TM 9-2350-300-20/1

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL MAINTENANCE MANUAL
FOR
GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED
20-MM, XM163
(2350-999-4392)
CANNON M168, MOUNT M157, SIGHT M61,
AND RADAR AN/VPS-2

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

HEADQUARTERS, DEPARTMENT OF THE ARMY

AUGUST 1971

WARNING

CANNON EQUILIBRATORS

Extreme care must be exercised when removing the equilibrators. There is a spring tension of approximately 150 pounds even when the cannon is at maximum elevation (+80°).

WARNING

BATTERIES

Be extremely careful when working in the vicinity of a battery when the battery case cover is open. Do not drop uninsulated tools onto the battery links. Severe arcing will result, with possible injury to personnel and damage to the battery. Do not wear rings, metal watch bands, or identification bracelets. Metal articles will, if allowed to contact intercell links of opposite polarity, fuse themselves to the links and severe burning will result.

WARNING

The electrolyte used in the mount batteries is a caustic solution of potassium hydroxide. Serious burns will result if it comes in contact with any part of the body. Use rubber gloves, rubber apron, and protective face shield when handling this electrolyte. If electrolyte gets on the skin, wash the affected areas with large quantities of water, then neutralize with 3 percent solution of acetic acid, vinegar, or lemon juice. If electrolyte gets into the eyes, flood with water and wash eyes with a 3 percent solution of boric acid or a weak solution of vinegar; seek immediate medical attention.

WARNING

The vapor from this electrolyte can be explosive. Extinguish any cigarettes or open flames in the vicinity of the battery before removing the cell caps.

WARNING

DRY-CLEANER SOLVENT

Dry-cleaner solvent and mineral spirits paint thinner are flammable and must not be used near an open flame. These materials should be used in a well-ventilated area with a fire extinguisher readily available.

WARNING

GUNS AND AMMUNITION

The procedures in this manual involve the use of a weapon system and live ammunition. All standard safety precautions governing the handling of weapons and ammunition must be observed. Do not walk in front of cannon. Clear cannon before servicing or maintenance.

DANGEROUS VOLTAGE

High voltage is used in the operation of this system—DEATH ON CONTACT—may result if safety precautions are not observed. Do not contact high voltage connections when operating or maintaining this system. Do not be misled by the term "low voltage". Potentials as low as 50 volts may cause death under adverse conditions.

RADIATION

Radiation is a potential hazard within 3 feet of radar antenna when in operation.

Failure to perform certain steps in the procedures can cause potentially dangerous situations. These steps are pointed out in the text and must be followed.

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 424 consisting of the following:

Page No.	*Change No.*
Cover	2
Warning	2
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4-61 and 4-62	1
4-63 through 4-68	0
4-69 and 4-70	1
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4-85 thorugh 4-110	0
4-111 through 4-112	1
4-113 through 4-118	0
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4-121 through 4-150	0
5-1	2
5-2 through 5-9 (5-10 blank)	0
6-1 through 6-8	0
6-9 and 6-10	1
6-11 and 6-12	0
6-13 and 6-14	1
6-15 and 6-16	0

* 0 in this column indicates an original page.

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TECHNICAL MANUAL

No. 9-2350-300-20/1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, D. C., *31 August 1971*

Organizational Maintenance Manual

for

GUN, ANTIAIRCRAFT ARTILLERY,

SELF-PROPELLED: 20-MM, XM163

(2350-999-4392)

CANNON XM168, MOUNT XM157, SIGHT XM61,

AND RADAR AN/VPS-2

* This manual together with TM 9-2350-300-20/2, 31 August 1971, supersedes TM 9-2350-300-20, 4 November 1968, including all changes and TM 9-2350-300-20/1, 18 December 1969.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope.

a. This manual contains instructions for organizational maintenance of Cannon XM168, Gun Mount XM157, Radar Set AN/VPS-2, and Automatic Lead Computing Sight XM61, which collectively form the armament portion of 20-MM Self-Propelled Antiaircraft Artillery Gun XM163 (XM163 system) (fig. 1-1). Instructions for organizational maintenance of the remaining major components of the XM163 system, Full Tracked Weapon Chassis XM741, are contained in TM 9-2300-257-20.

b. This manual consists of two volumes: TM 9-2350-300-20/1 containing all of the text material; TM 9-2350-300-20/2 all applicable functional, schematic, and wiring diagrams (figs. 3-1 through 3-76).

c. Appendix A contains a list of current references, including supply manuals, technical manuals, forms, and other available publications applicable to the XM163 system. Appendix B contains the maintenance allocation charts for the XM163 system armament components. These charts show the maintenance responsibilities allocated to each level of maintenance. Repair parts and special tools for the XM163 system armament components are contained in TM 9-2350-300-20P.

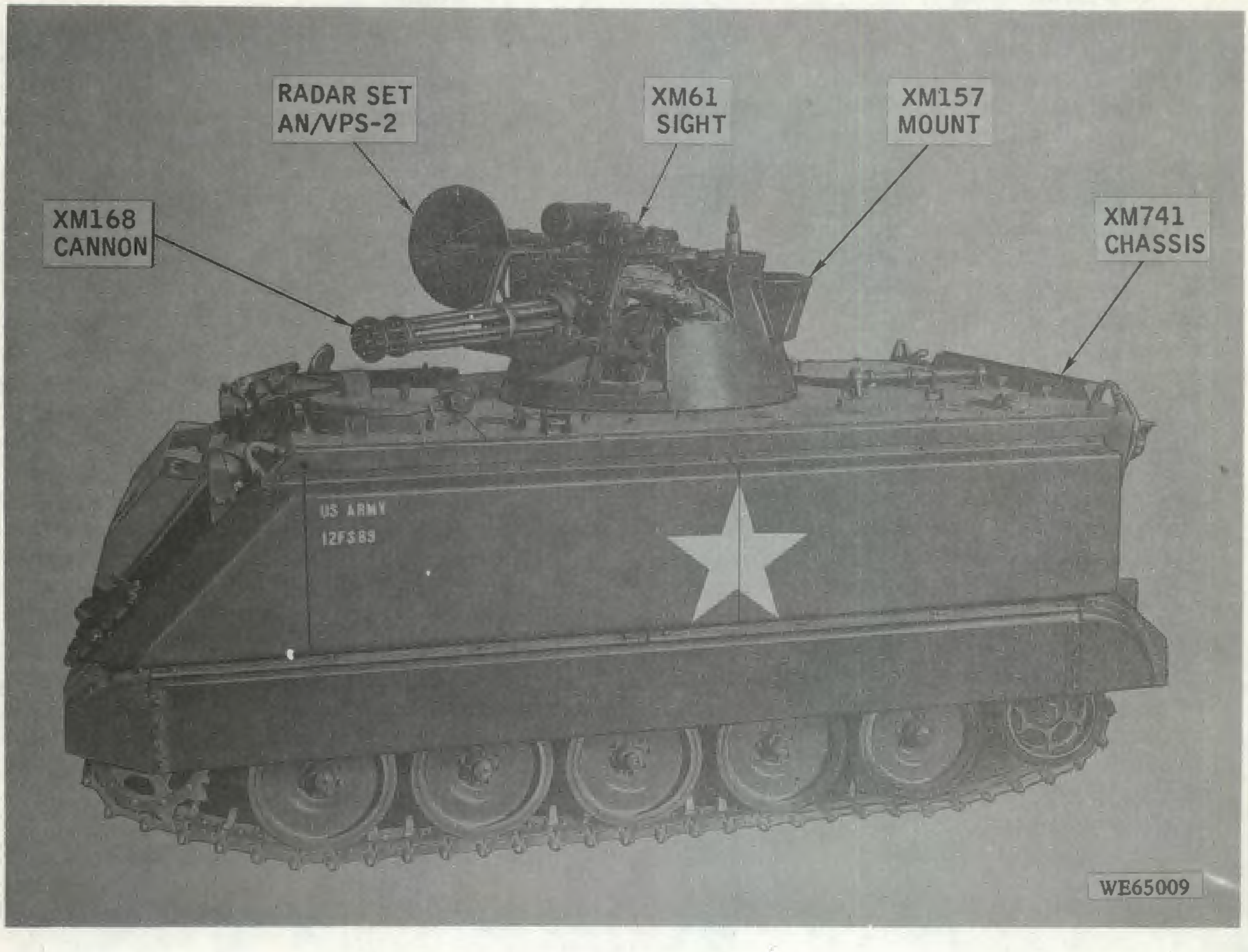


Figure 1-1. XM163 system.

1-2. Forms and Records.

Refer to TM 38-750 for instructions on the use of applicable forms, records, and reports.

1-3. Destruction of Materiel to Prevent Enemy Use.

Refer to TM 5-220 and FM 5-25 for procedures for destruction of materiel to prevent enemy use.

1-4. Reporting of Errors.

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded directly to: Commanding General, Headquarters, U. S. Army Weapons Command, ATTN: AMSWE-SMM-P, Rock Island Arsenal, Rock Island, Illinois 61201.

Section II. DESCRIPTION AND DATA

1-5. Description.

Refer to TM 9-2350-300-10 for a description of the overall XM163 system and its major components.

1-6. Tabulated Data.

a. Physical Characteristics.

(1) *XM168 cannon.* Refer to TM 9-2350-300-10.

(2) *XM157 gun mount.*

Battery (3)
- Height .... 10-1/4 in
- Width .... 10 in
- Length .... 11-1/2 in
- Weight .... 82 lb

Control assembly
- Height .... 11 in
- Width .... 21 in
- Length .... 12-1/4 in
- Weight .... 32 lb

Conveyor assembly
- Height .... 9 in
- Width .... 11 in
- Length .... 10 in
- Weight .... 11 lb

Declutching feeder assembly
- Height .... 5 in
- Width .... 6 in
- Length .... 13-1/4 in
- Weight .... 17 lb

Distribution box
- Height .... 13 in
- Width .... 10 in
- Length .... 18 in
- Weight .... 64 lb

Exit unit assembly
- Height .... 11 in
- Width .... 12 in
- Length .... 11 in
- Weight .... 16-1/2 lb

Gun drive assembly
- Height .... 7-1/2 in
- Width .... 5-3/4 in
- Length .... 12-1/2 in
- Weight .... 25 lb

Inverter
- Height .... 7 in
- Width .... 5 in
- Length .... 13-1/4 in
- Weight .... 17 lb

Servo amplifier
- Height .... 4-1/8 in
- Width .... 6-5/8 in
- Length .... 6-5/8 in
- Weight .... 9 lb

Sight current generator
- Height .... 14 in
- Width .... 8-3/4 in
- Length .... 14 in
- Weight .... 30 lb

(3) *AN/VPS-2 radar.* Refer to TM 9-2350-300-10.

(4) *XM61 sight.* Refer to TM 9-2350-300-10.

b. Electrical Characteristics. Refer to TM 9-2350-300-10.

CHAPTER 2
SERVICE AND PREVENTIVE MAINTENANCE

Section I. SERVICE UPON RECEIPT OF MATERIEL

2-1. General.

When a new or reconditioned XM163 system is received, the using organization must determine whether the system has been properly prepared for service by the supplying activity, and if the system is capable of performing any mission to which it may reasonably be assigned.

2-2. Inspection, Service, Installation, and Setup Instructions.

a. The armament components should be checked with the aid of Test Set, Antiaircraft Artillery Gun, AN/MWM-2 and Organizational Maintenance Test Set, AN/TPM-23, in accordance with instructions found in chapter 4 of this manual.

b. Parts of the XM163 system which may be coated with rust-preventative compound should be thoroughly cleaned with waste wiping cloths or a brush saturated with solvent cleaning compound. After the rust-preventative compound has been completely removed, the system should be lubricated in accordance with the lubrication chart in LO 9-2350-300-10.

c. As practicable, the XM163 gun crew will assist in servicing a new or reconditioned XM163 system.

d. Serious deficiencies involving unsatisfactory design or material are to be reported on appropriate forms in accordance with TM 38-750.

Section II. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-3. General.

Tools, equipment, and repair parts are issued to organizational maintenance personnel for use in maintaining the XM163 weapon system. Tools and equipment are to be used only for the purpose prescribed.

2-4. Repair Parts.

Repair parts are supplied to organizational maintenance personnel for the replacement of worn, broken, or otherwise unserviceable items. Repair parts supplied at the organizational level for the XM163 system are listed in TM 9-2350-300-20P, which is the authority for requisitioning.

2-5. Tools and Equipment.

a. Common Tools and Equipment. Standard and commonly used tools and equipment having a general application to the XM163 system are authorized for issue by tables of allowance and tables of organization and equipment.

b. Special Equipment. Special equipment required for organizational maintenance of the XM163 system armament components is listed in table 2-1 and briefly described in the following paragraphs.

(1) *Test Set AN/MWM-2.* Test Set, Antiaircraft Artillery Gun, AN/MWM-2 is designed specifically for use by organizational maintenance personnel in performing checkout and fault isolation procedures for all XM163 system

Table 2-1. Special Tools and Equipment.

Item	Identifying number	Use	Reference
Test Set, Antiaircraft Artillery Gun, AN/MWM-2	4933-852-6312	Test and fault-isolate gun system.	Fig. 2-1
Organizational Maintenance Test Set, AN/TPM-23	4931-878-0905	Test and fault-isolate radar system.	Fig. 2-2
Multimeter, 300M-A and adapter kit	6625-168-0585	Test and fault-isolate system.	Fig. 2-3
Purging kit	4931-065-1110	Purge XM61 sight.	Fig. 2-4

armament components, except the AN/VPS-2 radar set. The AN/MWM-2 (fig. 2-1) weighs approximately 95 pounds, complete with cables. Exterior dimensions are 26-1/8 inches x 13 inches x 12 inches. The AN/MWM-2 is portable, permitting optional placement during use. A complete description and operating and maintenance instructions are contained in TM 9-4933-209-14.

(2) *Test Set AN/TPM-23.* Organizational Maintenance Test Set, AN/TPM-23 is designed for use by organizational maintenance personnel in performing checkout and fault isolation of the AN/VPS-2 radar set. The AN/TPM-23 (fig. 2-2) weighs approximately 103 pounds, complete with cables. Exterior dimensions are 18 inches x 23 inches x 18 inches. The AN/TPM-23 is portable, permitting optional placement during use. A complete description and operating and maintenance instructions are contained in TM 9-4931-333-14.

(3) *Digital passive scaler.* The digital passive scaler (fig. 2-3) is a multimeter used in conjunction with test sets AN/MWM-2 and AN/TPM-23. The multimeter may also be used as an individual test equipment item. A complete description and operating instructions are contained in TM 9-6625-1754-14.

(4) *Purging kit.* The purging kit (fig. 2-4) consists of a tank of dry nitrogen with the fittings and gages required to purge the XM61 sight.

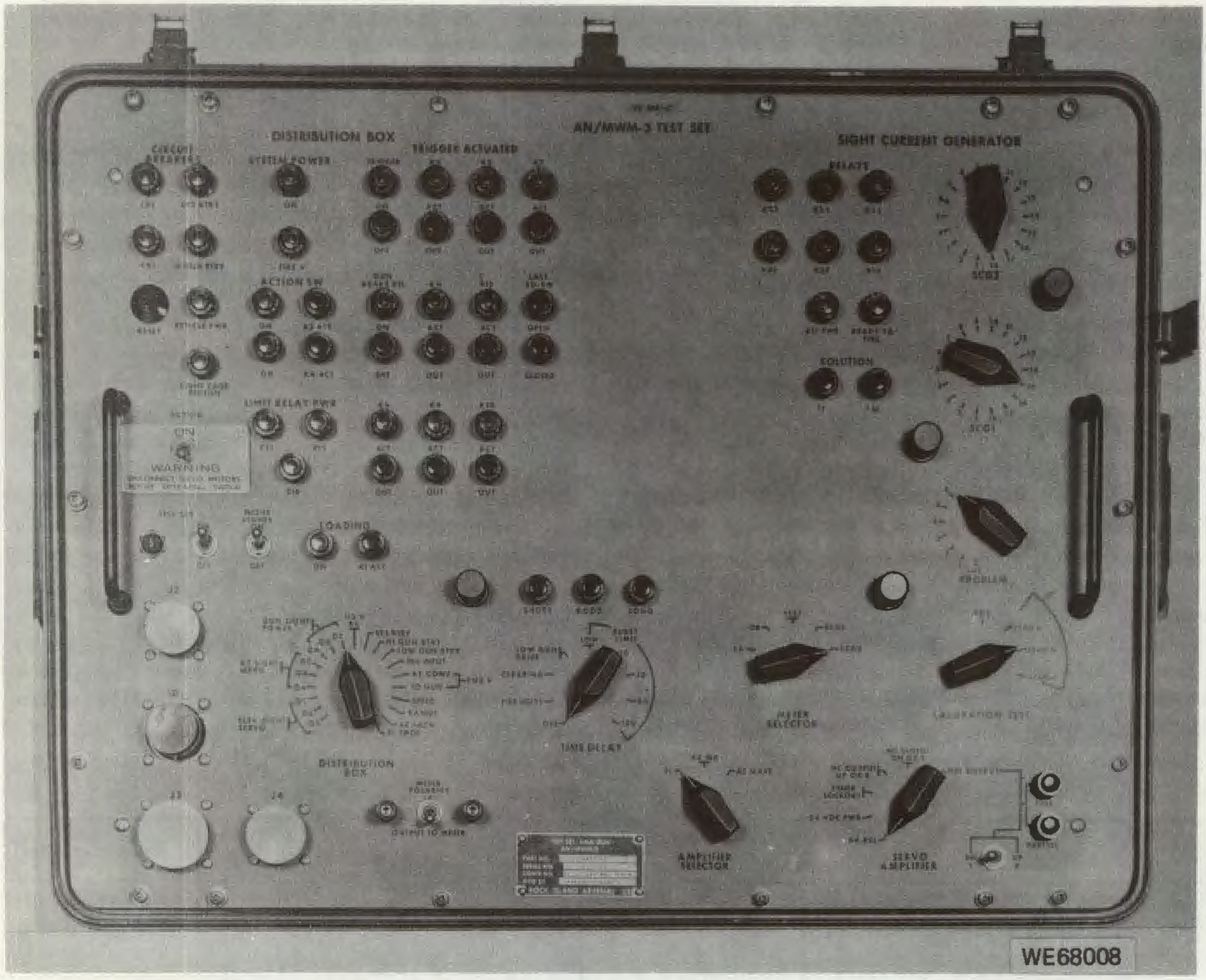


Figure 2-1. Test set, antiaircraft artillery gun, AN/MWM-2.

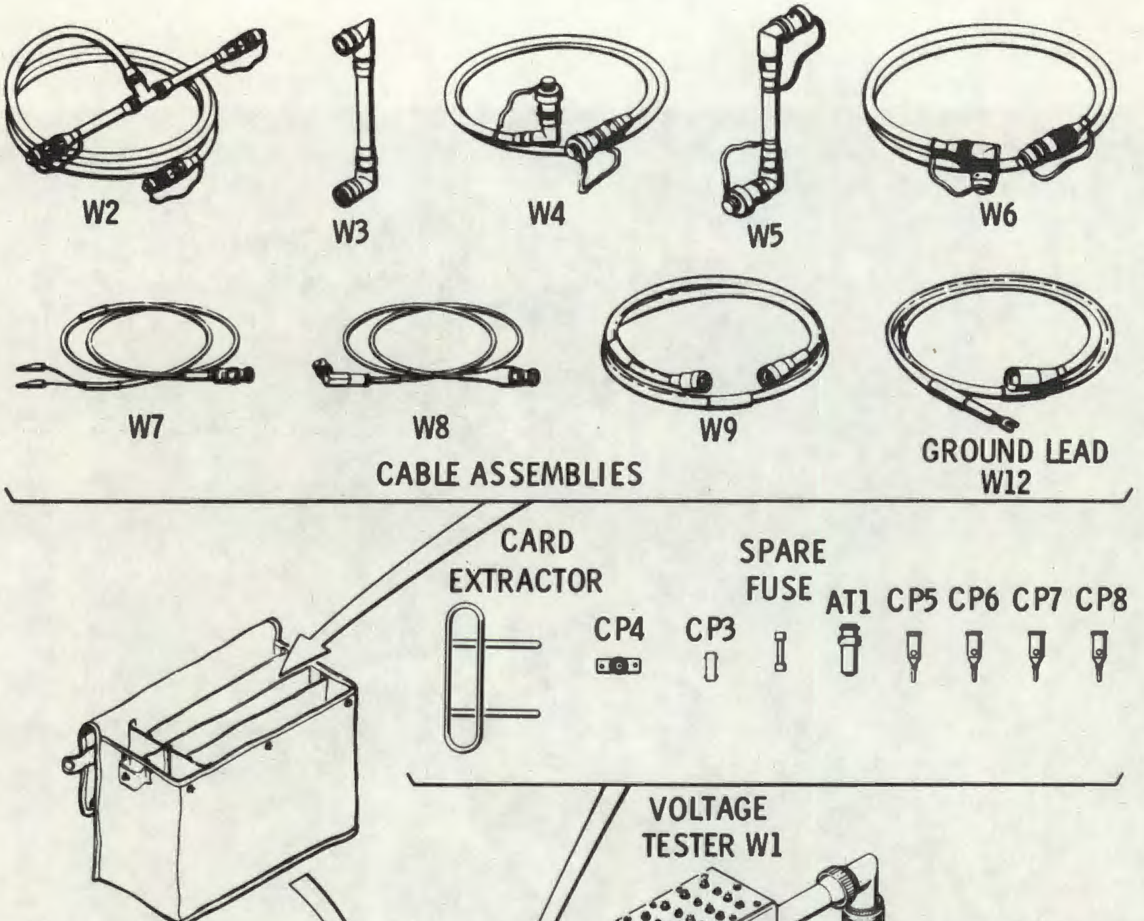
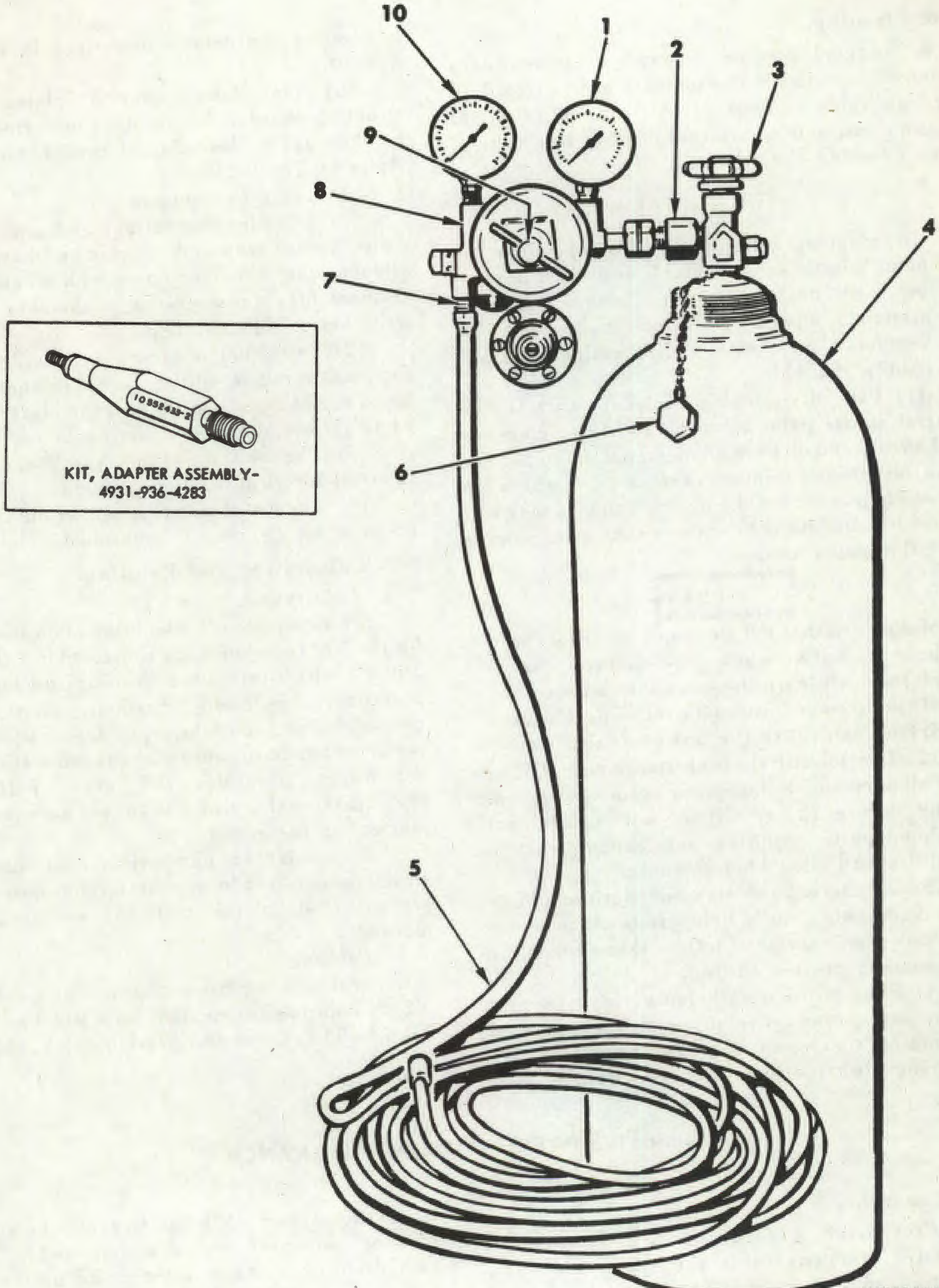


Figure 2-2. Organizational maintenance test set AN/TPM-23.

Figure 2-3. Multimeter 300M-A and adapters.



1 High pressure gage
2 Nitrogen filling adapter
3 Tank valve
4 Tank
5 Hose assembly
6 Protective cover
7 Low pressure port
8 Nitrogen filling regulator
9 Pressure regulator valve
10 Low pressure gage

Figure 2-4. Purging kit.

Section III. CLEANING, LUBRICATING AND PAINTING

2-6. Cleaning.

a. General. Special cleaning procedures required for specific components are provided in the applicable sections of this manual. General cleaning instructions are contained in this section.

b. Cleaning Procedures.

WARNING

Dry-cleaning solvent and mineral spirits paint thinner are flammable and must not be used near an open flame. These materials should be used in a well-ventilated area with a fire extinguisher readily available.

(1) Use dry-cleaning solvent (SD-1) or mineral spirits paint thinner (TPM) to clean or wash grease and oil from all metal parts. Do not use these solvents and thinners to clean parts which are exposed to powder fouling during firing as they will not readily dissolve the corrosive salts from powder and primer compositions.

CAUTION

Make sure that CR does not saturate the breech bolts when the barrels are cleaned while on the cannon. Saturation of the breech bolts without subsequent drying can cause the bolts to short out.

(2) Use solvent cleaning compound (CR) to clean all parts which have been exposed to powder fouling during firing. CR is not a lubricant; therefore, parts requiring lubrication must be wiped dry and oiled after cleaning.

(3) Whenever parts are cleaned, rinse and dry them thoroughly. Apply light grade oil to all unprotected metal surfaces (other than optical instruments) to prevent rusting.

(4) Prior to the installation of any new part, remove any preservative material such as rust-preventative compound or grease. Lubricate parts requiring lubrication in accordance with lubrication instructions prescribed in LO 9-2350-300-10.

(5) Nameplates, caution plates, and instruction plates which are dirty or corroded should be thoroughly cleaned and coated with lacquer. Refer to TM 9-213.

c. Cleaning Precautions.

(1) Dry cleaning solvent and mineral spirits paint thinner evaporate quickly and have a drying effect on the skin. When used without gloves, these cleaners may cause cracks in the skin and mild irritation or inflammation.

(2) Petroleum products such as dry-cleaning solvents, mineral spirits paint thinners, engine fuels, or lubricants must be kept clear of rubber parts as they deteriorate the rubber.

(3) The use of diesel fuel, gasoline, or benzene (benzol) for cleaning is prohibited.

(4) The use of water, steam, or air under high pressure for cleaning is prohibited.

2-7. Lubricating and Painting.

a. Lubricating.

(1) Complete periodic lubrication instructions for the XM163 system are contained in LO 9-2350-300-10, which prescribes cleaning and lubricating procedures, including locations, intervals, and proper cleaners and lubricants. Lubrication will be performed in accordance with the lubrication order. Whenever possible, the crew will assist organizational maintenance personnel in lubricating the system.

(2) Special or non-periodic lubricating instructions required for specific mechanisms or parts are provided in the pertinent sections of this manual.

b. Painting.

General painting instructions are included in TM 9-213, Painting Instructions for Field Use, and in TB 746-93-1, Color and Marking of Vehicles and Equipment.

Section IV. PREVENTIVE MAINTENANCE

2-8. General.

a. Preventive Maintenance Definition. Preventive maintenance is the systematic care, inspection, and servicing of equipment to prevent breakdown, to detect faults and failures, and to assure maximum operational condition. The preventive maintenance checks and services included in this manual are those assigned to organizational maintenance by the Maintenance Allocation Chart (MAC). Organizational maintenance personnel are also responsible for accomplishing certain repair, adjustment, or replacement tasks when the need is evidenced during an operator / crew preventive maintenance check or service as prescribed in TM 9-2350-300-10.

b. Services. Organizational maintenance services are defined as and restricted to the following general procedures, except where approval to perform a higher category maintenance service has been given by the direct support maintenance unit.

(1) *Adjustments.* Necessary adjustments shall be made in accordance with the pertinent sections of this manual or as specified by other applicable technical bulletins.

(2) *Cleaning.* General cleaning instructions are given in paragraph 2-6. Special cleaning procedures are provided where applicable in this manual.

(3) *Painting.* General painting instructions are provided in TM 9-213 and TB 746-93-1.

(4) *Repair.* Repair consists of restoring an item to service within the limitations specified by this manual. Repair may include, but is not limited to, inspection, cleaning, preservation, painting, adjustment, or replacement.

(5) *Service.* Service consists of performing special operations such as replenishing the mount battery water and purging the sight.

(6) *Special lubrication.* Special lubrication applies either to lubrication operations that do not appear in LO 9-2350-300-10 or to items which are to be performed in connection with the preventive maintenance or repair operations. Special or nonperiodic lubrication instructions are provided in pertinent sections of this manual.

(7) *Tightening.* Tightening operations consist of observing specified torque values, and where specified in applicable sections of this manual, a torque-indicating wrench shall be used. Tightening also includes the installation of lockwashers, locknuts, lock wire, or cotter pins wherever applicable.

c. Modification Work Orders. DA Form 2408-5 (Equipment Modification Record) must be checked against the current list of modification work orders (MWO's) in DA PAM 310-7 to determine if all modifications have been incorporated. Enter all modifications and major units replaced on DA Form 2408-5. If a modification has not been incorporated, promptly notify the local maintenance officer. No alterations or modifications are to be made by organizational personnel except as authorized by official publications.

2-9. Schedule of Checks and Services

a. Maintenance Intervals. Preventive maintenance checks and services performed by organizational maintenance personnel on the mount, cannon, sight, and radar are either time-dependent or rounds-dependent. The frequency prescribed for each check or service is considered as the minimum requirement for system operation under usual conditions. Unusual operating conditions, such as extreme temperatures, dust or sand, moist or salty atmosphere, and rain or snow, require more frequent checks and services.

(1) *Time-dependent checks and services.* The time-dependent checks and services consist primarily of inspection checks to ensure operational condition. They will be performed in conjunction with similar operator/crew checks and services whenever practical. The time dependent items normally will be performed strictly in accordance with intervals established by table 2-3.

(2) *Rounds-dependent checks and services.* The rounds-dependent checks and services assure that mechanical parts subject to adjustment variations, wear, or sudden failure are inspected, adjusted, or replaced before affecting overall system performance. These checks and services will be performed strictly as scheduled, following the firing or cycling through the system (as applicable) of the quantity of rounds specified for each item. Rounds cycled through the system include those rounds actually fired as well as the rounds that are cycled through the cannon and ejected unfired, such as during operational checkouts.

b. Schedule. Table 2-2 lists the rounds-dependent checks and services; table 2-3 lists the time-dependent checks and services. These tables include a complete list of all organizational preventive maintenance responsibilities. Each table specifies the time or rounds-cycled interval, describes the check or service to be accomplished, and makes reference to the detailed procedure.

Table 2-2. Preventive Maintenance Rounds-Dependent Checks and Services

Rounds interval	Sequence	Item checked or serviced	Procedure	Reference
NOTE A defective or damaged item that is replaced or serviced prior to the scheduled rounds / interval replacement or service, will assume the accumulative rounds fired / cycled of other like items and will be replaced / serviced with other like items at the next rounds / interval schedule.				
12,000 fired and / or cycled	1	Declutching feeder	Request direct support maintenance service.	Para 6-21
24,000 fired and / or cycled	2	Gundrive motor brake	Check torque required to turn cannon against brake. If torque required is less than 600 inch-pounds, replace gun drive assembly.	Para 6-13
36,000 fired and / or cycled	3	Cannon breech bolts	Repair breech bolt assemblies by replacing all components except breech bolt body.	Para 6-8
36,000 fired and / or cycled	4	Linkless feed drum assembly	Request direct support maintenance service.	N / A
72,000 fired	5*	Cannon barrels	Replace all six barrels; discard used barrels.	Para 6-6
72,000 fired	6*	Cannon recoil adapter	Replace both recoil adapters. Return recoil adapters to direct support for preventive maintenance.	Para 6-7
72,000 fired and / or cycled	7	Cannon breech bolt assembles	Replace breech bolt assemblies.	Para 6-8
72,000 fired and / or cycled	8	Conveyor elements	Replace all conveyor elements. Discard used conveyor elements.	Para 6-30
72,000 fired and / or cycled	9	Feeder lock pins	Replace feeder lock pins. Discard used lock pins.	Para 6-4c (4)
72,000 fired and or cycled	10	Guide bar pins Guide bar	Replace guide bar pins. Discard used pins. Replace guide bar. Discard used guide bar.	Para 6-14 Para 6-14
72,000 fired and / or cycled	11	M168 cannon	Return cannon (less barrels) to direct support for preventive maintenance.	N / A
144,000 fired and / or cycled	12	M168 cannon	Replace cannon.	N / A

* Replace on basis of rounds fired only.

Table 2-3. Preventive Maintenance Time-Dependent Checks and Services.

Interval	Item checked	Procedure	Reference
		CAUTION Do not use containers or syringes that have been used for servicing lead-acid batteries. Do not allow chassis lead-acid batteries to be inspected or serviced while mount nickel-cadmium battery cells are open. **NOTE** If excessive spewage has occurred, clean batteries before performing weekly checks and services.	
Weekly	M157 mount batteries	Inspect and charge batteries, and check electrolyte level when batteries are fully charged. Perform charging circuit and electrical leakage tests.	Para 6-63
Weekly	M163 system (includes AN / VPS-2 radar and M61 sight).	Perform system checkout using 300 M-A multimeter in conjunction with table 4-1.1.	Ch 4, para 4-2*a*
Monthly	M163 system (includes AN / VPS-2 radar and M61 sight).	Perform system checkout using Test Set, Antiaircraft Artillery Gun, AN / MWM-2, as required.	Ch 4, para 4-2*b*
Monthly*	M168 cannon	Disassemble cannon, clean and lubricate in accordance with LO 9-2350-300-10 and reassemble.	LO 9-2350-300-10
		CAUTION Do not attempt to operate radar set without the spark gap tube; extensive damage to the transmitter-receiver can result.	
Monthly*	Klystron spark gap	Clean spark gap and electrical cap and spark gap receiving cavities.	Para 6-45*d* (12)
Monthly	Radar reflector and feed assembly	Check reflector and feed assembly for damage.	Para 6-44
Monthly	Radar tuning tool	Inspect radar tuning tool.	Para 6-45*b* (5)
Monthly	M157 mount batteries	Clean batteries.	Para 6-63
Quarterly*	RF (crystal) oscillator subassemblies	Clean all six RF (crystal) oscillator subassemblies housed in the transmitter-receiver (unit 2).	Para 6-45*b* (6).
Quarterly	Radar AN / VPS-2	Inspect all radar units and accessories for damage, wear, and completeness.	Table 6-5
Quarterly**	M61 sight	Purge sight and recharge with dry nitrogen.	Para 6-54
Semi-annually	Drum assembly	Request direct support maintenance to remove for inspecton, cleaning, and lubrication (and reinstall).	TM 9-2350-300-34 LO 9-2350-300-10

* Interval is dependent upon environmental conditions; intervals should be adjusted accordingly.

** Perform more often if moisture is detected in the sight.

CHAPTER 3
FUNCTIONAL ANALYSIS

Section I. XM163 WEAPON SYSTEM

3-1. General.

a. Scope. This chapter provides an analysis of the total XM163 weapon system. The system is divided into functional groups for ease of explanation, and because system checkout/fault isolation procedures are based on understanding each function within the system. It is important that each function and its resulting indication or action be understood, as proper fault isolation depends upon quick determination of which function is abnormal. An understanding of how each function is performed will aid in quickly locating the malfunctioning component and restoring the system to operational status. The functional analyses presented in this chapter are keyed to simplified functional diagrams, each of which is a part of the more detailed diagrams that are keyed to the checkout/fault isolation tables.

b. Functional Groups. The system (fig. 3-1) is divided into five functional groups: the cannon control group, the mount control group, the fire control group, the radar group, and the XM61 sight. Each group is discussed briefly in the following paragraphs.

(1) The cannon control functional group contains the circuitry to perform the cannon safety and firing functions. Selection of firing rate is determined by switch settings on the control panel. Firing voltage is provided by a converter located in the distribution box. Firing voltage primary power is provided by the system battery. Gun drive motor power is provided by the gun battery.

(2) The mount control functional group provides the circuitry required to move the mount in azimuth and the cannon in elevation. Rate servo drive circuitry responds to manual inputs originated by operator movement of the control handles on the control panel. One motor drives the cannon in elevation; two motors drive the cannon and mount in azimuth. The control circuits are located in the control panel and distribution box.

(3) The fire control functional group provides the circuitry to position the radar antenna, position the sight reticle, and to determine and indicate when all firing conditions have been met. Fire control circuitry is physically located in the control panel, sight current generator, sight, elevation potentiometer, and radar.

(4) The radar measures target motion along the line-of-sight as range and range rate, and continuously transmits this information to the sight current generator as analog voltages, where they are used in the computation of target lead angles.

(5) The XM61 sight responds to signals from the fire control group to offset the sight reticle and thus, provides the proper cannon lead angle and superelevation. The lead angle depends basically on the target speed, target range, and direction of target travel with respect to the cannon. Cannon elevation (superelevation) relates to those factors that determine lead angle and also to target elevation with respect to the cannon. The lead angle and the superelevation both depend on air density and muzzle velocity.

3-2. Operating Modes.

a. General. The XM163 weapon system may be operated in any one of five modes: radar, manual, ground, external, or test. Mode selection is accomplished by positioning the MODE switch on the gunner's control panel. The system is automatically configured for the selected mode.

b. Radar Mode. The system is normally operated in the radar mode. In this mode the entire fire control system is utilized and provides the most accurate solution to the fire control problem.

(1) The radar accurately determines the target range and range rate.

(2) The sight current generator computes the sight magnet current (VI_M) and the sight torque current (VI_T) from values of range, range rate, ballistics, air density, and muzzle velocity.

(3) The sight computes the elevation and traverse lead angle from the input value of magnet current and the rate of mount movement. Superelevation is generated in the sight by the sight torque current and added to the elevation lead angle. The sight reticle is offset from the gun line by the total lead angle when the reticle is held on the target.

(4) The acquisition time delay circuit causes the mount (cannon) to slew to the computed lead angle at a fast rate when the radar locks on the target. The acquisition time delay circuit must de-energize prior to obtaining a ready-to-fire indication.

(5) The ready-to-fire indicator, on the sight, illuminates when all conditions required for firing are satisfied. The five required conditions are:

(a) Target range less than 2200 meters (1600 meters outbound)

(b) Lead angle less than 25 degrees

(c) Elevation angle less than 80 degrees

(d) Radar lock on

(e) Acquisition time delay completed

Operation of the system in the radar mode requires that the MODE switch on the gunner's control panel be in the RADAR position, placing the radar in standby condition. The sight reticle illuminates 10 seconds after system power is turned on. When a target is selected, the operator slews the mount in order to place the reticle on the target. While the mount is being slewed, the sight is electrically caged and the radar antenna servos follow the sight. When the sight reticle is placed on the target, the sight, radar antenna, and cannon point at the target (no lead angle). The operator continues to track the target by keeping the sight reticle on the target and depresses the radar radiate foot switch to energize the radar. When the fire conditions are satisfied, the ready-to-fire indicator lights and the operator may commence firing. When an electronic countermeasure (ECM) signal is detected by the radar, the ECM detection circuit causes the ready-to-fire indicator to blink rapidly. Release of the radar radiate foot switch returns the radar to standby.

c. Manual Mode. The manual mode provides a backup in the event of a radar failure. In the manual mode, the operator estimates range and target speed and sets the estimated values in the system by positioning the RANGE and TARGET SPEED controls on the gunner's control panel. These controls supply signals to the range and range rate servos in the sight current generator. The radar antenna servos are energized so the antenna position potentiometers can provide signals to the sight current generator for use in the sight error correction term. The acquisition time delay circuit and the ready-to-fire circuit are inoperative.

(1) The ready-to-fire indicator lights when the action switch is pressed.

(2) The sight reticle illuminates 10 seconds after the SYSTEM POWER switch is turned on.

Operation of the system in the manual mode requires the operator to observe the target and set the RANGE and TARGET SPEED controls on the gunner's control panel, to the estimated values of range and target speed. The slew button, on the left control assembly grip, is pressed to electrically cage the sight while the mount is slewed to position the sight reticle on the target. Once the sight reticle is positioned on the target, the slew button is released to uncage the sight and the target is tracked by maintaining the reticle on the target. When a smooth tracking rate has been established, the gunner may commence firing.

d. Ground Mode. In the ground mode, all lead computing features of the system are disabled and the sight functions as a regular optical gun sight. The sight is mechanically caged and provides 7 mils of superelevation. Firing, mount control, and the high speed slew circuits are operational. The sight reticle illuminates immediately and the operator may commence firing as soon as he determines that a target is in range.

e. External Mode. The external mode provides a backup for the radar and manual modes. System operation is similar to the manual mode except that range to the target is estimated by an observer external to the turret and provided to the sight current generator by a calibrated range knob on the external range unit. The sight reticle illuminates 10 seconds after system power is turned on. The observer also controls the ready-to-fire indicator by a momentary switch on the external range unit. When operating in the external mode, the operator slews the turret to place the sight reticle on the target and continues to track the target. The observer turns on the ready-to-fire indicator located on the sight when the target range corresponds to the external range unit range dial. The ready-to-fire light is turned on by depressing the switch on the external range unit. The observer may continually change the range setting as he deems necessary. The operator may commence firing as soon as he sees the ready-to-fire indicator light.

f. Test Mode. The test mode is provided as a system check. The radar is in standby and a fixed (stow) value of range (1600 meters) and range rate (200 meters per second) is supplied to the sight current generator. The sight current generator solves a simulated problem and the computed sight magnet current is compared to a predetermined solution. If the comparison is within tolerance, the GOOD WHEN LIT indicator on the gunner's control panel lights.

Section II. FUNCTIONAL GROUP ANALYSIS

3-3. General.

This section provides a detailed analysis of each function performed by the XM163 weapon system. Each function provides either a value or action necessary to the proper operation of the system. In order to maintain the system, it is necessary to be able to determine that a fault does exist and which function is absent or incorrect. An understanding of how a function is performed and the components which are used will aid in quickly isolating the malfunctioning unit or subassembly. Major units of the cannon and mount control groups are listed in table 3-1 with their nomenclature and unit number.

3-4. Cannon Control Group.

The cannon control group consists of the circuitry which controls the feed and firing functions of the cannon. These functions include the firing voltage, gun drive, gun brake, and declutching feeder operation.

a. Cannon Power Control. The cannon power control and firing circuits are shown in figure 3-2, sheets 1 through

Table 3-1. Major Units of Cannon and Mount Control Group.

Unit no.	Military nomenclature
A1	Distribution Box
A2	Control Assembly
A3	Sight, Lead Computing, Automatic, XM61
A4	(Mount) Storage Batteries
A5	Inverter
A6	Gun Drive Assembly
A7	Drum Assembly
A14	Slip Ring Assembly
A15	Servo Amplifier Assembly
A16	Elevation Drive Assembly
A17	Azimuth Drive Assembly
A18	Elevation Limit Switch Assembly
A19	Azimuth Switch Assembly
A21	Sight Current Generator
A24	Radiate Foot Switch Assembly

3. Power for the gun drive motor is provided by two gun batteries. The gun batteries provide 24 Vdc and 8.84 Vdc inputs to the gun motor. When the system is operated in temperatures of 32° F and below, the LO-rate battery taps must be manually moved from the 8.84 Vdc position to the 10.1 Vdc position in order to provide greater motor torque.

(1) *HI-rate firing (fig. 3-2, sheet 1).* HI-rate firing is accomplished by driving the gun motor at high speed. The high speed drive voltage is provided by the 24 Vdc from the gun batteries. HI-rate firing is selected by placing the FIRING RATE switch, on the control panel assembly (unit A2), in one of the HI-BURST LIMIT positions. When the SYSTEM POWER switch (A2A1S5) (not shown) is ON, the system power relay (A1K2) energizes and applies power to the GUN POWER switch on the control panel assembly. When the GUN POWER switch is set in the ON position, power is applied, through the last round switch (A7A5S1), to normally open contacts of the action relay (A1K3), and to the converter (A1A3), the firing relay (A1K6), and the gun power light (A2A1DS2). When the action relay (A1K3) is energized, power is applied to normally open contacts of the trigger relay (A1K5), and TRIGGER switch (A2A4S2). Pressing the trigger energizes the trigger relay (A1K5) through the TRIGGER switch (A2A4S2), the arming connector (A8A3) (or remote safe connector), and the normally closed contacts of the clearing relay (A1K11) and the burst limit relay (A1K7). When the trigger relay (A1K5) energizes, power is applied to energize the fire volts time delay (A1Q2), which provides a ground for the firing relay (A1K6). The HI gun motor relay (A1K8) energizes through normally closed contacts of the burst limit relay (A1K7), and power is applied to the coil of K7, A1Q5, SCR-1, and the burst time resistive network associated with the FIRING RATE switch. The ground provided by the timing delay (A1Q2) energizes the firing relay (A1K6), which applies the output of converter A1A3 to the firing contact. When the HI gun motor relay (A1K8) is energized, 24 Vdc is applied from the gun batteries to the gun motor, driving the gun motor at high speed. The burst limit timing circuit (A1Q5 and SCR-1) times at a rate determined by the resistive network selected by the FIRING RATE switch position. When the time duration equals the selected burst length, A1Q5 fires, turning on A1A1 SCR-1, which in turn provides a ground for the burst limit relay (A1K7). The burst limit relay (A1K7) energizes through the HI position of the FIRING RATE switch (A2A1S4) and the ground provided by the burst limit circuitry. The normally closed contacts of the burst limit relay (A1K7) open, which removes power from the trigger relay (A1K5). This opens timing circuit (A1Q5), thus preventing a recycling of the burst limit time delay, and de-energizes the firing volts relay (A1K6). When relay A1K6 is de-energized, firing volts is removed from the firing contact assembly (A6A1). The HI gun motor relay (A1K8) is de-energized when the normally closed contacts of the burst limit relay (A1K7) open. The burst limit relay (A1K7) remains energized. The trigger must be released in order to remove the voltage from the burst limit relay (A1K7) to de-energize it and shut off SCR-1.

