifle ammunition
5 First aid kit
6 M17 periscope head
8 Flashlight
9 Pamphlet bag
10 Air grille curtain
11 AN/TVS-2B sight
12 Muzzle clamp
13 M134 telescope
14 Flashlight
15 External range control
16 Generator
17 Fire extinguisher
18 Tool bag

Figure B-8. Stowage guide.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) Federal stock number	(2) Description Reference number & mfg code Usable on code	(3) Unit of meas	(4) Qty auth
4930-288-1511	ADAPTER, GREASE GUN: MILL4387 (81349)	EA	1
5120-144-5207	ADAPTER, SOCKET WRENCH: GGGW641 (81348)	EA	1
5120-240-8702	ADAPTER, SOCKET WRENCH: GGGW641 (81348)	EA	1
5110-293-2336	AXE, SINGLE BIT: GGGA926 (81348)	EA	1
2540-670-2459	BAG ASSEMBLY, PAMPHLET: 7961712 (06085)	EA	1
5140-473-6256	BAG, TOOL, SATCHEL: 6518760 (18876)	EA	1
1005-610-8828	BRUSH, CLEANING, SMALL ARMS: 6108828 (19206)	EA	1
1005-722-5087	BRUSH, CLEANING, SMALL ARMS: 7225087 (19204)	EA	4
7240-222-3088	CAN, GASOLINE, MILITARY: MILC1283 (81349)	EA	1
7240-242-6153	CAN, WATER, MILITARY: 64C281 (80244)	EA	2
5140-261-4994	CARRIER, TOOL: GGGC1520 (81348)	EA	1
8465-705-2438	CASE, AMMO, CARRYING, W/SLING: MILP43312 (81349)	EA	4
1290-809-1379	CASE, PLASTIC: W/INSERT 10557496 (19200)	EA	1
7910-526-1959	CLEANER, VACUUM, ELECTRIC: WC421 (81348)	EA	1
6150-378-2053	CORD, LIGHT EXTENSION: 17C35079-33 (19204)	EA	1
2590-898-6771	COVER ASSEMBLY, PERISCOPE: 10866115 (19207)	EA	5
2540-767-3147	COVER, PROTECTIVE, ENGINE: 10865823 (19207)	EA	1
5120-240-6040	CROWBAR: GGGB101, TYPE 2, CLASS 1, SIZE 2 (81348)	EA	1
2540-923-4250	CURTAIN, AIR GRILLE: 10950064 (19207)	EA	1
5110-595-8229	CUTTER, WIRE ROPE, HAND OPERATED: MILC386 (81349)	EA	1
5120-227-8074	EXTENSION, SOCKET WRENCH: GGGW641 (81348)	EA	1
5120-073-9736	FIXTURE, TRACK CONNECTING: 10932359 (19207)	EA	2
6230-264-8261	FLASHLIGHT: MILF3747 (81349)	EA	2
5120-061-8546	HAMMER, HAND: GGGH86 (81348)	EA	1
5120-900-6095	HAMMER, HAND: SLEDGE GGGH86 (81348)	EA	1
5120-903-8555	HAMMER, SOFT FACED: GGGH33 (81348)	EA	1
5120-288-6574	HANDLE, MATTOCK-PICK: NNH0093 (81348)	EA	1
5120-230-6364	HANDLE, SOCKET WRENCH: ½ SQ X 13L GGGW641 (81348)	EA	1
5120-236-7590	HANDLE, SOCKET WRENCH: ½ SQ X 18L GGGW641 (81348)	EA	1
1005-402-2200	HEAD, BELL RAMMER: STAFF CLEANING 8766006 (19206)	EA	1