(2) *LO-rate firing (fig. 3-2, sheet 2).* LO-rate firing is accomplished by driving the gun motor at a slow speed. The 8.84 Vdc (10.1 Vdc below 32° F) battery taps provide the low speed drive voltage. LO-rate firing is selected by placing the FIRING RATE switch (A2A1S4) on the control panel assembly (unit A2) in the LO NO BURST LIMIT position. When the GUN POWER switch is set in the ON position, power is applied through the last round switch (A7A5S1) to normally open contacts of the action relay (A1K3). Power is also applied to converter A1A3, and to the firing relay (A1K6) through the arming connector (or remote safe connector (A8A3)). When the action switch on either control grip assembly handle (not shown) is pressed, the action relay (A1K3) is energized, applying power to normally open contacts of the trigger relay (A1K5) and TRIGGER switch (A2A4S2). Pressing the TRIGGER energizes the trigger relay (A1K5) through the TRIGGER switch, the arming connector (or remote safe connector (A8A3)), and the normally closed contacts of the clearing relay (A1K11) and the burst limit relay (A1K7). When the trigger relay (A1K5) energizes, power is applied to the timing delay (A1Q2), providing a ground for the firing relay (A1K6). The HI gun motor relay (A1K8) energizes, applying 24 Vdc from the gun batteries to the gun motor, driving the gun motor at high speed to overcome inertia and quickly get the gun up to speed. The LO time delay relay (A1K9) is energized by the LO time delay (A1Q4) providing a ground. The LO gun motor relay (A1K10) is

energized through the normally open contacts of the LO time delay relay (A1K9), at which time both the LO gun motor relay (A1K10) and the HI gun motor relay (A1K8) are energized. The burst limit timing circuit (A1Q5 and SCR-1) times out in approximately 0.25 second, providing a ground for the burst limit relay (A1K7) which energizes and then removes power from the HI gun motor relay (A1K8), and system power from the timing circuit (A1Q5 and SCR-1). The burst limit relay (A1K7) remains energized through the ground provided by SCR-1; the trigger relay remains energized through the LO contacts of the FIRING RATE switch (A2A1S4); and firing continues until the trigger is released, de-energizing the trigger relay (A1K5). The firing relay (A1K6) is held energized by the fire volts time delay circuit (A1Q2) for 2 to 3 seconds after the trigger is released or the burst limit is reached to allow the cannon to fire the remaining rounds during the clearing cycle. As a safety measure to assure that static electrical charges or stray voltages do not discharge ammunition which may be chambered, the normally closed contacts of firing relay (A1K6) hold the firing contact at ground when relay A1K6 is de-energized.

b. Gun Clearing and Braking. The clearing and braking functions clear the gun of all chambered rounds, and stop the gun from rotating after firing.

(1) *HI-rate automatic clearing (fig. 3-3, sheet 1).* When a HI burst is selected by the FIRING RATE switch (A2A1S4) and the GUN CLEAR switch (A2A1S3) is in the AUTO position, gun clearing takes place automatically when the selected burst limit is reached. During the firing cycle, the gun brake is released by system power applied through normally open contacts of the trigger relay (A1K5) and the system power relay (A1K2). The time delay circuit (A1Q1 and A1C1) charges immediately through the action relay (A1K3), the AUTO position of the GUN CLEAR switch (A2A1S3), and the trigger relay (A1K5). When the selected burst limit is reached, the trigger relay (A1K5) (fig. 3-2, sheet 1) is de-energized by the action of the burst limit relay (A1K7). When the trigger relay (A1K5) is de-energized, the clearing relay (A1K11) (fig. 3-3, sheet 1) is energized through normally closed contacts of the trigger relay and the ground supplied briefly during discharge of the time delay circuit (A1Q1). De-energizing the trigger relay (A1K5) also removes the voltage from the gun brake release solenoid (A6A2A1), and the brake is applied to the gun. When the clearing relay (A1K11) is energized, it applies power through its normally open contacts to the declutching solenoid (A6A3L1) which prevents the declutching feeder from supplying ammunition to the gun. The gun continues to rotate by its own momentum for a short while after the brake is applied. During the time the gun continues to rotate, the firing volts are applied to the firing contact through the action of the firing relay (A1K6) (fig. 3-2, sheet 1). The declutching solenoid (A6A2L1) (fig. 3-3, sheet 1) is held energized by the action of the clearing relay (A1K11) and time delay circuit (A1Q1 and A1C1), permitting the gun to clear as it coasts to a stop.

(2) *LO-rate automatic clearing (fig. 3-3, sheet 2).* When the LO burst is selected by the FIRING RATE switch (A2A1S4) and the GUN CLEAR switch (A2A1S3) is in the AUTO position, gun clearing takes place automatically when the trigger is released at the end of a burst. During the firing cycle, the gun brake is released by system power applied through normally open contacts of the system power relay (A1K2) and trigger relay (A1K5). When the trigger relay (A1K5) is energized, the LO time delay circuit (A1Q4) is immediately charged through the normally open contacts of the trigger relay. The LO time delay circuit provides a ground for the LO time delay relay (A1K9), which is energized through the LO position of the FIRING RATE switch (A2A1S4). Contacts of the LO time delay relay (A1K9) energize the LO gun motor relay (A1K10) and charge the clearing relay (A1K11) time delay circuit (A1Q1). When the trigger is released, the clearing relay (A1K11) is energized through normally closed contacts of the trigger relay (A1K5) and will remain energized for two or three seconds while the time delay circuit (A1Q1 and A1C1) times out. Power is also removed from the time delay circuit (A1Q4 and A1C4) by the normally open contacts of the trigger relay (A1K5); but the LO time delay relay (A1K9) and firing relay (A1K6) (fig. 3-2, sheet 1) remain energized for 0.14 to 0.18 second, while the time delay circuit (A1Q4 and A1C4) times out, thus, keeping the LO gun motor relay (A1K10) energized long enough to clear all rounds which are in the gun.

(3) *Operator clearing (fig. 3-3, sheet 3).* Whenever the gun is fired with the GUN CLEAR switch in the OFF position, the clearing circuits are disabled (no power applied) and the gun contains live rounds at the end of a burst. The operator must then clear the gun by holding the GUN CLEAR switch in the OPERATOR position and depressing the action switch. During the operator clear cycle, the gun brake is released through normally open contacts of the action relay (A1K3) and the OPERATOR position of the GUN CLEAR switch (A2A1S3). The HI gun motor relay (A1K8) is energized and the clearing time delay circuit (A1Q1 and A1C1) is charged, placing a ground on the clearing relay (A1K11) which energizes. The declutching solenoid (A6A3L1) is energized by the normally open contacts of the clearing relay (A1K11). The gun continues to drive as long as the action switch is pressed and the GUN CLEAR switch is held in the OPERATOR position. When the action switch is released, the HI gun motor relay (A1K8) and gun brake are de-energized; the clearing relay (A1K11) remains energized for 2 to 3 seconds while the timing circuit (A1Q1 and A1C1) times out.

(4) *Last round clearing (fig. 3-3, sheet 4).* A high rate automatic clearing cycle is initiated when the last round is extracted from the drum, by the action of the last round switch (A7A5S1) as it moves to the drum empty position.

The drum empty position of the last round switch (A7A5S1) applied 24 Vdc (gun power) to the coil of the last round relay (A1K12). Since the last round timing circuit (A1Q3 and A1C3) has been charged through contacts of the action relay (A1K3) and the trigger relay (A1K5) when the LAST ROUND switch (A7A5S1) was in the DRUM FULL position, relay A1K12 energizes immediately. The last round switch removes power from the trigger relay (A1K5) (fig. 3-2, sheet 1). Contacts of the last round relay (A1K12) apply power to the gun brake release solenoid (A6A2A1), the HI gun motor relay (A1K8), and the clearing relay (A1K11) timing circuit (A1Q1 and A1C1). The clearing relay (A1K11) is energized through the normally closed contacts of the trigger relay (A1K5) and the ground provided by the clearing circuit (A1Q1 and A1C1). The clearing relay is held by the timing circuit (A1Q1 and A1C1), for 2 to 3 seconds while the gun completes a high rate automatic clearing cycle.

3-5. Mount Control Group.

a. General. The mount control group provides the gunner with the control of mount motion required to accurately track a moving target or train the cannon on a stationary target. Mount movement is controlled by the gunner's manipulation of the grip assemblies. Clockwise or counterclockwise rotation of the grip assemblies causes the mount to traverse right or left respectively. Forward and backward rotation of the grip assemblies elevates the cannon (down or up motion respectively). The grip assemblies are spring-centered, in the null positions, so that the mount remains stationary until the operator rotates the grip assemblies. Each servo motor contains a spring-loaded brake which holds the mount and cannon stationary until the action switch on the grip assemblies is squeezed. The brakes can be manually released by turning the brake release levers perpendicular to the axis of the motor. Both azimuth motor brakes must be released to free the mount in azimuth.

CAUTION

During normal operation the manual brake release levers must be parallel to the axis of the motors.

b. Mount Control Servo Drive, Block Diagram Analysis. The servo systems, used to drive the mount (fig. 3-4) in azimuth and elevation, consist of control circuits, servo amplifiers, and drive assemblies. Rate servo systems are used in order to provide smooth, constant rate tracking.

(1) *Control circuits.* An independent control circuit is provided for both the azimuth and the elevation servo loop. The control circuits provide the servo amplifiers with drive signals that correspond to the operator's manipulation of the grip assemblies. Each control circuit contains a tachometer which momentarily aids in the development of the drive signal, producing quicker mount reaction and helping to provide smooth acceleration and deceleration. A viscous damper is used to smooth out control movements during tracking.

(2) *Servo amplifiers.* The servo amplifiers produce an output signal proportional to the drive signal input, from the control circuits. The output signal is polarized to reflect the direction of the input signal (up/down-right/left) and drive the servo motor in the corresponding direction. The azimuth servo loop contains two synchronized servo amplifiers, the master servo amplifier, and the slave servo amplifier.

(3) *Drive assemblies.* The elevation drive assembly contains the elevation servo motor and the elevation dc feedback tachometer. The azimuth drive assembly contains two azimuth drive motors and the azimuth dc feedback tachometer. The servo motors drive the mount in response to the servo amplifier output signals and provide a brake for the mount whenever the action switch is not squeezed. The dc feedback tachometers are geared to the drive assemblies to develop a voltage of opposite polarity to the voltage developed by the control circuit tachometers. The dc feedback voltages are used to control the mount speed and help to provide smooth acceleration and deceleration.

c. Elevation Servo Loop (fig. 3-5, sheet 1). The elevation hand control potentiometer (A2A2R1), the elevation aided laying tachometer (A2A2G1), and the viscous damper are contained within the elevation control assembly. The elevation drive signal is initiated by the operator rotating the grip assemblies forward or backward. When the grip assemblies are rotated they position the wiper arm of the elevation hand control potentiometer (A2A2R1). In the null (spring-centered) position the wiper arm is centered and the outputs from pins f and s are equal. When the wiper arm is displaced from the center position, one output increases and the other decreases. The outputs from the elevation hand control potentiometer are applied to the servo amplifier (A15A3) through the normally open contacts of the lower limit relay (A1K13) and the upper limit switch (A18S4). The servo amplifier (A15A3) is a differential amplifier which produces an output proportional to the difference in the input signals (A15A3, pins R and G). When the input signals are equal, the amplifier does not produce an output and elevation drive ceases. Rotating the wiper arm further from the center of the elevation hand control potentiometer produces a greater difference in the input signals to the servo amplifier which increases the output signal. The polarity of the servo amplifier output reverses whenever the wiper arm on the elevation hand control potentiometer crosses the center position. The elevation servo motor (A16A1) is driven by the servo amplifier output. The direction of drive (up or down) is controlled by the polarity of the servo amplifier output. The speed of the servo motor is determined by the amplitude of the servo amplifier signal. The cannon is limited in elevation, from −5 degrees to +80 degrees.

(1) *Lower elevation limit.* When the cannon is driven down to −5 degrees (fig. 3-5, sheet 1), the lower limit relay is de-energized and prevents the cannon from driving further down by simulating the return of the elevation control wiper arm (A2A2R1) to the center position. Contacts of the lower limit relay (A1K13) open one side of the elevation hand control potentiometer, ground the center tap, and close the circuit containing the lower limit potentiometer (A1A2R23) and resistor A1A2R21. This provides an input signal to pin G of the servo amplifier that is equal to the input signal provided by the upper half of the elevation hand control potentiometer and resistor A1A2R28 to pin R. With the servo inputs balanced, the drive stops. Movement of the elevation hand control potentiometer wiper arm on the open (lower) side of the center tap, has no effect on the system. When the wiper arm is moved to the other side (upper) of the center tap, the input to the servo amplifier is again unbalanced, and the servo amplifier provides the motor with a drive signal, driving the cannon up, out of the lower limit.

(2) *Upper elevation limit (fig. 3-5, sheet 1).* When the mount is elevated to 80 degrees, the 80-degree limit switch (A18S4) opens the elevation hand control potentiometer circuit (upper end), grounds the center tap, and closes the circuitry consisting of the upper limit potentiometer (A1A2R24) and resistor A1A2R22. The circuit functions the same as in the lower limit. When the 80-degree switch (A18S5) opens, it extinguishes the ready-to-fire indicator.

(3) *Acquisition time delay (fig. 3-5, sheet 1).* In the radar mode the acquisition time delay relay (A1K14) is energized by a signal from the sight current generator when the radar locks on a target. The dc feedback from tachometer A16A2G1 is reduced, permitting a momentary increased rate of elevation drive.

d. Azimuth Servo Loop (fig. 3-6, sheet 1). The azimuth hand control potentiometer (A2A1R10), the azimuth aided laying tachometer (A2A1G1), and the viscous damper are contained on a plate inside the control assembly. The azimuth drive signal is initiated by the operator rotating the grip assemblies clockwise or counterclockwise. As the grip assemblies are rotated they rotate the entire elevation control assembly. This turns a bearing-mounted shaft that positions the wiper arm of the azimuth hand control potentiometer, which is geared to the aided-laying tachometer and the viscous damper. The operation of the azimuth hand control potentiometer is identical to the operation of the elevation hand control potentiometer. The outputs from the azimuth hand control potentiometer are applied to servo amplifier no. 1 (A15A1) through the distribution box. Servo amplifier no. 1 provides the drive signal to servo motor A17A1 and an input signal to servo amplifier no. 2 (A15A2) which synchronizes the output of servo amplifier no. 2 with the output from servo amplifier no. 1. Servo amplifier no. 2 provides the drive signal to servo motor A17A2. The operation of the azimuth servo amplifiers and servo motors is identical to the operation of the elevation servo amplifier and motor except that the two servo amplifiers and motors are operated in tandem. The tachometers (A2A1G1 and A17A3) perform the same functions as their counterparts in the elevation servo loop.

(1) *High speed slew.* In the ground mode, when the grip assemblies are rotated fully clockwise or counterclockwise, slew switch A2A1S6 or A2A1S7 closes, and the negative side of the dc feedback tachometer (A17A3) is reduced through high speed slew resistor (A1A2R9). Thus, less dc feedback is developed and the mount slews at its maximum rate.

(2) *Acquisition time delay.* The acquisition time delay function is the same as in the elevation servo loop.

e. Hatch Protection Circuit (fig. 3-7, sheet 1). The hatch protection circuit provides a safeguard for personnel and equipment by preventing the mount from driving the cannon into the area around an open hatch. An open hatch is protected by an area on each side of the hatch.

(1) The azimuth limits are inoperative whenever both hatches are closed or if the cannon is elevated above 13 degrees. When a hatch is open and the cannon elevation angle is less than 13 degrees, the hatch protection circuit keeps the mount from driving into a protected area.

(2) The azimuth limit circuit stops the mount in the same manner as the lower elevation limit circuit. When an azimuth limit is reached, the limit relay (A1K15 right or A1K16 left) is de-energized. When an azimuth limit relay de-energizes, it prevents the mount from driving further into the limit by simulating the return of the wiper arm (A2A1R10) to the center position. Contacts of the azimuth limit relay open one side of the azimuth hand control potentiometer, ground the center tap of A2A1R10, and close either the circuit containing A1A2R18 and the LEFT LIMIT potentiometer (A1A2R20) (fig. 3-7, sheet 1), or the circuit containing A1A2R17 and the RIGHT LIMIT potentiometer (A1A2R19).

(3) The azimuth limit relays (A1K15 and A1K16) are each provided with three energizing paths. In order to de-energize either one of the azimuth limit relays, all three energizing paths must be opened (fig. 3-7, sheet 1). Both relays are energized by +24 Vdc from contacts of the turret power relay (A1K4) through the hatch switches (A11S1 or A11S2), and the gun position switch (A14S1). When the cannon is in the area of a closed hatch, the azimuth relays cannot be de-energized and the hatch protection circuit is inactive. The second energizing path for both azimuth relays is from the contacts of the turret power relay

through the 13-degree elevation limit switch. When the cannon is elevated above 13 degrees, the 13-degree switch is closed and the hatch protection circuit remains inactive. When the cannon is below 13 degrees (13-degree switch (A18S2) open), and in the area of an open hatch (hatch switch open), the azimuth limit relays are energized through the right and left limit switches (A19S1 and A19S2). When the cannon is below 13 degrees and approaches an open hatch from the right, the right limit switch (A19S1) is opened by either the 51-degree or 95-degree cam (see fig. 3-7, sheet 2). When the right limit switch opens, it de-energizes the right limit relay (A1K15) and the mount stops. When an open hatch is approached from the left, the left limit switch (A19S2) opens and de-energizes the left limit relay (A1K16). Mount drive out of the limit is maintained in the same manner as for the negative 5-degree elevation limit.

3-6. Fire Control Group

a. General. The fire control group which provides the solution to the fire control problem, consists of the XM61 sight, the inverter, the elevation potentiometer, the sight current generator, and the VPS-2 radar.

b. Sight Current Generator. The sight current generator is an analog computer which computes lead angle (represented by sight magnet current VI_M), and superelevation (represented by sight torque current VI_T). Computation of sight magnet current (VI_M) requires inputs of muzzle velocity, correction data (range and range rate), traverse and elevation data, and air density. Sight magnet current (VI_M) is applied to the sight along with mount movement to offset the sight reticle to the proper lead angle. Computation of sight torque current (VI_T) requires inputs of radar antenna position in elevation, VI_M, range and range rate correction, and cannon position in elevation. Sight torque current (VI_T) is applied to the sight where it offsets the sight reticle to the proper superelevation.

(1) *Magnet current (VI_M).* Magnet current is derived by summing five terms in the ballistics data amplifier (A21A1). Magnet current is used by the sight (XM61), along with the turning rate of the mount, to produce the correct lead angle (fig. 3-8, sheet 1).

(a) First term. The first term provides the time-of-flight for the projectile from the muzzle to the target at its present range (uncorrected for future range). Time-of-flight data provides 80 to 100 percent of the lead angle solution, depending upon the direction of the target with respect to the line-of-sight. Time-of-flight is a direct function of muzzle velocity (ballistics) and range. Range information is provided by the radar (radar mode), the RANGE control on the gunner control panel (manual mode), or the external range unit (external mode). The range input to the sight current generator drives the range servo motor (A21A15B1), which positions the wiper of the range potentiometer (A21A15R11R2) to select a voltage (-15 to 0 Vdc) representing present range. The range voltage is applied to the muzzle velocity network, where the correct value has been selected (switch A21S1) by the operator in conjunction with the chart located on the sight current generator cover. The computed value of the first term (time-of-flight) is applied to the ballistics data amplifier (A21A1). It is summed with the four other terms to produce the sight magnet current (VI_M).

(b) Second term. The second term provides a target range rate correction to the basic ballistics curve. The range rate input to the sight current generator drives the range rate servo motor (A15B2), which positions the wiper arm on the range rate potentiometer (A21A15R12R3) to select a voltage (+15 to -15 Vdc) which represents present range rate. This voltage is applied to the buffer amplifier (A21A3A2) which inverts the polarity. The voltage is developed across the range potentiometer (A21A15R11R3). The second term voltage is then applied to the ballistics data amplifier (A21A1), and combined with the other terms to produce the sight magnet current.

(c) Third term. The third term provides the necessary compensation for the mechanical linkage gain factor of the sight. The third term is developed from range and range rate information similar to the second term, but of the opposite polarity. Combining of the second and third terms produces a correction which permits the gunner to track the target more smoothly. The range rate servo motor (A15B2) positions the wiper arm on the range rate potentiometer (A21A15R12R4), selecting a voltage (+15 to -15 Vdc) which represents the present range rate. This voltage is applied across the range potentiometer (A21A15R11R4), where the wiper arm is positioned by the range servo motor (A15B1). The selected wiper arm voltage is equal to the third term and is combined with the other terms within the ballistics data amplifier (A21A1).

(d) Fourth term. The fourth term provides a voltage level which represents the lead angle and distinguishes between targets at the same range with equal range rates. The λT^2 and λE^2 potentiometers in the radar antenna provide the elevation and traverse lead angle signals, which may vary from 0 to -15 Vdc. These two signals are combined by amplifier A21A8A1 and the lead angle squared

(λ^2) voltage is developed. The λ^2 voltage is applied across the range rate potentiometer (A21A15R12R5). The wiper arm of potentiometer A21A15R12R5 is positioned by the range rate servo motor (A15B2). This voltage is applied to the inverting amplifier (A21A3A3) which develops its output across the range potentiometer (A21A15R11R5). The wiper arm of A21A15R11R5 is positioned by the range servo motor (A15B1). The fourth term voltage is applied to the ballistics data amplifier through the inverting amplifier (A21A1A4) where it is combined with the other terms.

(e) Fifth term. The fifth term compensates for air density. The air density switch on the sight current generator is positioned as directed by the chart on the cover. Positioning the switch applies the correct voltage (+15 to -15 Vdc) across the range potentiometer (A21A15R12R2). The wiper arm of A21A15R12R2 is positioned by the range rate servo motor (A15B2). The voltage (a function of air density and range rate) is then applied across the range potentiometer (A21A15R11R6). The wiper arm is positioned by the range servo motor (A15B1). The voltage on the wiper arm is then combined with the other terms in the ballistics data amplifier (A21A1).

(f) Magnet current supply module. The five terms are properly summed by the ballistics data amplifier, forming an output signal which is applied to the magnet current supply (A21A13). The magnet current supply module (A13) provides current to the sight range magnet in proportion to the voltage supplied by the magnet current summing amplifier (A21A1A3). The current supplied to the sight magnet produces a precessional force equal to the computer lead angle. Magnet current is not applied to the sight range magnet during ATD (acquisition time delay). ATD is the time between radar lock-on and ready-to-fire.

(2) *Torque current (VI_T).* Torque current (fig. 3-9) used by the sight to produce the superelevation is derived by summing four terms in the ballistics data amplifier (A21A1).

(a) First term. The first term originates as VI_M in the magnet current circuit which is related to target range. The VI_M signal is applied to the diode function generator (A21A8). The output of the diode function generator is $VI_M{}^2$. This signal is applied as one input of multiplier A21A9A1 through A8A4 and A8A3. Also applied to the multiplier is $\lambda_E{}^2$ which is related to radar antenna elevation position (target elevation). The multiplier combines $VI_M{}^2$ and $\lambda_E{}^2$. The $VI_M{}^2$ component is converted to a pulse whose width is proportional to $VI_M{}^2$ amplitude (target range). The $\lambda_E{}^2$ input determines the amplitude of the multiplier output. Thus, the output of the multiplier is related to target range and target elevation. This output signal is applied, through inverter A21A8A2, to one side of the λ_E potentiometer and to inverter A21A11A1 whose output is inverted and applied to the other side of the λ_E potentiometer. The position of the λ_E potentiometer wiper is determined by the radar antenna elevation; thus, its output provides additional target elevation data which is applied to the ballistics data amplifier (A21A1A1) where it is summed with the other three terms that make up VI_T.

(b) Second term. The second term also originates from the magnet current circuit (VI_M) thus, it too is related to target range. The output of the diode function generator (A21A8) is applied to amplifier A21A8A4. The output of amplifier A21A8A4 is applied to one side of the $\lambda_E{}^3$ potentiometer and to amplifier A21A8A3 whose output is inverted and applied to the other side of the $\lambda_E{}^3$ potentiometer. The position of the $\lambda_E{}^3$ potentiometer wiper is determined by radar antenna elevation; thus, it too provides additional target elevation data which is summed with the other three terms in the ballistics data amplifier (A21A1A1).

(c) Third term. The third term originates in the cosine E potentiometer, which is located on the mount. The cosine E voltage varies from 0 to -15 Vdc, indicating the cannon elevation angle. The cosine E voltage is applied to the range potentiometer (A21A15R12R6). The voltage from the wiper arm is then applied to the buffer amplifier (A21A3A1), where it is inverted and applied to the range potentiometer (A21A15R11R7). The voltage on the wiper arm is applied to the ballistics data amplifier (A21A1A1) for summing with the three other terms by the ballistics data amplifier (A21A1A1).

(d) Fourth term. The output voltage from the cosine E potentiometer is applied directly to the ballistics data amplifier, where it is summed with the three other inputs.

(e) Torque current supply module (A21A14). The four terms are summed by the ballistics data amplifier, forming an output signal which activates the torque current supply module. The torque current supply module (A14) provides current to the sight torque motor in proportion to the voltage supplied by the torque current summing amplifier (A21A1A1). The current supplied to the sight torque motor drives the motor so as to produce the calculated superelevation.

(3) *Range servo.* The range servo (P/O A21A15), figure 3-10, positions the wiper arms on

the seven cups of the range potentiometer (A21A15R11) in the sight current generator. The range servo follows the radar range input in the radar mode and the manual range input in the manual mode. The range servo circuit consists of modulator T1, amplifier A1, motor B1, and the range reference potentiometer cup of the range potentiometer (A21A15R11 cup 1).

(a) In the radar mode the range voltage and a range reference voltage originate in the radar. The range voltage is developed in the radar ranging system as an analog voltage from 0 to +20 Vdc, representing 0 to 5000 meters. The radar range voltage is applied to modulator T1 through normally closed contacts of the manual relay (A21K26). The range clamp circuit prevents the radar range voltage from exceeding 12 volts at the modulator input. The radar ranging system also provides a +20 Vdc range reference signal which is clamped in the sight current generator by limiter A3Q9 to +12 Vdc. The +12 Vdc is applied to the range reference potentiometer (A21A15R11 cup 1) providing for a maximum dc feedback signal of +12 Vdc.

(b) Modulator T1 converts the input range dc voltage to an equivalent ac voltage. The phase of the output from modulator T1 is determined by the relative values of the dc input on pin 3 (dc range voltage) and on pin 4 (dc feedback from A21A15R11 cup 1). Amplifier A1 amplifies the ac signal from the modulator and produces an ac drive signal for motor B1. The direction of drive is dependent upon the phase of the input to amplifier A1. Servo motor B1 drives to position the wiper arms of the range potentiometer (A21A15R11) to the value of range input from the radar. As the range servo motor drives, it positions the wiper arm on the range reference cup which provides the dc feedback to modulator T1. When the feedback (T1 pin 4) is equal to the dc range voltage (T1 pin 3), the output of the modulator T1 ceases and the range servo motor (B1) stops.

(c) In the manual mode, the range voltage input is generated by positioning the manual range control on the gunner's control panel. The manual range signal (0 to +15 Vdc) is applied to modulator T1 through contacts of the manual relay (A21K26). A reference voltage of +15 Vdc is applied to the range potentiometer (A21A15R11) to supply the dc feedback input to the modulator. The modulator, amplifier, and motor operate as described in the radar mode.

(4) *Range clamp.* The range clamp circuit, figure 3-11, prevents the range inputs from exceeding +12 Vdc in the radar mode or +15 Vdc in the manual mode.

(a) In the radar mode, the radar range signal (0 to +12 Vdc) is applied to the clamping circuit through contacts of the manual relay (A21K26) and resistor A15R13. The +12 Vdc reference voltage is applied to the clamping circuit through contacts of the manual relay (A21K26). Differential comparator Q3 and Q4 compares the radar range signal (0 to +12 Vdc) on Q3 to the radar range reference voltage (+12 Vdc) on Q4. When the radar range voltage exceeds the reference voltage, Q3 conducts, back biasing and cutting off Q4 and turning on Q2. When transistor Q2 conducts, it clamps the range voltage to the reference voltage (+12 Vdc). When a range voltage of less than +0.8 Vdc is applied to the clamping circuit (A11Q3), the clamping circuit provides a constant range voltage of +0.8 Vdc which reflects a minimum range of 200 meters and stops the range servo drive before it reaches the low end of the range servo potentiometers. The +20 Vdc radar range reference voltage, provided by the radar, is clamped in the sight current generator by limiter A3Q9 to +12 Vdc and applied to the clamping circuit through contacts of the manual relay (A21K26).

(b) In the manual mode, the manual range signal (0 to +15 Vdc) is applied to the clamping circuit through contacts of the manual relay (A21K26) and resistor A15R13. The clamping circuit functions the same in manual mode as in radar mode, except the input range signal is clamped at +15 Vdc.

(5) *Range rate servo.* The range rate servo (P/O A21A15), figure 3-12, positions the wiper arms on the six cups of the range rate potentiometer (A21A15R12) in the sight current generator. The range rate servo follows the radar range rate input in the radar mode and the manual target speed input in the manual mode. The range rate servo consists of modulator T2, amplifier A2, motor B2, and the range rate reference cup of the range rate potentiometer (A21A15R12 cup 1).

(a) In the radar mode the range rate voltage and range rate reference voltages originate in the radar. The range rate voltage is developed in the ranging system as an analog voltage from -10 Vdc to +10 Vdc. A negative signal indicates an inbound target and a positive signal indicates an outbound target. The radar range rate signal is applied to modulator T2 through normally open contacts of the manual relay (A21K26). The radar ranging system also supplies two range rate reference voltages, -10 Vdc and +10 Vdc, which are applied across the range rate reference potentiometer (A21A15R12 cup 1). A ground is provided at the electrical center of the range rate reference potentiometer through normally closed contacts of the manual relay (A21K26). With the ground at the center of the range rate reference potentiometer, the top section provides a positive dc feedback for a positive radar range rate input (outbound target) and the lower half provides a negative feedback for a negative radar range rate input (inbound target).

(b) Modulator T2 converts the input range rate dc voltage to an equivalent ac voltage. The phase of the output from modulator T2 is determined by the relative values of the dc inputs on pin 3 (dc range rate voltage) and on pin 4 (dc feedback from A21A15R12 cup 1). Amplifier A2 amplifies the ac signal from modulator T2 and produces an ac drive signal for the servo motor (B2). The direction of drive is dependent upon the phase of the input to amplifier A2. The servo motor (B2) drives to position the wiper arms of the range potentiometer (A21A15R12) to the value of range rate input from the radar. As the range rate servo motor drives, it positions the wiper arm on the range rate reference cup which provides the dc feedback to the modulator T2. When the feedback (T2 pin 4) is equal to the dc range rate voltage (T2 pin 3) the output of the modulator ceases and the range rate servo motor (B2) stops.

(c) In the manual mode, the target speed signal (0 to +7.5 Vdc) is generated by positioning the target speed control on the gunner's control panel. The target speed signal is applied to modulator T2 through contacts of the manual relay (A21K26). The function of the modulator T2, amplifier A2, servo motor (B2), and the wiper arm of the range rate reference potentiometer (A21A15R12 cup 1) is the same in the manual mode as in the radar mode.

(6) *Ten-second time delay.* The 10-second time delay circuit (fig. 3-13) permits the gyro motor in the sight to get

up to speed before allowing any magnet current to be applied to the sight. The sight reticle lamp lights at the end of the 10-second time delay except in the ground mode when it lights when the system power relay is energized. In all other modes when the system is turned on, 24 Vdc from the mode switch is applied to the 10-second time delay circuit (Q5 and Q6) in the time delay module (A21A11). When the delay circuit times out, the time delay relay (A21K23) energizes as the time delay circuit provides the necessary ground. The sight current generator ±15 Vdc power supply (PS1) is enabled by +19 volts from inverter A5 through normally open contacts of the 10-second time delay relay (A21K23) and normally closed contacts of the external mode relay (A21K25). Power supply PS1 provides the +15 Vdc and -15 Vdc inputs to the various SCG printed circuit cards and modules. The 10-second time delay relay also applies power to the sight reticle lamp (DS1) from the MODE switch (A2S1) through normally open contacts of relay A21K23, resistor A2A1R2, and the reticle intensity potentiometer (A2A1R1). In the ground mode, 24-volt power from the system battery is applied to the sight reticle lamp through normally open contacts of the system power relay (A1K1), the GRD position of the MODE switch (A2S1), resistor A2A1R2, and the reticle intensity potentiometer (A2A1R1).

(7) *Outbound configuration control.*

(a) The outbound configuration control circuit (fig. 3-14) detects a positive range rate signal (outbound target) and energizes relays A21A2K1 through A21A2K7. When the outbound relays energize they rescale portions of the computing potentiometers which changes the computing circuitry for the outbound target condition. The ready-to-fire circuit is rescaled to produce a 1600-meter ready-to-fire condition instead of a 2200-meter ready-to-fire condition (see ready-to-fire circuit, fig. 3-16).

(b) In the radar mode with an outbound target the radar range rate signal is a positive voltage which is applied to voltage comparator (A21A4) (Q11 through Q15) pin 15. The other input of the voltage comparator is through resistors A21R49 and A21R50. The positive input causes the voltage comparator to provide a signal which causes the driver (A2Q1) to energize relays A21A2K1 through A21A2K7.

(c) In the manual mode input pin 16 of the voltage comparator is positive biased to prevent the positive manual target speed input (0 to 7.5 Vdc) from energizing the outbound configuration relays.

(8) *Acquisition time delay (ATD).*

(a) The acquisition time delay circuit (fig. 3-15) is activated at radar lock on. The radar lock-on signal starts the ramp generator, removes the magnet current from the sight, inhibits the sight correction signal, and causes the turret to speed up by inhibiting the turret servo amplifier tachometers. During the acquisition time delay the lead angle accumulates at the maximum rate as the sight gyro remains fixed in space when the magnet current is removed. When the ramp generator output is equal to a function of range as compared by the voltage comparator, the sight magnet current is restored, the turret servo feedback is enabled, and acquisition time delay signal is removed from the ready-to-fire circuit.

(b) When the radar locks on a target, the lock-on signal applies a positive voltage on the cathode of CR-1, through inverter A3Q7, causing Q1 to conduct and turn off Q4 which turns on Q5, Q6, and Q7. The output of Q5 inhibits the sight magnet current to the sight. The output of Q6 prevents the ready-to-fire lamp on the sight from lighting and inhibits the sight correction signal. The output of Q7 provides a ground which energizes relay K1 to provide +24 Vdc through its normally open contacts to energize the acquisition time delay relay (A1K14) and inhibit the tachometer feedback signal. The output of Q1 also shuts off Q2, causing the input to operational amplifier A1 to go more negative. When the input to amplifier A1 attempts to go negative, the output voltage prevents it from an instantaneous drop through feedback capacitor C6. Capacitor C6 and transistor Q9 (integrator) then charge to the value set by Q2; this charge curve is linear, causing the output of A1 to rise as a direct function of time. The ramp voltage output from A1 is limited by Q10 to 12 volts. The ramp voltage at the output of A1 is applied to one input of voltage comparator A6. The other input to voltage comparator A6 is radar range voltage from the range servo amplifier A15, rescaled for use by the comparator in buffer amplifier A2. When the ramp voltage from A1 exceeds the radar range voltage (scaled by A2), voltage comparator A6 shifts making the acquisition time delay a direct function of range. The output from voltage comparator A6 causes A7Q3 to conduct, cutting off Q6, Q5, and Q7 restoring sight magnet current, tachometer feedback, and removes the ATD inhibit signal to the ready-to-fire circuit and the sight correction circuit.

(c) When the radar lock-on signal is removed, the cathode of CR-1 goes to ground, and Q1 stops conducting, turning on Q2. The input to A1 from Q2 shifts to positive and the output tries to become a negative ramp, but Q9 prevents capacitor C6 from charging and prevents the generation of a negative ramp.

(9) *Ready-to-fire.*

(a) The ready-to-fire circuit (fig. 3-16) lights the ready-to-fire indicator, on the sight, indicating to the gunner when the target may be effectively fired upon. The ready-to-fire circuitry is active in the radar mode. The ready-to-fire indicator is illuminated in the manual, external, and radar modes, but it is not illuminated in the ground mode.

(b) In the manual mode, the manual mode relay (A21K26), the 10-second time delay relay (A21K23), and

the ready-to-fire relay (A21K27) are energized providing a ground return for the ready-to-fire lamp (A3DS1). The ready-to-fire indicator lights when the action switch is closed and the ready-to-fire relay is energized.

(c) In the external mode (fig. 3-17) the ground return for the ready-to-fire indicator is provided by the external ready-to-fire pushbutton (A10S1) on the external range control (fig. 3-16), through the external mode relay (A21K25), the 10-second time delay relay (A21K23), and the ready-to-fire relay (A21K27). The ready-to-fire indicator lights when the external ready-to-fire pushbutton (A10S1) is pressed.

(d) In the radar mode, the ready-to-fire indicator lights when the following conditions are satisfied:

1. Range less than 2200 meters inbound; 1600 meters outbound.

2. Lead angle less than 25 degrees.

3. Acquisition time delay completed.

4. Radar lock on.

5. Elevation angle less than 80 degrees.

When any one of the five conditions is not satisfied, the AND gate is not enabled and transistors Q4 and Q7 are cut off, removing the ground from the ready-to-fire lamp (A3DS1). When all five conditions are satisfied, the AND gate is enabled; transistors Q4 and Q7 conduct, lighting the RTF lamp. The five conditions are described in the following paragraphs.

(e) Range less than 2200 meters inbound; 1600 meters outbound. The radar range signal from the radar is scaled down by the buffer amplifier (A7A2) and applied to voltage comparator A6(Q1 through Q5). If the range signal is less than 2200 meters inbound or 1600 meters outbound, a true input (open circuit) is applied to the AND gate satisfying one condition. When the range is greater than 2200 meters inbound or 1600 meters outbound, a false input (ground) is applied to the AND gate and the lamp circuit is inhibited.

(f) Lead angle less than 25 degrees. The lead angle input originates as two signals in the radar antenna positioning system, λE^2 and λT^2. These signals are combined, inverted by inverter A8A1, and applied to the voltage comparator (A6Q11-Q15). If the signal is less than the voltage representing $\lambda^2 > 25°$ (+13 Vdc), a true input is applied to the AND gate, satisfying the second condition. When the combination lead angle signal is greater than the voltage representing $\lambda^2 > 25°$, a false input is applied to the AND gate and the lamp circuit is inhibited.

(g) Acquisition time delay (ATD) completed. During the ATD time a positive signal (false) is applied through inverter A7A2 to the AND gate, inhibiting the RTF lamp circuit. When the acquisition time delay is completed, the positive signal is removed and a true input is applied to the AND gate, satisfying the third condition.

(h) Radar lock on. The radar provides a +15 Vdc signal to the sight current generator when the radar *is not* locked on a target. The +15 Vdc signal (false) is applied through inverter A3Q7 to the AND gate, inhibiting the RTF circuit. When the radar locks on a target, the +15 Vdc signal is removed, and inverter A3Q7 produces a true input to the AND gate, satisfying the fourth condition.

(i) Elevation angle less than 80 degrees. When the mount is elevated to 80 degrees, the 80-degree limit switch provides a ground signal to voltage divider R14 in the sight current generator. When the elevation angle is greater than 80 degrees, the open signal allows the input of A3Q8 to the AND gate to go positive, turning on Q8 and inhibiting the RTF circuit. When the elevation angle is less than 80 degrees, a ground is applied to R14. Transistor Q8 is turned off, producing a true input to the AND gate, satisfying the fifth condition. When all five inputs to the AND gate are true, transistors Q4 and Q7 conduct and provide a ground for the ready-to-fire lamp (A3DS1). Any one false (condition not met) input to the AND gate inhibits the gate and shuts off Q4 and Q7, removing the RTF lamp ground.

(10) *Electronic countermeasure detection (ECM).* The electronic countermeasure detection circuit (fig. 3-18) causes the ready-to-fire indicator, on the sight, to blink at a 2.5-Hz rate when the radar detects an electronic countermeasure signal. The ECM detection circuit consists of an AND gate, an astable multivibrator, and a lamp driver amplifier. When a jamming signal (ECM) is detected by the radar a ground signal is placed on the cathode of CR-1, cutting off Q1. When Q1 cuts off, Q3 conducts and a ground signal is placed on the cathode of CR-9 which disables the ready-to-fire circuit by shutting off Q4 and Q7. When Q1 stops conducting, a positive signal at CR-7 removes the clamp from the multivibrator (Q9 and Q10). With the clamp removed multivibrator Q9 and Q10 runs, producing a square wave output at the 2.5-Hz rate. Each cycle of the multivibrator turns Q2 on and off which turns Q4 and Q7 on and off, causing the ready-to-fire lamp to blink at the 2.5-Hz rate.

(11) *Self test.* The self test circuit (fig. 3-19) lights the GOOD WHEN LIT indicator on the gunner control panel, when the system is in the TEST mode, the sight magnet current feedback (VI_{Mf}) is within tolerance, and the action switch is depressed. In the test mode the radar is in standby, and a fixed value of range (1600 meters) and a fixed value of range rate (200 meters-per-second) is supplied to the sight current generator. The sight current generator solves a simulated problem with the given inputs and compares the results with the predetermined solution. If the comparison is within tolerance, the GOOD WHEN LIT indicator lights. The solution of the simulated problem (sight magnet current feedback) is extracted and applied to two voltage comparators through an amplifier (A1A2). The magnet current feedback voltage must be between +3.7 and +3.9 Vdc at the voltage comparators for the GOOD WHEN

LIT indicator to light. When the VI_{Mf} input is between +3.7 and +3.9 Vdc, neither diode (CR10 or CR11) conducts, Q6 and Q8 are turned on, and Q8 provides a ground for the GOOD WHEN LIT lamp circuit. An input signal in excess of +3.9 Vdc causes voltage comparator A4(Q1 through Q5) to produce a ground on the cathode of CR11. CR11 conducts, cutting off Q6 and Q8, removing the GOOD WHEN LIT lamp circuit ground, and keeping the lamp from lighting. An input signal of less than +3.7 Vdc causes voltage comparator A4(Q6 through Q10) to produce a ground on the cathode of CR10. CR10 conducts, cutting off Q6 and Q8, removing the GOOD WHEN LIT lamp circuit ground, and keeping the lamp from lighting.

3-7. Radar Group.

a. General. Radar set AN/VPS-2, hereafter referred to as the radar, measures target motion along the line-of-sight as range and range rate, and transmits these values continuously to the sight current generator. The sight current generator then computes target motion lead angles. The radar is a coherent doppler, moving target indicator (MTI), X-band radar. The radar uses the doppler principle to distinguish between moving and stationary targets. The radar searches automatically in range, locks onto, and range-tracks selected low-flying aircraft within its range. The radar can track aircraft moving at range rates between 15 and 308.6 meters per second out to a maximum range of 5000 meters. Target range can be determined to an accuracy within one percent or ±10 meters, whichever is greater; range rate can be measured to an accuracy of ±5 meters per second on a constant velocity target. The radar can operate on any one of six transmit frequencies, permitting simultaneous operation of up to six weapon systems in a clustered deployment without concern for interference between radars. Frequency selection is accomplished by means of plug-in crystal oscillator subassemblies and subsequent tuning of the klystron power amplifier subassembly. The radar is composed of six major units. Table 3-2 lists all of the units with their military and common nomenclature. (A detailed listing of all the units, assemblies, and subassemblies appears under radar set AN/VPS-2 in the MAC (appendix B)). Three units (1, 2, and 6) are mounted to the vehicle exterior, while the other three units (3, 4, and 5) are mounted to the interior of the vehicle. The radar is divided into eight functional systems. Figure 3-21 illustrates the interrelationship of each functional system within the radar. The functional systems are:

(1) Synchronizing
(2) Transmitting
(3) Rf
(4) Receiving
(5) Ranging
(6) Antenna positioning
(7) Power
(8) Test facilities.

b. Radar Block Diagram Analysis.

(1) *Synchronizing system.* The synchronizing system establishes the pulse repetition frequency (PRF) of the radar, and using timing and control signals, coordinates the transmitting, receiving, ranging, and test facilities systems. The PRF of the radar is set at 20 kHz. The timing signals trigger the transmitting system and initiate range and range rate measurements in the ranging system.

(2) *Transmitting system.* The transmitting system produces a high-powered pulse of rf energy which is delivered to the rf system. Samples of the X-band local oscillator (L.O.) and 60-MHz L.O. are also delivered to the receiving system.

(3) *Rf system.* The rf system, which includes the antenna, radiates the pulsed rf energy, receives the target echoes, and couples the received signal to the receiving system.

(4) *Receiving system.* The receiving system processes the target echoes for range and range rate computation. The receiving system determines whether relative motion exists between the target and the radar, and monitors this change in motion to distinguish between fixed and moving targets. The radar rejects all stationary targets by rejecting all returns in which the frequency is the same as the transmittal frequency (no doppler shift).

Table 3-2. 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

(5) *Ranging system.* The ranging system generates target range and range rate voltages which are supplied to the sight current generator for use in computing target motion lead angle. The ranging system forms an electronic servo loop with the receiving system and compares actual range with predicted range. When a difference exists between the actual range and the predicted range, the receiving system develops a tracking error signal. When an error signal is developed, the ranging system changes the predicted range in order to nullify the error. When searching for a target, or if an established target is lost, the ranging system searches in range from 0 to 5000 meters. The system will lock on the closest target.

(6) *Antenna positioning system.* The antenna positioning system orients the antenna on the line-of-sight to the present target position. The antenna is carried in traverse by the gun turret and is servo-driven in elevation by a mechanical linkage which follows the gun elevation axis. Traverse and elevation lead angle components are furnished to the antenna positioning system, from the sight as synchro inputs. Two servo loops within the antenna positioning system subtract the traverse and elevation lead angle components from the gun position to align the antenna with the line-of-sight to the target.

(7) *Power system.* The power system generates, regulates, and controls the application of all dc power used by the radar. Primary dc power is 24 Vdc obtained from the system battery. This is converted to the various voltage levels, regulated, and distributed to all units of the radar. The power system receives 115-V 400-Hz synchro excitation voltage from the sight current generator and distributes it to the antenna positioning system. The application of all power to the radar is controlled by the system controls located on the gunner's control panel.

(8) *Test facilities.* The test facility provides a means of evaluating the operational condition of the radar. The test facilities system provides for two simulations, the clutter lockon and midrange calibration tests. The clutter lockon checks the ability of the radar to transmit, receive, and lock onto a stationary target. The midrange calibration test provides a check of the range prediction capability of the radar. Additional features of the test facilities system provide for the monitoring of the relative transmitted rf power and transmitter tuning quality.

c. Synchronizing System. The synchronizing system (fig. 3-22) establishes the time reference required for range and range rate computations. The synchronizing system triggers the transmitting system and initiates the time (range) measuring function at a 20-kHz rate. Range is measured by counting the time which expires after the transmission of rf energy by the transmitting system to the time the echo is received. The synchronizing system also provides all timing signals required to control the sequential computing operations in the ranging system.

(1) *Synchronizing system timing.* A timing diagram of the synchronizing system is shown in figure 3-23. The synchronizing system furnishes the pulses described in (a) through (j) following.

(a) 7.5-MHz clock pulse. Controls the range counting rate of the ranging system.

(b) 7.5-MHz clock pulse delayed. Used in a counter circuit of the PRF counter assembly to overcome a logical race condition.

(c) Ranging system phase control pulses T1 through T11. Eleven sequential pulses produced in the dead time between the maximum range of the radar and the start of the next ranging cycle. This time is used by the ranging system to compute range and range rate.

(d) Strobe pulse. Generated during each T pulse in order to initiate ranging computations.

(e) $\overline{\textit{PRF}}$. Resets the rate integrator assembly of the ranging system after the integrating function is completed and intiates the real-time ranging.

(f) Modulator trigger. Initiates the transmission of rf energy by the transmitting system.

(g) T 3/4 kHz pulse. Advances the tracking gate in range incrementally when the ranging system is in the search mode.

(h) $\overline{\textit{T 1/250}}$ *pulse.* Controls the rate of range rate sampling and integration.

(i) F 1/5 through $\overline{\textit{F 4/5}}$. Six pulses used in the ranging system for early/late (E/L) trigger fine/fine delay during operation in the search mode.

(2) *Synchronizing system assemblies.* The synchronizing system (fig. 3-22) is entirely digital and consists of the following assemblies located in the range computer:

(a) Master clock assembly. The master clock assembly (4A1) is the basic timing device for the range computer. The master clock assembly receives the 60 MHz L.O. signal from the transmitting system. The master clock produces a continuous 7.5 MHz square wave output which is sent to the range counter (4A6).

(b) Range counter assembly. The range counter assembly (4A6) receives the 7.5 MHz clock signal (square wave) from the master clock assembly (4A1) and develops the 7.5 MHz clock pulse and 7.5 MHz clock pulse delayed signals. The 7.5 MHz clock pulse is applied to the ranging system and to the PRF counter assembly (4A2). The 7.5 MHz clock pulse delayed is also applied to the PRF counter assembly (4A2).

(c) PRF counter assembly. The PRF counter assembly (4A2) divides the 7.5 MHz input from the range counter assembly (4A6) by 375, reducing the clock pulse repetition rate to 20 kHz, the PRF of the radar. The last third of each PRF time is allotted for ranging system computations. Ranging functions are performed digitally by a series of operations initiated by the 11 sequential T pulses generated during the last third of each PRF. The 20 kHz

PRF pulse is used by the ranging system and the modulator trigger generator assembly (4A3). During midrange calibration the 20 kHz PRF pulse is delayed by relay 4K1, selecting the $\overline{\text{PRF}}$ CAL input.

(d) Range rate counter B assembly. The range rate counter B assembly (4A12) uses the $\overline{\text{T3}}$ through T10 phase control pulses from the PRF counter (4A2) to time the conversion of parallel range rate information (7 bits plus a sign bit) to serial range rate information for use by the rate integrator. The range rate counter B assembly also generates the T_0 PRECOUNT pulse from inputs of $\overline{T_3}$, $\overline{T_4}$, or $\overline{T_7}$ from the PRF counter (4A2) for use in the ranging system range counter assembly (4A6).

(e) Universal board assembly. The universal board assembly (4A23) amplifies and inverts the 200 M signal from the computer timing generator assembly (4A4), producing the MIN RANGE TRIG pulse for use by the receiver (unit 3). The universal board assembly also inverts the $\overline{\text{PRF}}$ signal from the PRF counter assembly (4A4), producing the PRF signal used in the modulator trigger generator assembly (4A3).

(f) Fine/fine delay assembly. The fine/fine delay assembly (4A22) inverts the PRF pulse from the universal board assembly (4A23), producing the $\overline{T_0}$ pulse for use by the range counter assembly (4A6) in timing the PRE-RANGE TRIGGER. The F 1/5 through F 4/5 and T1 pulses are used by the fine/fine delay assembly to generate the E/L TRIGGER.

(g) Modulator trigger generator assembly. The modulator trigger generator assembly (4A3) shapes the PRF counter assembly output into a 0.5-μs modulator trigger pulse. The output pulse is applied to the transmitting and receiving systems.

(h) Computer timing generator assembly. The computer timing generator (4A4) produces three timing signals: the T 3/4 kHz, the $\overline{\text{T1/250}}$, and the $\overline{\text{200 M}}$ inhibit. The signals are produced by use of three binary counters in cascade, producing successively lower repetition frequencies. The T 3/4 kHz timing pulse is produced by dividing the 20-kHz PRF counter output by 5. The repetition rate is 4 kHz, and the pulse (T 3/4) is synchronous with pulse T3 from the PRF counter assembly. The 250 Hz $\overline{\text{T 1/250}}$ timing pulse is generated by dividing the T 3/4 pulse by 16. The $\overline{\text{T 1/250}}$ pulse is synchronous with pulse T1 from the PRF counter assembly. The $\overline{\text{200 M}}$ inhibit signal is produced by dividing the $\overline{\text{T 1/250}}$ timing pulse by 10. This signal is an inhibit for ranges less than 200 meters, based on the time scale used by the ranging system in the search mode only. In the search mode, 5000 meters are scanned in a one-second time period. The F 1/5 through F 4/5 pulses are generated by the divide-by-5 flip-flop which supplies the T 3/4 kHz pulse used to clock the divide-by-16 counter. The F 1/5 through F 4/5 pulses are input to the ranging system through the fine/fine delay assembly component (4A22).

d. Transmitting System. The transmitting system (fig. 3-24) generates a burst of rf energy for application to the rf system, where it is radiated into space by the antenna. The rf transmit pulse is formed by heterodyning the outputs of two stable-frequency local oscillators in a mixer. Both oscillators operate continuous wave(cw). However, the output of the 60-MHz oscillator is gated before heterodyning so that a pulse is formed at the output of the mixer. The rf pulse is then amplified by the klystron power amplifier to the desired level. Timing of the rf transmit pulse is controlled by the modulator trigger output of the synchronizing system.

(1) *60 MHz local oscillator.* The 60-MHz local oscillator (L.O.) assembly (2A3) generates a cw, 60 MHz, L.O. signal.

(2) *Power dividers 2Z1 and 3Z1.* The 60-MHz signal is applied to power divider 2Z1 where the signal is split and applied to the transmit gate assembly (2A5), and to the four-way power divider (3Z1). Three outputs of power divider 3Z1 are applied to the receiving system, where they are used to detect doppler frequencies in i-f echoes. The fourth output is applied to the master clock assembly in the synchronizing system.

(3) *Transmit gate.* The transmit gate assembly (2A5) receives the modulator trigger from the synchronizing system and the 60-MHz L.O. signal from power divider 2Z1. The transmit gate assembly delays the 60-MHz output signal, permitting time alignment with the klystron power amplifier modulator pulse. The output of the transmit gate assembly is the gated 60-MHz L.O. signal.

(4) *Directional coupler and fixed attenuator.* The directional coupler (2DC1) provides a low impedance path for signal flow from the transmit gate assembly (2A5) to the double sideband modulator (2A1A2), and extracts a sample of the gated 60-MHz signal for use in the receiving system. Signal flow in the opposite direction (double sideband modulator to the transmit gate assembly) is attenuated by the fixed attenuator (2AT1) and the directional coupler (2DC1) which attenuates the signal by an additional 20 dB.

(5) *X-band local oscillator.* The X-band L.O. signal input to the double sideband modulator (2A1A2) is generated by the X-band L.O. oscillator subassembly (2A1A1). A portion of this signal is coupled through the directional coupler (2A1DC1) and applied to the receiving system, where it is mixed with the incoming rf echoes to produce the receiver i-f.

(6) *Ferrite isolator (2A1AT3).* The ferrite isolator (2A1AT3) allows the 9.165 GHz L.O. signal to be applied to the double sideband modulator and prevents beat frequency signals generated in the double sideband modulator from entering the receiver. The output frequency of the X-band L.O. is determined by the crystal oscillator subassembly. Six crystal oscillator subassemblies are provided

with each radar, permitting a selection of output frequencies. Although the X-band L.O. and rf transmit pulse frequencies are designated nominally at 9.165 GHz and 9.225 GHz, respectively, actual operating frequencies are as follows:

Channel	X-band L.O. frequency (MHz)	Rf transmit pulse frequency (MHz)
1	9145	9205
2	9153	9213
3	9161	9221
4	9169	9229
5	9177	9237
6	9185	9245

(7) *Double sideband modular.* The rf transmit pulse is formed in the double sideband modulator subassembly (2A1A2). The double sideband modulator subassembly functions as a mixer and heterodynes the two L.O. input signals. One input is from the X-band L.O. subassembly (2A1A1) and is a continuous wave (cw) signal at 9.165 GHz (nominal). The other input is a gated 60 MHz signal from the 60 MHz L.O. assembly (2A3), which is gated by the modulator trigger (from the synchronizing system) through the transmit gate assembly (2A5). The double sideband modulator subassembly suppresses the carrier frequencies (the two L.O. frequencies) so only sum and difference frequencies are present at the output. The difference frequency is not amplified due to the bandwidth of the klystron power amplifier subassembly (2A1A3). The sum frequency component of the heterodyning process is present in the rf transmit pulse. The duration of the double sideband modulator output is determined by the duration of the gated 60 MHz L.O. input.

(8) *Variable attenuator.* The output of the double sideband modulator is applied to the variable attenuator (2A1AT1) through ferrite isolator 2A1AT5. The ferrite isolator prevents beat frequency signals generated in the klystron power amplifier from being coupled back into the double sideband modulator. The variable attenuator is used to adjust the output power level from the klystron power amplifier subassembly (2A1A3).

(9) *Pulse shaper.* The pulse shaper (2A7) amplifies and reshapes the modulator trigger received from the transmit gate assembly (2A5) to provide triggers for the modulator circuit in the klystron power supply assembly (2A2) and the trigger circuit of the diode switch driver subassembly (2A1A8) in the rf system.

(10) *Klystron power supply and klystron beam power supply.* The klystron power supply assembly (2A2) and the klystron beam power supply assembly (2A6) provide the operating potentials and modulator pulses required for operation of the klystron power amplifier subassembly (2A1A3). The klystron power supply assembly provides a low level dc voltage for heating the klystron filaments and a high negative dc voltage for use as an electron beam accelerating potential. When the modulator trigger is applied to the klystron power supply assembly, a line type modulator circuit produces a 0.6 μs modulator pulse which is applied to the klystron control grid. The klystron is gated into conduction for the duration of the modulator pulse, amplifying the rf input to produce the rf transmit pulse (fig. 3-25). The modulator pulse and the resultant rf transmit pulse are delayed from the modulator trigger input to the klystron power supply assembly. This delay (0.8 μs) is used to generate the modulator pulse and the time required for the klystron beam to be fully turned on. The klystron power supply assembly is energized by the radiate command received from the radiate foot switch. In the low power condition (standby), the low level trigger and control circuits are energized with only filament and bias power applied to the klystron. For maintenance, the SERV RAD CONT switch (2S6) in the transmitter-receiver (unit 2) provides a means of energizing and de-energizing the radar. An overload protection circuit is incorporated in the klystron power supply to remove the high voltage from the klystron power amplifier if an overload occurs in either the klystron beam power supply or the modulator circuit. The MODULATOR OVERLOAD indicator (2DS1) and the HIGH VOLTAGE POWER SUPPLY OVERLOAD indicator (2DS2) provide visual indications when an overload has occurred. The OVERLOAD switch (2S1) is used to reset the overload sensing circuitry and restore normal operation.

(11) *Klystron power amplifier.* The klystron power amplifier subassembly (2A1A3) is a five-cavity, aircooled, rf amplifier. Tuning adjustments on four klystron cavities permit operation on any of the six transmit frequencies within the band from 9.205 to 9.245 GHz.

(12) *Rf power monitor.* The rf output of the klystron power amplifier (2A1A3) is sampled by the rf power monitor subassembly (2A1A4) and applied to the power meter (2A1M1). The circuit provides a means of monitoring the output power level of the klystron power amplifier for tuning and maintenance.

(13) *Harmonic filter (2A1FL1).* The harmonic filter (2A1FL1) is used at the output of the klystron power amplifier to remove the harmonic energy in the output pulse while passing the fundamental frequency.

e. Rf System. The rf system, figure 3-25, functions as an electronic switch that couples the rf transmit pulses to the antenna for radiating, and couples the target echoes received by the antenna to the receiving system. The rf system consists of the circulator (2A1HY1), preselector filter (2A1FL2), TR limiter and shutter assembly (2A1A6), diode switch subassembly (2A1A7), diode switch driver subassembly (2A1A8), and the antenna (unit 1). All rf subassemblies and components are interconnected with a waveguide. Since the rf system is used for both transmitting and receiving, the operation of the rf system is described in the transmit and receive mode discussions, following.

(1) *Transmit mode.* In the transmit mode, the rf system couples the rf transmit pulses to the antenna for radiating into space.

(a) Circulator. In the transmit mode, the rf transmit pulse enters the circulator (2A1HY1) at port P1. The four-port circulator contains a polarized ferrite material which directs the rf energy to the port 90 degrees in a clockwise direction (P2). The transmit pulse exiting through port P2 is radiated through the antenna. Any rf energy traveling in a counterclockwise direction is dissipated in port P4. Rf energy which bypasses port P2, enters port P3 and is coupled to the TR limiter and shutter subassembly through the preselector filter.

(b) Transmit indicator. The rf transmit pulse from port P2 of the circulator is coupled to the antenna through a waveguide. A neon bulb is placed in the waveguide between the circulator and the antenna to provide a visual indication that the transmit pulse is being coupled to the antenna.

(c) Antenna rf coupling. The rf section of the antenna consists of two rotary joints (elevation 1E1 and traverse 1E2), the reflector, and the feed assembly (1A1). Since the antenna has two rotating axes (elevation and traverse), two rotary joints are required to couple the rf energy to the feedhorn, which transmits the rf energy to the reflector. The reflector focuses the rf energy into a conical shaped beam.

(d) Diode switch. The diode switch subassembly (2A1A7) further isolates the transmitting system from the receiving system during the transmit mode. During the transmit mode, the modulator trigger from the transmitting system is applied to the diode switch driver (2A1A8). The diode switch driver then generates a 2-microsecond pulse which reverse biases the diode switch (2A1A7). The reverse-biased diode switch presents a high impedance across the waveguide between the circulator (2A1HY1) and the receiving system. The high impedence across the waveguide reflects any rf energy reaching the diode switch into port P3 of the circulator, where it is dissipated in the termination of port P4.

(2) *Receive mode.* In the receive mode, the rf section couples the target echoes from the antenna to the receiving system.

(a) Antenna rf coupling. During the receive mode, target echoes striking the antenna are directed by the reflector to the feedhorn and coupled to port P2 of the circulator. The circulator directs the echo pulses out port P3 to the preselector filter (2A1FL2).

(b) Preselector filter. The preselector filter (2A1FL2) suppresses all frequencies outside the operating band of the radar. Signals within the bandpass of the preselector filter enter the input circuits of the receiving system. From the preselector filter the received signal is coupled through the TR limiter and shutter subassembly (2A1A6) and the diode switch subassembly (2A1A7) (which is forward biased in the receive mode) to the receiving system.

(c) TR, limiter, and shutter. In the TR, limiter, and shutter subassembly (2A1A6) the solenoid-operated shutter mechanism is held open during normal operation by +28 volts from the power system. When the system is de-energized, the solenoid is de-energized and the shutter closes, protecting the receiving system from stray high-powered rf energy which may be entering the antenna.

f. Receiving System. The receiving system, figure 3-26, processes target echoes for range and range rate computation in the ranging system. Low power target echoes containing the transmitter frequency, plus any doppler shift, are heterodyned and amplified, producing both the sum doppler and difference doppler signals. The doppler signals correspond to the shift in frequency of the transmitted pulse when reflected from a moving target. The doppler signals are applied to the ranging system for range and range rate computations. The receiving system produces the two (sum and difference) doppler signals by mixing the target echo (9.225 GHz) with the X-band L.O. signal (9.165 GHz) from the transmitting system in order to produce the two 60-MHz received i-f signals. The sum and difference doppler signals are then generated by heterodyning the two 60-MHz received i-f signals with the 60-MHz L.O. signal from the transmitting system. By mixing the two 60-MHz signals, any shift in frequency from the original transmit signal can be detected. Depending on the speed and direction of the target relative to the radar, the doppler signal will vary between 600 Hz and 10 kHz. The amplitude of the doppler signal varies in proportion to the difference in the phase relationship of the two mix frequencies, with a 90-degree phase difference producing the largest signal. The sum doppler signal output informs the ranging system that a moving target has been acquired. The difference doppler signal informs the ranging system of the direction in which to move the E/L (early/late) trigger in order to track the moving target.

(1) *Ferrite isolator.* The received signal is coupled from the rf system to the receiving system mixer-preamplifier assembly (2A1A5) through the ferrite isolator (2A1AT2). The ferrite isolator prevents the L.O. signal present in the mixer-preamplifier from entering the rf system.

(2) *Mixer-preamplifier.* In the mixer-preamplifier subassembly (2A1A5) the received signal is heterodyned in a balanced diode mixer with the 9.165 GHz L.O. signal from the transmitting system to produce an i-f. The L.O. frequency is always 60 MHz below the transmitted frequency. The difference in frequency between the local

oscillator and the received signal is always 60 MHz, plus any doppler shift due to moving targets, and is employed as the received i-f signal. The preamplifier section of the mixer-preamplifier subassembly provides the initial amplification of the received i-f signal. Gain of the i-f signal through the preamplifier is controlled by the agc (automatic gain control) signal from the agc circuit assembly (3A2).

(3) *I-f amplification.* The received i-f signal is coupled to the i-f amplifier assembly (3A1) through the i-f gate assembly (3A9), the i-f filter (3A13), the coaxial relay (3K1), and the doppler modulator assembly (3A12). The i-f gate assembly (3A9) contains gate circuits which open to pass the received i-f signals during the receive mode of the radar. The i-f gate assembly is timed by the modulator trigger from the synchronizing system to prevent passage of the transmit pulse into the receiver. The i-f filter (3A13) increases the receiver selectivity and reduces the amount of side lobe energy. The coaxial relay (3K1) and doppler modulator assembly (3A12) are used for test purposes and are discussed in the test facilities section of this chapter. During normal operation, the received i-f signal is allowed to pass through the assembly. The i-f amplifier assembly (3A1) amplifies the received i-f signal and provides two identical outputs to the doppler detector assembly (3A6). The two output i-f signals are identical in amplitude and phase relationship. The gain of the i-f amplifier is controlled by the amplitude of the agc signal from the agc circuit.

(4) *Automatic gain control (agc).* Automatic gain control for the mixer-preamplifier subassembly (2A1A5) and the i-f amplifier assembly (3A1) is supplied by the agc circuit assembly (3A2). The agc circuit assembly develops the preamp agc and the i-f agc in proportion to a video input signal from the i-f amplifier assembly. The pre-range trigger from the ranging system enables both outputs from the agc circuit assembly. In the track mode, the agc signals are displaced by an amount of time equal to the target range and increments the agc proportional to target range. (Refer to figs. 3-27 and 3-28 for waveform analysis.)

(5) *Multiple gate circuits.* Multiple gate circuit assembly (fig. 3-26), part of 3A5, receives an E/L (early/late) trigger from the ranging system and generates three 60-MHz gated outputs (sum, early, late). In the search mode, this trigger moves in 0.25 meter increments at a 20-kHz rate. The multiple gate circuits assembly receives three 60-MHz L.O. inputs from the four-way power divider (3Z1) in the transmitting system. The early gate circuit receives the 60-MHz L.O. signal direct. The sum and late gate 60-MHz inputs are through the variable phase shifter networks (3Z2 and 3Z3). Variable phase shifter 3Z2 shifts the phase of the 60-MHz L.O. signal at the sum gate so that the balanced mixer (3A6A6) input is in phase with the late gate portion of the L.O. signal input to the difference balanced mixer (3A6A5). Variable phase shifter 3Z3 shifts the phase of the 60-MHz L.O. signal at the late gate so the late gate signal is 180 degrees out of phase with the early gate signal at the summing hybrid (3HY1) input.

(6) *Summing hybrid.* The early and late gate (E/L) signals from the multiple gate circuits are combined in the summing hybrid (3HY1). The 60-MHz gated signals from the sum and early gate circuits are initiated 0.15 ms after the E/L trigger input to the multiple gate circuits. The sum gate duration is 0.70 ms and the early gate duration is 0.35 ms. The late gate is initiated 0.35 ms after the early gate and has a duration of 0.35 ms. The early and late gated signals are fed to the summing hybrid (3HY1) where the 60-MHz L.O. signal in the late gate is shifted 180 degrees out of phase with the 60 MHz local oscillator signal in the early gate. The output of the summing hybrid is the difference gate signal, which is in time with the sum gate output. The difference gate output is coupled to the balanced mixer subassembly (3A6A5) through fixed attenuator 3AT1. The attenuator sets the proper level of the local oscillator drive signal for input to the balanced mixer.

(7) *Sum channel.* The sum gate output is coupled to the balanced mixer subassembly (3A6A6) through fixed attenuator 3AT2, (fig. 3-26). The output of the sum gate mixer is a video pulse whose amplitude and polarity correspond to the phase relationship between the received i-f signal and the 60-MHz L.O. signal contained within the difference gate. A positive signal is produced by a phase relationship from 0 to 180 degrees, with 90 degrees producing the maximum amplitude. A negative signal is produced by a phase relationship of 180 to 360 degrees, with 270 degrees producing the maximum amplitude. The sum gate mixer (3A6A6) samples the phase relationship between the received i-f signal and the sum gate local oscillator signal (once per PRF), and produces a doppler modulated video signal whose frequency corresponds to target speed. The doppler modulated video signal from the sum gate balanced mixer (3A6A6) is passed through the doppler filter (3A6A4). The frequency of the output signal from the doppler filter is between 600 Hz and 10 kHz, depending upon target speed. When a target echo is received from a stationary target, the phase relationship between the received i-f and the 60 MHz local oscillator remains constant when heterodyned in the sum balanced mixer. The output of the balanced mixer is a series of pulses (one per PRF) whose polarity is dependent upon the phase relationship. Doppler filter 3A6A4 integrates the pulses and produces a constant dc level equal to the rms value of the pulses. This dc level is rejected by the ranging system as clutter.

(8) *Difference channel.* The difference gate signal is mixed with the 60-MHz received i-f signal in the difference channel balanced mixer (3A6A5). If the received i-f is centered over the early and late gate (zero tracking error),

the output of the difference balanced mixer is a bipolar video signal of equal amplitude. The late gate portion of the difference gate local oscillator input is in phase with the sum gate local oscillator input and produces a video signal with the same polarity as the sum gate balanced mixer output. The early gate portion of the difference gate balanced mixer is 180 degrees out of phase with the late gate and produces a video signal of equal amplitude and opposite polarity to the late gate video signal. Doppler filter 3A6A3 integrates the bipolar signals and produces a zero output when they are of equal amplitude but opposite polarity. This zero output corresponds to a zero tracking error. If the target echo (i-f received signal) is not centered within the early and late gate local oscillator input to the difference gate balanced mixer, the output from the mixer will be either in phase or 180 degrees out of phase with the sum gate local oscillator. If the received i-f signal coincides entirely within the late gate portion of the difference gate, the balanced mixer output is the same polarity as the sum gate balanced mixer output. The envelope formed by sampling (once per PRF) in the difference gate balanced mixer is recovered in doppler filter 3A6A3 before being input to doppler amplifier 3A6A1 as an in-phase or 180 degree out-of-phase signal relative to the sum gate balanced mixer output. The sum gate and difference gate doppler amplifiers (3A6A1 and 3A6A2) provide a low-level input signal with maximum amplification and a high-level input signal with minimum amplification. The ranging system compares the phase of the difference doppler signal with the phase of the sum doppler signal. The phase comparison is used in the ranging system to determine how E/L trigger input must be moved to center the sum and difference gates over the received i-f signal. A zero output from the difference gate amplifier indicates to the ranging system that the target is centered within the gates (zero tracking error).

g. Ranging System. The ranging system (fig. 3-29, sheets 1 and 2) computes target range and range rate. Range and range rate data are supplied to the sight current generator as analog dc voltages.

(1) *Modes.* The ranging system operates in the search and track modes.

(a) Search. In the search mode (no target lockon), the system drives the sum and difference gates in the receiving system out in range at a constant rate from 0 to 5000 meters (once per second) in search of a target. When a moving target with sufficient doppler signal energy appears in the gates, the system switches to the tracking mode.

(b) Track. In the track mode, the ranging and receiving systems operate together as a digital/analog electronic servo loop. Any misalignment between the sum and difference gates and the received i-f signal is sensed as a servo error by the loop. The rate of change of the error is a function of target acceleration. By integrating target acceleration, the loop derives the target range rate. Range rate is then integrated to derive the change in target range, which is added algebraically to the previous target range in order to provide present target range. The loop repositions the tracking gates, nullifying the range error and continuously updating target range at the PRF rate.

1. Masking. Masking occurs when the target returns are blocked by a natural object. The ranging system is programmed to react to this short term fade condition by maintaining the target track (coast) for one second prior to switching to the search mode.

2. Target fade. Target fade occurs when the target fades due to a loss of doppler energy. Doppler energy (signal) is lost when a zero range rate condition exists because the target course is perpendicular to the line-of-sight (constant range). The ranging system is programmed to maintain the target track (coast) for three seconds during this long term fade condition.

(c) Lockon and ECM detect. The ranging system provides a radar lockon signal, which indicates that the ranging system is in the tracking mode, and an ECM (electronic countermeasure) detect signal, which indicates the radar is receiving ECM interference. The lockon and ECM detect signals are utilized in the sight current generator.

(2) *Ranging system components.* The ranging system components are contained within the range computer (unit 4). The components perform the functions described below:

(a) Phase detector assembly. The phase detector is part of assembly 4A15. The phase detector translates the phase relationship between the difference doppler signal and the sum doppler signal from the receiving system into a digital signal which denotes an over-or-under-range condition. This digital range error signal ($\ddot{R}e$ error signal) represents target acceleration and the duration of the signal indicates the rate of acceleration.

(b) Control amplifier assembly. The control amplifier assembly (4A21) receives the sum doppler signal and converts it to a dc voltage that corresponds to the rms value of the input doppler signal. The control amplifier also generates an audio frequency which is applied to headset jack 2J4 on the transmitter-receiver to indicate target acquisition during clutter lockon checks.

(c) Comparator circuit. The comparator circuits are part of the phase detector assembly (4A15). The sum dc voltage from the control amplifier is applied to two comparators. One comparator produces the target data signal of +5 Vdc when the doppler energy level exceeds a preset noise threshold. The comparators also generate the target lockon and ECM relay control signals. The target lockon signal energizes the lockon relay (4K2) when the sum dc output exceeds the noise threshold. The lockon relay (4K2) closure transmits the lockon signal to the sight current generator. When the second comparator senses the presence of excessive doppler energy and a target range rate of less

than 10 meters per second, it responds by transmitting an ECM detect signal which energizes the ECM relay (4K3). The ECM relay (4K3) closure transmits the ECM detect signal to the sight current generator, causing the ready-to-fire indicator lamp on the sight to flash.

(d) Shift register circuit. The shift register circuit is part of the computer timing generator (4A4). The +5 Vdc output from the comparator (TGT DATA) causes the three-stage shift register to be loaded incrementally at a 250 pulse-per-second rate as timed by the $\overline{\text{T1/250}}$ signal from the synchronizing system. The three-stage shift register is fully loaded whenever the threshold target dc level (TGT DATA) is sustained for 12 ms. When fully loaded, the shift register transmits the $\overline{\text{TGT SET}}$ control signal to the search/track and gain control assembly (4A10), which switches the ranging system to the track mode. The shift register evaluates the target data, assuring that the average level of target returns is sustained for a minimum of 12 ms before it is recognized as a valid target. In the search mode, the $\overline{\text{200 M}}$ signal from the synchronizing system inhibits the input of target data to the shift register for target ranges of less than 200 meters. Whenever the target data is lost for a 12-ms period during track, the shift register generates the $\overline{\text{TGT RESET}}$ signal, which switches the ranging system to the search mode.

(e) Search/track and gain control. The search/track and gain control assembly (4A10) determines the ranging system mode of operation, and provides gain control and the target fade memory. These functions are controlled by the state of the $\overline{\text{TGT SET}}$ and $\overline{\text{TGT RESET}}$ signals from the shift register. The search/track and gain control assembly switches the system to the search mode whenever target data is lost for a period longer than the 12-ms memory of this circuit. When target data is received, the search/track and gain control assembly switches the ranging system to the track mode and activates the three gain control signals. The gain control signals activate sequentially within the first one-half second of acquisition. The initial gain condition (G1) provides the highest gain for the loop. After one-quarter second track duration the second gain condition (G2) is activated and provides medium gain for the loop. The third gain condition (G3) is activated one-quarter second later (one-half second total from start of track), providing the lowest loop gain.

(f) Up/down counter. Range rate counter A assembly (4A11) and the rate scaler assembly (4A13) form the up/down counter, which accumulates (integrates) the scaled acceleration input to derive range rate. The counting direction of the up/down counter is controlled by range acceleration error signal ($\ddot{R}e$) from the phase detector (P/O 4A15). The synchronizing system supplies the T2 range rate count pulses at a fixed 20-kHz rate, but the rate is counted down in the scaling process. Upon acquisition of a valid target the rate scaler assembly (4A13) reduces the counting rate in three steps, reducing the overall gain of the electronic servo loop progressively during the initial phase of the track mode. This gain reduction slows the movement of the tracking gate as the target nears the center of the gate, minimizing overshoot. The final count rate is reached one-half second after the ranging system switches to the track mode. The $\ddot{R}e$ scaled signal output of the rate scaler assembly (4A13) is counted by the range rate counter A assembly (4A11) to determine the range rate. The $\dot{R}$ DOWN and $\dot{R}$ UP signal outputs control the direction of count in the range rate counter A assembly. In track, after the gain control sequence is completed, the rate scaler assembly counts up or counts down. After an accurate track is established, the counting direction alternates continuously and the servo loop hunts above and below the actual target range rate. The rate scaler operates at a fixed rate due to the fixed frequency of T2 so the tracking gate overtakes any acceleration target at a fixed rate. Each count pulse in the range rate counter A assembly (4A11) is equivalent to an incremental change in range rate. The accumulation of range rate changes in the range rate counter A assembly represents the instantaneous predicted value target range rate. Range rate is in parallel-binary form (7 bits) in the counter. The range rate information contained in the range rate counter A assembly (4A11) is distributed to the range rate counter B assembly (4A12).

(g) Range rate counter B. The range rate counter B assembly (4A12) gates and distributes the range rate information to the range rate digital to analog (D/A) converter assembly (4A17) and rate integrator assembly (4A14). Range rate information furnished to the range rate D/A converter assembly is in the form of a 7-bit parallel binary word plus a sign bit. In the search mode, range rate information to the range rate D/A converter assembly represents a constant range rate of −205 meters per second. Range rate information ($\dot{R}$ serial) supplied to the rate integrator assembly (4A14) is in the form of an 8-bit binary word that has been converted from parallel to serial in the range rate counter B assembly (4A12). The additional bit is used to preserve range resolution. Pulses T3 through T10 from the synchronizing system are used to time the parallel-to-serial conversion in the range rate counter B assembly.

(h) Range rate D/A converter. The range rate D/A converter assembly (4A17) converts the parallel binary range rate word to an equivalent dc voltage. The range rate D/A converter assembly also provides the range D/A converter assembly (4A16) with a −10 Vdc reference voltage for use in generating the range reference and range analog output voltages. Range rate reference voltages of +10 V and −10 V and a range reference voltage of +20 V are provided for use by the sight current generator.

(i) Rate integrator. The rate integrator assembly (4A14) performs the second integration of acceleration to derive incremental changes in target range (ΔR). Integration

is accomplished by a series of additions of range rate. In the track mode, ΔR from the integrator is used to update the range stored in the range register B assembly (4A9). In the search mode the T3/4 Hz output from the synchronizing system updates range at a constant 4 kHz rate. The search/track and gain control assembly (4A10) determines which of the two ΔR signals is to be fed to the range register B assembly (4A9). During target track (electronic servo loop gain at its lowest), a significant error may result when the target is accelerating or decelerating. The rate scaler assembly (4A13) provides for such errors by feeding a sample of target acceleration ($\ddot{R}e$ x G) to the rate integrator assembly (4A14) in order to update it faster than ΔR can alone. The $\ddot{R}e$ x G signal is scaled in the rate scaler (4A13) by the G1 through G3 gain control signals. The rate scaler monitors the 5 meter-per-second and 10 meter-per-second output pulses from the range rate counter A assembly (4A11), and generates the $\ddot{R}e$ x G signal when target acceleration is sensed.

(j) RCFD decoder (range control fine delay). The RCFD decoder assembly (part of 4A5) generates control signals which are used in determining the time duration of target fade ($\dot{R}<\pm$ 10 M/S) and are used to lock up the range rate counter when a target of maximum range rate is being tracked ($\dot{R}$MAX and $\dot{R}$MIN). The logic input signals to the RCFD decoder assembly that are used to generate these control signals are:

1. $\overline{\dot{R}\text{ UP}}$ signal from the rate scaler assembly (4A13). Logic O (active state) whenever the target range rate is increasing.

2. $\overline{+\dot{R}_O}$ and $\overline{-\dot{R}_O}$ signals from the range rate counter B assembly (4A12). $+\dot{R}_O$ is logic 0 (active state) when the value of range rate stored in the range rate counter B assembly is +310 meters per second. $-\dot{R}_O$ is logic 0 (active state) when the value of range rate stored in the range rate counter B assembly is -310 meters per second.

3. $+\dot{R}_S$ and $-\dot{R}_S$ signals from the rate integrator assembly (4A14). $+\dot{R}_S$ is logic 1 (active state) when range rate is positive (outbound target). $-\dot{R}_S$ is logic 1 (active state) when range rate is negative (inbound target).

(k) Range register. Range register B assembly (4A9) and range register A assembly (4A8) work together to store and update target range. Range register B assembly stores the three low-order range bits and range register A assembly stores the nine high-order bits. The value in the registers increases or decreases under the control of the $-\Delta R$ sign signal. The ten high-order range bits are supplied to the range D/A converter assembly (4A16) when the system is in the track mode. In the search mode, the registers supply a constant range of 1600 meters to the range D/A converter (4A17). The range D/A converter assembly converts the range word to a dc analog voltage which is furnished with the +20 volt reference voltage to the sight current generator. The eight high-order bits are transferred in parallel to the range counter assembly (4A6) during the last third of each PRF, and the four low-order range bits are transferred in parallel to the range control fine delay (RCFD) decoder assembly (4A5) via the fine/fine delay assembly (4A22) for real time control.

(l) Range counter. The range counter assembly (4A6) converts the range word (digital value of range) from range register A assembly (4A8) into an E/L (early/late) coarse trigger. The range counter assembly counts up the range word incrementally at 7.5 MHz and generates the E/L coarse trigger when the range register is full. A count is completed during each PRF. A pre-range trigger is produced 1.8 μs prior to the E/L coarse trigger in order to gate on the i-f amplifier in the receiving system. The prerange trigger is inhibited for ranges 0 to approximately 250 meters, eliminating target data for near targets. In the track mode the count rate is established by the synchronizing system at 7.5 MHz which corresponds to range increments of 20 meters.

(m) RCFD generator. The RCFD generator assembly (4A7) further delays the E/L coarse trigger from the range counter assembly (4A6). This delay is accomplished by the RCFD decoder assembly (P/O 4A5) selecting one of 16 fixed 1-1/4 meter delays in the RCFD generator. The RCFD decoder selects the correct delay line by observing the state of the low order of magnitude bits of the range registers A and B. The accuracy of the E/L trigger is now 1-1/4 meters (track mode). The E/L trigger from the RCFD generator assembly is fed through the RCFD decoder assembly (4A5) and the fine/fine delay assembly (4A22) to the universal board assembly (4A23). The universal board assembly delays the E/L trigger by 0.4 ± 0.1 μs to compensate for circuit delays in the transmitting system. The E/L trigger is fed to the receiving system to close the servo loop. In the search mode the E/L trigger is fed to the fine/fine delay assembly where it causes the E/L trigger to advance from 0 to 5000 meters in one-quarter meter increments. The one-quarter meter increments are timed by the F1/5 to F4/5 signals from the synchronizing system. The universal board assembly delays the E/L trigger by 0.4 μs and sends it to the receiving system to close the servo loop.

(3) *Self-check.* The self-check test facilities incorporated in the range computer (unit 4) are:

(a) MODE toggle switch (4S2). The mode toggle switch in the NORM position passes the $\ddot{R}e$ error signal from the phase detector assembly (P/O 4A15) to the rate scaler assembly (4A13), and target data from the comparator circuits (P/O 4A15) to the shift register circuit (P/O 4A4). In the TEST position the mode toggle switch connects the target data line from the comparator circuits to the common contact of the RETURN toggle switch (4S4) and the $\ddot{R}e$ error signal from the phase detector circuit (P/O 4A15) to the common contact of the ACCEL toggle switch (4S3).

(b) ACCEL toggle switch (4S3). The ACCEL toggle switch is active only when the MODE toggle switch (4S2) is in the TEST position. With the MODE toggle

switch in TEST and the ACCEL toggle switch in NEG, a +5 Vdc is input to the rate scaler assembly (4A13) in place of the $\ddot{R}$e error signal from the phase detector circuit (P/O 4A15). The +5 Vdc commands the counter assembly to count down simulating a negative acceleration of the target (inbound). When the ACCEL toggle switch is in the POS position the +5 Vdc return (ground) is input to the rate scaler assembly (4A13) in place of the $\ddot{R}$e error signal from the phase detector circuit (P/O 4A15). The +5 Vdc return (ground) input commands the counter assembly to count up simulating a positive acceleration of the target (outbound).

(c) RETURN toggle switch (4S4). The RETURN toggle switch is active only when the MODE toggle switch (4S2) is in the TEST position. When the MODE toggle switch is in TEST and the RETURN toggle switch (4S4) is in the TGT position, a +5 Vdc signal is input to the shift register circuit (P/O 4A4) in place of the target data signal from the comparator circuits (P/O 4A15), simulating a target return to the shift register circuit (P/O 4A4). When the RETURN toggle switch is in the NO TGT position, a +5 Vdc return input is provided to the shift register circuit, simulating the absence of a target return.

(d) RANGE toggle switch (4S5). The range toggle switch operates independent of the other switches on the range computer. In RUN, the range computer operates normally. In FREEZE, a +5 Vdc return (ground) signal (logic 0) is applied to the search/track and gain control assembly (4A10) manual range freeze input, holding the ranging system in the track mode. A logic 0 is also applied to the universal board assembly (P/O 4A23) manual range freeze input. The universal board inverts the logic 0 and applies a logic 1 to the manual range freeze input to the range register B assembly (P/O 4A9) and freezes range by preventing the ΔR input signal from updating the range register.

(e) RATE toggle switch (4S6). The RATE toggle switch operates independent of the other switches on the range computer. In RUN there is no effect on the operation of the range computer. The rate toggle switch is spring loaded in the RUN position. Releasing the switch causes the range rate counter to start counting either up or down from the zero range rate state. In RESET, a +5 Vdc return (ground) signal (logic 0), is applied to the universal board assembly (P/O 4A23) manual reset input. The logic 0 is inverted twice by driver NAND circuits on the universal board assembly. The output signal from the universal board assembly (R RESET) is a logic 0 and is applied to the range rate counter A assembly (4A11) to reset and lock the range rate counter at zero.

h. Antenna Positioning System. In order for the radar to determine target range and range rate for use in solving the fire control problem, the electrical axis of the antenna must be aligned with the line-of-sight to the target. The gun sight produces two signals corresponding to the traverse and elevation lead angles. Since the antenna is carried in traverse with the turret, it is automatically aligned with the traverse line-of-fire. The antenna traverse axis is displaced from the line-of-fire by the traverse servo, which subtracts the traverse lead angle from the traverse line-of-fire. Elevation line-of-sight is obtained by positioning the antenna along the actual line-of-sight. As the movement of the antenna in elevation is independent of the gun mount, antenna elevation is obtained by an elevation servo, which subracts the elevation lead angle from the gun elevation angle to obtain the elevation line-of-sight.

(1) *Elevation line-of-sight displacement.* To align the antenna (fig. 3-30) with the line-of-sight, the antenna is displaced from the elevation line-of-fire (superelevation) by an amount equal to the elevation lead angle.

(a) Elevation positioning circuit power. The antenna positioning system is activated when either the ACTION switch on the gunner's control assembly grip is depressed, or the MAINT switch (6S4) on the radar stow control (unit 6) is to ON. Activating either switch applies +24 Vdc to the MODE switch (6S1). When the MODE switch is in the NORMAL position, the voltage is applied to the elevation servo power relay (5K1) which couples +24 Vdc to the elevation servo electronics assembly (5A2). The MODE switch also applies voltage to the elevation brake solenoid (1A2L1). The energizing solenoid (1A2L1) releases the brake and frees the elevation drive mechanism.

(b) Elevation synchro. During normal operation (NORMAL position of 6S1) the output of elevation synchro (1A2B1) is used to drive the motor generator (1A2MG1). The stator of the elevation synchro is excited by an ac signal from the sight which represents the elevation lead angle. The rotor of the elevation synchro is positioned through a differential, by the drive mechanics to the elevation axis of the gun. The output from the synchro rotor (B1) is an ac signal with the amplitude dependent upon the position of the rotor in respect to the stator. The output signal is applied to the preamplifier section of the elevation servo electronics assembly (5A2).

(c) Preamplifier. In normal operation the preamplifier section of assembly 5A2 provides initial amplification of the synchro error signal. It is

coupled to the demodulator section through the normally closed contacts of the stow control relay (5A2K1).

(d) Demodulator. The demodulator circuits in assembly 5A2 compare the phase relationship of the amplified ac signal and the 155-V, 400-Hz reference signal. The reference signal is phase-locked with the 115-V, 400-Hz excitation signal which is applied to the elevation lead angle transmitter synchro in the sight. The output of the demodulator circuits is a dc voltage whose amplitude and polarity are determined by the phase relationship of these two signals. The dc output from the demodulator circuits is applied to the servo amplifier circuits through the compensation circuits.

(e) Compensation circuits. The compensation circuits provide filtering for the dc output of the demodulator circuits. The attenuator network between the compensation circuits and the servo amplifier circuits is out of the circuit until the elevation limit switch (1A2S1) is activated by the elevation cam. When the elevation cam closes the elevation limit switch (1A2S1), the attenuator control relay (5A2K3) energizes. With the attenuator control relay (5A2K3) energized, a voltage divider is formed through the attenuator resistor to ground, reducing the dc drive signal to the servo amplifier. The reduced dc drive signal allows the antenna to coast into the mechanical elevation stops.

(f) Dc servo amplifier. The dc servo amplifier circuits provide the final amplification of the drive signal before being coupled to the motor generator (1A2MG1).

(g) Elevation servo drive. Motor generator MG1 is used to drive the harmonic drive assembly through appropriate gearing. The drive mechanics is mechanically linked with the shaft of the elevation synchro (1A2B1) and the shaft of lead angle potentiometers R1, R2, and R3 through the mechanical differential. The mechanical linkage transmits the antenna position to the shaft of elevation synchro 1A2B1 and nulls out the loop when the antenna is positioned along the elevation line-of-sight. The output of potentiometers R1, R2, and R3 is lead angle information used by the sight current generator in solving the fire control problem. The dc tachometer (P/O 1A2MG1) provides a dc feedback voltage, proportional to the motor speed, for use in stabilizing the output of the elevation servo electronics (5A2).

(2) *Elevation stow.* When the MODE switch (6S1) is placed in the STOW position relay 5K1 de-energizes, deactivating the antenna positioning system. Power is removed from the elevation brake assembly solenoid (1A2L1), locking the elevation drive mechanism. The stow control relay (5A2K1) is energized through another section of 6S1, removing the preamplifier output from the demodulator input and coupling the 115-volt, 400-Hz reference voltage to the demodulator input through the UP/DOWN relay (5A2K2). ELEV switch (6S3) is a spring-loaded center position return toggle switch. Holding the switch in either the UP or DOWN position couples +24 Vdc, through the MODE switch, to energize the elevation servo power relay (5K1) (activating the elevation servo electronic assembly (5A2)) and to energize the elevation brake assembly solenoid (1A2L1) (releasing the elevation drive mechanism). The phase of the reference voltage input to the demodulator circuits is selected by the ELEV switch energizing the UP/DOWN control relay (5A2K2) to drive the antenna up, or not energizing 5A2K2 to drive the antenna down. In stow operation, the motor (1A2MG1) is driven by the 115-volt, 400-Hz reference input to the demodulator circuit and is controlled (up or down drive) by reversing the phase of the reference voltage with the UP/DOWN control relay (5A2K2). The drive signal from the demodulator circuits is rectified, filtered, and amplified before being applied to the motor (1A2MG1).

(3) *Traverse line-of-sight displacement.* To align the antenna with the line-of-sight, the antenna is displaced from the traverse line-of-fire (fig. 3-31) by an amount equal to the traverse lead angle.

(a) Traverse positioning circuit power. The antenna positioning system is activated when either the ACTION switch on the gunner's control assembly grip is depressed, or the MAINT switch (6S4) on the radar stow control (unit 6) is set to ON. Activating either switch applies +24 Vdc to the MODE switch (6S1). When the MODE switch is in the NORMAL position the voltage is applied to the traverse servo power relay (5K2) which couples +24 Vdc to the traverse servo electronics assembly (5A1). The MODE switch also applies voltage to the traverse brake assembly solenoid (1A3L1). Energizing solenoid 1A3L1 releases the brake and frees the traverse drive mechanism.

(b) Traverse synchro. During normal operations (NORMAL position of 6S1) the output of traverse synchro 1A3B1 is used to drive the motor generator (1A3MG1). The stator of the traverse synchro is excited by an ac signal from the sight, which represents the traverse lead angle. The synchro rotor is positioned by the drive mechanics to the position of the antenna in respect to the mount in traverse. The output from the synchro rotor is an ac signal with the amplitude dependent

upon the position of the rotor in respect to the stator. The output signal is applied to the preamplifier section of the traverse servo electronics assembly (5A1).

(c) Preamplifier. In normal operation, the preamplifier section of assembly 5A1 provides initial amplification of the synchro error signal. It is coupled to the demodulator section through the normally closed contacts of the stow control relay (5A1K1).

(d) Demodulator. The demodulator circuits (5A1) compare the phase relationship of the amplified ac signal and the 115-volt, 400-Hz reference signal. The reference signal is phased-locked with the 115-volt, 400-Hz excitation signal which is applied to the traverse lead angle transmitter synchro in the sight. The output of the demodulator circuits is a dc voltage, the amplitude and polarity determined by the phase relationship between these two signals. The dc output from the demodulator circuits is applied to the servo amplifier circuits through the compensation circuits.