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST —Continued

(1) Federal stock number	(2) Description Reference number & mfg code / Usable on code	(3) Unit of meas	(4) Qty auth
5120-224-2504	KEY, SOCKET HEAD SCREW: GGGK00275 (81348)	EA	1
4930-253-2478	LUBRICATING GUN, HAND: MILG3859 (81349)	EA	1
5120-243-2395	MATTOCK: GGGH506 (81348)	EA	1
4930-262-8868	OILER, HAND: N493020 (42397)	EA	1
5340-682-1508	PADLOCK: MS35647-3 (96906)	EA	1
8345-174-6865	PANEL MARKER: MILP40061, AMEND 1 (81349)	EA	2
5120-678-2795	PIN, DRIFT, TRACK: 10861180 (19207)	EA	1
5120-239-8251	PLIERS: LINEMANS GGGP471, TYPE 9, CLASS 1, STYLE A (81348)	EA	1
5120-223-7397	PLIERS, SLIP JOINT: GGGP00471 (81348)	EA	1
5120-624-8065	PLIERS, SLIP JOINT: AT508K (00784)	EA	1
2540-923-4249	POST CURTAIN: AIR GRILLE 10950078 (19207)	EA	5
5120-278-1283	SCREWDRIVER, FLAT TIP: GGGS121, TYPE 1, CLASS 5, STYLE 1, DESIGN B, SHAPE B (81348)	EA	1
5120-293-3169	SCREWDRIVER, FLAT TIP: GGGS121, TYPE 1, CLASS 4, STYLE 1, SHAPE A (81348)	EA	1
1005-709-7668	SECTION ASSEMBLY, BRUSH: 8766014 (19204)	EA	3
1015-790-3611	SECTION END, CLEANING STAFF: 8766008 (19206)	EA	1
5120-293-3336	SHOVEL, HAND: GGGS326, TYPE 4, CLASS A, STYLE 1 (81348)	EA	1
5120-189-7913	SOCKET, SOCKET WRENCH: 1-1/16 GGGW641 (81348)	EA	1
5120-189-7917	SOCKET, SOCKET WRENCH: 1-¼ GGGW641 (81348)	EA	1
5120-189-7927	SOCKET, SOCKET WRENCH: GGGW641 (81348)	EA	1
5120-189-7932	SOCKET, SOCKET WRENCH: 9/16 GGGW641 (81348)	EA	1
5120-189-7934	SOCKET, SOCKET WRENCH: 7/8 GGGW641 (81348)	EA	1
5120-189-7935	SOCKET, SOCKET WRENCH: 15/16 GGGW641 (81348)	EA	1
5120-189-7946	SOCKET, SOCKET WRENCH: ⅝ GGGW641 (81348)	EA	1
5120-189-7985	SOCKET, SOCKET WRENCH: ¾ GGGW641 (81348)	EA	1
5120-235-5870	SOCKET, SOCKET WRENCH: 11/16 GGGW641 (81348)	EA	1
7240-177-6154	SPOUT, CAN, FLEXIBLE: 838A7511 (09647)	EA	1
1010-832-9153	STAFF, CLEANING: HANDLE 11687054 (19204)	EA	1
1025-965-7833	STRAP, WEBBING: 8690532 (19204)	EA	4
2540-968-4060	STRAP, WEBBING: 8690527 (19207)	EA	2
5340-543-3756	STRAP, WEBBING:	EA	4
5340-753-3743	STRAP, WEBBING: 8690519 (19207)	EA	1

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST —Continued

(1) Federal stock number	(2) Description Reference number & mfg code / Usable on code	(3) Unit of meas	(4) Qty auth
5340-753-3745	STRAP, WEBBING: 8690477 (19207)	EA	10
5340-827-8483	STRAP, WEBBING: 8690513 (19207)	EA	1
8340-817-2126	TARPAULIN: KP146 (81348)	EA	1
4010-767-3149	WIRE ROPE ASSEMBLY, SINGLE LEG: 10861718 (19207)	EA	1
5120-224-3141	WRENCH, BOX: GGGW636 (81348)	EA	1
5120-224-3154	WRENCH, BOX: GGGW636 (81348)	EA	1
5120-187-7126	WRENCH, OPEN END: GGGW636 (81348)	EA	1
5120-240-5609	WRENCH, OPEN END: GGGW636 (81348)	EA	1
5120-277-2342	WRENCH, OPEN END: GGGW636 (81348)	EA	1
5120-277-7025	WRENCH, OPEN END: GGGW636 (81348)	EA	1
5120-277-8300	WRENCH, OPEN END: GGGW636 (81348)	EA	1
5120-264-3796	WRENCH, OPEN END ADJUSTABLE: GGGW631 (81348)	EA	1
5120-542-2972	WRENCH, TORQUE: 100 to 750 IN LBS GGGW00686 (81348)	EA	1

INDEX

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