(e) Compensation circuits. The compensation circuits provide filtering for the dc output of the demodulator circuits. The attenuator network between the compensation circuits and the servo amplifier circuits is out of the circuit until the traverse limit switch (1A3S1) is activated by the

traverse cam. When the traverse cam closes the traverse limit switch (1A3S1), the attenuator control relay (5A1K3) energizes. With the attenuator control relay (5A1K3) energized, a voltage divider is formed through the attenuator resistor to ground, reducing the dc drive signal to the servo amplifier. The reduced dc drive signal allows the antenna to coast into the mechanical stops.

(f) Dc servo amplifier. The dc servo amplifier circuits provide the final amplification of the drive signal before being coupled to the motor generator (1A3MG1).

(g) Traverse servo drive. The motor generator (1A3MG1) is used to drive the harmonic drive assembly through appropriate gearing. The drive mechanics is mechanically linked with the shaft of the synchro motor (1A3B1) and the shaft of the traverse lead angle-squared potentiometer (1A3R1). The mechanical linkage transmits the antenna position (traverse) to the shaft of the synchro motor (1A3B1) and nulls out the loop when the antenna is positioned along the traverse line-of-sight. The output of 1A3R1 is the traverse lead angle-squared and is used by the sight current generator in solving the fire control problem. The tachometer (P/O 1A3MG1) provides a dc feedback voltage for use in stabilizing the output of the traverse servo electronics (5A1).

(4) *Traverse stow.* When the MODE switch (6S1) is placed in the STOW position, relay 5K2 de-energizes, deactivating the antenna positioning system (traverse). Power is removed from the traverse brake assembly solenoid (1A3L1), locking the traverse drive assembly. The stow control relay (5A1K1) is energized through another section of 6S1, removing the preamplifier output from the demodulator input and coupling the 115-V, 400-Hz reference voltage to the demodulator input through the LEFT/RIGHT relay (5A1K2). TRAV switch (6S2) is a spring-loaded center position return toggle switch. Holding the switch in either the LEFT or RIGHT position, couple +24 Vdc through the MODE switch to energize the traverse servo power relay (5K2) (activating the traverse servo electronics assembly (5A1)), and to energize the traverse brake assembly solenoid (1A3L1) (releasing the traverse brake mechanism). The phase of the reference voltage input to the demodulator circuits is selected by the TRAV switch energizing the RIGHT/LEFT control relay (5A1K2) to drive the antenna right, or not energized to drive the antenna left. In stow operation, the motor (1A3MG1) is driven by the 115-volt, 400-Hz reference input to the demodulator circuits and is controlled (right or left) by reversing the phase of the reference voltage with the LEFT/RIGHT control relay (5A1K2). The drive signal from the demodulator is rectified, filtered, and amplified before being applied to the motor (1A3MG1).

i. Power System. The radar power system (fig. 3-32) receives 24 Vdc primary power from the mount and distributes this power to the servo control circuits, the antenna stow control circuits, and to the converter circuits which generate and regulate the various dc operating voltages within the radar. When the primary power is applied, the power system provides a two-minute time delay which allows the filaments of the klystron power amplifier to heat up before the radar can be operated.

(1) *Primary power distribution.* System battery power is applied to the radar through the radar power relay (A1K17) in the mount. The radar power relay is energized from the gunner's control panel when the SYSTEM POWER switch is in the ON position and the MODE switch is in either the RADAR, MANUAL, or TEST position. 24 Vdc battery power is supplied through circuit breakers in the power supply to the following units and assemblies:

(a) Converter assembly 5A3 through circuit breaker 5CB1.

(b) Elevation servo relay 5K1 in the antenna positioning system through circuit breaker 5CB3.

(c) Traverse servo relay 5K2 in the antenna positioning system through circuit breaker 5CB2.

(d) Radar distribution box (stow control) for distribution throughout the radar system (unit 6) through circuit breaker 5CB4.

(e) Inverter 5PS1 in the radar power supply (unit 5).

(f) Transmitter-receiver (unit 2) through circuit breaker 5CB4.

(g) Standby relay 5K3 in the radar power supply (unit 5) through circuit breaker 5CB4.

(2) *Converter assembly (5A3).* The converter assembly produces and regulates the eight dc voltages required by the radar. All voltages produced by the converter assembly are regulated to a ±1 percent tolerance. The outputs of the converter assembly are +6.5, -23, +23, +33, -33, -15, +15, and +29 volts.

NOTE

The +29 volts notation is designated as +28 volts nominal throughout the radar.

(a) Positive 6.5-volt output. The +6.5 V output from the converter assembly (5A3) is applied through circuit breaker 5CB6 to the +5 V filter assembly (4A18) which contains an overvoltage sensing and protection network and a filter circuit. The input to the +5 V filter assembly is 6.0 V, and its output is +5 V ±0.5 V. The +5 V filter assembly output is distributed to assemblies in the range computer (unit 4).

(b) Positive and negative 23-volt outputs. The ±23 V outputs of the converter assembly (5A3) are applied to the 15-volt regulator assembly (4A19) which contains two regulators and two overvoltage sensing and protection networks. The regulators produce ±15 V outputs which are distributed to the receiver (unit 3), and components in the range computer (unit 4).

(c) Positive and negative 33-volt outputs. The −33 V output from the 33-volt regulator subassembly (5A3A4) in the converter assembly (5A3) is applied directly to the transmitter-receiver (unit 2) for use by the diode switch driver subassembly (2A1A8). The ±33 V outputs from the 33-volt regulator subassembly (5A3A4) are applied to the 25-volt regulator assembly (4A20) which contains two regulators and two overvoltage sensing and protection networks. The regulators produce ±25 ± 0.5 percent volt outputs which are distributed to the receiver (unit 3) and components within the range computer (unit 4).

(d) Positive and negative 15-volt outputs. The ±15 V outputs of the converter assembly (5A3) are distributed to the transmitter-receiver (unit 2) and the receiver (unit 3).

(e) Positive 28-volt output. The +28 V output of the converter assembly (5A3) is distributed to all radar units.

(3) *Power control.* The power control circuit provides the safety and time delay circuits used in the radar.

(a) Standby relay (5K3). The standby relay (5K3) controls the application of the +24 V primary and the +28 V secondary standby power in the radar. These voltages are used to control the range tracking and transmitter radiating functions of the radar. The standby relay (5K3) (fig. 3-32) is connected in series with the access interlock circuit, and is energized when 24 V battery power is applied through the radar power relay. The access interlock circuit consists of the overtemperature thermostat (2S5), cover interlock switch (2S3) in the transmitter-receiver, connector interlock switch (2A2S1) in the klystron power supply, and thermostat (5S1). The connector interlock switch (2A2S1) is actuated by the cover which secures the beam power supply assembly and the klystron power amplifier subassembly interface cabling to the klystron power supply. When these cables are removed, the interlock switch (2A2S1) opens, de-energizes standby relay (5K3), removing power from the klystron power supply. When the standby relay (5K3) is energized, it applies +28 volts standby power to contacts of the operate relay (2K1), the transmitter-receiver (unit 2), and the 2-minute time delay relay (5K5). The standby relay (5K3) (fig. 3-32) also supplies +24 V standby power to operate blower motor 2B1 in the transmitter-receiver (unit 2). Two minutes after power is supplied to the standby relay (5K3), the 2-minute time delay relay (5K5) times out and provides the ground to energize the operate relay (5K4) which lights the RADAR READY indicator lamp on the gunner's control panel. The RADAR READY lamp indicates that the 2-minute time delay has elapsed and the radar is ready to radiate.

(b) Radiate command. The +24 V radiate command is applied to the contacts of the operate relay (2K1) through the ACTION switch on the gunner's control assembly grips, and the radiate foot switch in the mount. The 2-minute time delay must expire prior to the radar radiating as the +24 V return for relay 2K1 is through the normally open contacts of the 2-minute time delay relay (5K5). The radiate interlock relay (2A2K1) is energized by the radiate command through the normally open contacts of the operate relay (2K1). The operate relay (2K1 through 2A1K1) provides +28 volts to energize the klystron power supplies.

(4) *Blowers and temperature sensing circuits.* The power supply (unit 5) and the transmitter-receiver (unit 2) require forced air ventilation in order to dissipate the heat generated in these units. Air circulation is provided by blowers 2B1 (transmitter-receiver) and 5B1 (power supply). Each unit is provided with a thermostat (2S5 and 5S1) which removes power from the radar by opening the interlock circuit when an overtemperature condition exists.

(a) Blower 5B1. The converter assembly (5PS1) produces 24-volt 400-cycle power to drive blower motor 5B1. Thermostat 5S1 senses the temperature of the power supply and opens when the temperature reaches 180°F, removing power from the radar by opening the interlock circuit and de-energizing the standby relay (5K3). Power is not removed from blower 5B1 allowing it to cool the unit. When the temperature drops below 180°F, thermostat 5S1 closes and power is restored to the radar.

(b) Blower 2B1. The inverter assembly (2PS1) produces 24-V 400-Hz power to drive blower motor 2B1. Thermostat 2S5 senses the temperature of the transmitter-receiver and opens when the temperature reaches 180°F, removing the power from the radar by opening the interlock circuit and de-energizing the standby relay (5K3). Power is not removed from blower 2B1 allowing it to cool the unit. When the temperature drops below 180°F, the thermostat (2S5) closes and power is restored.

j. Test Facilities. The radar incorporates test facilities which permit operating and maintenance personnel to rapidly evaluate the operational condition of the radar. These test facilities provide for an overall operational condition check without the use of external test equipment.

(1) *Clutter lockon check.* The clutter lockon check evaluates the ability of the radar to transmit, receive, and lock on to a stationary target. The radar configuration used in the radar lockon check is shown in figure 3-33. The radar transmitted energy is directed towards a stationary target within the range of the radar (5000 meters). Since a stationary target does not produce a doppler shift, the received i-f is modulated in the receiving system by a doppler test signal which simulates a return from a moving target. The doppler detection circuits within the receiving system extract this doppler test signal and couple it to the ranging system. Since the test target appears to have a fixed range and zero range rate, the receiving system sends a zero tracking error signal continuously to the ranging system, once the ranging system has locked on the target. Once tracking is established (lockon), a 1.5-kHz audible tone is produced in the sum doppler signal by the simulated doppler shift and is

monitored by the operator to verify that tracking is established. When the clutter lockon check is being performed, the transmitting system is in its normal configuration but the return signal (echo) is heterodyned down to the 60-MHz i-f in the first receiver-mixer and preamplifier and is modulated by a 1.5-kHz doppler test signal in the doppler modulator assembly (3A12) before being coupled to the doppler detection circuits. In the TEST position, the CLUTTER LOCKON switch (2S2) applies 28 Vdc to the doppler oscillator assembly (3A11), which energizes the oscillator. The 1.5-kHz output of the doppler oscillator assembly is applied to the doppler assembly, modulating the 60 MHz stationary i-f target return with the 1.5-kHz signal before it is coupled to the doppler detection circuits.

(2) *Midrange calibration.* The midrange calibration check evaluates the ability of the radar to receive, lock on, and track a synthetic doppler signal positioned at a known range. The radar configuration used in the midrange calibration check is shown in figure 3-34. During a midrange calibration check, the radar is made to track an internally generated test doppler signal, positioned accurately at a known range. Indicator lamp 4DS1, on the range computer, lights when the track has been established within the preset range limits.

(a) The MID RANGE CALIBRATION switch (4S1) performs three functions in the midrange calibration check:

(1) Applies +28 Vdc to coaxial relay (3K1) which couples the 60-MHz stalo signal from directional coupler (2DC1) to the doppler modulator assembly in the receiving system.

(2) Applies +28 Vdc to the doppler oscillator, which enables the 1.5-kHz continuous wave output to the doppler modulator assembly.

(3) Energizes a relay in the synchronizing system, which displaces the modulator trigger 2400 ± 120 meters (in range) from the normal PRF sent to the ranging system.

(b) The gated 60 MHz L.O. from the transmitting system is coupled to the i-f amplifier assembly through coaxial relay (3K1). This signal is modulated by the 1.5 kHz continuous wave output to the doppler oscillator. The receiving system processes the test target in the same manner as in the clutter lockon test. Because the synchronizing system initiates a range counting operation in the ranging system 2400 ±120 meters before the generation of the test doppler signal, the test doppler signal is seen as a 2400 ±120-meter target by the ranging system if its prediction is accurate. Present target range is stored in a range register in the ranging system. Logic circuitry detects ranges between 2400 and 2560 meters, monitors the contents of the register, and illuminates indicator lamp 4DS1 on the range computer when the range in the register holds within the preset limits. Any out-of-range condition results in the absence of lamp illumination.

3-8. XM61 Sight.

a. General. The XM61 sight is a gyro-stabilized automatic lead computing sight which computes the lead angle by offsetting a collimated reticle image, representing the line-of-sight, from the axis of the cannon by the amount of the lead angle.

b. Physical Description. The sight (fig. 3-35) is housed in a sealed case which is mounted to a support on the gun saddle assembly and is aligned with the axis of the cannon.

(1) *Gyro and linkage.* The gyro is mounted in a gimbal that is free to move in traverse, and the gyro itself is free to move in elevation allowing freedom of motion in both planes, elevation and traverse.

(a) An eddy current disc, on the shaft of the gyro motor, is acted upon by the range magnet to generate lead angles. A nutation damper, attached to the end of the gyro, damps out small elliptical vibrations of the gyro. A caging pin, attached to the nutation damper, engages the caging device to hold the gyro in a zero lead-angle position (caged position), or to limit gyro travel (uncaged position).

(b) A permanent magnet torque motor is located below the gimbal. The torque motor applies a precession force on the gyro, proportional to the correction required in superelevation, to compensate for projectile gravity drop.

(c) Coupled to the gyro and gimbal are two synchros (elevation and traverse) which provide angular signals to position the radar antenna and provide information to the sight current generator for computing future sight inputs. The elevation synchro is mounted on the left side of the gimbal with its rotor carried on a shaft extension of the gyro bearing pin. The traverse synchro is mounted beneath the torque motor. Its rotor is carried on a shaft extension of the lower gimbal bearing pin. Since the synchro rotors are carried on shaft extensions of the gyro pivot and gimbal pivot axes, the synchro stator signals provide a direct indication of gyro and gimbal angular deviation from their centered position.

(d) The combining glass assembly is coupled to the gyro by a link assembly. The glass moves to provide aiming information to the gunner in the form of a reticle displaced from the gun line. The glass moves right or left as the gimbal (and gyro) moves on its pivots and, because of the linkage, tilts up and down. The reticle pattern is formed below, and passed up through, the combining glass, reflected off the mirror, and reflected back to the gunner off the combining glass. The recticle mirror, which reflects the reticle pattern to the mirror, turns as part of the gimbal.

(e) A scale and pointer, visible through the rear window, indicate traverse lead angles. There are five dots on the scale indicating zero lead angle, ±100-mil lead angles, and ±200-mil lead angles.

(2) *Reticle lamp assembly.*

(a) The reticle lamp assembly and reticle forming disk, form and project the reticle image. The housing for

the dual filament reticle lamp is designed to permit changing the lamp without exposing the internal sight parts to outside atmosphere.

(b) The reticle pattern, etched on the reticle forming disk, consists of two concentric circles. The reticle pattern is projected through the optics to the gunner's field of view. In tracking, the gunner positions the sight to superimpose the reticle image over the target.

(c) The reticle image the gunner sees has an outer circle 60 mils in diameter and an inner circle 15 mils in diameter. A 3-mil gap is provided in the 15-mil reticle circle, in the 6 o'clock position, to provide a ground mode reference for a superelevation of 7.5 milliradians, in excess of that provided by the caging device.

(3) *Mangin mirror and mount.* The mirror projects the reticle image on the combining glass. It does this by reflecting and collimating the light rays coming from that portion of the optical system mounted on the gimbal. Collimation causes the reticle image to appear at infinity, allowing the target and reticle image to appear in focus simultaneously. Because the reticle is collimated, movement of the gunner's head does not cause degradation in aiming. The mirror serves as both mirror and lens. Access to the adjusting screws is gained by removing the three caps from the top of the sight case. O-ring seals provided on the adjustments permit boresighting and collimating without exposing the internal parts to outside atmosphere.

(4) *Range magnet.* The range magnet assembly consists of a pole piece housing, which combines the pole piece and flux return path. The coil surrounds the pole piece and is held in place by the magnet housing cover.

(5) *Caging device.*

(a) The caging device consists of a linkage secured to a rotatable inner ring and to a stationary outer ring. The inner ring is turned by the caging knob and moves the links to the caged or uncaged position. A ball detent holds the ring in either position.

(b) The damper is mounted on the end of the motor opposite the eddy current disk and carries the caging pin. In the caged position, the links grasp the caging pin on the back of the gyro and hold the gyro in a zero traverse lead angle position. A 7.5-mil elevation offset in the line-of-sight from the zero elevation angle is introduced in the caged position. The reticle image is displaced downward. This sets in a value of superelevation for the ground firing mode. The 7.5-mil depression of the reticle in mechanical cage compensates for 20-mm projectile gravity drop for a range of 500 meters (1640 feet).

(c) The inner ring also limits the displacement of the gyro. In the uncaged position, the links clear the inner ring, permitting the caging pin full freedom of motion in any direction until it strikes the ring. Inclined slots in the inner edge catch the pin and prevent it from precessing around the ring. The gyro is free to move 31.25 degrees in any direction from its centered position before striking the limiting ring. Rectile image displacement is limited on the combining glass to 25 degrees in any direction from its centered position.

c. Sight-Radar Interface. The XM61 (fig. 3-36) is a lead-computing type that produces elevation and traverse error signals which are proportional to sight reticle elevation and traverse offset (relative to the gun axis). These error signals are fed to radar antenna servo circuitry to position the antenna for target tracking. The elevation and traverse error signals are produced by the elevation synchro (A2B3) and traverse synchro (A3B4). The elevation synchro (A3B3) is paired with the radar antenna elevation synchro (1A2B2). The rotor of the elevation synchro (A3B3) is physically connected to the sight gyro-motor gimbal. Changes in elevation lead angle cause corresponding changes in the sight gimbal and sight rotor positions. These changes in synchro rotor position cause imbalance in the sight elevation synchro circuit, which causes error signals to be developed by the radar antenna elevation synchro (1A2B2). These error signals are applied to the antenna elevation servo electronics (5A2), which produces operating power for the antenna elevation servo-motor (1A2MG1). The servo-motor (1A2MG1) operates until the rotor of servo 1A2B2 is driven to a position that corresponds with the position of the sight elevation synchro (A3B3) rotor. When the sight and antenna servo synchros are in corresponding positions, the elevation synchro circuit is balanced and no error signal exists. The rotor of the sight traverse synchro (A3B4) is physically connected to the sight gyro-motor shaft. Synchro A3B4 is paired with the radar antenna traverse servo-drive synchro (1A3B2). The traverse synchro circuit functions in a manner similar to the elevation synchro circuit. The stator of synchro 1A3B2 is the input to the radar antenna traverse servo electronics (5A1). Servo electronics 5A1 processes applied error signals and produces operating power for the radar antenna traverse servo-motor (1A3MG1). Servo-motor 1A3MG1 operates until the antenna traverse synchro (1A3B2) is in balance with the sight traverse synchro (A3B4) (no error signal developed). Elevation and traverse positioning occurs continuously during target lockon.

NOTE

Pages 3-27 through 3-123, containing figures 3-1 through 3-76, are located in TM 9-2350-300-20/2.

CHAPTER 4

CHECKOUT / FAULT ISOLATION OF ELECTRONIC COMPONENTS

4-1. General

This chapter provides procedures for performing checkout and fault isolation of the M163 system electronic components at the organizational maintenance level. Interconnection, cabling, and functional schematic diagrams (figs 3-1 through 3-76) are provided in TM 9-2350-300-20 / 2 for use in conjunction with the procedures for identification of a specific fault. In figure 3-38 (sheets 1 through 20), system electronic components are identified by reference designations, and their locations in the detailed interconnection diagram (fig 3-38) are pinpointed by reference to specific zone coordinates. Lists of components and test points, cross-referenced to zone coordinates within figure 3-38, are also provided as an aid in checkout / fault isolation procedures.

4-2. Checkout / Fault Isolation Procedures

The following information provides a guide to usage of checkout / fault isolation procedures in this manual:

a. Weekly M163 System Checkout. Table 4-1.1 is to be used in conjunction with the 300 M-A multimeter when performing the weekly M163 system checkout as prescribed by table 2-3. Sequential performance of table 4-1.1 procedures provides a complete functional checkout of the M163 system.

b. Monthly M163 Ssystem Checkout. Checkout / fault isolation procedures in tables 4-2 through 4-8 also provide a complete system checkout. When performing the monthly system checkout prescribed by table 2-3, tables 4-2 through 4-8 are to used in conjunction with the AN / MWM-2 Test Set.

c. Functional Area Checkout. The checkout / fault isolation procedures in tables 4-2 through 4-8 are also structured as checkout / fault isolation procedures for specific functional areas of the M163 system. As such, each table can be performed individually without performing the preceding table. For instance, if it is known that a problem exists in the fire control area, you can begin with table 4-6 without doing the procedures in tables 4-2 through 4-5.

d. Fault Isolation Tables. Tables 4-9 through 4-15 provide detailed fault isolation procedures, primarily for the radar system. In those case where extensive fault isolation procedures are required, reference is made to these tables from the checkout / fault isolation tables.

e. Abnormal Indications. If an abnormal indication is obtained for any step in the checkout / fault isolation tables, the "If indication is abnormal" column provides identification of the most likely cause of the fault and gives the corrective procedures. The "Reference for abnormal indication" column provides references to appropriate adjustment or repair procedures and to wiring diagrams, functional schematic diagrams, and other illustrations that will help to identify and correct the fault.

f. Verifying Proper System Operation After Repair / Replacement of a Defective Component. Following the identification and repair / replacement of a defective component, a complete system checkout shall be performed to verify proper system operation. Table 4-1.1 shall be performed if defective component was replaced during weekly checkout; tables 4-2 through 4-8 shall be performed if corrective action occurred during monthly checkout.

g. Cross-Reference Guide to Crew-Reported Malfunctions. Table 4-1 is a cross-reference guide to usage of checkout / fault isolation tables when you are reponding to a crew-reported malfunction. When the crew identifies a malfunction during the daily system checkout prescribed in TM 9-2350-300-10, table 4-1 will provide a means to quickly cross-reference the crew-reported malfunction to a corrective procedure in this manual. This should enable you to identify and correct the malfunction without first performing the complete system checkout / fault isolation procedures.

Table 4-1. Cross-Reference Guide: Crew-Reported Malfunctions Cross-Referenced to Checkout / Fault Isolation Tables.

Crew dail system check (TM 9-2350-300-10)	Perform
System Power Check	Table 4-10
Hatch protective circuits check	Tables 4-2 and 4-3
Antenna servo operational check	Table 4-15
Sight traverse lead angle check	Table 4-6
Sight elevation lead angle check	Table 4-6
Sight current generator check	Table 4-6
Radar check	Table 4-7
Ground mode check	Table 4-2
External range control check	Table 4-8

Table 4-1.1. System Checkout / Fault Isolation Procedures

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Set the MODE switch on the gunner's control panel (A2) to RADAR. NOTE Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box (A1): *a.* SIGHT GYRO PWR . . . A1CB4 *b.* SCG PWR . . . . A1CB1 *c.* INVERTER PWR . . . . . A1CB3 *d.* SYS PWR . . . . A1CB2 Radar power supply (UNIT 5): *a.* TRAV . . . . 5CB2 *b.* ELEV . . . . 5CB3 *c.* CONTROL CKT . . . . . . 5CB4 *d.* BLOWERS . . . . 5CB5 *e.* 6.3 VDC . . . . 5CB6 *f.* CONVERTER 5CB1			
2	Verify the following radar control positions: *CONTROL* / *LOCATION* / *POSITION* *a.* CLUTTER LOCK ON / Transmitter-receiver (UNIT 2) / NORMAL *b.* MODE / Radar Distribution Box (UNIT 6) / NORMAL *c.* MAINT / Radar Distribution Box (UNIT 6) / OFF			
3	Set the SYSTEM POWER Switch (S2A1S5) on the control panel (A2) to ON.	*a.* SYSTEM POWER indicator (A2A1DS1) lights.	*a.* Perform "Cannon control circuits" checkout.	*a.* Table 4-4
		b. Radar power supply (unit 5) blower operates.	*b.* Perform "power control and distribution system" fault isolation.	*b.* Table 4-11
		c. Transmitter-receiver (unit 2) blower operates.	*c.* Perform "power control and distribution system" and "transmitting system" fault isolation.	*c.* Table 4-11; Table 4-14
		d. HIGH VOLTAGE POWER SUPPLY OVERLOAD indicator on transmitter-receiver (unit 2) does *not* light.	*d-e.* Momentarily set the OVERLOAD RE-set toggle switch on the transmitter-receiver (unit 2) to ON. If light fails to extinguish, perform the "transmitting system" fault isolation.	*d-e.* Table 4-14
		e. MODULATOR OVERLOAD indicator on transmitter-receiver (unit 2) does *not* light.		
		f. M61 Sight reticle light (A3DS1) comes on after 10 seconds.	*f.* Perform "cannon control circuits" check-out.	*f.* Table 4-4.

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
4	**WARNING** A potential health hazard exists to personnel within 3 feet in front of the radar antenna dish while radar is radiating.			
	Depress the action switch on either control assembly grip assembly.	Antenna servo drives are energized and respond to positioning commands. Antenna positions on the cannon axis.	*a.* Check TRAV circuit breaker (5CB2) on power supply (unit 5); reset if tripped. If circuit fails to reset, perform "antenna positioning" fault isolation. *b.* Check ELEV circuit breaker (5CB3) on power supply (unit 5); reset if tripped. If circuit fails to reset, perform "antenna positioning" fault isolation.	*a.* Table 4-15 *b.* Table 4-15
5	Wait 2 minutes ± 15 seconds (system warmup).	READY WHEN LIT indicator (A2A1DS4) on the control panel lights.	*a.* Depress grip assembly action switch and depress foot switch (A24). Observe RF power indicator on antenna (unit 1) wave guide assembly (W109). If RF power indicator lights, replace power supply (unit 5) relay 5K4. If RF power indicator fails to light, replace power supply (unit 5) relay 5K5, or transmitter-receiver (unit 2) relay 2K1. *b.* Perform "power control and distribution system" fault isolation.	*a.* Table 4-11 *b.* Table 4-11
6	Press and hold the action switch and depress the foot switch (A24) assembly.	RF power indicator mounted in antenna (unit 1) waveguide (W109) lights, and tone from transmitter-receiver (unit 2) changes.	Perform "transmitting system" fault isolation.	Table 4-14
7	Set the CLUTTER LOCK ON switch on the transmitter-receiver (unit 2) to TEST. Connect headset to J4 on transmitter-receiver (unit 2) front panel.			
8	Aim at a fixed target 250 to 2000 meters in range.			
9	Hold the action switch and depress the foot switch (A24) assembly.	*a.* Ready-to-fire indicator (A3DS2) on the M61 sight lights. *b.* Doppler audio tone is heard in headset.	*a.* Perform "ranging system" fault isolation and "sight current generator" checkout / fault isolation. *b.* Perform "ranging system" fault isolation and "sight current generator" checkout / fault isolation. (1) Replace diodes 2A1A5CR1 and 2A1A5CR2 in transmitter-receiver (unit 2). (2) Replace receiver (unit 3).	*a.* Table 4-13 and 4-6 *b.* Table 4-13 and 4-6 (1) Fig. 4-9 (2) Para 6-46

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
9—Continued		*b.*—Continued	*b.*—Continued (3) Adjust 4A21R13 pot of range computer control amplifier assembly 4A21. (4) Replace control amplifier assembly 4A21 in range computer (unit 4), or replace cable W105.	*b.*—Continued (3) Fig. 4-5 (4) Fig. 6-105
10	Release the action switch and the foot switch (A24) assembly.			
11	Set the CLUTTER LOCKON switch on the transmitter-receiver (unit 2) to NORMAL.			
12	Press the PRESS TO TEST switch on the range computer (unit 4). (MID RANGE CALIBRATION indicator on range computer (unit 4) must flash once per second.)	MID RANGE CALIBRATION indicator lights brightly. Proceed to step 16; *do not* perform steps 13, 14 or 15.	*a.* Check ground straps for proper connections to transmitter-receiver and other radar units. *b.* If malfunction still is not corrected, perform steps 13, 14 and 15 in sequence to establish cause. As soon as malfunction is corrected, stop and return to step 12; do not continue with steps 13, 14 and 15 once the malfunction has been corrected.	Fig. 3-37
13	**NOTE** When an abnormal indication in step 12 is not resolved, perform steps 13, 14 and 15 in sequence to establish cause of malfunction. When malfunction is corrected, stop and return to step 12; do not continue with steps 13, 14 and 15 once the malfunction has been corrected. MID RANGE CALIBRATION indicator (4DS1) on range computer (unit 4) does not light.		**NOTE** Where several items are listed to replace, they will be replaced in turn until malfunction is corrected.	
	a. Set multimeter 300 M-A to read 10 VDC scale. Connect red (positive) lead to pin A of power supply connector 5J4 and black (negative) lead to pin C.	*a.* Meter indicates 6.3 VDC.	*a.* Check 6.3 VDC circuit breaker (CB6) on power supply (unit 5). Replace power supply converter assembly (5A3).	*a.* Fig. 6-108, sheet 2.

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
13—Continued	**NOTE** Locations of range computer numbered test points (TP and E) are shown in figure 4-3.			
	b. Connect multimeter leads in range computer (unit 4), red lead to TP1 and black lead to E10 (fig. 4-3).	*b.* Meter indicates 6 VDC.	*b.* Check cable W103.	*b.* Fig. 3-62, sheet 5
	c. Connect multimeter leads in range computer (unit 4) red lead to E9 and black lead to E10.	*c.* Meter indicates 5 VDC.	*c.* Replace 5 volt filter assembly (4A18).	*c.* Fig. 6-105, sheet 1
14	MID RANGE CALIBRATION indicator (4DS1) on range computer (unit 4) is not flashing (range computer will not search).			
	a. Set RANGE switch (S5) in range computer (unit 4) to RUN, and MODE switch to NORM (fig. 4-5).			
	b. Set multimeter 300 M-A to read 100 VAC scale. connect red lead to TP 38 and black lead to ground.	*b.* Meter indicates 18 VAC.	*b.* Replace range computer master clock assembly (4A1), receiver (unit 3), and/or transmitter-receiver 60 MHz local oscillator (2A3).	*b.* Fig. 6-105, sheet 2; fig. 6-101, sheet 4
	c. Connect red lead to 4TP35 and black lead to ground.	*c.* Meter indicates 12 VAC.	*c.* Replace range computer range counter assembly (4A6).	*c.* Fig. Fig. 6-105, sheet 1
	d. Set multimeter 300 M-A to read 1 VAC scale using DIGITAL MODE. Connect red lead to TP 12 and black lead to ground.	*d.* Meter indicates .1 VAC	*d.* Replace range computer assemblies: rate integrator (4A14), computer timing generator (4A4), and/or pulse-repetition frequency counter (4A2).	*d.* Fig. 6-105, sheet 1
	e. Connect red lead to TP 39 and black lead to ground. Reverse polarity (set TEST LEAD POLARITY to REV).	*e.* Meter indicates .95 VAC.	*e.* Replace range computer range register A assembly (4A8) and/or range register B assembly (4A9).	*e.* Fig. 6-105, sheet 1
	f. Set multimeter 300 M-A to read 10 VAC scale. Connect black lead to ground and in turn, connect red lead to (1) TP 33 and (2) TP 36.	*f.* Meter indicates 1 to 2 VAC at both test points.	*f.* Replace range computer range counter assembly (4A6).	*f.* Fig. 6-105, sheet 1
	g. Set multimeter 300 M-A to read 1 FAC scale, DIGITAL MODE. Connect red lead to TP 33 and black lead to ground. Set TEST LEAD POLARITY to NORM.	*g.* Meter indicates .2 to .3 VAC.	*g.* Replace range computer assemblies: RCFD decoder (4A5), RCFD generator (4A7), and/or fine/fine delay (4A22).	*g.* Fig. 6-105, sheet 1
	h. Connect red lead to TP 44 and black lead to ground.	*h.* Meter indicates .17 to .19 VAC.	*h.* Replace fine/fine delay assembly (4A22).	*h.* Fig. 6-105, sheet 1
	i. Set multimeter 300 M-A to read 100 VDC scale. Connect red lead to pin J and black lead to pin B of range computer connector 4J5 (fig. 6-104).	*i.* Meter indicates 20 VDC.	*i.* Replace range computer range D/A converter assembly (4A16) and/or range rate D/A converter assembly (4A17).	*i.* Fig. 6-105, sheet 1

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
14—Continued				
	j. Connect red lead to pin A and black lead to pin B.	*j.* Meter indicates 6.4 VDC.	*j.* Replace range rate D/A converter assembly (4A17), range register B assembly (4A9), and/or range register A assembly (4A8).	*j.* Fig. 6-105, sheet 1
	k. Connect red lead to pin K and black lead to pin F. Set TEST LEAD POLARITY to REV.	*k.* Meter indicates -10 VDC.	*k.* Replace range rate D/A converter assembly (4A17) and/or power supply converter assembly (5A3).	*k.* Fig. 6-105, sheet 1; fig. 6-108, sheet 2
	l. Connect red lead to pin K and black lead to pin F. Set TEST LEAD POLARITY to NORM.	*l.* Meter indicates 10 VDC.	*l.* Replace range rate D/A converter assembly (4A17) and/or power supply converter assembly (5A3).	*l.* Fig. 6-105, sheet 1; fig. 6-108, sheet 2
	m. Connect red lead to pin H and black lead to pin F. Set TEST SET POLARITY to REV.	*m.* Meter indicates -6.4 VDC.	*m.* Replace range rate D/A converter assembly (4A17) and/or range rate counter B assembly (4A12).	*m.* Fig. 6-105, sheet 1
15	MID RANGE CALIBRATION indicator flashing (range computer search operation is proper) but indicator does not brighten when push button is pressed (range computer will not lock).			
	a. Insure that range computer MODE switch is set to NORM and RANGE switch to RUN.			
	b. Connect headset to connector 2J4 on front panel of unit 2, transmitter-receiver. Press MID RANGE CALIBRATION push button.	*b.* Doppler audio tone is audible.	*b.* Replace control amplifier assembly (4A21) and/or unit 3, receiver. Check cables.	*b.* Fig. 6-105, sheet 1; para 6-46
	c. Set multimeter 300 M-A to read 1 VAC scale, DIGITAL MODE and TEST LEAD POLARITY to NORM. Connect red lead to 4TP6 and black lead to ground. Press MID RANGE CALIBRATION push button.	*c.* Meter indicates .4 VAC.	*c.* Replace range computer phase detector assembly (4A15) and/or control amplifier assembly (4A21).	*c.* Fig. 6-105, sheet 1
	d. Set multimeter 300 M-A to read 10 VDC, DIGITAL MODE. Connect red lead to 4TP15 and black lead to ground. Press MID RANGE CALIBRATION push button.	*d.* Meter indicates 3.8 VDC.	*d.* Replace range computer assemblies: search/track and gain control (4A10), computer timing generator (4A4), rate integrator (4A14), phase detector (4A15), universal board (4A23), fine/fine delay (4A22), range rate counter B (4A12), and/or range register B (4A9).	*d.* Fig. 6-105, sheet 1
16	Uncage M61 sight. Insure radar distribution box (unit 6) MODE switch is in NORMAL.			
17	Set range computer (unit 4) switches as follows: (1) MODE switch to TEST. (2) ACCEL switch to NEG. (3) RETURN switch to TGT. (4) RANGE switch to RUN.			

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
18	With cannon positioned at approximately 0° elevation (using scribe lines for reference, fig. 6-56), press action switch. Allow 17 ± 2 seconds for normal indications.	*a.* Ready-to-fire indication (A3DS2) lights for a short duration then goes out. This cycle repeats every 17 ± 2 seconds.	*a.* Perform "sight current generator" checkout / fault isolation and "ranging system" fault isolation.	*a.* Tables 4-6 and 4-13
		b. Observe that M61 sight reticle moves in elevation.	*b.* Perform "sight current generator" checkout / fault isolation and "ranging system" fault isolation.	*b.* Tables 4-6 and 4-13
		c. Observe that antenna moves in elevation in conjunction with M61 sight reticle.	*c.* Perform "antenna positioning" fault isolation.	*c.* Table 4-15
		d. Proceed to step 20, *do not* perform step 19.	*d.* If malfunction still is not corrected, perform step 19 to determine which components to fault isolate further. As soon as malfunction is corrected, stop and return to step 18; *do not* continue with step 19 once the malfunction has been corrected.	*d.* Step 19
19	When an abnormal indication in steps 18, 20 or 22 is not resolved, perform the following sequence to determine which components to fault isolate further. As soon as malfunction is corrected, stop and return to step (18, 20 or 22) which sent you here; do not continue with step 19 once the malfunction has been corrected.			
	a. Assure that range computer (unit 4) MODE switch is set to NORM. Set multimeter 300 M-A to read 100 VDC scale.			
	(1) Connect red lead to pin J and black lead to pin B of range computer connector 4J5 (fig. 6-104).	(1) Meter indicates 20VDC; proceed to step 19 *(c)* and continue from that point.	(1) Replace range computer range D / A converter assembly (4A16) and / or range rate D / A converter assembly (4A17).	(1) Fig. 6-105, sheet 1
	(2) Connect red lead to pin A and black lead to pin B.	(2) Meter indicates 6.4 VDC; proceed to step 19 *(c)* and continue from that point.	(2) Replace range rate D / A converter assembly (4A17), range register B assembly (4A9), and / or range register A assembly (4A8).	(2) Fig. 6-105, sheet 1
	b. Assure that range computer (unit 4) switches are set as follows: MODE switch to TEST ACCEL switch to NEG RETURN switch to TGT RANGE switch to RUN Set multimeter 300 M-A to read 100 VDC scale.			
	(1) Connect red lead to pin K and black lead to pin F of 4J5.	(1) Meter indicates 10 VDC; proceed to step 19*c* and continue from that point.	(1) Replace range rate D / A converter 4A17.	(1) Fig. 6-105, sheet 1
	(2) Connect red lead to pin J and black lead to pin B of 4J5.	(2) Meter indicates sweep from 20 to 0 VDC; proceed to step 19*c* and continue from that point.	(2) Replace range D / A converter 4A16; range register A assembly 4A8; range register B assembly 4A9.	(2) Fig. 6-105, sheet 1

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19—Continued				
	c. Refer to steps (1) through (5) following and determine malfunction symptom that applies to your situation: (1) Ready-to-fire indicator lights every 17±2 seconds, but M61 sight reticle does not move properly in step 18, 20 or 22: *(a)* Remove cover of sight current generator (A21) (fig. 6-78). *(b)* Press action switch. **NOTE** Operation or non-operation of range potentiometer (A21A15R11) in-following step *(c)* can indicate areas of malfunction. *(c)* Observe gears in range potentiometer (A21A15R11) in A21A15 servo assembly (fig. 6-80). Refer to "If indication is abnormal" column.		*(c)*(1) If gears do not turn, replace the following sight current generator (A21) assemblies: buffer amplifier circuit card (A2A3); time delay circuit card (A21A11). if trouble is not resolved, proceed to step 19*d* and continue from that point. *(c)*(2) If gears turn, replace ballistics data circuit card assembly (A21A1); magnet current supply module (A21A13); check / replace cables and connectors. If trouble is not resolved, proceed to step 19*d* and continue from that point.	*(c)* (1) Fig. 6-81 *(c)* (2) Fig. 6-78 Fig. 6-79
	(2) Ready-to-fire indicator does not light every 17±2 seconds, but M61 sight reticle moves properly in step 18, 20 or 22. Assure that range computer (unit 4) switches are still as set in step 19*b* preceding: Refer to "If indication is abnormal" column.		(2) Replace the following circuit card assemblies one at a time; press action switch after replacing each circuit card and allow 17 ± 2 seconds for indication. Continue procedure of replacing circuit cards and actuating action switch until ready-to-fire indicator lights: firing indicator (A21A5); voltage comparator (A21A6); acquisition time delay (A21A7); sight correction (A21A8); pulse width multiplier (21A9); and voltage comparator (A21A10).	(2) Fig 6-81

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19	Continued			
	(3) Ready-to-fire indicator does not light, and M61 sight reticle does not move properly in step 18, 20, or 22. Refer to "If indication is abnormal" column.		3) Perform step 19*d*. Replace system distribution box (A1), servo amplifiers (A15A1, A15A2, A15A3), and / or cable assemblies associated with each.	
	(4) Ready-to-fire indicator and M61 sight reticle work properly, but antenna does not in step 18, 20 or 22. Refer to "If indication is abnormal" column.		4) Perform "antenna positioning" fault isolation. Replace M61 sight.	
	(5) NOTE The following procedure is applicable as corrective action for steps 18 and 20 only. MIDRANGE CALIBRATION light flashes and remains brightly lit when push button is depressed in step 18 or 20. NOTE Symptoms may very in the following ways: Ready-to-fire indicator may remain on during 17±2 second cycle. Ready-to-fire indicator may light, but will go out and not come back on within 17±2 second cycle. Ready-to-fire indicator may not light within 17±2 second cycle. Ready-to-fire indicator may blink and repeat cycle every 17±2 seconds.			
	(a) Set multimeter 300 M-A to read 1 VDC scale. Connect red lead to 4TP28 (fig. 4-3) and black lead to ground.	*(a)* Meter indicates .1 VDC. Proceed to step *(b)*.	*(a)* Replace phase detector (4A15); rate scaler (4A13); RCFD decoder (4A5).	*(a)* Fig. 6-105, sheet 1
	(b) Connect red lead to 4TP30 and black lead to ground.	*(b)* Meter indicates .1 VDC. Proceed to step *(c)*.	*(b)* Replace range rate counter (A4A11); universal board (4A23).	*(b)* Fig. 6-105, sheet 1
	(c) Connect red lead to 4TP18 and black lead to ground.	*(c)* Meter indicates .2 to .3 VDC. Proceed to step *(d)*.	*(c)* Replace range rate counter (4A12); rate integrator (4A14).	*(c)* Fig. 6-105, sheet 1
	(d) Connect red lead to 4TP12 and black lead to ground.	*(d)* Meter indicates .5 to 1 VDC. Proceed to step *(e)*.	*(d)* Replace rate integrator (4A14).; RCFD decoder (4A5).	*(d)* Fig. 6-105, sheet 1

Table 4-1.1. System Checkout/Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19—Continued				
	(e) Set multimeter 300 M-A to read 100 VDC scale. Set TEST LEAD POLARITY to REV. Connect red lead to pin G and black lead to pin F of range computer (unit 4) connector 4J5.	*(e)* Meter indicates -10 VDC. Proceed to step *(f)*.	*(e)* Replace range rate D/A converter (4A17) and/or power supply (unit 5) converter assembly (5A3).	*(e)* Fig. 6-105, sheet 1; fig. 6-108, sheet 2.
	(f) Set TEST LEAD POLARITY to NORM. Connect red lead to pin K and black lead to pin F of connector 4J5.	*(f)* Meter indicates +10 VDC. Proceed to step *(g)*.	*(f)* Replace range rate D/A converter (4A17).	*(f)* Fig. 6-105, sheet 1
	(g) Set TEST LEAD POLARITY to REV. Connect red lead to pin H and black lead to pin F of connector 4J5.	*(g)* Meter indicates -10 VDC. Proceed to step *(h)*.	*(g)* Replace range rate D/A converter (4A17).	*(g)* Fig. 6-105, sheet 1
	(h) Set TEST LEAD POLARITY to NORM. Connect red lead to pin J and black lead to pin B of converter 4J5.	*(h)* Meter indicates +20 VDC. Proceed to step *(i)*.	*(h)* Replace range D/A converter (4A16).	*(h)* Fig. 6-105, sheet 1
	(i) Connect red lead to pin A and black lead to pin B of converter 4J5.	*(i)* Meter indicates sweep from 20 to 0 VDC.	*(i)* Replace range D/A converter (4A16); range register A (4A8); range register B (4A9).	*(i)* Fig. 6-105, sheet 1
	d. Place MODE switch on control panel (A2) to MAN. Use scribe marks and position at zero degrees elevation (fig. 6-56).		**NOTE** When actions in this column correct the trouble, stop and return to step 18, 20 or 22, as applicable. Do not continue this step once the trouble has been corrected.	
	(1) Set multimeter 300 M-A to read 100 VDC scale. Reverse polarity (set TEST LEAD POLARITY to REV). Connect red lead to sight current generator (A21) test connector A21J7 (fig. 6-79), pin *a*, and black lead to ground.	(1) Meter indicates -15 VDC. (Use test cable W32 of the AN/M-WM-2 Test Set as required to check pins of test connector A21J7.)	(1) Check for -15 VDC at pin Y of A21J7. If -15 VDC present, check cable (W7) to (cosine E) elevation potentiometer assembly. If -15 VDC is not present at pin Y, set TEST LEAD POLARITY to NORM. Connect red lead to pin A of A5 inverter connector A5J2 (fig 6-87) and black lead to pin B. Replace inverter (A5) if meter does not indicate 19 VDC. If meter reads 19 VDC and -15 VDC was not present at pin Y, replace sight current generator (A21).	(1) Fig. 6-52; 3-37 and 3-45.

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19	*d.*—Continued			
	(2) Place AIR DENSITY knob on sight current generator to 12 and MUZZLE VELOCITY to 1. Set multimeter 300 M-A to read 10 VDC DIGITAL MODE. Connect red lead to pin *x* of test connector A21J7 and black lead to ground. Adjust RANGE knob on control panel (A2) to obtain required reading.	(2) Meter indicates 2.5 VDC.	(2) Replace sight current generator relay (A21K26). Check W9 cable and connectors to control panel (A2) and range potentiometer (A2A1R3).	(2) Fig. 6-81, 6-77 (sheet 1)
	(3) Connect red lead of multimeter to pin AA of test connector A21J7 and black lead to ground. Adjust TARGET SPEED knob on control panel (A2) to obtain required reading.	(3) Meter indicates 3.75 VDC.	(3) Replace sight current generator manual mode relay (A21K26). Check W9 cable and connectors to control panel (A2) and target speed potentiometer (A2A1R4).	(3) Fig. 6-81, 6-77 (sheet 1)
	(4) Connect red lead of multimeter to pin *g* of test connector A21J7 and black lead to ground.	(4) Meter indicates 6.90 to 7.20 VDC. NOTE If indication is proper, proceed with 19*c* (5).	(4) If meter indicates 12.5 VDC, replace sight current generator outbound configuration circuit card assembly (A21A2) and relay (A21K21). If meter indicates a reading other than 12.5 VDC, proceed to step 19*d*(6).	(4) Fig. 6-81
	(5) Connect red lead of multimeter to pin W of test connector A21J7 and black lead to ground. Set TEST LEAD POLARITY to REV.	(5) Meter indicates -.875 to 1.80 VDC.	(5) Replace sight current generator magnet current supply module (A21A13) and / or M61 sight (A3).	(5) Fig. 6-81; para 6-52
	(6) Set TEST LEAD POLARITY to NORM. Connect red lead of multimeter to pin *s* of test connector A21J7 and black lead to ground. Take reading, then set TEST LEAD POLARITY to REV and connect red lead to pin *t* of A21J7.	(6) Meter indicates 1.90 VDC for pin *s* and -7.60 to -8 VDC for pin *t*.	(6) Place MODE switch on control panel (A2) to TEST. Place SYSTEM POWER to ON, allow system warmup time, and check that radar radiates (RF power indicator lights). If radar does not radiate, perform step (7). If normal indication is obtained in step (7), replace sight current generator relay (A21K22).	
	(7) Set TEST LEAD POLARITY to NORM. Set multimeter 300 M-A to read 1000 VAC scale. Connect red lead to pin A of test connector A21J7 and black lead to pin B.	(7) Meter indicates 115 VAC.	(7) If 115 VAC is not present, replace inverter (A5).	
20	Set ACCEL switch in range computer (unit 4) to POS and repeat step 18.	*a.* Ready-to-fire indicator (A3DS2) lights for a short duration then goes out. This cycle repeats every 17±2 seconds.	*a.* Replace A21A2, A21A4, and A21A7 circuit cards in sight current generator (A21).	*a.* Fig. 6-81

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
20—Continued				
		b. (Same as step 18*b* except movement is greater.)	*b.* If malfunction still is not corrected, perform step 19 to determine which components to fault isolate further. As soon as malfunction is corrected, stop and return to step 20; *do not* continue with step 19 once the malfunction has been corrected.	*b.* Step 19
		c. (Same as step 18*c* except movement is greater.)		
		d. Proceed to step 21.		
21	*a.* Set range computer (unit 4) switches as follows: (1) MODE switch to NORMAL. (2) ACCEL switch to POS. (3) RETURN switch to NO TGT. (4) RANGE switch to RUN. *b.* Replace cover on range computer (unit 4).			
22	**WARNING** Make certain all personnel are clear of area of cannon travel above deck and of the mount travel below deck before performing steps *a* and *b* following.			
	a. Press action switches separately and rotate the grip assembly slowly left and right.	*a.* Mount rotates following grip assembly movement smoothly.	*a.* Perform "mount servo system" checkout / fault isolation.	*a.* Table 4-2
	WARNING After push button is pressed in following step *b*, remove hand quickly from components as mount will slew rapidly in direction of travel.			
	b. Press MID RANGE CALIBRATION push button on range computer (unit 4) while rotating mount.	*b.* (1)Mount speed up in direction of travel.	*b.* (1) Perform lock threshold adjustment.	*b.* (1) Para 6-66
		(2) M61 Sight reticle moves in opposite direction of mount.	(2) Replace phase detector assembly 4A15.	(2) Fig. 6-105
		(3) Antenna moves in direction opposite to mount movement.	(3) Replace control amplifier assembly 4A21.	(3) Fig. 6-105
			(4) Replace distribution box A1.	(4) Para o-42
			c. If malfunction still is not corrected, perform step 19 to determine which components to fault isolate further. As soon as malfunction is corrected, stop and return to step 22; do not continue with step 19 once the malfunction has been corrected.	*c.* Step 19

Table 4-1.1. System Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
23	Mechanically cage M61 sight.			
24	Set MODE switch on control panel (A2) to TEST: place AIR DENSITY switch to 5 and MUZZLE VELOCITY switch to .85 on sight current generator (A21); and press action switch.	GOOD WHEN LIT indicator on control panel (A2) lights.	*a.* Perform "sightcurrent generator" checkout / fault isolation. *b.* Replace A21A4, A21A5, and A21A1 circuit cards in sight current generator (A21).	*a.* Table 4-6 *b.* Fig. 6-81
25	Verify the following equipment conditions: *a.* SYSTEM POWER switch—ON. *b.* GUN POWER switch—ON. *c.* FIRING RATE switch—LO-NO BURST LIMIT. *d.* GUN CLEAR switch—OPERATOR. *e.* NORM-STATIC-TEST switch—STATIC. *f.* Declutching feeder assembly removed (para 6-21).			
26	Disconnect cable W3P2 from firing connector A6A1J1 (fig. 6-3).			
27	Set 300 M-A to 1000 VDC setting and connect leads to read voltage on W3P2 connector of firing contact assembly (A6A1).			
28	**WARNING** Insure that no rounds are present in cannon before performing following step. Press action and trigger switches.	*a.* Meter reads 315 to 335 VDC. *b.* Cannon rotates.	*a.* Replace system distribution box A1. *b.* Perform "cannon control circuits" checkout / fault isolation.	*a.* Para 6-42 *b.* Table 4-4
29	Place GUN CLEAR switch (A2A1S3) on control panel (A2) to AUTO. Repeat step 24 with FIRING RATE switch (A2A1S4) at HI-BURST LIMIT 10, 30, 60 and 100.	With firing rates increased, time of connon rotation increases.	Perform "cannon control circuits" checkout / fault isolation.	Table 4-4
30	Turn off SYSTEM POWER (A2A1S5) and GUN POWER (A2A1S2) switches. Install declutching feeder assembly (para 6-21). Reconnect cable W3P2 to firing connector A6A1J1.			

Table 4.2. Mount Servo System Checkout / Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Verify that power source (vehicle engine or APU) is providing a charging voltage and current to system batteries.	Distribution box (A1) meters indicate +26 to +28.5 Vdc at less than 10 A.	Perform power source adjustment. **CAUTION** Damage to the servo amplifiers will result if the action switch is activated with a servo motor disconnected.	Para 6-64 or 6-65. Fig. 3-20
2	Verify the following equipment conditions: *a.* Conveyor assembly locked in the firing position. *b.* Drum drive assembly shift pin at F. *c.* Arming connector removed from the distribution box. *d.* Ramp locking handle ....Up (locked) *e.* Hatches closed and latched. *f.* Elevation and azimuth drive motor brakes ....On *g.* SYSTEM POWER switch ....OFF *h.* GUN POWER switch ....OFF *i.* Control panel MODE switch ....MAN *j.* NORM-STATIC-TEST switch ....NORM (up) *k.* Sight mechanically caged. **WARNING** Make certain that all personnel are clear of the area of cannon travel above deck and of the mount travel below deck. **NOTE** Assure that distribution box SYS PWR circuit breaker (A1CB2) is in set position prior to performing checkout.			
3	Set the SYSTEM POWER switch on the control panel to ON.	SYSTEM POWER indicator on the control panel lights.		Table 4-11.

Table 4-2. *Mount Servo System Checkout / Fault Isolation Procedures—Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
4	Press each action switch separately, and slowly rotate the grip assembly to the right and left. Release the action switch.	Mount responds following the grip assembly movement smoothly.	No response: **CAUTION** **Verify that system power is off prior to making any continuity checks.** a. Check cable connections and continuity. b. Replace the following components in the order shown. If changing a component does not correct the malfunction, reinstall the original: (1) Azimuth servo amplifier (master) (A15A1). (2) Distribution box (A1). (3) Resistor and gear assembly (A2A1R10). c. Uncontrolled response: Disconnect (slave) servo amplifier cable (W8P2): (1) If response becomes controlled, replace the (slave) servo amplifier (A15A2). (2) If response remains uncontrolled, replace the (master) servo amplifier (A15A1). d. Controlled but jerky response: Replace the following components	a. Fig. 3-6. (1) Fig. 6-87. (2) Par. 6-42. (3) Par. 6-40 ■ (1) Fig. 6-87. (2) Fig. 6-87.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
			in the order given. If replacing a component does not correct the malfunction, reinstall the original:	
			(1) Azimuth tachometer (A17A3).	(1) Par. 6-16.
			(2) Resistor and gear assembly (A2A1R10).	(2) Par. 6-40
			(3) Distribution box (A1).	(3) Par. 6-42.
			(4) Tachometer (A2A1G1).	(4) Par. 6-40
5	Press the action switch and slowly rotate the control grip assembly to elevate and depress the cannon. Release action switch.	Cannon responds following the grip assembly smoothly.	No response:	
			a. Check cable connections and continuity.	a. Fig. 3-5 and applicable wiring diagrams.
			b. Replace the following components in the order given. If a component does not correct the malfunction, reinstall the original:	
			(1) Elevation amplifier servo (A15A3).	(1) Fig. 6-87.
			(2) Distribution box (A1).	(2) Par. 6-42.
			(3) Resistor and gear assembly (A2A2R1).	(3) Par. 6-39.
			(4) Elevation servo motor (A16A1).	(4) Par. 6-16.
			c. Uncontrolled response: Replace the elevation servo amplifier (A15A3).	c. Fig. 6-87.
			d. Controlled but jerky response: Replace the following components in the order given. If replacing a	

Table 4-2. Mount Servo System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
			component does not correct the malfunction, reinstall the original: (1) Dc feedback tachometer (A16A2G1). (2) Aided laying tachmeter (A2A2G1). (3) Distribution box (A1). (4) Resistor and gear assembly (A2A2R1).	 (1) Par. 6-17. (2) Par. 6-39. (3) Par. 6-42. (4) Par. 6-39.
6	Position the cannon at approximately zero degrees in elevation as indicated by the scribe marks on the sight saddle and support, left-hand side (fig. 6-56).			
7	Complete one revolution of the mount by pressing the action switch and rotating the control grip assembly to the right.	Mount rotates smoothly to the right.	Mount stops when entering a hatch protective circuit area (hatch closed): (1) Perform hatch protective circuit check. (2) Check for mechanical obstruction of the mount.	 Table 4-3.
8	Set the control grip assembly in its centered position in azimuth.			
9	Press the action switch without moving hand controls from centered position.	Mount does not move in azimuth.	Mount creeps (right or left): a. Creeps at a rate of less than 5 degrees per second (more than 70 seconds per revolution): (1) Perform hatch protective circuit check. (2) 2,000,000 series distribution box:	 (1) Table 4-3. (2) Fig. 6-86, sheet 2.

Table 4-2. Mount Servo System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
			Adjust the AZ DEAD-BAND potentiometer (R33) in the distribution box as necessary to stop creep.	
			(3) 1,000,000 series distribution box: Check that the control grip assembly variable resistor and gear assembly potentiometer (A2A1R10) is properly zeroed.	(3) Par. 6-56; fig. 6-77, sheet 1.
			b. Creeps at a rate of greater than 5 degrees per second (70 seconds or less per revolution): Replace the following components in the order give. If malfunction is not corrected, reinstall original:	
			(1) Dc feedback tachometer (A17A3).	(1) Par. 6-16.
			(2) Servo amplifier (master) (A15A1).	(2) Fig. 6-87.
10	Reposition the cannon to approximately 60 degrees in elevation (fig. 6-56).			
11	Set the control grip assembly in its zero (center) position.			

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
12	Press the action switch (do not move the control grip assembly).	Cannon does not move in elevation.	Cannon creeps (up or down):	
			NOTE	
			If cannon creeps up, measure rate from zero degrees index line to +60 degrees index line; if it creeps down, measure from +60 degrees index line to zero degrees index line.	Fig. 6-56.
			a. Creeps at a rate of less than 60 degrees in 12 seconds (5 degrees per second):	
			(1) 2,000,000 series distribution box: Adjust the EL DEADBAND potentiometer (R34) in the distribution box as necessary to stop creep.	(1) Fig. 6-86, sheet 2.
			(2) 1,000,000 series distribution box: Check that the control grip assembly elevation variable resistor and gear assembly potentiometer (A2A2R1) is properly centered.	(2) Par. 6-56; fig. 6-73.
			b. Creeps at a rate greater than 60 degrees in 12 seconds (5 degrees per second):	Fig. 6-56.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
12 con.			Replace the following components in the order given. If replacing a component does not correct the malfunction, reinstall the original: (1) Dc feedback tachometer (A16A2G1). (2) Elevation servo amplifier (A15A3).	 (1) Par. 6-17. (2) Fig. 6-87.
13	Position the cannon at zero degrees elevation.			
14	Rotate the control grip assembly fully clockwise; press and hold the action switch.	Mount rotates to the right.		
15	Time five complete revolutions of the mount.	Mount completes five revolutions in 24 to 30 seconds.	a. Mount completes five revolutions in less than 24 seconds: In 2,000,000 series distribution box adjust the SLEW R potentiometer (A1A2R29) counterclockwise to reduce slew speed. In 1,000,000 series distribution box adjust SLEW RT-AZ (A1A2R29). b. Mount completes five revolutions in more than 30 seconds: (1) In 2,000,000 series distribution box adjust the SLEW R potentiometer	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1. (1) Fig. 6-86, sheet 2.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
15 con.			(A1A2R29) clockwise to increase slew speed. In 1,000,000 series distribution box adjust SLEW RT-AZ (A1A2R29).	Fig. 6-86, sheet 2.
			(2) Check the slave servo amplifier (A15A2) as follows: (a) Disconnect connector W8P2 from slave servo amplifier (A15-A2) and connector W8P4 from elevation servo amplifier (A15A3). (b) Connect W8P2 to elevation servo amplifier (A15A3). Leave connector W8P4 disconnected.	(2) Fig. 6-87.
			(3) Check the master servo amplifier (A15A1) as follows: (a) Disconnect connector W8P3 from master servo amplifier (A15A1). Connect connector W8P3 to slave servo amplifier (A15A2). Leave connector W8P4 disconnected.	(3) Fig. 6-87.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
15 con.			**NOTE** Reconnect cable W8P2 to slave servo amplifier (A15A2); W8P3 to master servo amplifier (A15A1); and W8P4 to elevation servo amplifier (A15A3). (4) Replace the slew circuit card assembly (A1A2) in the distribution box.	 (4) Par. 6-42; fig. 6-86, sheets 1 and 2.
16	Position the cannon at zero degrees elevation.			
17	Rotate the control grip assembly fully counterclockwise; press and hold the action switch.	Mount rotates to the left.		
18	Time five complete revolutions of the mount. Release action switch.	Mount completes five revolutions in 24 to 30 seconds. **NOTE** Slew rate may differ in each direction of rotation, but must be within 24 to 30 seconds in each case.	a. Mount completes five revolutions in less than 24 seconds: In 2,000,000 series distribution box adjust the SLEW L potentiometer (A1A2R30) counterclockwise to increase slew speed. In 1,000,000 series distribution box adjust SLEW RT-AZ (A1A2R29). b. Mount completes five revolutions in more than 30 seconds: (1) In 2,000,000 series distribution box adjust the SLEW L	 Fig. 6-86, sheet 2. Fig. 6-86, sheet 1. (1) Fig. 6-86, sheets 2.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
18 con.			potentiometer (A1A2R30) clockwise to reduce slew speed. In 1,000,000 series distribution box adjust SLEW RT-AZ (A1A2R29).	Fig. 6-86, sheet 1.
			(2) Check the slave servo amplifier (A15A2) as follows:	(2) Fig. 6-87.
			(a) Disconnect connector W8P2 from slave servo amplifier (A15A2) and connector W8P4 from elevation servo amplifier (A15A3).	
			(b) Connect W8P2 to elevation servo amplifier (A15A3). Leave connector W8P4 disconnected.	
			(3) Check the master servo amplifier (A15A1) as follows:	(3) Fig. 6-87.
			(a) Disconnect connector W8P3 from master servo amplifier (A15A1).	
			(b) Connect connector W8P3 to slave servo am-	

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
18 con.			plifier (A15A2). Leave connector W8P4 disconnected. **NOTE** Reconnect cable W8P2 to slave servo amplifier (A15A2); W8P3 to master servo amplifier (A15A1); and W8P4 to elevation servo amplifier (A15A3). (4) Replace the slew circuit card assembly (A1A2) in the distribution box.	(4) Par. 6-42; fig. 6-86, sheets 1 and 2.
19	Set the MODE switch on the control panel in the GRD position.			
20	Position the cannon at zero degrees elevation.			
21	Press the action switch and rotate the control grip assembly fully clockwise.	Mount rotates to the right.		
22	Time five complete revolutions of the mount. Release action switch.	Mount completes five revolutions in 20 to 24 seconds.	a. Adjust R9 in distribution box. b. Replace slew circuit card assembly (A1A2) in the distribution box.	a. Fig. 6-86, sheets 1 and 2. b. Par. 6-42; fig. 6-86, sheets 1 and 2.
23	Position the cannon to zero degrees elevation.			
24	Press the action switch and rotate the control grip assembly fully counterclockwise.	Mount rotates to the left.		
25	Time five complete revolutions of the mount. Release action switch.	Mount completes five revolutions in 20 to 24 seconds.	a. Adjust R9 in distribution box.	a. Fig. 6-86, sheets 1 and 2.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
25 con.		**NOTE** Slew rate may differ in each direction of rotation but must be between 20 and 24 seconds in each case.	b. Replace slew circuit card assembly (A1A2) in the distribution box.	b. Par. 6-42; fig. 6-86, sheets 1 and 2.
26	Press the action switch and slowly rotate the control grip assembly to the up position.	Cannon drives up in elevation smoothly and stops before the mechanical stop is reached.	Adjust the upper limit (80 degrees) switches (A18S4) and (A18S5).	Par. 6-32f.
27	Hold the control grip assembly in the up position with the action switch pressed.	Cannon remains stationary at 80 degrees, does not drive into the mechanical stops nor drift away (down) and drive back (oscillate).	In 2,000,000 series distribution box, adjust the UPPER LIMIT potentiometer (A1A2R24) clockwise to stop drive, counterclockwise to stop drift. In 1,000,000 series distribution box, adjust EL LIM-UP (A1A2R24).	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1.
28	With the action switch pressed, slowly rotate the control grip assembly to the down position.	Cannon drives down in elevation smoothly and stops before the mechanical stop is reached (–5 degrees elevation).	Adjust the lower limit switch (A18S3).	Par. 6-32e.
29	Hold the control grip assembly in the down position with the action switch pressed.	Cannon remains stationary at –5 degrees, does not drive into the mechanical stops, nor drift away (up) and drive back (oscillate).	In the 2,000,000 series distribution box adjust the LOWER LIMIT (EL LIM-DN) potentiometer (A1A2R23) clockwise to stop drive, counterclockwise to stop drift. In 1,000,000 series distribution	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1.

Table 4-2. Mount Servo System Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
29 con.			box adjust EL LIM-DN (A1A2R23).	
30	Position the cannon at its minimum elevation. Release action switch.			
31	Rotate the control grip assembly to the up position and press the action switch.	Cannon slews to its upper limit in 1.4 to 1.9 seconds.	a. If the cannon slews to its upper limit in 2 to 2.5 seconds in the 2,000,000 series distribution box, adjust the SLEW UP potentiometer (A1A2R32) clockwise to increase the slew rate.	a. Fig. 6-86, sheet 2.
			In the 1,000,000 series distribution box adjust SLEW RT-EL (A1A2R30).	Fig. 6-86, sheet 1.
			b. Leave the cannon in the fully elevated position and examine the equilibrators for scoring, pits, dirt, etc.	b. Par. 6-33.
			c. Replace the following components in the order given. Whenever a new component does not correct the malfunction, reinstall the original unit and proceed to the next component.	
			(1) Servo amplifier (A15A3).	(1) Fig. 6-87.
			(2) A1A2 slew circuit card assembly in the distribution box.	(2) Par. 6-42.
			(3) Distribution box (A1).	(3) Par. 6-42.

Table 4-2. Mount Servo System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
31 con.			(4) Control potentiometer (A2A2R1) in the control assembly.	(4) Par. 6-39.
32	Release the action switch.			
33	Rotate the control grip assembly to the down position and press the action switch.	Cannon slews to its lower limit in 1.4 to 1.9 seconds.	a. If the cannon slews to its lower limit in 2 to 2.5 seconds in the 2,000,000 series distribution box, adjust the SLEW DN potentiometer (A1A2R31) clockwise to increase slew rate. In 1,000,000 series distribution box, adjust SLEW RT-EL (A1A2R30). b. Replace the following components in the order given. Whenever a new component does not correct the malfunction, reinstall the original unit and proceed to the next component. (1) Servo amplifier (A15A3). (2) A1A2 slew circuit card assembly in the distribution box. (3) Distribution box (A1). (4) Resistor and gear assembly (A2A2R1).	a. Fig. 6-86, sheet 2. Fig. 6-86, sheet 1. (1) Fig. 6-87. (2) Par. 6-42. (3) Par. 6-42. (4) Par. 6-39.

Table 4-2. Mount Servo System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
34	Center the control grip assembly and release the action switch. *NOTE* If you are performing a complete system checkout and will continue with table 4-3, do not perform step 35.			
35	Set the SYSTEM POWER switch on the control panel to OFF.			

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE If this procedure is performed in sequence immediately after completion of table 4-2, begin at step 4. If the preceding procedure has not been performed, begin at step 1 to establish the proper equipment conditions.			
1	Verify that power source (vehicle engine or APU) is providing a charging voltage and current to system batteries.	Distribution box (A1) meters indicate +26 to +28.5 Vdc at less than 10 A.	Perform power source adjustment.	Par. 6-64 or 6-65.
2	Verify the following equipment conditions: a. Conveyor assembly locked in the firing position. b. Drum drive assembly shift pin at F. c. Arming connector removed from the distribution box. d. Ramp locking handle .... Up (locked) e. Hatches closed and latched. f. Elevation and azimuth drive motor brakes .. On g. SYSTEM POWER switch .... OFF h. GUN POWER switch .... OFF i. Control panel MODE switch .... GRD j. NORM-STATIC-TEST switch .... NORM (up) k. Sight mechanically caged. **WARNING** Make certain that all personnel are clear of the area of cannon travel above deck and of the mount travel below deck. **NOTE** Assure that distribution box SYS PWR circuit breaker (A1CB2) is in set position prior to performing check-out.			

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
3	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.	Perform "power control and distribution system" fault isolation.	Table 4-11.
4	Position the cannon to zero degrees elevation.			
5	Press the action switch and slowly rotate the control grip assembly clockwise slewing the mount. Complete one revolution, 360 degrees.	Mount completes one revolution, cannon moves freely over both hatches.	a. Cannon stops at driver's hatch: (1) Check connectors on slip ring for tightness. (2) Check wiring (continuity). (3) Check, adjust, or replace driver's hatch switch (A11S1). b. Cannon stops at commander's hatch: (1) Check connectors on slip ring for tightness. (2) Check wiring (continuity). (3) Check, adjust, or replace commander's hatch switch (A11S2). c. Cannon stops at both hatches: (1) Check connectors on slip ring for tightness. (2) Check, adjust, or replace gun position switch (A14S1). (3) Check for damage to the actuator bar.	 (1) Fig. 6-87. (2) Fig. 3-7. (3) TM 9-2300-257-20 (1) Fig. 6-87. (2) Fig. 3-7. (3) TM9-2300-257-20 (1) Fig. 6-87. (2) Par. 6-61. (3) Fig. 6-30 B.

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
6	Position cannon over travel lock.			
7	Set the SYSTEM POWER switch on the gunner's control panel to OFF.	SYSTEM POWER indicator extinguishes.		
8	Open and latch the driver's hatch.			
9	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		
10	Press the action switch and slowly rotate the control grip assembly clockwise.	Mount moves to the right and stops before cannon reaches the driver's hatch.	a. Cannon stops at commander's hatch: (1) Check, adjust, or replace gun position switch (A14S1). (2) Check for damage to the actuator bar. b. Cannon moves into open hatch area: Check and adjust azimuth limit switch (A19S1) or replace limit switch assembly (A19). c. Cannon coasts into open hatch area: Azimuth drive gearbox clutch or azimuth dc feedback tachometer is probably faulty. d. Cannon moves through open hatch protective area: (1) Check driver's hatch switch (A11S1) wiring (continuity).	 (1) Par. 6-61. (2) Fig. 6-30 B. b. Fig. 3-7; par. 6-60 c. Notify DS/GS maintenance. (1) Fig. 3-7.

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
10 con.			(2) Check, adjust, or replace driver's hatch switch (A11S1).	(2) TM 9-2300-257-20
11	Hold the action switch pressed and rotate the control grip assembly to its fully clockwise position.	Mount remains stationary, does not drift over the open hatch or drift away and drive back (oscillate).	In 2,000,000 series distribution box adjust RIGHT LIMIT potentiometer (R20) clockwise to stop drift away from hatch, counterclockwise to stop oscillation or drift into the hatch. In the 1,000,000-series distribution box adjust AZ LIM-R potentiometer R20.	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1.
12	Hold the action switch pressed and rotate the control grip assembly slowly counterclockwise.	Mount moves to the left and stops before cannon reaches the driver's hatch.	a. Cannon moves into open hatch protective area: (1) Check or adjust azimuth limit switch (A19S2). (2) Replace azimuth limit switch assembly (A19). b. Cannon coasts into open hatch area: Azimuth drive gearbox clutch or azimuth dc feedback tachometer is probably faulty.	(1) Fig. 3-7; par. 6-18. (2) Par. 6-18. Notify DS/GS maintenance.
13	Hold the action switch pressed and rotate the control grip assembly to its fully counterclockwise position.	Mount remains stationary, does not drift over open hatch, or drift away and drive back (oscillate).	In the 2,000,000 series distribution box adjust LEFT LIMIT potentiometer R19 in the distribution box: clockwise to stop drift away from hatch; counterclockwise to stop oscillation	Fig. 6-86, sheet 2.

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
13 con.			or drift into hatch. In the 1,000,000-series distribution box adjust AZ LIM-L potentiometer R19.	Fig. 6-86, sheet 1.
14	Position cannon over travel lock. Release action switch.			
15	Set the SYSTEM POWER switch on the gunner's control panel to OFF.	SYSTEM POWER indicator extinguishes.		
16	Close and latch the driver's hatch.			
17	Open and latch the commander's hatch.			
18	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.
19	Keeping the cannon at approximately zero degrees elevation, hold the action switch pressed, and rotate the control grip assembly slowly clockwise.	Mount moves to the right and stops before cannon reaches the commander's hatch.	a. Cannon moves through open hatch protective area: Check, adjust, or replace commander's hatch switch (A11S2).	TM 9-2300-257-20
			b. Cannon moves into open hatch area: Check and adjust azimuth limit switch (A19S1) or replace limit switch assembly (A19).	Fig. 3-7; par. 6-18.
			c. Cannon coasts into open hatch area: Azimuth drive gearbox clutch or azimuth dc feedback tachometer is probably faulty.	Notify DS/GS maintenance.

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
20	Hold action switch pressed and rotate the control grip assembly to its fully clockwise position.	Mount remains stationary, does not drift over the open hatch, or drift away and drive back (oscillate).	Adjust RIGHT LIMIT R20 potentiometer in the 2,000,000 series distribution box or AZ LIM-R in the 1,000,000 series clockwise to stop drift away from hatch, counterclockwise to stop oscillation or drift into the hatch.	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1.
21	Position the cannon over the left rear corner of vehicle at zero degrees elevation.			
22	Hold the action switch pressed and rotate the control grip assembly slowly counterclockwise.	Mount slews left and stops before cannon reaches the commander's hatch.	Cannon moves through open hatch protective area: Check, adjust, or replace commander's hatch switch (A11S2).	TM 9-2300-257-20.
23	Hold the action switch pressed and rotate the control grip assembly to its fully counterclockwise position.	Mount remains stationary, does not drift over open hatch, or drift away and drive back (oscillate).	In the 2,000,000 series distribution box adjust LEFT LIMIT potentiometer R19 clockwise to stop drift away from hatch, counterclockwise to stop oscillation or drift into hatch. In the 1,000,000 series distribution box adjust AZ LIM-L potentiometer R19.	Fig. 6-86, sheet 2. Fig. 6-86, sheet 1.
24	Elevate the cannon to 60 degrees in elevation, as indicated by the scribe marks on the sight saddle and support (fig. 6-56), and position it over an open hatch.			

Table 4-3. Hatch Protective Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
25	Hold the action switch pressed and rapidly tilt the control grip assembly forward.	Cannon stops at approximately 17 to 19 degrees (302 to 338 mils) in elevation (relative to chassis).	Check or adjust elevation limit switch (A18S1) or replace limit switch assembly (A18).	Fig. 3-7; par. 6-32.
26	Move cannon away from open hatch and position to approximately zero degrees elevation.			
27	Slowly slew cannon toward open hatch until cannon stops.			
28	While attempting to slew cannon past open hatch, slowly elevate cannon until it begins to slew over hatch.	Cannon slews over hatch at 12 to 14 degrees (212 to 248 mils) in elevation (relative to chassis).	Check or adjust the 13-degree limit switch (A18S2) or replace elevation limit switch assembly (A18).	Fig. 3-7; par. 6-32.
29	Set the SYSTEM POWER switch on the gunner's control panel to OFF. **NOTE** If a complete system checkout is being performed, continue to table 4-4.			

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE If you are performing this procedure in sequence immediately after completion of table 4-3, begin at step 6. If the preceding procedure has not been performed, begin at step 1 to establish the proper equipment conditions.			
1	Verify that power source (vehicle engine or APU) is providing a charging voltage and current to system batteries. **NOTE** Verify that the following distribution box circuit breakers are in the set position prior to performing checkout: SIGHT GYRO PWR .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR A1CB2	System distribution box (A1) meters indicate +26 to +28.5 Vdc at less than 10 A.	Perform power source adjustment.	Par. 6-64 or 6-65.
2	Set the gunner's control panel switches, as listed: a. GUN POWER .... OFF b. SYSTEM POWER .... OFF c. MODE .... MAN			
3	Set the NORM-STATIC-TEST switch on the system distribution box in the STATIC (center) position.			
4	Verify that the shift pin on the drum assembly is in the F position.			
5	Verify that the conveyor assembly is in the firing (down) position and locked.			

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
6	Manually position the cannon over the rear of the vehicle.			
7	Disconnect the gun motor cable connector (W3P1) from J3 on the distribution box.			
8	Connect the arming connector to J6 on the distribution box.			
9	Place the AN/MWM-2 on the floor next to the loader's bench and attach to the system in accordance with figure 4-1.			
10	Set the AN/MWM-2 controls in the positions listed: a. TEST SET .... OFF b. ACTION .... Off (down) c. DISTRIBUTION BOX .... SYS BTRY d. TIME DELAY .... OFF e. AMPLIFIER SELECTOR .... Unmarked position f. METER SELECTOR .... DB g. SERVO AMPLIFIER .... BK REL h. SCG1 .... 1 i. SCG2 .... 1 j. PROBLEM .... OFF k. CALIBRATION TEST .... Unmarked position l. METER POLARITY .... + (up)			
11	Connect the 300M-A to the AN/MWM-2 OUTPUT TO METER jacks (black lead to the left jack and red lead to the right jack).	**NOTE** In performing the cannon control checks, ignore all AN/MWM-2 indicators except those listed.		
12	Set the MODE SELECTOR switch on the 300M-A to SEARCH.			
13	Set function selector switch on the 300M-A to VOLTS DC 100.			

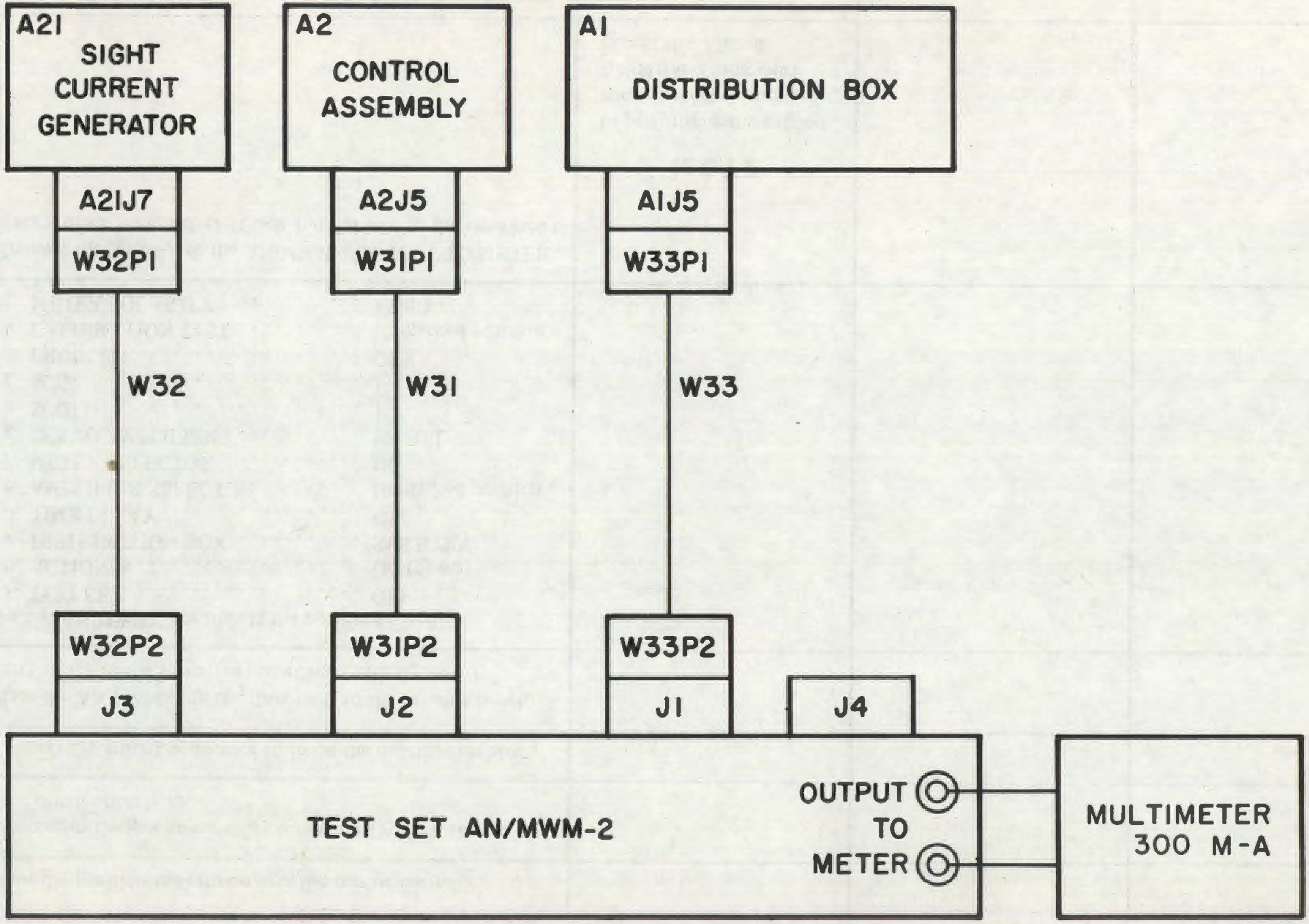


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Figure 4-1. Cannon control circuits checkout/fault isolation, test setup diagram.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
14	Set the TEST SET ON/OFF switch on the AN/MWM-2 to ON. **NOTE** The last round switch (A7A5S1) must be open (ammunition loaded) in order to perform the cannon control circuits checks.	a. SYS BTRY indicator on AN/MWM-2 lights. b. H GUN BTRY indicator on AN/MWM-2 lights. c. LAST RD SW OPEN indicator on the AN/MWM-2 lights. LAST RD SW CLOSED indicator does not light. d. 300M-A indicates +26.0 to +28.5 Vdc.	a. Check system battery output (+22.0 to +28.5 Vdc). b. Check gun battery output (+22.0 to +28.5 Vdc). c. Load drum with dummy ammo. Check last round switch (A7A5S1) and associated wiring. d. Check the system battery charging supply.	TM 9-2350-300-10 Fig. 3-3.
15	Momentarily depress each indicator on the AN/MWM-2.	Each indicator lights when depressed.	a.. Replace defective indicator lamps. b. Check the AN/MWM-2.	a. TM 9-4933-209-14 b. TM 9-4933-209-14
16	Set the DISTRIBUTION BOX switch on the AN/MWM-2 to HI GUN BTRY.	300M-A indicates +26.0 to +28.5 Vdc.	Check the mount battery charging supply.	Pars. 6-64 and 6-65.
17	Set the DISTRIBUTION BOX switch on the AN/MWM-2 to LO GUN BTRY.	a. 300M-A indicates +8.04 to +10.93 Vdc.	a. If the HI GUN BTRY reading was normal, check the position of the low rate battery tap. b. Check the battery cables to the distribution box (W1 and W4).	a. Fig. 6-116. b. Fig. 6-58.
18	Set the SYSTEM POWER switch on the gunner's control panel to ON.	a. SYSTEM POWER indicators on the gunner's control panel and on the AN/MWM-2 light.	a.(1) If neither indicator lights: (a) Check the SYS PWR circuit breaker on the distribution box. (b) Check the SYSTEM POWER switch on the control assembly.	(a) Fig. 6-11. (b) Fig. 3-38, sheet 9.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
18 con.			(2) If the AN/MWM-2 indicator lights but the control panel indicator does not:	
			(a) Check the SYSTEM POWER indicator on the control panel (press-to-test).	(a) Fig. 3-38, sheet 9.
			(b) Make continuity check on (A2A1DS1) circuitry.	
		b. CB1 indicator on the AN/MWM-2 lights.	b.(1) Check the SCG PWR circuit breaker (A1CB1) on the distribution box.	(1) Fig. 6-11.
			(2) Replace the distribution box.	
		c. CB3 indicator on the AN/MWM-2 lights.	c.(1) Check the INVERTER PWR circuit breaker (A1CB3) on the distribution box.	(1) Fig. 6-11.
			(2) Check continuity through MODE switch (A2A1S1-B) and its associated wiring (SCG power).	(2) Fig. 3-38, sheet 9.
			(3) Check the 10-second time delay relay (A21K23) (energized) in the sight current generator as indicated by K23 light on the AN/MWM-2.	(3) Fig. 3-38, sheet 4.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19	Rotate the SIGHT LAMP control on the control panel fully clockwise, then fully counterclockwise.	Sight reticle illuminates and becomes brighter on each side of the center position. **NOTE** RETICLE PWR indicator on AN/MWM-2 becomes dimmer on each side of the center position.	a. If the sight reticle does not illuminate on one or both sides of center, check the reticle lamp and replace if defective. b. If the reticle lamp checks good and still does not illuminate, check the associated circuitry on the gunner's control panel.	a. Par. 6-52. b. Fig. 3-13.
20	Disconnect the 300M-A from the AN/MWM-2.			
21	Set the function selector switch on the 300M-A to VOLTS AC 1000.			
22	Set the DISTRIBUTION BOX switch on the AN/MWM-2 to 115 VAC.			
23	Set the MODE switch on the 300M-A to SEARCH.			
24	Reconnect the 300M-A to the AN/MWM-2.	300M-A indicates 109 to 121 Vac. **NOTE** If indication is normal (step 24), proceed to and continue with step 33.	Momentarily position the SYSTEM POWER switch on the control panel in the OFF position. If the indication is still abnormal, proceed with step 25.	
25	Disconnect the 300M-A from the AN/MWM-2.			
26	Set the function selector switch on the 300M-A to VOLTS DC 100.			

Table 4-4. Cannon Control Circuits Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
27	Set the DISTRIBUTION BOX switch on the AN / MWM-2 to INV INPUT.			
28	Reconnect the 300M-A to the AN / MWM-2.	300M-A indicates 22.0 to 28.5 Vdc. *NOTE* If indication is normal replace inverter (A5).	Check the control assembly MODE switch (A2 A1S1) for continuity.	Fig. 3-38, sheet 9.
29	Disconnect the 300M-A from the AN / MWM-2.			
30	Set the DISTRIBUTION BOX switch on the AN / MWM-2 to 115 VAC.			
31	Set the function selector switch on the 300M-A to VOLTS AC 1000.			
32	Reconnect the 300M-A to the AN / MWM-2.			
33	Set the DISTRIBUTION BOX switch on the AN / MWM-2 to GUN SIGHT POWER ØA.	300M-A indicates 103 to 127 Vac.	a. Check the SIGHT GYRO PWR circuit breaker (A1CB4). b. Replace the inverter (A5).	a. Fig. 6-11. b. Fig. 6-87.
34	Set the DISTRIBUTION BOX switch on the AN / MWM-2 to GUN SIGHT POWER ØB position.	300M-A indicates 103 to 127 Vac.	a. Check the SIGHT GYRO PWR circuit breaker (A1CB4). b. Replace the inverter (A5).	a. Fig. 6-11. b. Fig. 6-87.
35	Set the DISTRIBUTION BOX switch on the AN / MWM-2 to GUN SIGHT POWER ØC.	300M-A indicates 103 to 127 Vac.	a. Check the SIGHT GYRO PWR circuit breaker (A1CB4). b. Replace the inverter (A5).	a. Fig. 6-11. b. Fig. 6-87.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
36	Set the GUN POWER switch on the gunner's control panel to ON. **WARNING** Before continuing assure that the NORM-STATIC-TEST switch on the distribution box is in the STATIC position (fig. 6-11).	GUN POWER indicator on the control panel lights.	a. Check the indicator lamp, press-to-test; replace if defective. b. Check the circuit associated with the GUN POWER indicator.	a. Fig. 6-1. b. Fig. 3-38, sheet 9.
37	Press the action switch on the control grip assembly.	READY TO FIRE indicator on the sight lights. ACTION SW (upper) ON indicator on the AN/MWM-2 lights.	a. Verify MODE switch on gunner's control panel is in MAN position. b. If the ACTION SW (upper) ON indicator on the AN/MWM-2 does not light, check circuit associated with the control grip assembly action switches (A2A3S1 and A2A4S1). c.(1) If the K27 indicator on the AN/MWM-2 is not lit, check continuity from cable W9P1-A to W9P2-A. (2) Check sight current generator relays (A21K23, A21K26, and A21K27) as indicated by lights on the AN/MWM-2.	a. Fig. 6-1. b. Fig. 3-16, and fig. 3-38, sheet 9. (1) Fig. 3-47. (2) Fig. 3-38, sheets 3 and 4; par. 6-41.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
38	Release action switch and disconnect the 300M-A from the AN/MWM-2.			
39	Set the FIRING RATE switch on the gunner's control panel to HI BURST LIMIT-10.			
40	Set the GUN CLEAR switch on the gunner's control panel to AUTO.			
41	Set the TIME DELAY switch on the AN/MWM-2 to FIRE VOLTS. **WARNING** Verify that cable connector W3P1 is disconnected from the distribution box.			
42	Press and hold (for at least 3 seconds), the action and trigger switches, on the right handle of the control grip assembly, then release the switches.	TIME DELAY GOOD indicator (on the AN/MWM-2) lights approximately one second after the end of burst.	a. If the TIME DELAY SHORT or TIME DELAY LONG indicator lights, change the time delay circuit card assembly (A1A1) in the distribution box. If the TIME DELAY GOOD indicator still fails to light, replace the distribution box. b. If no TIME DELAY indicator lights, check trigger switch.	a. Par. 6-42. b. Par. 6-39.
43	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
44	Set the TIME DELAY switch on the AN/MWM-2 to CLEARING.			
45	Press and release the action and trigger switches on the right handle of the control grip assembly.	TIME DELAY GOOD indicator (on the AN/MWM-2) lights approximately two seconds after the end of burst.	If the TIME DELAY SHORT or TIME DELAY LONG indicator lights, replace the time delay circuit card assembly (A1A1) in the distribution box. If the TIME DELAY GOOD indicator still fails to light, replace the distribution box.	Par. 6-42.
46	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
47	Set the TIME DELAY switch on the AN/MWM-2 to BURST LIMIT-10.		**NOTE** In the following burst limit circuit checks, if one or two faulty indications are obtained, the problem is most likely in the system and can be corrected by the specified adjustment. However, if several or all checks provide abnormal indications, the problem is most likely in the AN/MWM-2. If any of the first three checks (steps 48, 52, and 56) are faulty, complete the entire series (through step 64) before performing any adjustment. If most	

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
47 con.			or all of the checks are faulty, replace the AN/MWM-2 and repeat the entire test.	
48	Press and hold the action and trigger switches on the right handle of the control grip assembly.	TIME DELAY GOOD indicator (on the AN/MWM-2) lights (indicates 7 to 13 rounds cycled during actual firing).	If the TIME DELAY SHORT or TIME DELAY LONG indicator on the AN/MWM-2 lights, adjust the control assembly potentiometer (A2A1R8) clockwise (SHORT) or counterclockwise (LONG).	Par. 6-56f.
49	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
50	Set the FIRING RATE switch on the gunner's control panel to HI BURST LIMIT-30.			
51	Set the TIME DELAY switch on the AN/MWM-2 to BURST LIMIT-30.			
52	Press and hold the action and trigger switches on the right handle of the control grip assembly.	TIME DELAY GOOD indicator (on the AN/MWM-2) lights (indicates 25 to 35 rounds cycled during actual firing).	If the TIME DELAY SHORT or LONG indicator on AN/MWM-2 lights, adjust the control assembly potentiometer (A2A1R7) clockwise (SHORT) or counterclockwise (LONG).	Par. 6-56f.
53	Release action switch, then momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
54	Set the FIRING RATE switch on the gunner's control panel to HI BURST LIMIT-60.			

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
55	Set the TIME DELAY switch on the AN/MWM-2 to BURST LIMIT-60.			
56	Press and hold (for at least 3 seconds) the action and trigger switches on the right handle of the control grip assembly. Release switches.	TIME DELAY GOOD indicator, (on the AN/MWM-2) lights (indicates 50 to 70 rounds cycled during actual firing).	If the TIME DELAY SHORT or TIME DELAY LONG indicator on the AN/MWM-2 lights, adjust control assembly potentiometer (A2A1R6) clockwise (SHORT) or counterclockwise (LONG).	Par. 6-56f.
57	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
58	Set the FIRING RATE switch on the gunner's control panel to HI BURST LIMIT-100.			
59	Set the TIME DELAY switch on the AN/MWM-2 to BURST LIMIT-100.			
60	Press and hold (for at least 3 seconds) the action and trigger switches on the right handle of the control grip assembly. Release switches.	TIME DELAY GOOD indicator (on the AN/MWM-2) lights (indicates 80 to 120 rounds cycled during actual firing).	If the TIME DELAY SHORT or TIME DELAY LONG indicator on the AN/MWM-2 lights, adjust control assembly potentiometer (A2A1R5) clockwise (SHORT) or counterclockwise (LONG).	Par. 6-56f.
61	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
62	Set the FIRING RATE switch on the gunner's control panel in the LO-NO BURST LIMIT position.			

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
63	Set the TIME DELAY switch on the AN/MWM-2 in the LOW GUN DRIVE position.			
64	Press and hold (for at least 3 seconds) the action and trigger switches on the right handle of the control grip assembly, then release the switches.	TIME DELAY GOOD indicator on AN/MWM-2 lights.	a. If the TIME DELAY SHORT or TIME DELAY LONG indicator on the AN/MWM-2 lights, adjust the control assembly potentiometer (A2A1R9) clockwise (SHORT) or counterclockwise (LONG). b. If the TIME DELAY SHORT or TIME DELAY LONG indicator on the AN/MWM-2 lights, replace the time circuit card assembly (A1A1) in the distribution box.	Par. 6-56f.
65	Momentarily depress the RESET pushbutton on the AN/MWM-2.	TIME DELAY indicators extinguish.		
66	Set the TIME DELAY switch on the AN/MWM-2 in the BURST LIMIT-LOW position.			
67	Set the function selector switch on the 300M-A to VOLTS DC 1000.			
68	Set the DISTRIBUTION BOX switch on the AN/MWM-2 in the FIRE V TO GUN position.			
69	Connect the 300M-A to the AN/MWM-2.			
70	Press and hold (for approximately 3 seconds) the action and trigger switches on the right handle of the control grip assembly. Release switches.	The 300M-A indicates 168 to 188 Vdc.	Replace the distribution box (unit A1).	Par. 6-42.

Table 4-4. Cannon Control Circuits Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
71	Set the GUN POWER switch on the gunner's control panel to OFF.			
72	Disconnect 300M-A from AN/MWM-2. If you are performing a complete system checkout, continue to table 4-5. If not, perform step 73.			
73	Set the SYSTEM POWER switch on the gunner's control panel to OFF.			

Table 4-5. Elevation Potentiometer Assembly Checkout/Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE If this procedure is performed in sequence immediately after completion of table 4-4, begin at step 3. If the preceding procedure has not been performed, begin at step 1 to establish the proper equipment conditions. **NOTE** Verify that the following distribution box circuit breakers are in the set position prior to performing checkout: SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR A1CB2			
1	Perform steps 1 through 9 of table 4-4.			
2	Set the AN/MWM-2 controls as listed: a. TEST SET .... ON b. ACTION .... Off (down) c. DISTRIBUTION BOX .... FIRE V TO GUN d. TIME DELAY .... BURST LIMIT-LOW e. AMPLIFIER SELECTOR ..... Unmarked position f. METER SELECTOR .... DB g. SERVO AMPLIFIER .... BK REL h. SCG1 .... 1 i. SCG2 .... 1 j. PROBLEM .... OFF k. CALIBRATION TEST .... Unmarked position l. METER POLARITY .... +			
3	Set the SCG1 switch on the AN/MWM-2 to 14.			
4	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.			

Table 4-5. Elevation Potentiometer Assembly Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
5	Set the function selector switch on the 300M-A to 100 VOLTS DC.			
6	Set the METER POLARITY switch on the 300M-A to REV (negative).			
7	Connect the 300M-A to the AN / MWM-2 and set the SYSTEM POWER switch on the gunner's control panel to ON.			
8	Manually release the elevation drive motor brake.			
9	Manually elevate the cannon to 60 degrees as indicated by the scribe lines on the sight and linkage assembly (fig. 6-56).	300M-A indicates -7.40 to -7.60 Vdc.	a. Check SCG-15 Vdc power. b. Adjust elevation potentiometer.	a. Table 4-6. b. Par. 6-58.
10	Manually lower the cannon to zero degrees as indicated by the scribe lines on the sight support and linkage assembly.	300M-A indicates a smooth rise to -14.8 to -15.0 Vdc.	Replace elevation potentiometer assembly.	Par. 6-31.
11	Set the elevation drive brake.			
12	Set the SYSTEM POWER switch on the gunner's control panel to OFF.			

Table 4-6. Sight Current Generator Checkout / Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE The sight current generator check is a continuation of the preceding checks. If the preceding checks have not been completed, it is necessary to perform the elevation potentiometer assembly check (table 4-5) prior to performing the sight current generator check. *NOTE* Verify that the following circuit breakers are in the set position prior to performing the checkout: Distribution box SIGHT GYRO PWR .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR .... A1CB2 Radar power supply TRAV .... 5CB2 ELEV .... 5CB3 CONTROL CKT .... 5CB4 BLOWERS 5CB5			
1	Verify that ballistic correction assembly (A21A12) is installed in the M220 ballistic position of the sight current generator (fig. 6-83).			
2	Set the AIR DENSITY control on the sight current generator to 1.0.			
3	Set the MUZZLE VELOCITY control on the sight current generator to 12.			
4	Set the MAINTENANCE switch on the stow control to ON.			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
5	Set the MODE switch on the stow control to NORMAL.			
6	Verify that the CALIBRATION TEST switch on the AN/MWM-2 is in an unmarked position.			
7	Set the METER SELECTOR switch on the AN/MWM-2 to SCG-1.			
8	Set the SCG1 switch on the AN/MWM-2 to 14.			
9	Set the PROBLEM switch on the AN/MWM-2 to 1 (problem no. 1).			
10	Set the selector switch on the 300M-A to VOLTS DC 100.			
11	Set the TEST LEAD POLARITY switch on the 300M-A to REV.			
12	Set the SYSTEM POWER switch on gunner's control panel to ON.			
13	Place the cannon at zero degrees elevation (fig. 6-56) as follows: a. Release elevation drive motor brake and manually position cannon to zero degrees (elevation) while observing 300M-A. b. Set the elevation drive motor brake.	a. 300M-A indicates –14.8 to –15.2 Vdc.		
14	Verify that the MODE switch on the gunner's control panel is in the MAN position.			
15	Set the TEST LEAD POLARITY switch on the 300M-A to NORM, and set function selector switch to VOLTS DC 10.			
16	Set the METER SELECTOR switch on the AN/MWM-2 to SCG2.			
17	Verify that the SCG2 switch on the AN/MWM-2 is set to 1.			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	WARNING Before continuing, verify that the NORM-STATIC-TEST switch on the distribution box is in the STATIC position.			
18	Press and hold the action switch on the control assembly grip (either handle). Position the RANGE knob on the gunner's control panel to 500. Release the action switch. **CAUTION** Avoid damaging the 300M-A multimeter. Be certain the multimeter function switch is returned to SEARCH before continuing.	Ignore all AN/MWM-2 indicators. 300M-A indicates 2.3 to 2.7 Vdc.	Adjust range potentiometer (A2A1R3).	Par. 6-56b.
19	Set the SCG2 switch on the AN/MWM-2 to 2.			
20	Press and hold the ACTION switch, on the control assembly grip (either handle). Position the TARGET SPEED-control on the gunner's control panel to 300 knots. Release the ACTION switch.	a. 300M-A indicates 3.55 to 3.95 Vdc. b. I_T and I_M indicators on the AN/MWM-2 light. If neither I_M or I_T indicator lights, disconnect the 300M-A as it may load the AN/MWM-2 (all problems).	a. Adjust the target speed potentiometer (A2A1R4). b.(1) I_T indicator does not light: Perform torque current fault isolation procedures, problem no. 1. (2) I_M indicator does not light: Perform magnet current fault isolation procedures (problem no. 1).	Par. 6-56c. (1) Table 4-10. (2) Table 4-9.

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
21	Set the AIR DENSITY switch on the sight current generator to 0.95.			
22	Set the MUZZLE VELOCITY switch on the sight current generator to 6.			
23	Set the SCG2 switch on the AN/MWM-2 to 1.			
24	Set the PROBLEM switch on the AN/MWM-2 to 2 (problem no. 2).			
25	Hold the ACTION switch pressed and, to obtain the indication specified, adjust the range knob on gunner's control panel to approximately 1000 meters.	300M-A indicates 4.8 to 5.2 Vdc.		
26	Release ACTION switch and set the SCG2 switch on the AN/MWM-2 to 2.	a. 300M-A indicates 3.55 to 3.95 Vdc. b. I_T and I_M indicators on the AN/MWM-2 light.	a. Adjust the TARGET SPEED knob on the gunner's control panel until the 300M-A multimeter indicates 3.75 Vdc. b.(1) I_T indicator does not light: Proceed with TORQUE CURRENT fault isolation procedures (problem no. 2). (2) I_M indicator does not light: Proceed with MAGNET CURRENT fault isolation procedures (problem no. 2).	(1) Table 4-10. (2) Table 4-9.
27	Disconnect the 300M-A from the AN/MWM-2.			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
28	Disconnect cable connector (W12P1) from J6 on the sight current generator.			
29	Set the MODE switch on the gunner's control panel to RADAR.			
30	Set the AIR DENSITY control on the sight current generator to 1.05.			
31	Set the MUZZLE VELOCITY control on the sight current generator to 4.			
32	Set the PROBLEM switch on the AN/MWM-2 to 3 (problem no. 3).			
33	Set the CALIBRATION TEST switch on the AN/MWM-2 to RDR.			
34	Depress the ACTION switch on either control grip assembly.	I_T and I_M indicators on the AN/MWM-2 light.	a. I_T indicator does not light: Proceed with TORQUE CURRENT fault isolation procedures (problem no. 3). b. I_M indicator does not light: Proceed with MAGNET CURRENT fault isolation procedures (problem no. 3).	a. Table 4-10. b. Table 4-9.
35	Release ACTION switch and set the AIR DENSITY control on the sight current generator to 1.			
36	Verify that the MUZZLE VELOCITY control on the sight current generator is in the 4 position.			
37	Set the SCG1 switch on the AN/MWM-2 to 15.			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
38	Set the SCG2 switch on the AN/MWM-2 to 18.			
39	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.			
40	Set the TEST LEAD POLARITY switch on the 300M-A to REV (negative) and set function selector switch to VOLTS DC 1.			
41	Set the PROBLEM switch on the AN/MWM-2 to 4 (problem no. 4).			
42	Connect the 300M-A to the AN/MWM-2.			
43	Pull the TRAV and ELEV circuit breakers on the radar power supply (unit 5). **CAUTION** In the following steps (44 through 56), while positioning the antenna manually, grasp only the counterweight (39, fig. 6-96). Do not grasp any other portion of the antenna.			
44	While observing the 300M-A multimeter, slowly move antenna manually right or left until the meter indicates 0 to –0.04 Vdc (approximately zero degrees traverse angle).			
45	Set the METER SELECTOR switch on the AN/MWM-2 to SCG2 and set function selector switch on 300M-A to VOLTS DC 10.			
46	Manually position the radar antenna slowly in elevation until 300M-A indicates –5.81 to –6.01 Vdc (approximately –16 degrees elevation).			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
47	Depress the ACTION switch on either control grip assembly.	I_T and I_M indicators on the AN/MWM-2 light.	a. I_T indicator does not light: Proceed with TORQUE CURRENT fault isolation procedures (problem no. 4). b. I_M indicator does not light: Proceed with the MAGNET CURRENT fault isolation procedures (problem no. 4).	a. Table 4-10. b. Table 4-9.
48	Release ACTION switch and set the PROBLEM switch on the AN/MWM-2 to 5 (problem no. 5), and set function selector switch on 300M-A to VOLTS DC1.			
49	Manually position the radar antenna slowly in elevation to attain a 300M-A indication of –0.33 to –0.43 Vdc (below zero degrees (horizontal) elevation).			
50	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1 and set function selector switch on the 300M-A to VOLTS DC 10.			
51	Manually position the radar antenna slowly in traverse for a 300M-A indication of –4.4 to –4.6 Vdc (approximately 14 degrees lead angle).			
52	Depress the ACTION switch on either control grip assembly.	I_T and I_M indicators on the AN/MWM-2 light.	a. I_T indicator does not light: Proceed with the TORQUE CURRENT fault isolation procedures (problem no. 5). b. I_M indicator does not light:	a. Table 4-10. b. Table 4-9.

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
52 con.			Proceed with MAGNET CURRENT fault isolation procedures (problem no. 5).	
53	Release ACTION switch and set the PROBLEM switch on the AN/MWM-2 to 6 (problem no. 6) and set function selector switch on 300M-A to VOLTS DC 1.			
54	Manually position the radar antenna slowly in traverse for a 300M-A meter indication of 0 to –0.125 Vdc, but as close to zero as possible.			
55	Set the METER SELECTOR switch on the AN/MWM-2 to SCG2 and set function selector switch on 300M-A to VOLTS DC 10.			
56	Manually position the radar antenna slowly above zero degrees in elevation for a 300M-A indication of –4.85 to –4.95 Vdc.			
57	Depress the ACTION switch on either control grip assembly. **NOTE** It may be necessary to disconnect the 300M-A from the AN/MWM-2 to obtain indication.	I_T and I_M indicators on the AN/MWM-2 light.	a. I_T indicator does not light: Proceed with TORQUE CURRENT fault isolation procedures (problem no. 6). b. I_M indicator does not light: Proceed with MAGNET CURRENT fault isolation procedures (problem no. 6).	a. Table 4-10. b. Table 4-9.
58	Release ACTION switch and reset (depress) the TRAV and ELEV circuit breakers on the radar power supply (unit 5).			

Table 4-6. Sight Current Generator Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
59	Set the METER SELECTOR switch on the AN/MWM-2 to TEST.			
60	Set the CALIBRATION TEST switch on the AN/MWM-2 to 1500.			
61	Set the MODE switch on the gunner's control panel to TEST.			
62	Momentarily depress the GOOD WHEN LIT indicator on the gunner's control panel.	GOOD WHEN LIT indicator lights.	Replace the GOOD WHEN LIT indicator lamp assembly.	Fig. 6-75.
63	Set the AIR DENSITY switch on the sight current generator to 0.85.			
64	Set the MUZZLE velocity switch on the sight current generator to 5.			
65	Hold the ACTION switch depressed and rotate the CALIBRATION TEST switch on the AN/MWM-2 from the 1500 position to the 1600 position and then to the 1700 position.	GOOD WHEN LIT indicator on the gunner's control panel lights when the CALIBRATION TEST switch is in the 1600 position. The indicator does not light in the 1500 and 1700 positions.	Replace the firing indicator circuit card assembly (A21A5). If indications are still abnormal, reinstall the original A5 and replace buffer amplifier circuit card assembly (A21A3).	Par. 6-41.
66	Set all power switches in the OFF positions.			
67	Set the MAINT switch on the stow control to OFF.			
68	Disconnect all test cables and reconnect all system cables (fig. 3-37). **NOTE** Assure that cable W12P1 is reconnected to sight current generator connector J6.			

Table 4-6. Sight Current Generator Checkout / Fault Isolation Procedures—Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
69	Remove the AN / MWM-2 and the 300M-A from the vehicle.			
70	Return the AIR DENSITY and MUZZLE VELOCITY controls on the sight current generator to their original settings.			
71	If the ballistic correction circuit card was changed for the check, reinstall in the original position.			
72	For checkout of radar proceed to table 4-7.			

Table 4-7. Radar System Checkout / Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Set the MODE switch on the gunner's control panel to RADAR. *NOTE* Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box SIGHT GYRO PWR .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR .... A1CB2 Radar power supply TRAV .... 5CB2 ELEV .... 5CB3 CONTROL CKT .... 5CB4 BLOWERS .... 5CB5 6.3 VDC .... 5CB6 CONVERTER 5CB1			
2	Verify the following radar control positions: *CONTROL* — *LOCATION* — *POSITION* CLUTTER LOCK ON — Transmitter-receiver — NORMAL MODE — Stow control — NORMAL MAINT — Stow control — OFF			

Table 4-7. Radar System Checkout/Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
3	Lower the transmitter-receiver (unit 2) front panel by loosening the four thumbscrews and check that SERV RAD CONT is in OFF position. **CAUTION** **Keep unit 2 front panel closed except when necessary to perform checkout or servicing, since the klystron power supply (2A2) requires proper air flow.** *NOTE* If DS/GS maintenance has replaced the double sideband modulator in the microwave chassis assembly (A2A1) with the new modulator (with replaceable diodes at DS/GS), attenuator AT1 (fig. 6-101) will have been disconnected from the circuit in order to increase the RF signal. In this case, connectors P11 and P12 (fig. 6-101, sheet 3 of 4) will have been removed from AT1 and connected together to bypass AT1. Although not in use, attenuator AT1 should be retained in its clip in the transmitter-receiver.			

Table 4-7. Radar System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
4	Pull actuator of interlock switch (S3) (fig. 4-9) forward and up to the service position.			
5	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights and radar power supply (unit 5) blower operates. Interlock power indicator lamp (DS3) (fig. 4-9) lights.	Perform "power control and distribution system" fault isolation.	Table 4-11.
6	Wait 2 minutes ±15 seconds (system warmup).	a. READY WHEN LIT indicator on the gunner's control panel lights. b. Blower motor (2B1) (transmitter-receiver) runs. c. HIGH VOLTAGE POWER SUPPLY OVERLOAD indicator does not light. d. MODULATOR OVERLOAD indicator does not light.	a. Perform "power control and distribution system" fault isolation. b. Replace transmitter-receiver (unit 2). c-d. Momentarily set the OVERLOAD RESET toggle switch on the transmitter-receiver to ON. If light fails to extinguish perform the "transmitting system" fault isolation.	a. Table 4-11. b. Par. 6-45. c-d. Table 4-14.
7	Depress the action switch on either control assembly grip. **WARNING** **There is a potential radiation hazard to personnel when the radar is energized. Personnel should not be within 3 feet in front of radiating feedhorn (located in center of antenna dish) from which the beam is transmitted.**	Antenna servo drives are energized and respond to positioning commands. Antenna positions on the cannon axis.	a. Check TRAV circuit breaker (5CB2); reset if tripped. If circuit fails to reset, perform "antenna positioning" fault isolation. b. Check ELEV circuit breaker (5CB3); reset if tripped. If circuit fails to reset, perform "antenna positioning" fault isolation.	a. Table 4-15; fig. 6-107. b. Table 4-15, fig. 6-107.

Table 4-7. Radar System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
7 con.			c. Check thermostatic switch (5S1) (normally closed) for open condition. Replace power (unit 5) if defective.	c. Fig. 3-68, sheet 1.
8	**CAUTION** **Damage to the radar set will occur if it is operated with the antenna disconnected.**			
8 con.	Hold the action switch pressed and depress the foot switch assembly.	a. RF POWER indicator mounted in waveguide (W109) lights, and tone from transmitter-receiver changes. **CAUTION** **Do not depress foot switch assembly or turn on radiate switch in transmitter-receiver while resetting the overload, as the safety circuit may be bypassed.**	a. Check MODULATOR OVERLOAD and HIGH VOLTAGE POWER SUPPLY OVERLOAD indicator lamps. If either is lit, reset by momentarily setting the OVERLOAD toggle switch on the transmitter-receiver to ON. If indicator fails to extinguish: (1) Inspect waveguide; replace if damaged. (2) Inspect antenna elevation and traverse joints; replace if damaged. (3) Check 6.3 Vdc circuit breaker (5CB6); reset if tripped. If circuit fails to reset, perform "power control and distribution" fault isolation. (4) Perform "transmitting system" fault isolation. (5) Perform "power control and distribution" fault isolation.	 (1) Par. 6-44*d*. (2) Par. 6-44*d*. (3) Fig. 6-107; table 4-11. (4) Table 4-14. (5) Table 4-11.

Table 4-7. Radar System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
8 con.		b. RF POWER METER indicator deflects (fig. 4-10).	(6) Perform "synchronizing system" fault isolation. (7) Check external power source. (8) Replace spark gap; if malfunction is not corrected, replace unit 2. b. Retune klystron. If still no indication, perform the "transmitting system" fault isolation procedures.	(6) Table 4-12. (7) Table 4-11. (8) Par. 6-45*d* (12). b. Table 4-14.
9	Release action and foot switches and place SERV RAD CONT switch (fig. 4-9) (S6) to ON.	RF POWER indicator mounted in waveguide (W109) lights.	Check switch (S6) and replace if defective. If switch (S6) checks good, replace unit 2.	Fig. 3-32.
10	Set SERV RAD CONT switch (S6) to OFF and set the CLUTTER LOCK ON switch on the transmitter-receiver to TEST. Connect headset to J4 on transmitter-recevier front panel (fig. 4-10).			
11	Aim at a fixed target 250 to 2000 meters in range.			
12	Hold the action switch pressed and press the foot switch assembly.	READY TO FIRE indicator on the XM61 sight lights. Doppler audio is heard in headset.	Perform "ranging system" fault isolation.	Table 4-13.
13	Release the action switch and the foot switch assembly.			
14	Set the CLUTTER LOCK ON switch on the transmitter-receiver to NORMAL.			
15	Press the PRESS TO TEST switch on the range computer. Set the POWER switch on the gunner's control panel to OFF.	MID RANGE CALIBRATION indicator on the range computer lights brightly. SYSTEM POWER and	a. Check ground straps for proper connections to transmitter-receiver and other radar units.	a. Fig. 6-94.

Table 4-7. Radar System Checkout / Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
15 con.		READY WHEN LIT indicators extinguish.	b. Perform "ranging system" fault isolation.	b. Table 4-13.
16	Depress the actuator of interlock switch (S3) on the transmitter-receiver.			
17	Close the transmitter-receiver (unit 2) front panel and tighten the four thumbscrews.			

Table 4-8. External Range Control Checkout/Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box SIGHT GYRO POWER .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR A1CB2			
1	Connect the external range control to A9J1 (right rear exterior of chassis).			
2	Set the MODE switch on the control panel assembly to EXT.			
3	Set the NORM-STATIC-TEST switch on the distribution box to NORM.			
4	Set the SYSTEM POWER switch on the control panel assembly to ON.	SYSTEM POWER indicator lights.		Table 4-11.
5	Set the METERS X 100 control on the external range unit to 5.			
6	Manually uncage the sight.			
7	Depress the action switch and position the mount so the bottom of the inner circle of the sight reticle is on a fixed object at least 30 feet away, and hold the action switch depressed.			
8	Set the NORM-STATIC-TEST switch on the distribution box to STATIC.			
9	Release the action switch.			
10	Set the METERS X 100 control on the external range unit to 20.	XM61 sight reticle moves down until top of inner circle is near target.	Replace external range control assembly.	

Table 4-8. External Range Control Checkout/Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
11	Set the METERS X 100 control on the external range unit to 30.	XM61 sight reticle continues moving downward smoothly.	Replace external range control assembly.	
12	Rotate the METERS X 100 control counterclockwise from the 30 position to the stop beyond the 5 setting.	XM61 sight reticle moves smoothly upward.	Replace external range control assembly.	
13	Depress and hold the action switch.			
14	Depress the pushbutton (RTF) on the external range control.	Ready-to-fire indicator on the XM61 sight illuminates.	Replace external range control assembly.	
15	Release the pushbutton on the external range unit.	Ready-to-fire indicator on XM61 sight extinguishes.	Replace external range control assembly.	
16	Release the action switch.			
17	Manually cage the sight.			
18	Disconnect the external range control from A9J1.			
19	Connect the external range control to A9J2 (right rear interior of chassis).			
20	Repeat steps 4 to 17.			
21	Disconnect the external range control from A9J2 and stow.			

Table 4-9. SCG Magnet Current Fault Isolation Procedures.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication 1	2	3	4	5	6	If indication normal	If indication abnormal
	NOTE Verify that the following circuit breakers are in the set position prior to performing checkout: Distribution box SIGHT GYRO PWR ....A1CB4 SCG PWR ....A1CB1 INVERTER PWR ....A1CB3 SYS PWR ....A1CB2 Radar power supply TRAV ....5CB2 ELEV ....5CB3 CONTROL CKT ....5CB4 BLOWERS 5CB5								
1	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.							*NOTE* Refer to figure 6-78 for location of sight current generator assemblies identified in this procedure and to paragraph 6-41 for replacement procedures.	
2	Set the SCG1 switch on the AN/MWM-2 to 1 (read VI_M).	+6.73 to +7.33	+4.69 to +5.29	+7.17 to +7.77	+2.66 to +3.26	+2.66 to +3.26	+3.93 to +4.53	Proceed with step 3.	Proceed to and continue with step 4.
3	Set the SCG1 switch on the AN/MWM-2 to 2 (read VI_M feedback).	—0.875 to —1.805	—0.585 to —0.715	—1.00 to —1.13	—0.365 to —0.485	—0.365 to —0.485	—0.535 to —0.665	Verify operation of AN/MWM-2. If step 2 and step 3 indications normal, return to "sight current generator" checkout/fault isolation procedure (table 4-6).	a. Replace magnet current supply module (A21A13) and repeat step 3. b. If indication still abnormal, replace XM61 sight.

Table 4-9. SCG Magnet Current Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication 1	2	3	4	5	6	If indication normal	If indication abnormal
4	Set the SCG1 switch on the AN / MWM-2 to 3 (read 1st term).	—8.60 to —9.00	—5.51 to —5.91	—8.80 to —9.20	—3.25 to —3.55	—3.25 to —3.55	—5.51 to —5.91	Proceed with step 5.	Replace the servo assembly (A21A15) and repeat from step 1.
5	Set the SCG1 switch on the AN / MWM-2 to 4 (read 2nd term).	—2.65 to —3.05	—4.83 to —5.23	—4.05 to —4.65	—7.25 to —7.65	—7.25 to —7.65	+2.69 to +3.09	Proceed with step 6.	Proceed to and continue with step 9.
6	Set the SCG1 switch on the AN / MWM-2 to 5 (read 3rd term).	+3.54 to +3.94	+2.10 to +2.50	+6.87 to +7.27	+1.16* to +1.56	+1.16* to +1.56	—1.30* to —1.70	Proceed with step 7.	Replace servo assembly (A21A15). Repeat from step 1.
7	Set the SCG1 switch on the AN / MWM-2 to 6 (read 4th term).	0 to —0.075	0 to —0.075	0 to —0.075	—0.170 to —0.300	—0.150 to —0.280	—0.190 to —0.320	Proceed with step 8.	Proceed to and continue with step 11.
8	Set the SCG1 switch on the AN / MWM-2 to 7 (read 5th term).	+0.135 to +0.265	+0.095 to +0.225	+0.165 to +0.295	+0.470 to +0.550	+0.470 to +0.550	+1.06* to +1.14	Replace the ballistic data circuit card assembly (A21A1).	Replace servo assembly (A21A15). If indication still abnormal, replace the sight current generator.
9	Set the METER SELECTOR switch on the AN / MWM-2 to SCG2.								
10	Set the SCG2 switch on the AN / MWM-2 to 10 (rear buffer amp 1).	—7.60 to —8.00	—7.60 to —8.00	—11.8 to —12.2	—7.59 to —7.99	—7.59 to —7.99	+4.00 to +4.40	Replace servo assembly (A21A15). Repeat step 5.	Replace buffer amplifier circuit card assembly (A21A3). If indication still abnormal, replace servo assembly (A21A15). Repeat step 5.

* Must be read on the 10-volt scale of the 300M-A, as values are based on circuit loading caused by 300M-A in 10-volt scale.

Table 4-9. SCG Magnet Current Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication						If indication normal	If indication abnormal
		1	2	3	4	5	6		
	CAUTION Steps 11, 12, and 13 must be performed in the sequence given to prevent possible damage to the 300M-A.								
11	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.								
12	Set the SCG2 switch on the AN/MWM-2 to 18 (read λE^2).								
13	Set METER SELECTOR switch on the AN/MWM-2 to SCG2.	0 to ±0.05	0 to ±0.05	0 to ±0.05	–5.88 to –5.97	–0.285 to –0.395	–4.85 to –4.95	Proceed with step 14.	Perform radar antenna positioning fault isolation procedure (table 4-15).
14	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.								
15	Set the SCG1 switch on the AN/MWM-2 to 15 (read λT^2).	0 to ±0.125	0 to ±0.125	0 to ±0.125	0 to ±0.125	–4.32 to –4.72	0 to ±0.125	Proceed with step 16.	Perform radar antenna positioning fault isolation procedure (table 4-15).
16	Set the SCG1 switch on the AN/MWM-2 to 16 (read λ^2).	0 to ±0.125	0 to ±0.125	0 to ±0.125	+4.88 to +5.28	+4.13 to +4.53	+4.04 to +4.44	Proceed with step 17.	Replace sight correction circuit card assembly (A21A8).
17	Set the METER SELECTOR switch on the AN/MWM-2 to SCG2.								
18	Set the SCG2 switch on the AN/MWM-2 to 12.	0 to ±0.175	0 to ±0.175	0 to ±0.175	–0.063 to –0.463	–0.027 to –0.427	–0.201 to –0.601	Replace the servo assembly (A21A15).	Replace buffer amplifier circuit card assembly (A21A3).

Table 4-9. SCG Magnet Current Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication						If indication normal	If indication abnormal
		1	2	3	4	5	6		
18 con.									If indication still abnormal, replace servo assembly (A21A15).
19	Repeat SCG checkout procedure (table 4-6).								

Table 4-10. SCG Torque Current Fault Isolation Procedures.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication						If indication normal	If indication abnormal
		1	2	3	4	5	6		
	NOTE **Verify that the following circuit breakers are in the set position prior to performing checkout:** Distribution box SIGHT GYRO PWR ....A1CB4 SCG PWR ....A1CB1 INVERTER PWR ....A1CB3 SYS PWR ...A1CB2 Radar power supply TRAV ....5CB2 ELEV ...5CB3 CONTROL CKT ...5CB4 BLOWERS ...5CB5								
1	Set the METER SELECTOR switch on the AN/MWM-2 to SCG1.								
								NOTE **Refer to figure 6-78 for location of sight current generator assemblies identified in this procedure and to paragraph 6-41.**	
2	Set the SCG1 switch on the AN/MWM-2 to 8 (read VI_T).	−0.185 to −0.315	−0.195 to −0.325	−0.155 to −0.285	−1.28* to −1.42	−0.400 to −0.530	+0.519 to +0.649	Proceed with step 3.	Proceed to and continue with step. 4.
3	Set the SCG1 switch on the AN/MWM-2 to 9 (rear VI_T feedback).	0 to +0.125	0 to +0.125	0 to +0.125	+0.020 to +0.155	0 to +0.125	−0.04 to −0.165	Check AN/MWM-2 operation.	Replace the torque current supply module (A21A14). If indication still abnormal replace the XM61 sight.

*Must be read on the 10-volt scale of the 300M-A, as values are based on circuit loading caused by 300M-A in 10-volt scale.

Table 4-10. SCG Torque Current Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication						If indication normal	If indication abnormal
		1	2	3	4	5	6		
4	Set the SCG1 switch on the AN/MWM-2 to 14 (read Cos E).	—14.6 to —15.2	—14.6 to —15.2	—14.6 to —15.2	—14.6 to —15.2	—14.6 to —15.2	14.6 to —15.2	Proceed with step 5.	Check cosine E potentiometer.
5	Set the SCG1 switch on the AN/MWM-2 to 13 (read f7Rf7R).	+0.252 to +0.352	+0.333 to +0.435	+0.11 to +0.21	+1.11* to +1.21	+1.11* to +1.21	+2.06 to +2.16	Proceed with step 6.	Proceed to and continue with step 9.
6	Set the SCG1 switch on the AN/MWM-2 to 12 (read $\lambda_E 3K1_M 2$).	0 to ±0.05	0 to ±0.05	0 to ±0.05	+0.03 to +0.13	0 to ±0.05	—0.15 to —0.21	Proceed with step 7.	Proceed to and continue with step 11.
7	Set the SCG1 switch on the AN/MWM-2 to 11 (read $\lambda^2 KI_M 2$).	0 to ±0.05	0 to ±0.05	0 to ±0.05	—0.18 to —0.20	—0.16 to —0.18	—0.31 to —0.33	Replace the ballistic data circuit card assembly (A21A1). Repeat step 2. If indication still abnormal, reinstall original (A21A1) and replace the time delay circuit card assembly (A21A11). Repeat step 2. If indication is still abnormal, reinstall original A21A11 and replace the sight correction circuit card assembly (A21A8). Repeat step 2; if indication abnormal, reinstall original (A21A8) and check the radar elevation servo drive assembly (antenna positioning fault isolation, table 4-15).	Proceed with step 8.

* Must be read on the 10-volt scale of the 300M-A, as values are based on circuit loading caused by 300M-A in 10-volt scale.

Table 4-10. SCG Torque Current Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication Test set problem switch position 300M-A multimeter indication						If indication normal	If indication abnormal
		1	2	3	4	5	6		
8	Set the SCG1 switch on the AN/MWM-2 in the 16 position (read λ^2).	0 to ±0.125	0 to ±0.125	0 to ±0.125	+4.88 to +5.28	+4.13 to +4.53	+4.04 to +4.44	Replace the pulse width multiplier circuit card assembly (A21A9). If indication is still abnormal, reinstall original (A21A9) and change the voltage comparator circuit card assembly (A21A10).	Replace circuit card assembly (A21A8). If malfunction is not corrected perform antenna positioning fault isolation (table 4-15).
9	Set the METER SELECTOR switch on the AN/MWM-2 in the SCG2 position.								
10	Set the SCG2 switch on the AN/MWM-2 in the 11 position (read Buffer Amp 2).	+1.86 to +1.94	+1.86 to +1.94	+0.43 to +0.83	+1.72 to +2.12	+1.72 to +2.12	+6.37 to +6.77	Replace the servo assembly (A21A15).	Replace the buffer amplifier circuit card assembly (A21A3). If indication still abnormal, reinstall original (A21A3) and replace the servo assembly (A21A15).
11	Set the METER SELECTOR switch on the AN/MWM-2 in the SCG1 position.								
12	Set the SCG1 switch on the AN/MWM-2 to 10 (read $I_{M}2$).	+3.75 to +4.15	+1.77 to +2.17	+4.20 to +4.60	+0.29 to +0.69	+0.29 to +0.69	+1.10* to +1.50	Perform radar antenna positioning fault isolation procedures (table 4-15).	Replace the sight correction circuit card assembly (A21A8). If indication still abnormal, perform SCG magnet current supply module fault isolation procedures (table 4-9).
13	Repeat SCG checkout procedure (table 4-6).								

*Must be read on 10-volt scale of the 300M-A as values are based on circuit loading caused by 300M-A in 10-volt scale.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Set the SYSTEM POWER and GUN POWER switches on the gunner's control panel to OFF. Set the MODE switch to RADAR.			
2	Set the NORM-STATIC-TEST switch on the distribution box to STATIC. Verify that the following distribution box circuit breakers are in the set position: SIGHT GYRO PWR .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR A1CB2			
3	Verify that the following circuit breakers on the radar power supply (unit 5) are in the set position, and that the power supply cover is closed and secured: TRAV .... 5CB2 ELEV .... 5CB3 CONTROL CKT .... 5CB4 BLOWERS .... 5CB5 6.3 VDC .... 5CB5 CONVERTER 5CB1			
4	Set the MODE switch on the stow control (unit 6) to NORMAL. Set the MAINT switch to OFF.			
5	Verify that the transmitter-receiver (unit 2) cover is closed and secured.			
6	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights, radar power supply (unit 5) blower runs, and transmitter-receiver (unit 2) blower (2B1) runs.	a. Neither indicator nor blowers operate: (1) Verify that circuit breaker CB2 in distribution box is still depressed. (2) Check connections of cable W10 at control	(1) Fig. 6-11. (2) Fig. 3-62, sheet 1.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
6 con.			panel and distribution box.	
			(3) Check connections of cable W1 at distribution box and batteries.	(3) Fig. 3-62, sheet 1.
			(4) Connect 300M-A between distribution box test connector (J5) pin Y and ground; should indicate +22 to +28.5 Vdc. If not, replace cable W1. If good, proceed to (5).	(4) Fig. 3-38, sheet 5.
			(5) Check continuity of cable W10. If cable is good, check continuity of SYSTEM POWER switch (A1S5). If switch is good, replace control assembly.	(5) Fig. 3-48, and fig. 3-38, sheet 9. Par. 6-38.
			b. Indicator lights, power supply blower does not operate:	
			(1) Listen for clicking sound at distribution box elapsed time meter. If sound is heard, proceed to (2). If not, check continuity of cable W10.	(1) Fig. 3-48.
			(2) Verify that circuit breaker CB5 in radar power supply	(2) Par. 6-48; fig. 6-107.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
6 con.			(unit 5) is depressed. If circuit breaker won't reset, replace the power supply. (3) Check connections of cable W5 at distribution box and radar power supply. (4) Connect 300M-A between distribution box TEST connector pin P and ground; should indicate +22 to +28.5 Vdc. If not, replace distribution box (A1). If good, proceed to step 8. c. Blowers operate, indicator does not light: Replace SYSTEM POWER lamp or indicator light assembly. d. Transmitter-receiver blower does not run: Replace the following components in order listed. (1) Fan (2B1) (2) Inverter (2PS1) (3) Filter (2L2) (4) Filters (2FL11 and 2FL12)	(3) Fig. 3-62. (4) Par. 6-42. c. Fig. 6-75, sheet 1. d. Par. 6-45; fig. 3-68, sheet 1.
7	Wait 2 minutes ±15 seconds (system warmup).	READY WHEN LIT indicator lights.	a. Replace converter assembly (5A3). If malfunction is not corrected, reinstall the original 5A3 and	a. Par. 6-48.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
7 con.			replace the power supply (unit 5). b. Replace the receiver (unit 3). c. Replace the transmitter-receiver (unit 2).	 b. Par. 6-46. c. Par. 6-45.
8	Set the SYSTEM POWER switch on the gunner's control panel to OFF.			
9	Set the radar rack in the maintenance (down) position.			
10	Connect the AN/TPM-23 voltage tester (W1) and cable assembly (W2) to the system as shown in figure 4-2.			
11	Repeat steps 6 and 7.			
12	Check the power input to the radar power supply at pins A and B of the AN/TPM-23 cable assembly W2P1 with the 300M-A, as shown in figure 4-2.	300M-A indicates +22 to +28.5 Vdc.	Check continuity of system cable W5.	Fig. 3-43.
13	Measure the power supply voltage with the voltage tester W1 and 300M-A (see fig. 4-2). 300M-A LEAD CONNECTION — REV-NORM SWITCH POSITION Black lead to — Red lead to	300M-A indication.	Replace the converter assembly (5A3). If malfunction is not corrected, reinstall original 5A3 and replace the power supply (unit 5).	Par. 6-48.
	a. Black — +33 Red — NORM	a. 32.7 to 33.3		
	b. Black — −33 Red — NORM	b. 32.7 to 33.3		
	c. Black — +23 Red — NORM	c. 22.8 to 23.2		
	d. Black — −23 Red — NORM	d. 22.8 to 23.2		
	e. Black — +15 Red — NORM	e. 14.8 to 15.2		
	f. Black — −15 Red — NORM	f. 14.8 to 15.2		
	g. Black — +28 Red — NORM	g. 28.7 to 29.3		
	h. Black — +6.5 Red — NORM	h. 6.1 to 6.7		

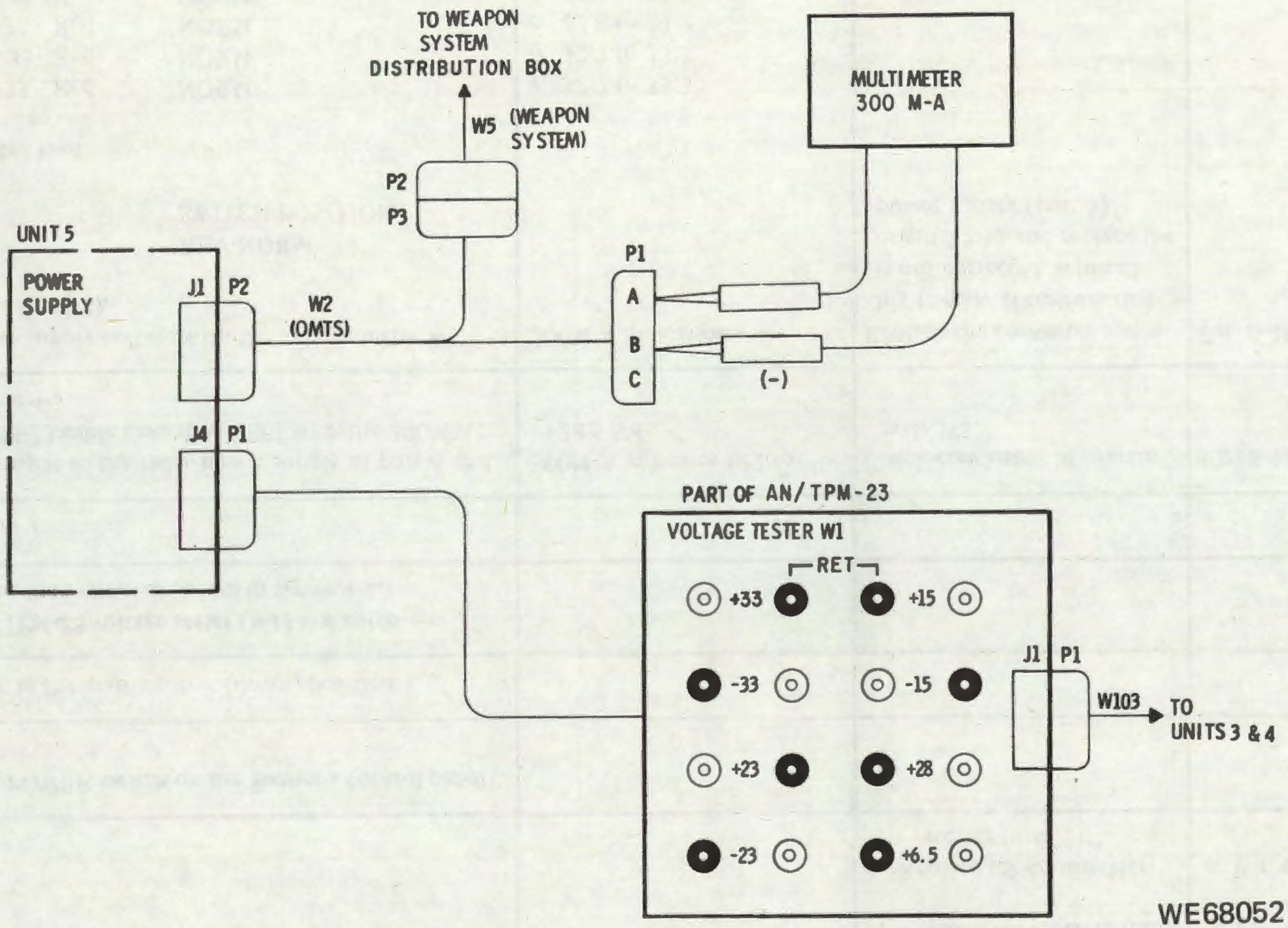


Figure 4-2. Power control and distribution system fault isolation, test setup diagram.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
14	Set SYSTEM POWER switch on gunner's control panel to OFF.			
15	Remove the range computer (unit 4) front panel assembly from its enclosure by loosening the four thumbscrews and sliding the assembly forward; place on a suitable support.			
16	Repeat steps 6 and 7.			
17	With the 300M-A, check the voltage between test points TP1 (+) and E10 (—) on the range computer, figure 4-3.	300M-A indicates +5.7 to 6.3 Vdc.	Replace cable W103.	
18	With the 300M-A, check the voltage between test points E7(+) and TP2(—) on the range computer.	300M-A indicates +22.8 to 23.2 Vdc.	Replace cable W103.	
19	With the 300M-A, check the voltage between test points TP3 (+) and E7 (—) on the range computer.	300M-A indicates +22.8 to 23.2 Vdc.	Replace cable W103.	
20	With the 300M-A, check the voltage between test points E2(+) and TP4(—) on the range computer.	300M-A indicates +32.7 to 33.3 Vdc.	Replace cable W103.	
21	With the 300M-A, check the voltage between test points TP5(+) and E4(—) on the range computer.	300M-A indicates +32.7 to 33.3 Vdc.	Replace cable W103.	
22	With the 300M-A, check the voltage between points E2(+) and E1 (—) on the range computer.	300M-A indicates +24.7 to 25.3 Vdc.	Replace the 25-volt regulator assembly (4A20).	Par. 6-47.
23	With the 300M-A, check the voltage between test points E3(+) and E4(—) on the range computer.	300M-A indicates +24.7 to 25.3 Vdc.	Replace the 25-volt regulator assembly (4A20).	Par. 6-47.
24	With the 300M-A, check the voltage between test points E6(+) and E5(—) on the range computer.	300M-A indicates +14.8 to 15.2 Vdc.	Replace the 15-volt regulator assembly (4A19).	Par. 6-47.
25	With the 300M-A, check the voltage between test points E8(+) and E7(—) on the range computer.	300M-A indicates +14.8 to 15.2 Vdc.	Replace the 15-volt regulator assembly (4A19).	Par. 6-47.
26	With the 300M-A, check the voltage between test points E9(+) and E10(—) on the range computer.	300M-A indicates +4.75 to 5.25 Vdc.	Replace the 5-volt filter assembly (4A18).	Par. 6-47.

Table 4-11. Power Control and Distribution System Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
27	Set the SYSTEM POWER switch on the gunner's control panel to OFF.	POWER and READY WHEN LIT indicators extinguish.		
28	Disconnect and stow voltage tester (W1) and cable assembly (W2).			
29	Reconnect all system interconnecting cables (Figs. 3-37 and 3-62).			
30	Resinstall the range computer front panel assembly and tighten the four thumbscrews.			
31	Set the radar rack in the stowed (up) position.			

Table 4-12. Synchronizing System Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Put the radar rack in the service (down) position.			
2	Remove the range computer (unit 4) front panel assembly from its enclosure by loosening the four thumbscrews and sliding the assembly forward; place on a suitable support.			
3	Set the AN/TPM-23 on the vehicle floor next to the range computer.			
4	Connect AN/TPM-23 cable assembly (W2) as indicated in figure 4-4.			
5	Set the POWER switch on the AN/TPM-23 to ON.			
6	Set the SIGNAL SELECTOR switch on the SIGNAL TEST section of the AN/TPM-23 to 3.			
7	Connect cable assembly (W8) to the RF INPUT jack (J4) on the AN/TPM-23.			
8	Attach adapter (CP3) to cable assembly (W8). (See fig. 2-2.)			
9	Disconnect connector (4P1) from (4A1J1). (See fig. 4-3.) **CAUTION** In the following steps, do not let cable come in contact with other components of the computer.			
10	Connect cable assembly W8 (CP3) to connector (4P1) (60 MHz input to 7.5 MHz clock 4A1).			
11	Set the STATIC-NORM-TEST switch on the system distribution box to STATIC (center position).			
12	Set the MODE switch on the gunner's control panel to RADAR.			

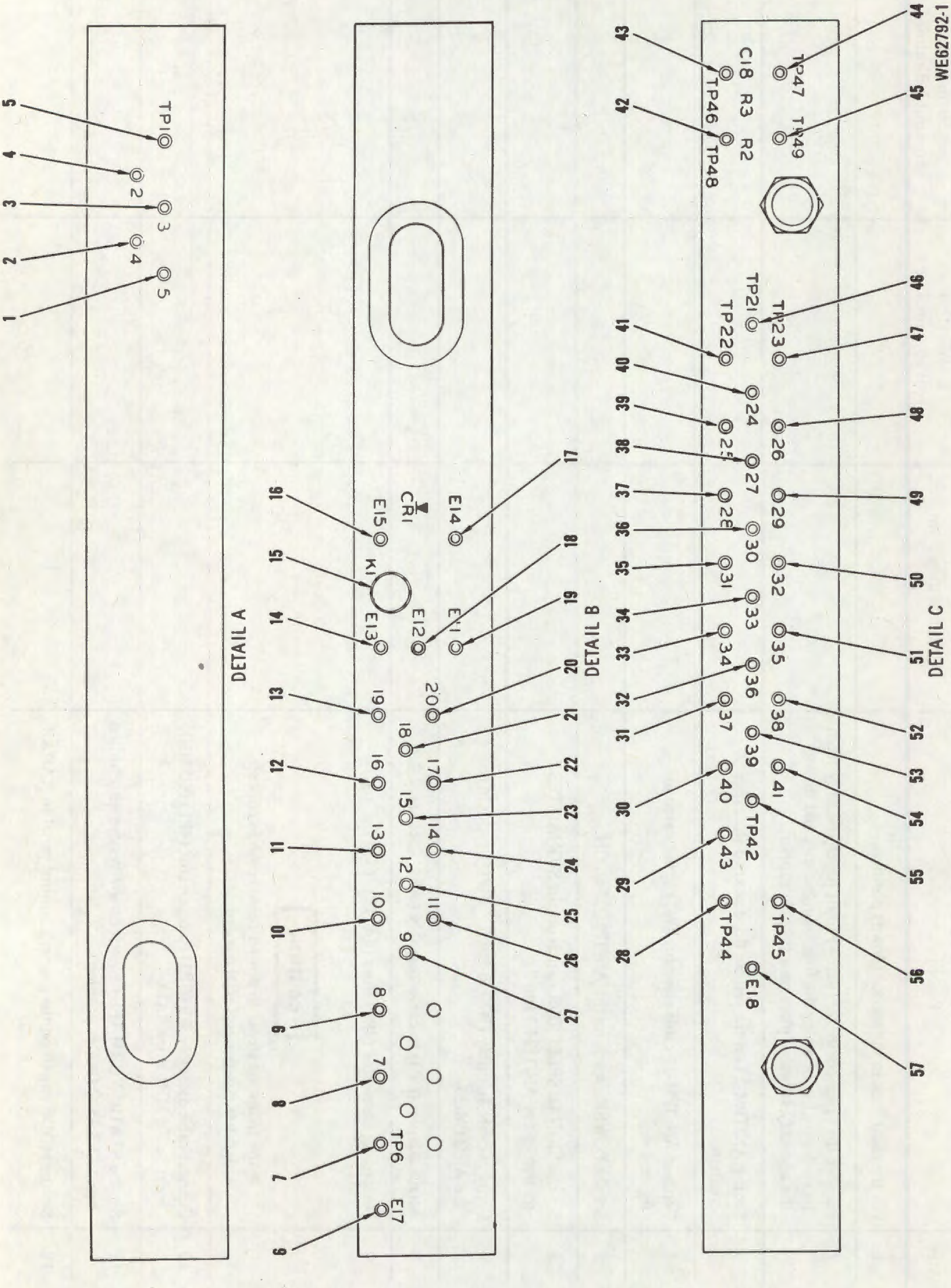
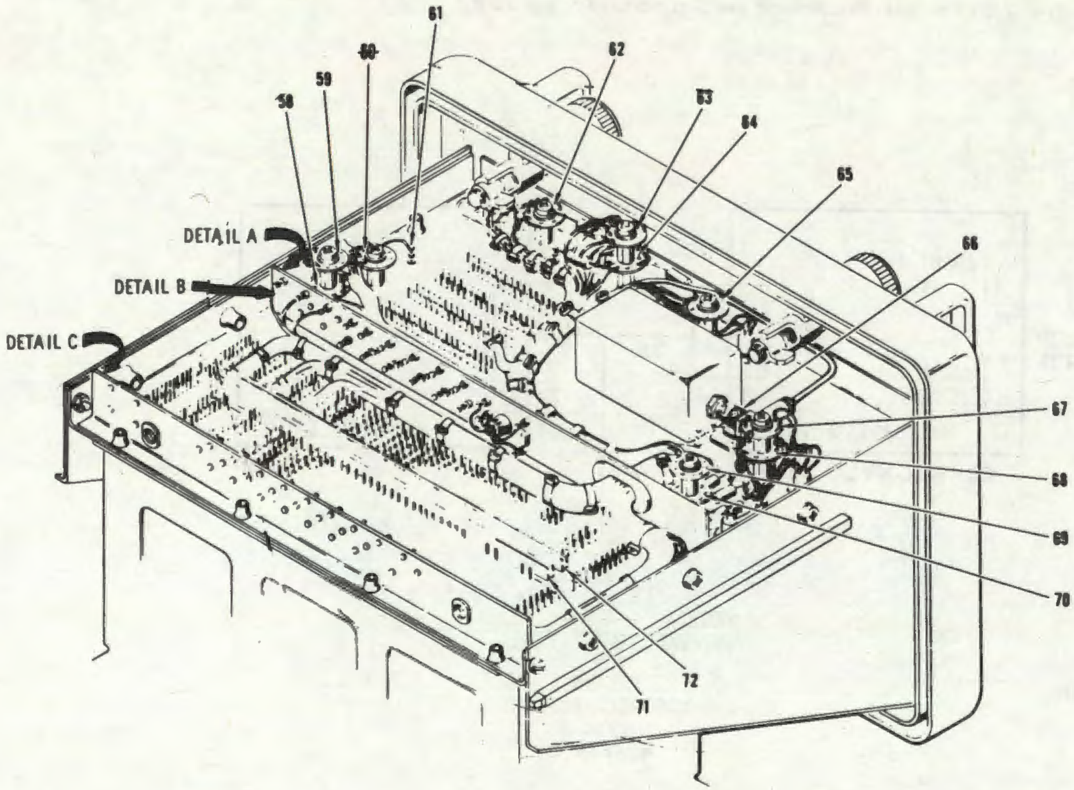


Figure 4-3. Range computer, location of test points (sheet 1 of 2).



REFERENCE DESIGNATION	INDEX NO.	REFERENCE DESIGNATION	INDEX NO.
E1	69	TP16	12
E2	70	TP17	22
E3	67	TP18	21
E4	68	TP19	13
E5	65	TP20	20
E6	63	TP21	46
E7	64	TP22	4
E8	62	TP23	47
E9	59	TP24	40
E10	58	TP25	39
E11	19	TP26	48
E12	18	TP27	38
E13	14	TP28	37
E14	17	TP29	49
E15	16	TP30	36
E17	6	TP31	35
E18	57	TP32	50
E20	61	TP33	34
E22	60	TP34	33
K1	15	TP35	51
P1	66	TP36	32
TP1	5	TP37	31
TP2	4	TP38	52
TP3	3	TP39	53
TP4	2	TP40	30
TP5	1	TP41	54
TP6	7	TP42	55
TP7	8	TP43	29
TP8	9	TP44	28
TP9	27	TP45	56
TP10	10	TP46	43
TP11	26	TP47	44
TP12	25	TP48	42
TP13	11	TP49	45
TP14	24	W1	71
TP15	23	W2	72

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Figure 4-3. Range computer, location of test points (sheet 2 of 2).

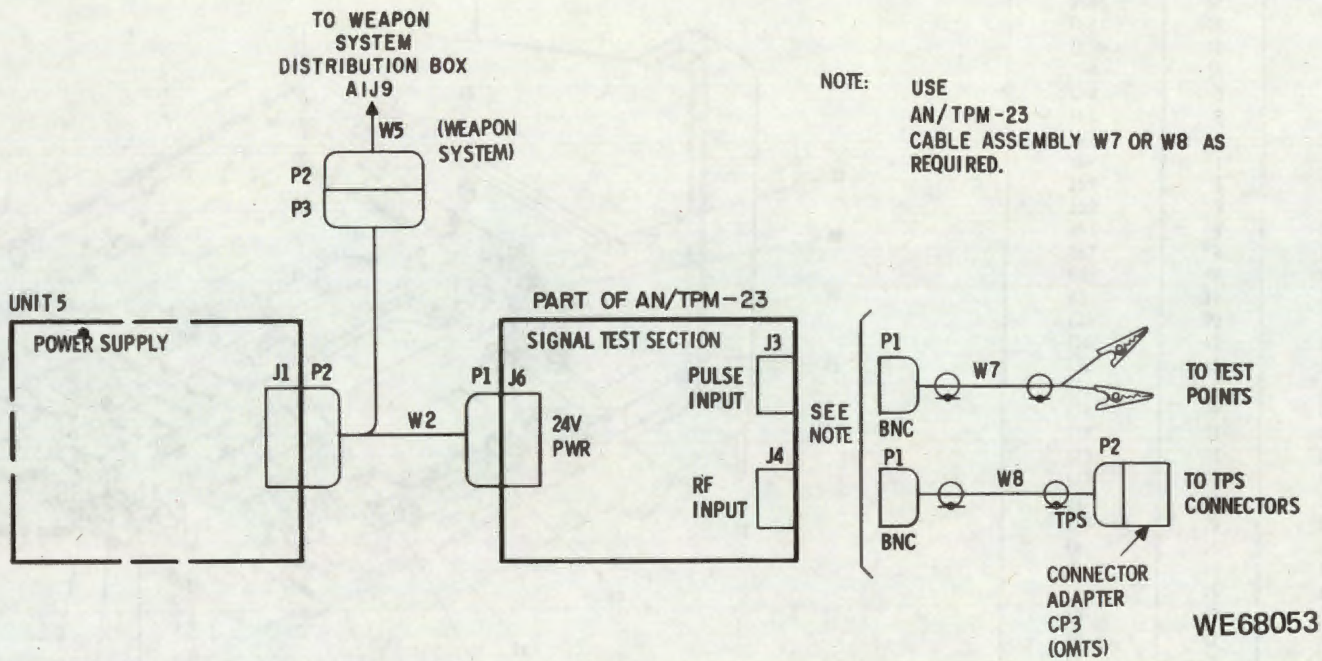


Figure 4-4. Synchronizing and transmitting systems fault isolation, test setup diagram.

Table 4-12. Synchronizing System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR .... A1CB2 Radar power supply CONTROL CKT .... 5CB4 BLOWERS .... 5CB5 6.3 VDC .... 5CB6 CONVERTER 5CB1			
13	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.
14	Wait 2 minutes ±15 seconds (system warmup).	READY WHEN LIT indicator lights.	Perform the "power control and distribution" fault isolation procedures.	Table 4-11.
15	Check the SIGNAL INDICATOR meter on the SIGNAL TEST section of the AN/TPM-23.	SIGNAL INDICATOR meter indicates a reading of 2.5 to 3.5 mA (60 MHz STALO signal input to master clock assembly (4A1).	Replace the receiver (unit 3) if the malfunction is not corrected perform the "transmitting system" fault isolation procedures.	Par. 6-46.
16	Set the SYSTEM POWER switch on the gunner's control panel, to OFF.	SYSTEM POWER indicator extinguishes.		
17	Reconnect connector (4P1) to (4A1J1).			
18	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.

Table 4-12. Synchronizing System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
19	Wait 2 minutes ±15 seconds (system warmup).	READY WHEN LIT indicator lights.		
20	Remove adapter (CP3) from cable assembly (W8) and place in AN/TPM-23 cover (fig. 2-2).			
21	Remove cable assembly (W8) from (J4) on the AN/TPM-23 and stow in carrying bag.			
22	Connect cable assembly (W7P1) to (J4) on the AN/TPM-23.			
23	Clip the black lead (W7) to any convenient point on the range computer (unit 4) chassis.			
24	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 7.			
25	Connect cable assembly (W7) to test point (4TP38) on the range computer. (See fig. 4-3.)	SIGNAL INDICATOR meter indicates a reading of 9.5 to 10.5 (7.5 MHz master clock output (4A1)).	Replace the master clock assembly (4A1).	Par. 6-47.
26	Connect cable assembly (W7) to test point (4TP35) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (7.5 MHz clock pulse-delayed output (4A6)).	Replace the range counter assembly (4A6).	Par. 6-47.
27	Disconnect cable assembly (W7) from (J4) on the AN/TPM-23 and connect it to (J3).			
28	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
29	Connect cable assembly (W7) to test point (4TP19) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the PRF counter assembly (4A2); if malfunction is not corrected, reinstall the original 4A2 and replace the range computer (unit 4).	Par. 6-47.

Table 4-12. Synchronizing System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
30	Depress and hold the MID RANGE CALIBRATION switch on the range computer (unit 4).	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the range computer (unit 4).	Par. 6-47.
31	Connect cable assembly (W7) to test point (4TP20) on the range computer.	SIGNAL INDICATOR indicates a reading in the green zone. ($\overline{\text{PRF}}$ $\overline{\text{RESET}}$ (20 Hz) output from the PRF counter (4A2)).	Replace the PRF counter assembly (4A2).	Par. 6-47.
32	Connect cable assembly (W7) to test point (4TP31) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. ($\overline{\text{PRF}}$ output from the PRF counter (4A2)).	Replace the PRF counter assembly (4A2).	Par. 6-47.
33	Connect cable assembly (W7) to test point (4TP32) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (T11 output from the PRF counter (4A2)).	Replace the PRF counter assembly (4A2).	Par. 6-47.
34	Connect cable assembly (W7) to test point (4TP39) on the range computer.	SIGNAL INDICATOR meter indicates full scale deflection once every 2 seconds. (R MAX signal from ranging system.)	Perform the "ranging system" fault isolation procedures.	Table 4-13.
35	Connect cable assembly (W7) to test point (4TP11) on the range computer.	SIGNAL INDICATOR meter indicates full scale deflection once every 2 seconds. (200M output from computer timing generator assembly (4A4)).	Replace the computer timing generator assembly (4A4). If malfunction is not corrected, replace the PRF counter assembly (4A2).	Par. 6-47.
36	Connect cable assembly (W7) to test point (4TP9) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the	Replace the computer timing generator assembly (4A4).	Par. 6-47.

Table 4-12. Synchronizing System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
36 con.		green zone. (T1/2 50 output from computer timing generator assembly (4A4)).	If malfunction is not corrected, replace the PRF counter assembly (4A2).	
37	Connect cable assembly (W7) to test point (4TP23) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (T3 output from computer timing generator assembly (4A4)).	Replace the computer timing generator assembly (4A4). If malfunction is not corrected, replace the PRF counter assembly (4A2).	Par. 6-47.
38	Connect cable assembly (W7) to test point (4TP10) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (T3/4 kHz output from computer timing generator assembly (4A4).	Replace the computer timing generator assembly (4A4). If malfunction is not corrected, replace the PRF counter assembly (4A2).	Par. 6-47.
39	Connect cable assembly (W7) to test point (4TP21) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (T1 output from computer timing generator assembly (4A4)).	Replace the computer timing generator assembly (4A4). If malfunction is not corrected, replace the PRF counter assembly (4A2).	Par. 6-47.
40	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 6.			
41	Connect cable assembly (W7) to test point (4TP45) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone. (Modulator trigger generator assembly (4A3) output.)	Replace the modulator trigger generator assembly (4A3). If malfunction is not corrected, reinstall original 4A3 and replace the universal board assembly (4A23).	Par. 6-47.
42	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
43	Connect cable assembly (W7) to test point (4TP17) on the range computer.	SIGNAL INDICATOR meter indicates a reading of 11.5	Replace the range rate counter B assembly (4A12). If	Par. 6-47.

Table 4-12. Synchronizing System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
43 con.		to 12.5. (T3 through T10 serial output from the range rate counter B assembly (4A12)).	malfunction is not corrected, reinstall the original (4A12) and replace the PRF counter assembly (4A2).	
44	Connect cable assembly (W7) to test point (4TP16) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the range rate counter B assembly (4A12). If malfunction is not corrected, reinstall the original (4A12) and replace the PRF counter assembly (4A2).	Par. 6-47.
45	Connect cable assembly (W7) to test point (4TP34) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the range rate counter assembly (4A6). If malfunction is not corrected, reinstall original 4A6 and replace the fine/fine delay assembly (4A22).	Par. 6-47.
46	Set the SYSTEM POWER switch on the gunner's control panel to OFF.	SYSTEM POWER indicator extinguishes.		
47	Set the POWER switch on the AN/TPM-23 to OFF.	AN/TPM-23 POWER indicator extinguishes.		
48	Disconnect the AN/TPM-23 cable assemblies (W2 and W7) from the system.			
49	Return all AN/TPM-23 cables to the carrying bag.			
50	Reconnect cable assembly (W5P1) to (5J1) on the range computer.			
51	Insert the range computer front panel assembly into case and tighten the four thumbscrews.			
52	Return the radar rack to its stowed (up) position.			

Table 4-13. Ranging System Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Set the AN/TPM-23 on the vehicle floor next to the range computer (unit 4).			
2	Place the radar equipment rack in the service position.			
3	Remove the range computer front panel assembly from its enclosure by loosening the four thumbscrews and sliding the assembly forward. Place on a suitable support.			
4	Remove the two card clamps from the card file in the range computer.			
5	Remove the range D/A converter assembly (4A16) from the card file in the range computer (fig. 4-5).			
6	Remove the range rate D6A converter assembly (4A17) from the card file in the range computer (fig. 4-5).			
7	Insert the range rate converter test board assembly into the slot vacated by the range rate D/A converter assembly (4A17) in the range computer.			
8	Connect cable assembly (W4P1) to the range rate converter test board assembly.			
9	Connect cable assembly (W4P2) to J9 on the range test section of the AN/TPM-23.			
10	Insert the range converter test board assembly into the slot vacated by the range D/A connecter assembly (4A16) in the range computer.			
11	Connect cable assembly (W6P1) to range converter test board assembly.			
12	Connect cable assembly (W6P2) to J12 on the RANGE TEST section of the AN/TPM-23.			

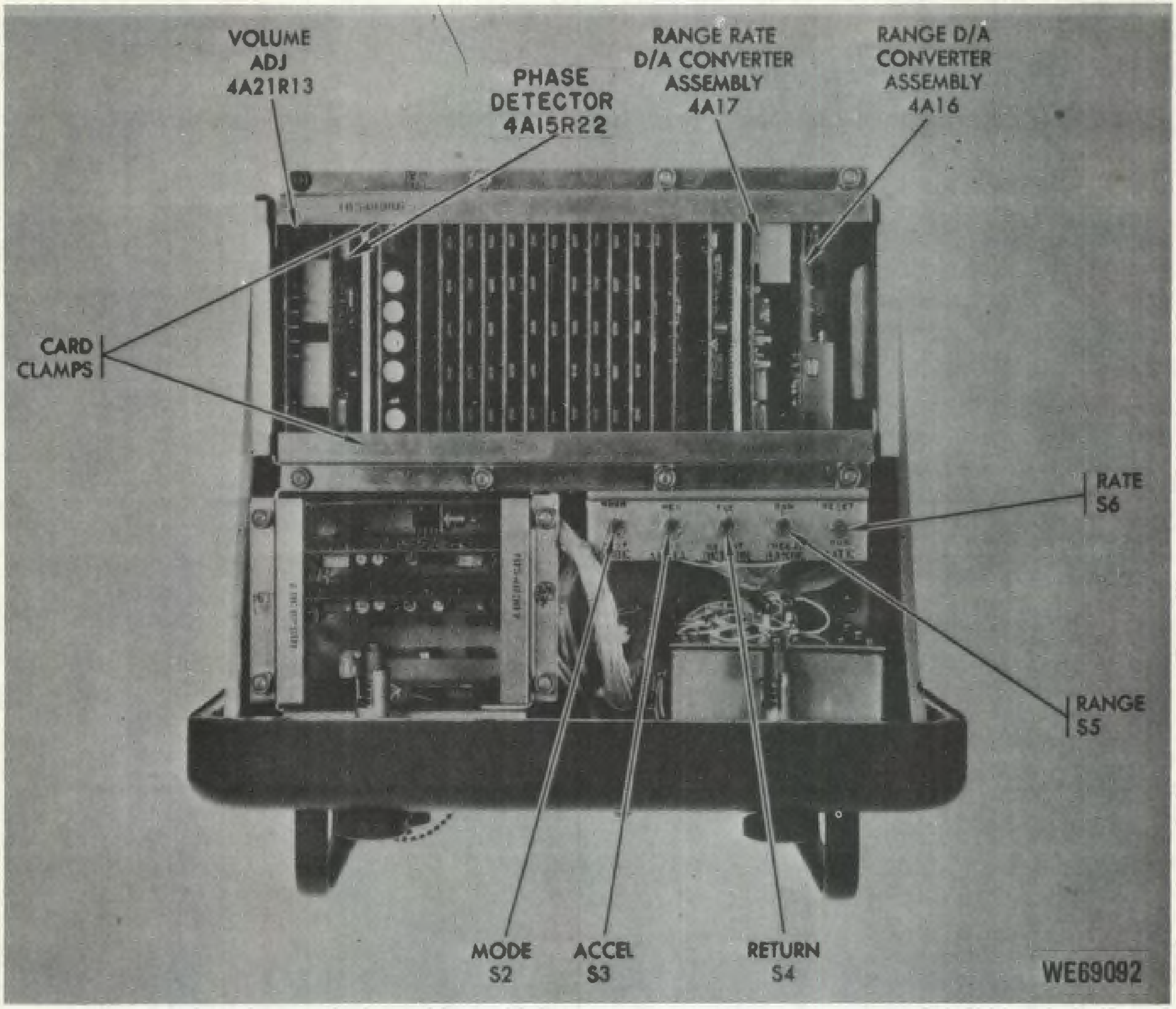
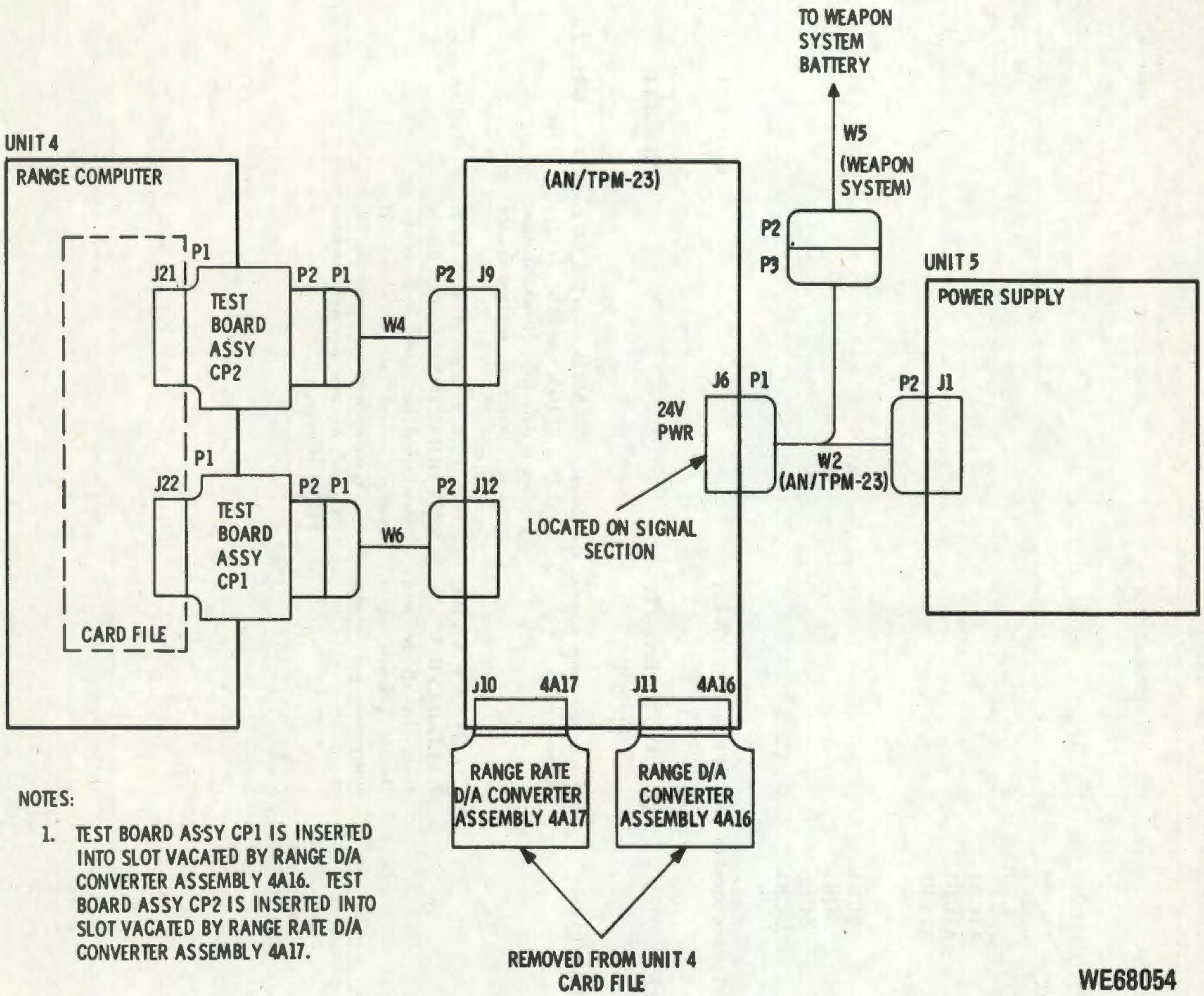


Figure 4-5. Range computer unit 4, interior controls and adjustments.

Table 4-13. Ranging System Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
13	Insert the RANGE D/A CONVERTER assembly (4A16) into J11 on the AN/TPM-23.			
14	Insert the RANGE RATE D/A CONVERTER assembly (4A17) into J10 on the AN/TPM-23.			
15	Connect cable (W2) from 24V connector J6 on the AN/TPM-23 to the power supply (unit 5) connector J1, and to system cable (W5P2) in accordance with figure 4-6. E/L TRIGGER AND PRERANGE TRIGGER TEST (search mode) *NOTE* Steps 16 through 36 check out the E/L trigger circuits located on assemblies 4A5, 4A6, 4A7, 4A22, and 4A23.			
16	Set the range computer test switches (fig. 4-5) in the positions indicated: *SWITCH* — *POSITION* MODE (S2) — NORM ACCEL (S3) — POS RETURN (S4) — NO TGT RANGE (S5) — RUN RATE (S6) — RUN			
17	Set the STATIC NORM TEST switch on the system distribution box to STATIC (center position).			
18	Set the MODE switch on the gunner's control panel to RADAR.			
19	Set the MODE switch on the stow control (unit 6) to NORMAL.			
20	Set the MAINT switch on the stow control (unit 6) to OFF.			



NOTES:

1. TEST BOARD ASSY CP1 IS INSERTED INTO SLOT VACATED BY RANGE D/A CONVERTER ASSEMBLY 4A16. TEST BOARD ASSY CP2 IS INSERTED INTO SLOT VACATED BY RANGE RATE D/A CONVERTER ASSEMBLY 4A17.

Figure 4-6. Ranging system fault isolation, test setup diagram.

Table 4-13. Ranging System Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR .... A1CB2 Radar power supply CONTROL CKT .... 5CB4 BLOWERS .... 5CB5 6.3 VDC .... 5CB6 CONVERTER 5CB1			
21	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.
22	Wait 2 minutes ±15 seconds (system warmup).	READY WHEN LIT indicator lights.		Table 4-11.
■23	Connect headset to J4 on the transmitter-receiver front panel.	a. No doppler audio tone present.	a. Check MID RANGE CALIBRATION switch (4S1); replace if defective. If malfunction is not corrected, replace range computer.	a. Par. 6-47; fig. 3-76, sheet 5.
		b. MID RANGE CALIBRATION lamp lit dimly and flashes brightly at a one-per-second rate.	b. (1) MID RANGE CALIBRATION lamp dimly illuminated, but does not flash at a one-per-second rate in search. If meter indications for steps 26, 28, 29, and 31 are normal, resistor (4R1) is open.	(1) Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
23 con.		**NOTE** If the MID RANGE CALIBRATION indicator is normal (dimly lit flashing at a one-per-second rate), proceed to and continue with step 32. If the indication is abnormal, proceed with step 24.	Replace range computer (unit 4). (2) MID RANGE CALIBRATION lamp lit brightly or not at all; check for malfunction in the 5-volt return circuitry. Perform "power control and distribution" fault isolation procedures. If 5-volt return circuitry is good and lamp does not light, replace lamp 4DS1.	(2) Table 4-11; fig. 6-105, sheet 2, item 5.
24	Set the POWER switch on the SIGNAL TEST section of the AN/TPM-23 to ON. Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.	POWER indicator on the AN/TPM-23 lights.	a. Perform "power control and distribution system" fault isolation procedures. b. Defective AN/TPM-23.	a. Table 4-11. b. TM 9-4931-333-14.
25	Connect cable assembly (W7) to J3 (PULSE INPUT) on the AN/TPM-23. **CAUTION** When using cable assembly (W7) ground the black lead to any convenient spot on the chassis.			
26	Connect cable assembly (W7) to the ΔR test point (4TP12) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 indicates a reading in the green zone.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, perform the "synchronizing system" fault isolation procedures.	Par. 6-47; table 4-12.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
27	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.			
28	Connect cable assembly (W7) to the $-\Delta$R test point (4TP22) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 indicates approximately 12.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, perform the "synchronizing system" fault isolation procedures.	Par. 6-47; table 4-12.
29	Connect cable assembly (W7) to the R up test point (4TP41) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 shows no deflection (0).	a. Replace range register B assembly (4A9). If malfunction is not corrected, reinstall the original and replace the universal board assembly (4A23). b. Check RANGE test switch (4S5). If defective, replace the range computer (unit 4).	a. Par. 6-47. b. Par. 6-47; fig. 3-76, sheet 1.
30	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
31	Connect cable assembly (W7) to the 5M pulse test point (4TP40) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 indicates a reading in the green zone.	a. Replace range register B assembly (4A9). If malfunction is not corrected, reinstall the original and replace the universal board assembly (4A23). b. Check RANGE test switch (4S5). If defective, replace the range computer (unit 4).	a. Par. 6-47. b. Par. 6-47; fig. 3-76, sheet 1.
32	Connect cable assembly (W7) to the E/L TRIGGER test point (4TP44) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 indicates a reading in the green zone.		

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
		NOTE If step 32 indication is normal, proceed to and continue with step 35. If indication is abnormal, proceed with step 33.		
33	Connect cable assembly (W7) to the E/L TRIGGER test point (4TP43) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter on the AN/TPM-23 indicates a reading in the green zone. If step 33 is abnormal, proceed with step 34.	Abnormal meter indication for step 32 with normal indication for step 33, replace the fine/fine delay assembly (4A22).	Par. 6-47.
34	Set SIGNAL SELECTOR switch to position 9 and connect cable assembly (W7) to the E/L coarse test point (4TP33) on the range computer.	SIGNAL INDICATOR meter on the AN/TPM-23 indicates an oscillation at a one-per-second rate through a minimum of five major divisions.	a. Abnormal indication for steps 32 and 33, with normal indication for step 34: Replace RCFD generator assembly (4A7). If malfunction is not corrected, reinstall original (4A7) and replace the RCFD decoder assembly (4A5). b. Abnormal indication for steps 32, 33, and 34: Replace the range counter assembly (4A6). If malfunction is not corrected, reinstall original and perform the "syn-	a. Par. 6-47. b. Par. 6-47; table 4-12.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
34 con.			chronizing system" fault isolation procedures.	
35	Connect cable assembly (W7) to the PRERANGE TRIGGER test point (4TP36) on the range computer.	SIGNAL INDICATOR meter on the AN/TPM-23 indicates an oscillation through a minimum of five major divisions at a one-per-second rate.	Replace the range counter assembly (4A6).	Par. 6-47.
36	Disconnect cable assembly (W7) from the PRE RANGE TRIGGER test point on the range computer. RANGE AND RANGE RATE OUTPUT TEST (search mode) **NOTE** Steps 37 through 78 check out the range and range rate channels located on assemblies 4A8, 4A9, 4A11, 4A13, 4A14, 4A16, and 4A17.			
37	Set the MODE switch (S2) in the range computer to TEST (fig. 4-5).			
38	Set the following switches on the range test section of the AN/TPM-23 in the position indicated: SWITCH — POSITION RANGE — NORM TEST-NORM — TEST TEST SELECTOR — 1.	TEST INDICATOR meter on the range section of the AN/TPM-23 deflects left and indicates –310 (negative range rate reference voltage).	Replace range rate D/A converter assembly (4A17).	Par. 6-47; fig. 4-5.
39	Set the TEST SELECTOR switch on the AN/TPM-23 to 2.	TEST INDICATOR meter on the range section of the	Replace range rate D/A converter assembly (4A17).	Par. 6-47; fig. 4-5.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
39 con.		AN/TPM-23 deflects right and indicates +310 (positive range rate reference voltage).		
40	Set the TEST SELECTOR switch on the AN/TPM-23 to 3.	TEST INDICATOR meter indicates a reading in the green zone 2 (fig. 4-7) (range rate output voltage).	a. If an abnormal indication is obtained for step 40, and a normal indication is obtained for step 43, replace the range rate D/A converter assembly (4A17). b. If an abnormal indication is obtained for step 40, and an abnormal indication is obtained for step 43, replace the range rate counter B assembly (4A12). If the malfunction is not corrected, reinstall the original 4A12 and replace the range rate counter A assembly (4A11).	a. Par. 6-47; fig. 4-5. b. Par. 6-47; fig. 4-5.
41	Set the TEST SELECTOR switch on the AN/TPM-23 to 4.	TEST INDICATOR meter deflects to the right and indicates 5000 (range reference voltage).	Replace range D/A converter assembly (4A16).	Par. 6-47.
42	Set the TEST SELECTOR switch on the AN/TPM-23 to 5.	TEST INDICATOR meter indicates a reading in green zone 1 (fig. 4-7) (range output voltage).	a. If an abnormal indication is obtained for step 42, and a normal indication is obtained for step 44, replace the range D/A converter assembly (4A16).	a. Par. 6-47; fig. 4-5.

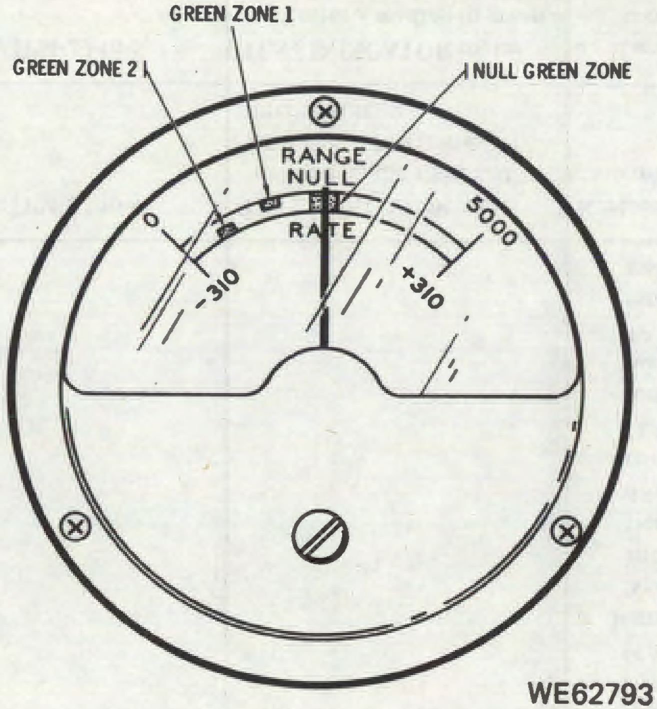


Figure 4-7. Test indicator meter M3.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
42 con.			b. If an abnormal indication is obtained for steps 42 and 44, replace the range register B assembly (4A9). If the malfunction is not corrected, reinstall the original 4A9 and replace the range register A assembly (4A8).	b. Par. 6-47; fig. 4-5.
43	Check the RANGE RATE indicators on the range test section of the AN/TPM-23. **NOTE** Whenever the $\overline{\text{SIGN}}$ rate indicator is lit, actual RANGE RATE is derived from the sum of the extinguished RANGE RATE indicators. When the SIGN range rate indicator is lit, actual RANGE RATE is derived from the sum of the illuminated RANGE RATE indicators.	The following RANGE RATE indicators are illuminated: 80 M/S 20 M/S 10 M/S 2.5 M/S $\overline{\text{SIGN}}$	See step 40.	See step 40.
44	Check the RANGE indicators on the range test section of the AN/TPM-23.	The following RANGE indicators are illuminated: 1280 M 320 M (search mode range; digital readout of 1600 meters).	See step 42.	See step 42.
45	Set the RETURN switch (S4) on the range computer (fig. 4-5) to TGT.			
46	Set the ACCEL switch (S3) on the range computer to NEG (fig. 4-5).			
47	Set the TEST SELECTOR switch on the range test section of of the AN/TPM-23 to 3.	TEST INDICATOR meter on the AN/TPM-23 deflects to the left and indicates –310.	If the meter indication is abnormal, and the indicator lamps are normal, replace	Par. 6-47; fig. 4-5.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
47 con.		$\overline{\text{SIGN}}$ RANGE RATE, 5 M/S, and 2.5 M/S indicators light (range rate output of −310 M/S).	the range rate D/A converter assembly (4A17).	
48	Set the RATE switch (S6) on the range computer to RESET and hold (switch S6 is spring-loaded) (fig. 4-5).	TEST INDICATOR meter indicates a reading in the NULL green zone. SIGN RANGE RATE indicator lights, all other RANGE RATE indicators are extinguished (range rate output of 0 M/S).	See note, step 50.	
49	Release the RATE (S6) switch.	TEST INDICATOR meter indicates −310 and is steady. RANGE RATE indicators flash in a counting down sequence with a cycle time of 1 ±0.5 second. At completion of the counting down sequence the $\overline{\text{SIGN}}$ RANGE RATE, 5 M/S, and 2.5 M/S indicators remain lit.	See note, step 50.	
50	Set the ACCEL switch (S3) on the range computer to POS (fig. 4-5). **NOTE** If indications for steps 48, 49, and 50 are all normal, proceed to and continue with step 54. If any abnormal indications occur in steps 48, 49, or 50, proceed with step 51.	TEST INDICATOR meter indicates +310 and is steady. RANGE RATE indicators flash in a counting up sequence and stop with 160 M/S, 80 M/S, 40 M/S, 20 M/S, 10 M/S, and SIGN RANGE RATE indicators illuminated. Cycle time is 2 ±1 seconds (range rate output of +310 M/S).	See note, step 50.	

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
51	Verify that cable assembly (W7) is connected to the J3 (PULSE INPUT) on the AN/TPM-23.			
52	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.			
53	Connect cable assembly (W7) to the TRACK signal test point (4TP15) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the computer timing generator assembly (4A4). If malfunction is not corrected, replace the range computer (unit 4).	Par. 6-47.
54	Connect cable assembly (W7) to the TRACK signal test point (4TP24) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the rate integrator assembly (4A14).	Par. 6-47.
55	Connect cable (W7) to the G3 signal test point (4TP13) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the search/track and gain control assembly (4A10). If the malfunction is not corrected, perform the "synchronizing system" fault isolation procedures.	Par. 6-47; table 4-12.
56	Connect cable assembly (W7) to the G1 signal test point (4TP25) on the range computer.	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the search/track and gain control assembly (4A10).	Par. 6-47.
57	Set the RETURN switch (S4) on the range computer (fig. 4-5) to NO TGT.			
58	Connect cable assembly (W7) to the TRACK signal test point (4TP15) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the search/trach and gain control assembly (4A10). If malfunction is not corrected, check RETURN test switch (S4); if defective, replace the range computer (unit 4).	Par. 6-47; fig. 3-76, sheet 1.
59	Connect cable assembly (W7) to the TRACK signal test point (4TP24) on the range computer.	SIGNAL INDICATOR meter indicates a reading of	Replace the search/track and gain control assembly	Par. 6-47; fig. 3-76, sheet 1.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
59 con.		approximately 12.	(4A10). If malfunction is not corrected, check RETURN test switch (S4); if defective, replace the range computer (unit 4).	
60	Connect cable assembly (W7) to the G3 signal test point (4TP13) on the range computer.	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the search/track and gain control assembly (4A10). If malfunction is not corrected, check RETURN test switch (S4); if defective, replace the range computer (unit 4).	Par. 6-47; fig. 3-76, sheet 1.
61	Connect cable assembly (W7) to the G1 signal test point (4TP25) on the range computer.	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the search/track and gain control assembly (4A10). If malfunction is not corrected, check RETURN test switch (S4); if defective, replace the range computer (unit 4).	Par. 6-47; fig. 3-76, sheet 1.
62	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
63	Connect cable assembly (W7) to the $\overline{\dot{R}}$ scaled test point (4TP28) on the range computer.	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the following components in the order listed; if the malfunction is not corrected, reinstall the original and replace the next component. a. Rate scaler assembly (4A13). b. RCFD decoder assembly (4A5). c. Rate integrator assembly (4A14).	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
64	Set the ACCEL switch (S3) on the range computer (fig. 4-5) to NEG.			
65	Set the RETURN switch (S4) on the range computer to TGT.			
66	Connect cable assembly (W7) to the $\overline{\dot{R}\text{ up}}$ signal test point (4TP29) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading in the green zone.	a. Replace the rate scaler assembly (4A13). If malfunction is not corrected, reinstall the original. b. Check the ACCEL switch (4S3) in the range computer. If defective, replace the range computer (unit 4). c. Perform the "synchronizing system" fault isolation procedures.	a. Par. 6-47. b. Par. 6-47; fig. 3-76, sheet 1. c. Table 4-12.
67	Leave cable assembly (W7) connected to the $\overline{\dot{R}\text{ up}}$ signal test point (4TP29) on the range computer.			
68	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.			
69	Set the ACCEL switch (S3) on the range computer (fig. 4-5) to POS.	SIGNAL INDICATOR meter indicates a reading of 0.	a. Replace rate scaler assembly (4A13); if malfunction is not corrected, reinstall original. b. Check the ACCEL switch (4S3) in the range computer; if defective, replace range computer (unit 4). c. Perform "synchronizing system" fault isolation procedures.	a. Par. 6-47. b. Par. 6-47; fig. 3-76, sheet 1. c. Table 4-12.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
70	Connect cable assembly (W7) to the $\dot{R}$ OVERFLOW signal test point (4TP30) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the range rate counter A assembly (4A11).	Par. 6-47.
71	Set the ACCEL switch (S3) on the range computer to NEG (fig. 4-5).			
72	Set the RETURN switch (S4) on the range computer to NO TGT.			
73	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.	SIGNAL INDICATOR meter indicates a reading in the green zone.	Replace the range rate counter A assembly (4A11).	Par. 6-47.
74	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.			
75	Set the RETURN SWITCH (S4) on the range computer to TGT.			
76	Connect cable assembly (W7) to the $\dot{R} < \pm 10$ M/S signal test point (4TP42) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the RCFD decoder assembly (4A5).	Par. 6-47.
77	Hold the RATE switch (S6) on the range computer in the RESET position (spring-loaded switch) (fig. 4-5).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the RCFD decoder assembly (4A5).	Par. 6-47.
78	Disconnect cable assembly (W7) from the test point 4TP42 on the range computer. <u>RANGE OUTPUT TEST (track mode)</u> **NOTE** Steps 79 through 99 check out the range channel circuits located on assembly components 4A8, 4A9, 4A12, 4A14, and 4A16.			

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
79	Set the range computer test switches in the positions indicated: SWITCH — POSITION MODE (S2) — TEST ACCEL (S3) — POS RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN			
80	Set the TEST SELECTOR switch on the AN/TPM-23 to 5.	TEST INDICATOR meter dial slowly travels from 0 (full scale left) to 5000 (full scale right) and moves quickly back to 0. Cycle repeats every 17 ±2 seconds. RANGE indicators continue to flash during counting sequence.	Replace range D/A converter assembly (4A16).	Par. 6-47.
81	Set the ACCEL switch (S3) on the range computer to NEG (fig. 4-5).	TEST INDICATOR dial slowly travels from 5000 (full scale right) to 0 (full scale left) and moves quickly back to 5000. Cycle repeats every 17 ±2 seconds. RANGE indicators continue to flash during counting sequence.	Replace range D/A converter assembly (4A16).	Par. 6-47.
82	Set the RETURN switch (S4) on the range computer to NO TGT.			
83	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
84	Connect cable assembly (W7) to the $\overline{\text{R MAX}}$ test point (4TP39) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter sweeps between 0 and	Replace range register A assembly (4A8).	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
84 con.		approximately 12 at a one-per-second rate.		
85	Set the RETURN switch (S4) on the range computer to TGT (fig. 4-5). **NOTE** If all indications for steps 80 through 85 were normal, proceed to and continue with step 88. If any abnormal indications were noted, proceed to step 86.			
86	Connect cable assembly (W7) to the $\dot{R}$ SERIAL signal test point (4TP18) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a momentary reading in the green zone (starts at zero, goes to green zone then back to zero).	Replace the range rate counter B assembly (4A12).	Par. 6-47.
87	Set the ACCEL switch (S3) on the range computer to POS.	SIGNAL INDICATOR meter indicates a momentary reading in the green zone (starts at zero, goes to green zone then back to zero).	Replace the range rate counter B assembly (4A12).	Par. 6-47.
88	Connect cable assembly (W7) to the ΔR signal test point (4TP12) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter oscillates in the green zone.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, reinstall original and perform the "synchronizing system" fault isolation procedures.	Par. 6-47.
89	Set the ACCEL switch (S3) on the range computer to NEG.	SIGNAL INDICATOR meter oscillates in the green zone.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, reinstall original and perform the "synchronizing system" fault isolation procedures.	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
90	Connect cable assembly (W7) to the $-\Delta$R SIGN signal test point (4TP22) on the range computer (fig. 4-3).			
91	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.	SIGNAL INDICATOR meter indicates approximately 10.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, reinstall original and perform the "synchronizing system" fault isolation procedures.	Par. 6-47.
92	Set the ACCEL switch (S3) on the range computer to POS.	SIGNAL INDICATOR meter indicates approximately 12.	Replace the rate integrator assembly (4A14). If malfunction is not corrected, reinstall original and perform the "synchronizing system" fault isolation procedures.	Par. 6-47.
93	Set SIGNAL SELECTOR switch on the AN/TPM-23 to 8.			
94	Connect cable assembly (W7) to the 5M PULSE test point (4TP40) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter oscillates rapidly within the green zone.	Replace the range register B assembly (4A9).	Par. 6-47.
95	Set the ACCEL switch (S3) on the range computer to NEG.	SIGNAL INDICATOR meter oscillates rapidly within the green zone.	Replace the range register B assembly (4A9).	Par. 6-47.
96	Connect cable assembly (W7) to the R up signal test point (4TP41) on the range computer (fig. 4-3).			
97	Set the SIGNAL SELECTOR switch on the AN/TPM-23 to 9.	SIGNAL INDICATOR meter indicates a reading of approximately 2.	Replace the range register B assembly (4A9).	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
98	Set the ACCEL switch (S3) on the range computer to POS (fig. 4-5).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the range register B assembly (4A9).	Par. 6-47.
99	Disconnect cable assembly (W7) from test point (4TP41) on the range computer. RANGE FREEZE TEST **NOTE** Steps 100 through 107 check out the range register B circuit, located on assembly 4A9.			
100	Set the range computer test switches in the positions listed: SWITCH — POSITION MODE (S2) — TEST ACCEL (S3) — POS RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN	RANGE indicators on the AN/TPM-23 flash in a counting up sequence.	Continue with step 101.	
101	Set the RANGE switch (S5) on the range computer to FREEZE.	RANGE indicators on the AN/TPM-23 stop sycling.	Replace the universal board assembly (4A23). If malfunction is not corrected, reinstall original and replace the range register B assembly (4A9).	Par. 6-47.
102	Set the RANGE switch (S5) on the range computer to RUN. **NOTE** If normal indications are obtained in steps 100 through 102, proceed to and continue with step 108. If abnormal indications were noted, proceed with step 103.	RANGE indicators on the AN/TPM-23 commence to cycle in a counting up sequence.	Continue with step 103.	

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
103	Verify that the SIGNAL SELECTOR switch on the AN/TPM-23 is in position 9.			
104	Connect cable assembly (W7) to the MAN RANGE FREEZE signal test point (4TP26) on the range computer (fig. 4-3).	SIGNAL INDICATOR meter indicates a reading of 0.	Replace the range register B assembly (4A9). If malfunction is not corrected, reinstall original and check the RANGE switch (4S5); if defective, replace the range computer (unit 4).	Par. 6-47.
105	Set the RANGE switch (S5) on the range computer to FREEZE (fig. 4-5).	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the range register B assembly (4A9).	Par. 6-47.
106	Connect cable assembly (W7) to the 5M PULSE signal test point (4TP40) on the range computer.	SIGNAL INDICATOR meter indicates a reading of approximately 12.	Replace the range register B assembly (4A9).	Par. 6-47.
107	Remove cable assembly (W7) from test point (4TP40).			
108	Set the range computer test switches (fig. 4-5) in the positions listed: SWITCH — POSITION MODE (S2) — TEST ACCEL (S3) — POS RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN	**NOTE** Disregard all indicators except those listed.		
109	Hold the RATE switch (S6) on the range computer in the RESET position.	SIGN RANGE RATE indicator lights.	Continue with step 110.	
110	Set the RETURN switch (S4) on the range computer to NO TGT.	Three seconds after setting the RETURN switch to NO	Replace the search/track and gain control assembly	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
110 con.	RANGE AND RANGE RATE OUTPUT TEST **NOTE** Steps 111 through 122 check out the range and range rate digital to analog (D/A) converters located on assemblies 4A16 and 4A17.	TGT, the following RATE indicators light: SIGN, 80 M/S, 20 M/S, 10 M/S, and 2.5 M/S.	(4A10).	
111	Set the range computer test switches in the positions listed: SWITCH — POSITION MODE (S2) — TEST ACCEL (S3) — POS RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN			
112	Set the TEST SELECTOR switch on the AN/TPM-23 to 5.			
113	Set the RANGE switch on the range test section of the AN/TPM-23 to 5000 METER.	TEST INDICATOR meter indicates a reading of 5000.	Replace range D/A converter assembly (4A16); if malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly component (4A17).	Par. 6-47.
114	Set the TEST SELECTOR switch on the AN/TPM-23 to 6.	TEST INDICATOR meter indicates a reading in the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is nor corrected, reinstall original and replace	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
114 con.			the range rate D/A converter assembly (4A17).	
115	Hold the READ switch on the range test section of the AN/TPM-23 depressed (spring loaded).	TEST INDICATOR meter indicates a reading just below (left) the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly (4A17).	Par. 6-47.
116	Release the READ switch.			
117	Set the TEST SELECTOR switch on the AN/TPM-23 to 7.	TEST INDICATOR meter indicates a reading in the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly (4A17).	Par. 6-47.
118	Hold the READ switch on the range test section of the AN/TPM-23 depressed (spring loaded).	TEST INDICATOR meter indicates a reading just above (right) the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly (4A17).	Par. 6-47.
119	Release the READ switch.			
120	Set the TEST SELECTOR switch on the AN/TPM-23 to 8.			
121	Set the ACCEL switch (S3) on the range computer to NEG (fig. 4-5).	TEST INDICATOR meter indicates a reading in the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly (4A17).	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
122	Hold the READ switch on the range test section of the AN/TPM-23 depressed (spring loaded).	TEST INDICATOR meter indicates a reading in the NULL green zone.	Replace range D/A converter assembly (4A16). If malfunction is not corrected, reinstall original and replace the range rate D/A converter assembly (4A17).	Par. 6-47.
	<u>OVERALL RANGING SYSTEM TEST</u> **NOTE** Steps 123 through 134 check out the search/track gain control and E/L trigger circuits contained on assemblies 4A5, 4A6, 4A7, 4A15, 4A21, and 4A22. **CAUTION** The overall ranging system test is to be performed only after successful completion of the preceding ranging system checks.			
123	Set MODE switch on gunner's control panel to MAN and set the range computer test switches in the positions indicated: <u>SWITCH</u> — <u>POSITION</u> MODE (S2) — NORM ACCEL (S3) — POS RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN			
124	Set the TEST-NORM switch on the range test section of the AN/TPM-23 to NORM.			

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
125	Depress the MID RANGE CALIBRATION switch on the front panel assembly of the range computer. **NOTE** If indications are normal for step 125, proceed to and continue with step 130; if abnormal, continue with step 126.	MID RANGE CALIBRATION indicator on the range computer lights brightly. Audio tone in headset.	Check headset; replace if defective. If headset is good, continue with step 126.	
126	Verify that the SIGNAL SELECTOR switch on the AN/TPM-23 is in position 8.			
127	Connect cable assembly (W7) to the PRERANGE TRIGGER test point (4TP36) on the range computer (fig. 4-3).			
128	Hold the MID RANGE CALIBRATION switch on the range computer depressed.	SIGNAL INDICATOR meter indicates a reading in the green zone (needle stops pulsing when the CAL switch is depressed).	Replace the range counter assembly (4A6).	Par. 6-47.
129	Connect cable assembly (W7) to the E/L TRIGGER signal test point (4TP44) on range computer.			
130	Hold the MID RANGE CALIBRATION switch on the range computer depressed. **NOTE** If step 130 indications are normal, proceed to and continue with step 135. If indications are abnormal, continue with steps 131 through 134, as necessary.	SIGNAL INDICATOR meter indicates a reading in the green zone.	If step 132 indication is normal, replace the fine/fine delay assembly (4A22).	Par. 6-47.

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
131	Connect cable assembly (W7) to the E/L TRIGGER test point (4TP43) on the range computer (fig. 4-3).			
132	Hold the MID RANGE CALIBRATION switch on the range computer depressed.	SIGNAL INDICATOR meter indicates a reading in the green zone.	If step 134 indication is normal, replace the RCFD decoder assembly (4A5). If the malfunction is not corrected, reinstall the original and replace the RCFD generator assembly (4A7).	Par. 6-47.
133	Connect cable assembly (W7) to the E/L COARSE signal test point (4TP33) on the range computer.			
134	Hold the MID RANGE CALIBRATION switch on the range computer depressed.	SIGNAL INDICATOR meter indicates a reading in the green zone.	a. Replace the phase detector assembly (4A15). If the malfunction is not corrected, replace the control amplifier assembly (4A21). b. Replace the receiver (unit 3). c. Perform the "transmitting system" fault isolation procedures.	a. Par. 6-47. b. Par. 6-46. c. Table 4-14.
135	Set the SYSTEM POWER switch on the gunner's control panel to OFF.	All indicators extinguish.		
136	Set the switches on the AN/TPM-23 in the positions indicated: SWITCH — POSITION POWER — OFF SIGNAL SELECTOR — 1 TEST SELECTOR — OFF RANGE — NORM TEST-NORM — NORM			

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
137	Disconnect cable assembly (W2P1) from J6 on the AN/TPM-23.			
138	Disconnect cable assembly (W5P2) from cable assembly (W2P3).			
139	Disconnect cable assembly (W2P2) from J1 on the power supply (unit 5).			
140	Return cable assemblies (W2), (W7), and (W8) to the AN/TPM-23 carrying bag.			
141	Disconnect cable assembly (W4P1) from the range rate converter test board assembly.			
142	Disconnect cable assembly (W6P1) from the range converter test board assembly.			
143	Remove the range rate converter test board assembly from (4J21) in the range computer.			
144	Remove the range converter test board assembly from (4J22) in the range computer.			
145	Stow the range converter test board assembly and the range rate converter test board assembly in the cover of the AN/TPM-23.			
146	Remove cable assembly (W4P2) from J9 on the AN/TPM-23.			
147	Remove cable assembly (W6P2) from J12 on the AN/TPM-23.			
148	Stow cable assemblies (W4) and (W6) in the AN/TPM-23 carrying bag.			
149	Remove the range rate D/A converter assembly component (4A17) from J10 on the AN/TPM-23.			
150	Remove the range D/A converter assembly component (4A16) from J11 on the AN/TPM-23.			

Table 4-13. Ranging System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
151	Install the range rate D/A converter assembly (4A17) in the card file of the range computer (4J21) (fig. 4-5).			
152	Install the range D/A converter assembly component (4A16) in the card file of the range computer (4J22).			
153	Install the two card clamps on the card file in the range computer and place card removal tool in storage position on unit 4 chassis.			
154	Set the range computer test switches (fig. 4-5) in the positions indicated: SWITCH — POSITION MODE (S2) — NORM ACCEL (S3) — NEG RETURN (S4) — TGT RANGE (S5) — RUN RATE (S6) — RUN			
155	Insert the range computer front panel assembly into its case.			
156	Secure the range computer front panel assembly by tightening the four thumbscrews, and connect W5P1 to unit 5 J1.			
157	Remove the AN/TPM-23 from the vehicle.			
158	Return the radar rack to its stowed (up) position.			

Table 4-14. Transmitting System Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Place the AN/TPM-23 on top of the commander's hatch			
2	Disconnect W5P2 from unit 5 and connect AN/TPM-23 cable assembly W2 as indicated in figure 4-4.			
3	Connect AN/TPM-23 ground lead (W12) from the AN/TPM-23 ground terminal to the external ground strap of the transmitter-receiver (unit 2).			
4	Set the POWER switch on the signal test section of AN/TPM-23 to ON.			
5	Lower the back of the gunner's seat.			
6	Lower the front panel of the transmitter-receiver by loosening the four thumbscrews.			
7	Pull the actuator of interlock switch S3 forward and up to the service position (fig. 4-8).			
8	Set the STATIC NORM TEST switch on the fire control distribution box in the STATIC (center) position.			
9	Set the MODE switch on the gunner's control panel in either RADAR or MAN. **NOTE** Verify that the following circuit breakers are in the set position prior to performing check out. Distribution box SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR A1CB2			

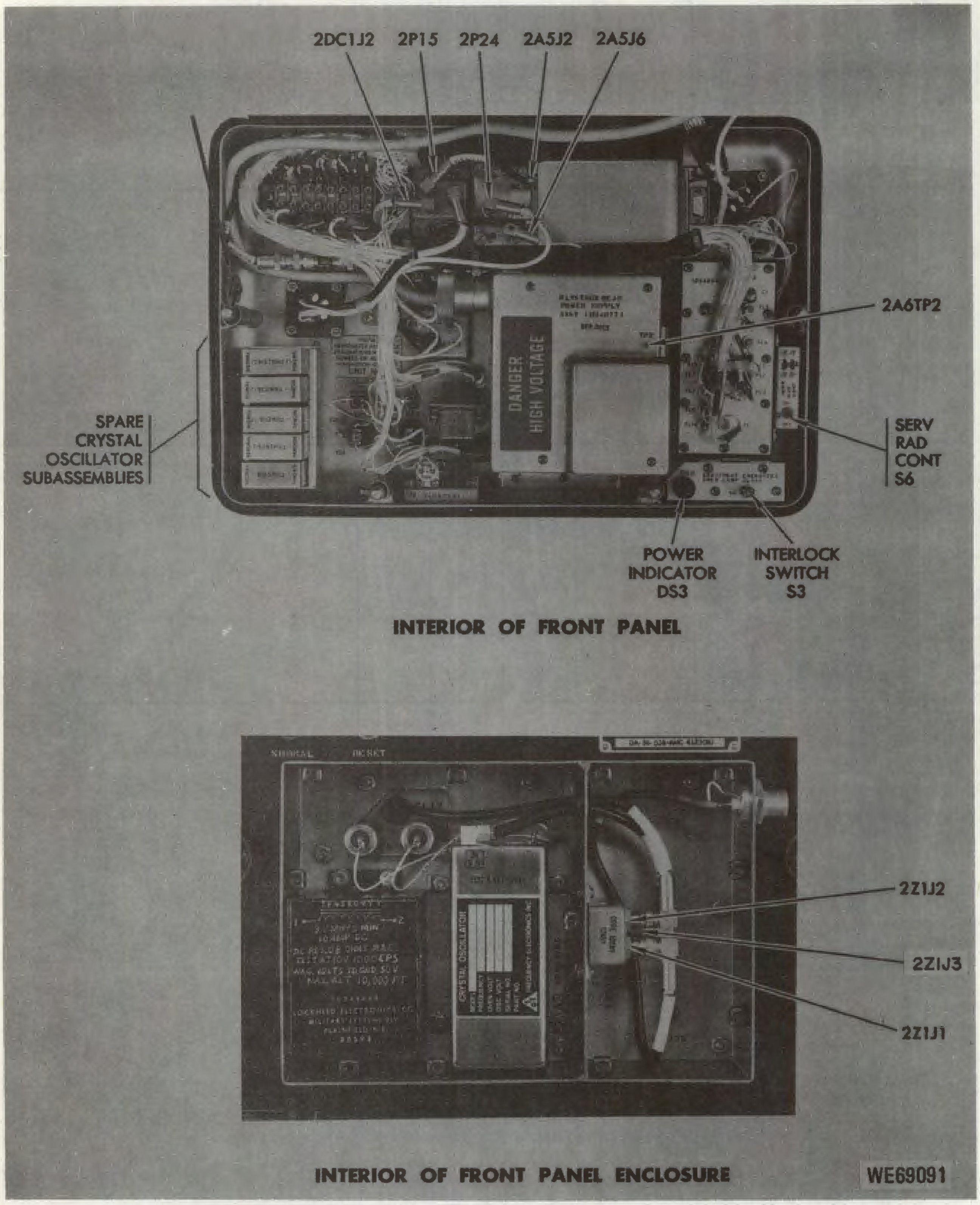


Figure 4-8. Transmitter-receiver unit 2, interior of front panel enclosure.

Table 4-14. Transmitting System Fault Isolation Procedures—Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
9 con.	Radar power supply CONTROL CKT .... 5CB4 BLOWERS .... 5CB5 6.3 VDC .... 5CB6 CONVERTER 5CB1			
10	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights. Power indicator (2DS3) lights. Transmitter-receiver blower motor runs. Power supply blower motor runs.	Perform "power control and distribution system" fault isolation procedures.	Table 4-11.
11	Wait 2 minutes±15 seconds (system warmup).	READY WHEN LIT indicator lights (system in standby).	Perform "power control and distribution system" fault isolation procedures.	Table 4-11.
12	Deleted			
13	Deleted			
14	Deleted			
15	Connect cable assembly W8P1 to the RF INPUT, J4 on the signal test section of the AN / TPM-23.	CAUTION Test points 2A1A1TP1, 2A1A1TP2, and 2A1A1TP3 (fig. 4-9) of the X-band local oscillator subassembly (2A1A1) will not be used for checkout / fault isolation at organizational level.		

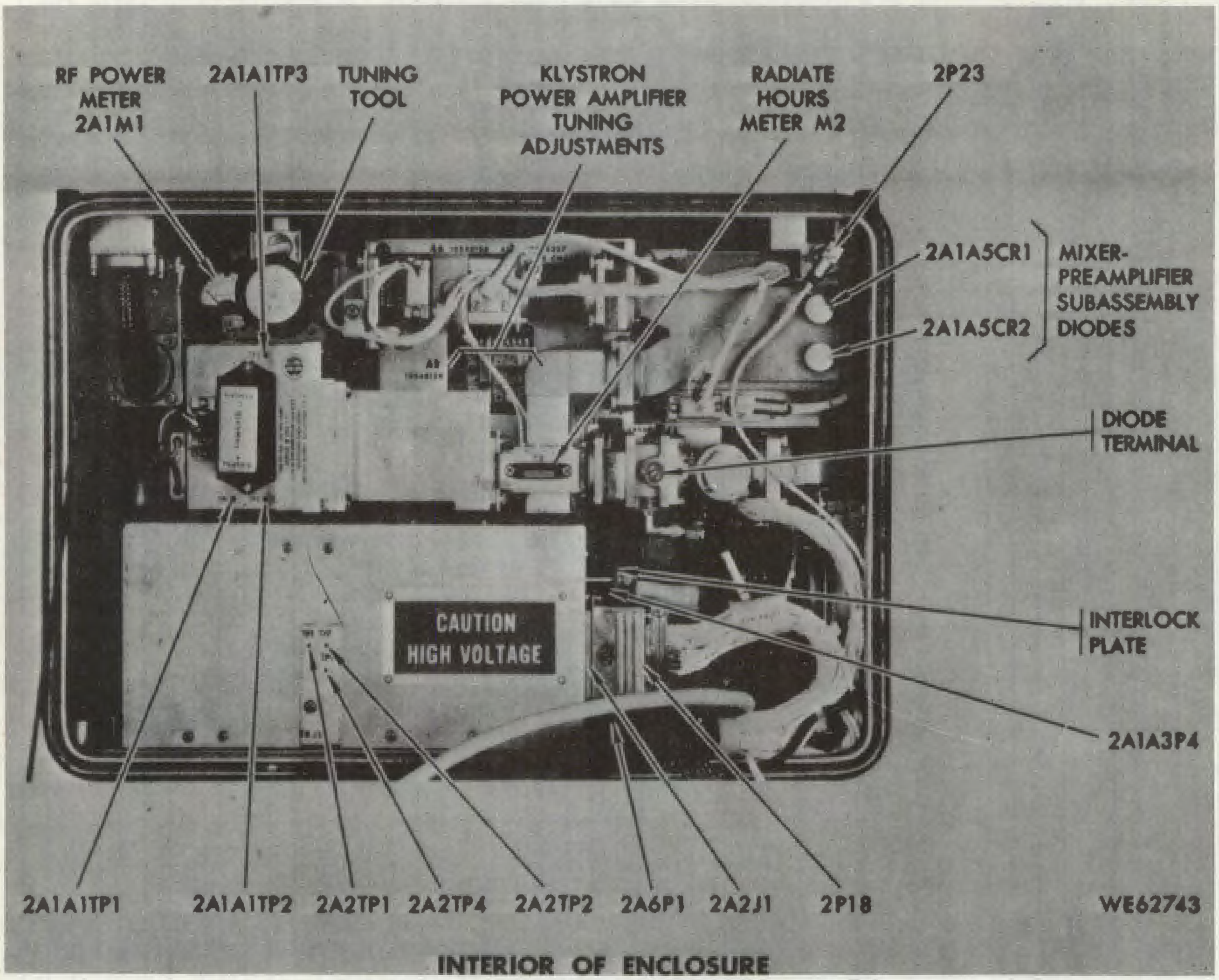


Figure 4-9. Transmitter-receiver unit 2, interior of unit.

Table 4-14. *Transmitting System Fault Isolation Procedures - Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
16	Set the SIGNAL SELECTOR switch on the signal test section of the AN/TPM-23 to 4.			
17	Disconnect the connector from 2A5J2 in the transmitter-receiver (fig. 4-8).			
18	Connect cable assembly W8P2 from the signal test section of the AN/TPM-23 to 2A5J2 in the transmitter-receiver (unit 2).	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (60 MHz gated output).	Note abnormal indication and continue with step 19.	
19	Disconnect cable assembly W8P2 from 2A5J2 and reconnect 2P8 to 2A5J2.			
20	Disconnect the connector from 2DC1J2 in the transmitter-receiver (unit 2).			
21	Connect cable assembly W8P2 from the signal test section of the AN/TPM-23 to 2DC1J2 in the transmitter-receiver (unit 2).	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (60 MHz gated output).	Note abnormal indication and continue with step 22.	
22	Disconnect cable assembly W8P2 from 2DC1J2 and reconnect 2P13 to 2DC1J2. **NOTE** If normal indications (null green zone) were obtained in steps 18 and 21, proceed to and continue with step 55. If an abnormal indication was obtained in either step 18 or 21, proceed with step 23.			
23	Reinstall the front panel of the transmitter-receiver and tighten the four thumbscrews.			

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
24	Set the SIGNAL SELECTOR switch on the signal test section of the AN/TPM-23 to 1.			
25	Remove the front panel enclosure cover from the transmitter-receiver by removing the 11 screws.			
26	Disconnect connector 2P21 from 2Z1J3 in the front panel enclosure of the transmitter-receiver (fig. 4-8).			
27	Reconnect cable assembly W8 to J4 on the signal test section of the AN/TPM-23, through a BNC tee connector adapter CP4 having one input terminated with 50-ohm load plug connector AT1.			
28	Connect cable assembly W8 to 2P21 in the transmitter-receiver through adapter CP3.	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading of 9.5 to 10.5 (60 MHz local oscillator signal).	Replace the 60 MHz local oscillator assembly (2A3). If malfunction is not corrected, replace the transmitter-receiver (unit 2).	Par. 6-45d (11); fig. 6-101, sheet 4.
29	Disconnect cable assembly W8 from 2P21 and reconnect 2P21 to 2Z1J3.			
30	Set the SIGNAL SELECTOR switch on the signal test section of the AN/TPM-23 to 3.			
31	Disconnect the connector from 2Z1J1 in the front panel enclosure of transmitter-receiver (unit 2) (fig. 4-8).			
32	Connect cable assembly W8 to 2Z1J1.	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (power splitter (2Z1) output).	Replace transmitter-receiver (unit 2).	Par. 6-45.
33	Disconnect cable assembly W8 from 2Z1J1 and reconnect 2P22 to 2Z1J1.			

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
34	Disconnect the connector from 2Z1J2 in the front panel enclosure of transmitter-receiver (fig. 4-8).			
35	Connect cable assembly W8 to 2Z1J2.	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (power splitter (2Z1) output).	Replace transmitter-receiver (unit 2).	Par. 6-45.
36	Disconnect cable assembly W8 from 2Z1J2 and reconnect 2P20 to 2Z1J2.			
37	Reinstall the front panel enclosure cover by replacing 11 screws (fig. 4-8).			
38	Open the transmitter-receiver cover by loosening the four thumbscrews (fig. 4-10).			
39	Disconnect 2P24 from connector 2A5J1 in the transmitter-receiver (fig. 4-8).			
40	Set the SIGNAL SELECTOR switch on the signal test section of the AN/TPM-23 to 6.			
41	Disconnect cable assembly W8 from J4 on the signal test section of the AN/TPM-23 and remove the tee connector and AT1.			
42	Return the tee connector and AT1 to the cover of the AN/TPM-23.			
43	Connect cable assembly W8 to pulse input jack J3 on the signal test section of the AN/TPM-23 and pull interlock switch forward and up to restore power.			
44	Connect cable assembly W8 to 2P24 in the transmitter-receiver using connector adapter CP3.	SIGNAL INDICATOR meter on the signal test section of	Perform "synchronizing system" fault isolation	Table 4-12.

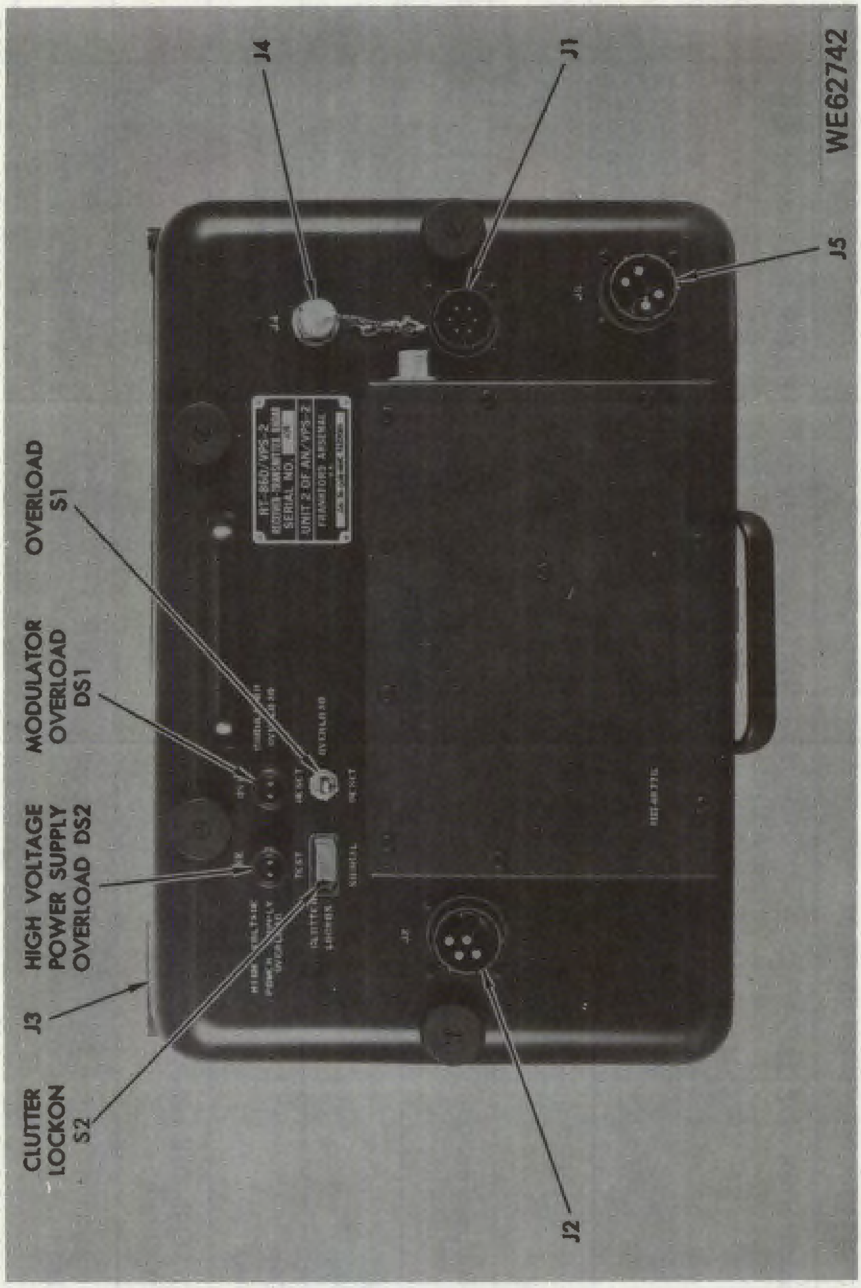


Figure 4-10. Transmitter-receiver unit 2, front panel.

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
44 con.		the AN/TPM-23 indicates a reading in the green zone (modulator trigger signal).	procedures.	
45	Disconnect cable assembly W8 from 2P24 in the transmitter-receiver and reconnect 2P24 to 2A5J1.			
46	Disconnect connector 2P3 from 2A5J6 in the transmitter-receiver (unit 2).			
47	Connect cable assembly W8 to 2A5J6 in the transmitter-receiver (unit 2).	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (modulator trigger signal).	Replace transmit gate assembly (2A5).	Par. 6-45d (8).
48	Disconnect cable assembly W8 from 2A5J6 and reconnect 2P3 to 2A5J6.			
49	Disconnect 2P23 from connector 2A1J2 in the transmitter-receiver (unit 2) (fig. 4-9).			
50	Set the SIGNAL SELECTOR switch on the signal test section of the AN/TPM-23 to 6.			
51	Connect cable assembly W8 to 2P23, using adapter CP3.	SIGNAL INDICATOR meter on the signal test section of the AN/TPM-23 indicates a reading in the green zone (modulator trigger signal).	Replace pulse shaper assembly (2A7).	Par. 6-45d (4).
52	Disconnect cable assembly W8 from 2P23 and reconnect 2P23 to 2A1J2.			
53	Disconnect cable assembly W8 from J3 on the signal test section of the AN/TPM-23, and stow in carrying bag.			

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	WARNING High Voltages are used in the operation of the transmitter-receiver assembly. High voltage is present in the transmitter-receiver when the radar is energized to radiate. Death on contact may result from failure to observe all safety precautions.			
54	Set the SERV RAD CONT switch (S6) in the transmitter-receiver to ON.	a. RF POWER meter (2A1M1) in the transmitter-receiver deflects greater than half scale (radar energized to radiate).	a.(1) If less than half scale deflection, retune the klystron (2A1A3).	(1) TM 9-2350-300-10.
			(2) Replace microwave chassis (2A1).	(2) Par. 6-45d (3).
		b. MODULATOR OVERLOAD and HIGH VOLTAGE POWER SUPPLY OVERLOAD indicators do not light.	b. Set the SERV RAD CONT switch to OFF; momentarily set the OVERLOAD switch in reset. Return the SERV RAD CONT switch to ON. If malfunction is not corrected repeat step 55.	
55	Connect the 300M-A black lead to 2A2TP1 and the red lead to 2A2TP2 in the transmitter-receiver (fig. 4-9).	300M-A indicates +8 to +11 Vdc.	Replace klystron power supply (2A2).	Par. 6-45d (1).
56	Connect the black lead of the 300M-A to 2A2TP4 in the transmitter-receiver.	300M-A indicates +2 to +3.5 Vdc.	Replace klystron power supply (2A2).	Par. 6-45d (1).
57	Remove the 300M-A from the klystron power supply (2A2).			

Table 4-14. *Transmitting System Fault Isolation Procedures—Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
58	Set the SYSTEM POWER switch on the gunner's control panel to OFF. **CAUTION** **When removing, inspecting, and/or replacing spark gap, do not handle glass area of the spark gap. Do not attempt to operate radar set without the spark gap tube; extensive damage to the transmitter-receiver can result.**			
59	Remove cap from klystron beam power supply (2A6); remove and inspect spark gap (2A6E2).	No visible damage.	Replace spark gap (2A6E2).	Par. 6-45*d* (12).
60	Reinstall spark gap (2A6E2) and reconnect the cap to the klystron beam power supply (2A6).			
61	Set the SYSTEM POWER switch on the gunner's control panel to ON.			
62	Wait 2 minutes ±15 seconds.			
63	Connect the black lead from the 300M-A to any convenient point on the klystron beam power supply chassis (2A6) and set TEST LEAD POLARITY switch to REV.			
64	Connect the red lead of the 300M-A to test jack 2A6TP2 on the klystron beam power supply (2A6).	300M-A indicates —36 to —40 Vdc in 100 Vdc range.	Replace the klystron beam power supply (2A6).	Par. 6-45*d* (9).
65	Disconnect the 300M-A from the radar and set SYSTEM POWER switch on gunner's control panel to OFF. *NOTE* For the following steps, 66 through 106, refer to figure 4-11.			
66	Disconnect 2P18 from 2A2J1.			

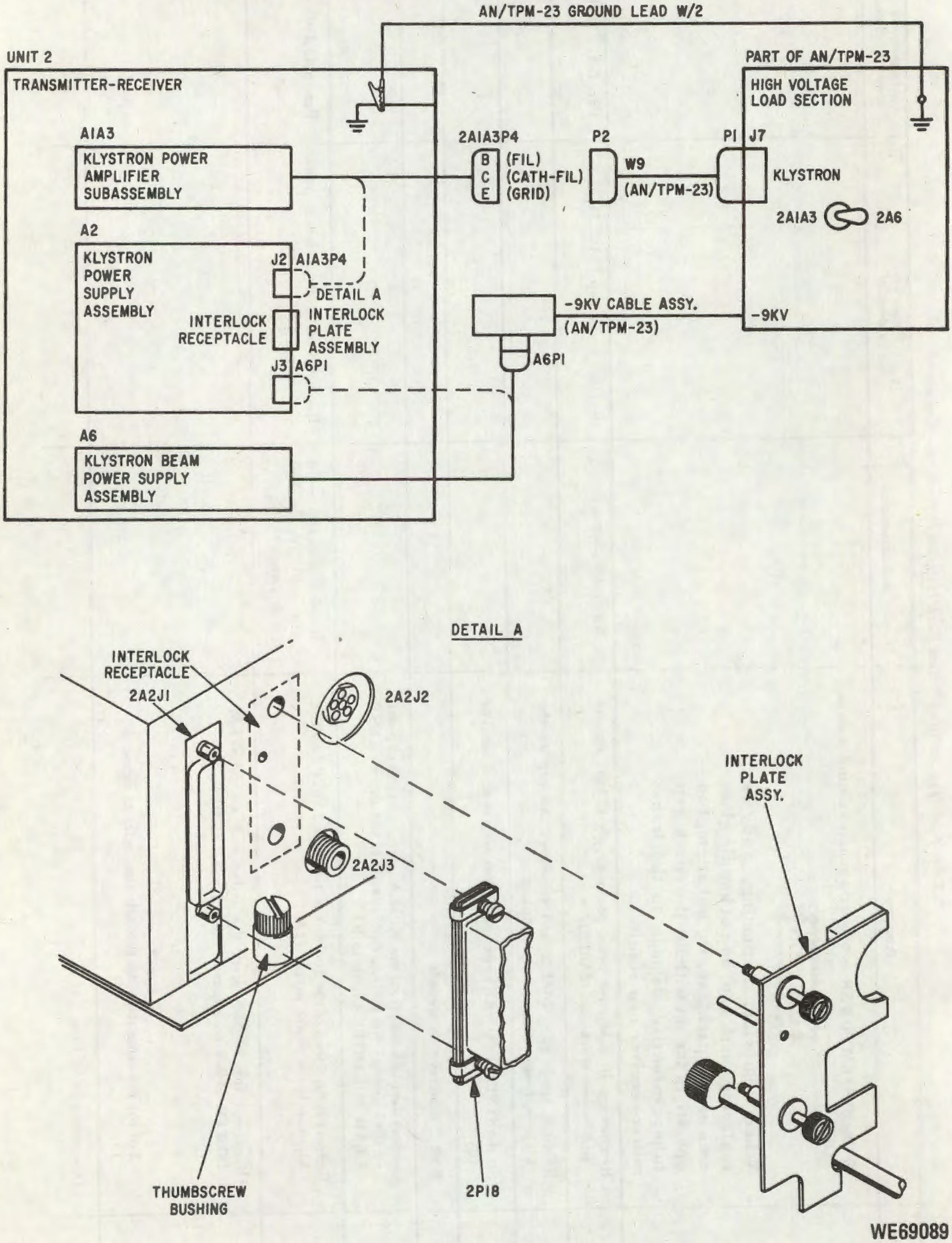


Figure 4-11. High voltage load, test setup diagram.

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
67	Remove the transmitter-receiver interlock plate assembly from the klystron power supply assembly (2A2).			
68	Disconnect 2A6P1 from 2A2J3.			
69	Disconnect 2A1A3P4 from 2A2J2 and leave disconnected.			
70	Connect GRD cable from AN/TPM-22 GRD terminal to the transmitter-receiver grounding strap.			
71	Connect 2A6P1 to –9 kV cable assembly on AN/TPM-23.			
72	Place transmitter-receiver interlock plate on the klystron power supply assembly.			
73	Connect 2P18 to 2A2J1.			Par. 6-45d (3).
74	Using 300M-A, check for continuity between filament pin 2A1A3P4-B and cathode-filament pin 2A1A3P4-C.	Less than 2.5 ohms.	Replace microwave chassis assembly (2A1).	
75	Using 300M-A, check for open between the following: 2A1A3P4-B and grid pin 2A1A3P4-E 2A1A3P4-C and grid pin 2A1A3P4-E 2A1A3P4-E and chassis ground 2A1A3P4-B and chassis ground 2A1A3P4-C and chassis ground	Greater than 500k ohms.	Replace microwave chassis assembly (2A1).	Par. 6-45d (3).
76	Verify that the interlock switch (S3) in the transmitter-receiver is in the SERVICE position (forward and up).			

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	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 from failure to observe safety precautions.			
77	Set the SYSTEM POWER switch on the gunner's control panel in the ON position.	SYSTEM POWER indicator illuminates. Transmitter-receiver blow motor runs. Power supply blower motor runs.		
78	Wait 2 minutes ±15 seconds (system warmup).	READY WHEN LIT indicator illuminates. (System in standby.)		
79	Place 2A1A3/2A6 toggle switch on the high voltage load section of the AN/TPM-23 in the 2A6 position. **WARNING** High voltage is used in operation of transmitter-receiver. High voltage is present in –9 kV cable assembly when radar is energized to radiate. To assure maximum safety, place end of –9 kV cable assembly on top case of transmitter-receiver and assure that personnel do not come in contact with the cable assembly when radar is energized to radiate. Death on contact may result from failure to observe safety precautions.			
80	Apply –9 kV to the high voltage load section of the AN/TPM-23 by placing the SERV RAD CONT toggle switch (S6) in	MODULATOR OVERLOAD and HIGH VOLTAGE	a. Replace spark gap (2A6E2).	a. Par. 6-45d (12).

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
80 con.	the ON position.	POWER SUPPLY OVERLOAD indicators remain extinguished.	b. If both indicators remain extinguished, proceed with step 81. If one or both indicators illuminate, replace the klystron power supply assembly (2A2) and/or replace the klystron beam power assembly (2A6) as required to correct overload.	b. Par. 6-45d (1) and (9).
81	Check the TEST LOAD meter on the high voltage load section of the AN/TPM-23 (2A1A3/2A6 toggle switch in 2A6 position).	Meter indicates mid-scale reading.	a. Replace klystron beam power supply assembly (2A6). b. Replace klystron power supply assembly (2A2).	a. Par. 6-45d (9). b. Par. 6-45d (1).
82	Set the SERV RAD CONT toggle switch (S6) to the OFF position and set SYSTEM POWER switch to OFF.			
83	Connect cable assembly W9P1 to jack J7 on the high voltage load section of the AN/TPM-23.			
84	Connect cable assembly W9P2 to plug 2A1A3P4 on the klystron power amplifier subassembly (2A1A3).			
85	Set the 2A1A3/2A6 switch on the high voltage section of the AN/TPM-23 in the 2A1A3 position.			
86	Energize the radar (steps 77 and 78).			
87	Check the TEST LOAD meter on the high voltage load section of the AN/TPM-23 (2A1A3/2A6 toggle switch in 2A1A3 position).	Meter indicates mid-scale reading.	If meter reading 0 or full scale, defective klystron power amplifier subassembly (2A1A3); replace microwave chassis assembly (2A1).	Par. 6-45d (3).

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	NOTE In the following three steps, turn the SERV RAD CONT toggle switch (S6) to the OFF position while connecting the 300M-A. Then turn switch to the ON position to obtain proper indication.			
88	Connect the positive (+) lead of the 300M-A to test point 2A2TP2 on the klystron power supply and the negative (–) lead to test point 2A2TP1.	300M-A indicates 8 to 11 Vdc.	Replace klystron power supply assembly (2A2).	Par. 6-45d (1).
89	Leave the positive (+) lead of the 300M-A connected to test point 2A2TP2 and connect the negative (–) lead to test point 2A2TP4 on the klystron power supply.	300M-A indicates 2 to 3.5 Vdc.	Replace klystron power supply assembly (2A2).	Par. 6-45d (1).
90	Connect the negative (–) lead of the 300M-A to test point 2A6TP2 on the klystron beam power assembly 2A6TP2 and the positive (+) lead to the chassis.	300M-A indicates between 36 and 40 Vdc.	Replace the klystron beam power supply assembly (2A6).	Par. 6-45d (9).
91	Set the SERV RAD CONT toggle switch (S6) to the OFF position and set SYSTEM POWER switch to OFF.			
92	Disconnect W9P2 from 2A1A3P4.			
93	Remove 2P18 from 2A2J1 and remove the transmitter-receiver interlock plate.			
94	Disconnect 2A6P1 from the –9 kV cable assembly.			
95	Reconnect 2A1A3P4 to 2A2J2 and reconnect 2A6P1 to 2A2J3.			
96	Fasten the transmitter-receiver interlock plate in position on the klystron power supply assembly.			
97	Reconnect 2P18 to 2A2J1.			

Table 4-14. Transmitting System Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
98	Energize the radar (steps 77 and 78). **NOTE** In the following three steps, set the SERV RAD CONT toggle switch (S6) to the OFF position while connecting the 300M-A, then to the ON position to obtain proper indication.			
99	Connect the positive (+) lead of the 300M-A to test point 2A2TP2 on the klystron power supply and the negative (–) lead to test point 2A2TP1.	300M-A indicates 8 to 11 Vdc.	Replace klystron power supply assembly (2A2).	Par. 6-45d (1).
100	Leave the positive (+) lead of the 300M-A connected to test point 2A2TP2 and connect the negative (–) lead to test point 2A2TP4 on the klystron power supply.	300M-A indicates 2 to 3.5 Vdc.	Replace klystron power supply assembly (2A2).	Par. 6-45d (1).
101	Connect the negative (–) lead of the 300M-A to test point 2A6TP2 on the klystron beam power assembly (2A6TP2) and the positive (+) lead to the chassis.	300M-A indicates between 36 and 40 Vdc.	Replace the klystron beam power supply assembly (2A6).	Par. 6-45d (9).
102	Set the SYSTEM POWER switch on the gunner's control panel to OFF.			
103	Set the SERV RAD CONT toggle switch (S6) to the OFF position, push interlock switch (S3) to the normal position, and set SYSTEM POWER switch to OFF.			
104	Close the transmitter-receiver front panel and tighten the four thumbscrews.			
105	Disconnect cable assembly W2 and reconnect W5P2 to 5J1.			
106	Stow the AN/TPM-23 cables in the carrying bag and replace the AN/TPM-23 accessories in their respective positions inside the AN/TPM-23 lid.			

Table 4-15. Antenna Positioning Fault Isolation Procedures.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	CAUTION Never move the antenna manually without first electrically releasing the brakes. **NOTE** If antenna operates electrically in elevation, proceed to and continue with step 83. If antenna does not operate electrically in elevation, commence with step 1.			
1	Place the AN/TPM-23 on top of the vehicle.			
2	Install the boresight telescope in the radar antenna (TM 9-2350-300-10).			
3	Verify that the sight is mechanically caged.			
4	Verify that the following circuit breakers are in the set position prior to performing checkout. Distribution box SIGHT GYRO PWR .... A1CB4 SCG PWR .... A1CB1 INVERTER PWR .... A1CB3 SYS PWR .... A1CB2 Radar power supply TRAV .... 5CB2 ELEV .... 5CB3 CONTROL CKT .... 5CB4 BLOWERS 5CB5			
5	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
6	Set the MODE switch on the gunner's control panel to RADAR. **CAUTION** Assure that no one touches any controls or switches while using the boresight telescope.			
7	Sight the boresight crosshairs on a distant aiming point (TM 9-2350-300-10).			
8	Set the SYSTEM POWER switch on the gunner's control panel to OFF. **NOTE** Assure that the XM157 mount is not moved.	SYSTEM POWER indicator extinguishes.		
9	Connect the AN/TPM-23 to the radar system in accordance with figure 4-12A. **NOTE** Route cable W6 under the antenna support bracket (57, fig. 6-95).			
10	Set the AMPLIFIER OUTPUT switch on the ANTENNA TEST section of the AN/TPM-23 to LOAD.			
11	Set the AMPL ERR SIG switch on the ANTENNA TEST section of the AN/TPM-23 to ON.			
12	Set the EL/TRAV POS dial on the ANTENNA TEST section of the AN/TPM-23 to 0 (exactly).			
13	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.

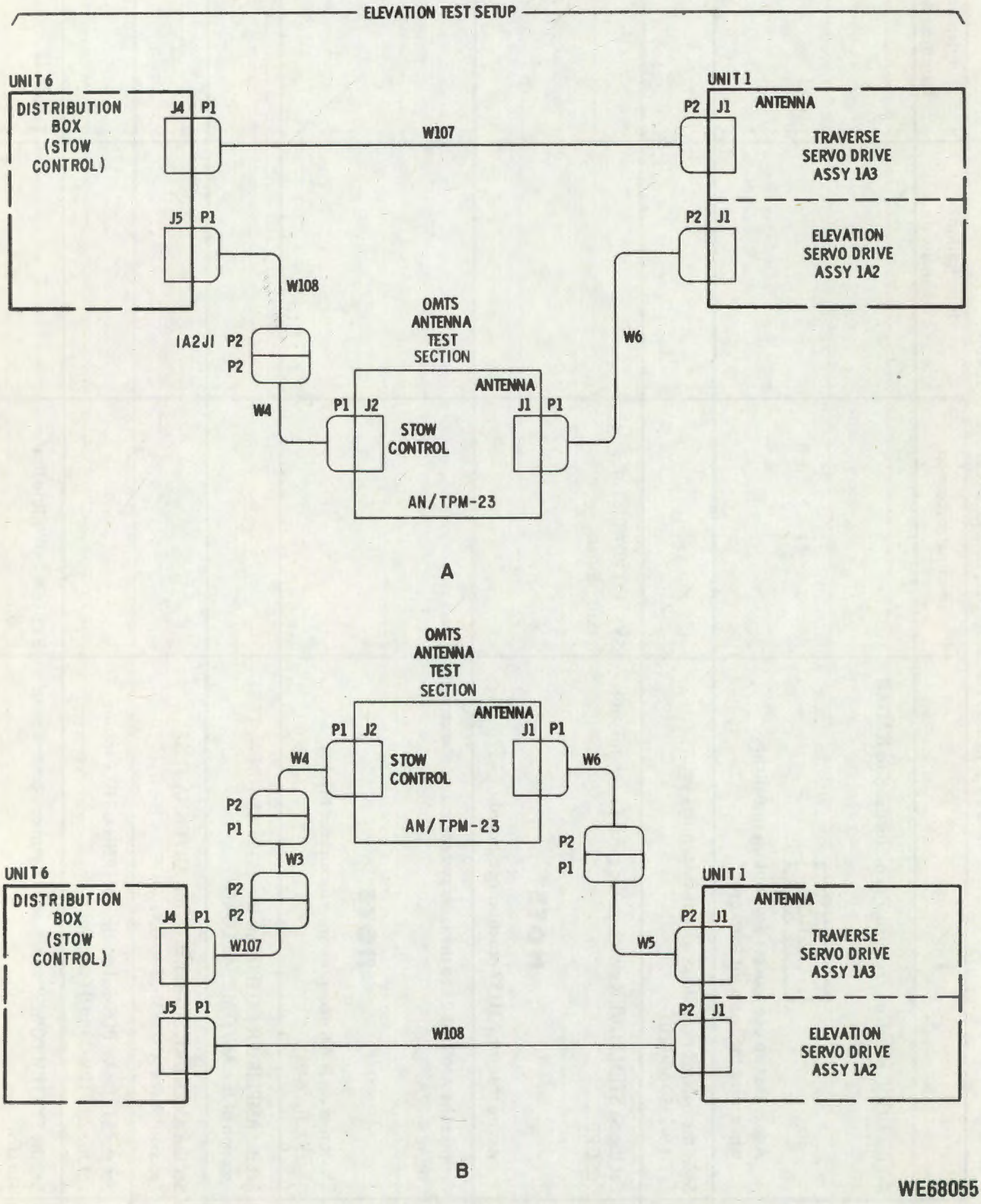


Figure 4-12. Antenna positioning system fault isolation, test setup diagram.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
14	Set the MAINT switch on the stow control to ON. **CAUTION** Assure that no one touches any controls or switches while using the boresight telescope.			
15	Look at the distant aiming point (step 7) through the boresight telescope.	Crosshairs have moved less than 10 mils.	AN/TPM-23 requires calibration.	
16	Remove the boresight telescope from the antenna.			
17	Verify that the MODE switch on the stow control (unit 6) is in NORMAL position.			
18	Set the MAINT switch on the stow control (unit 6) to OFF.			
19	Set the λPOT EXCITATION switch on the ANTENNA TEST section of the AN/TPM-23 to OFF.			
20	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to NO LOAD.			
21	Set the AMPL ERR SIG switch on the antenna test section of the AN/TPM-23 to OFF.			
22	Verify that the STATIC-NORM-TEST switch on the system distribution box is in the STATIC (center) position.			
23	Set the MAINT switch on the stow control (unit 6) to ON.			
24	Manually uncage the sight.			
25	Set the 300M-A to read 30 Vdc.			

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
26	Connect the 300M-A black lead to the 24V RET test jack and the red lead to the BRAKE REL VOLTS test jack on the antenna test section of the AN/TPM-23.	300M-A indicates +22 to +28.5 Vdc. (Record value obtained for future reference.)	a. Assure control circuit breaker CB-4 (unit 5) is reset. b. Check the following components for continuity and replace as necessary: (1) Stow control (unit 6). (2) Power supply (unit 5). (3) Cable W101.	(1) Par. 6-49. (2) Par. 6-48. (3) Fig. 3-54, and fig. 3-62, sheet 5.
27	Manually position the cannon to zero degrees in elevation as indicated by the scribe marks on the sight saddle and support.	Antenna positions to zero degrees elevation.	Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original component: (1) Elevation servo electronics assembly (5A2). (2) Elevation servo drive assembly (1A2). (3) Stow control (unit 6). (4) Cable W108.	(1) Par. 6-48c (2). (2) Par. 6-44d (9). (3) Par. 6-49. (4) Fig. 3-61, and fig. 3-62, sheet 5.
28	Set the AMPL ERR SIG switch on the antenna test section of the AN/TPM-23 to ON.			
29	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.	Antenna remains at zero degrees elevation.	Continue with step 30.	
30	Check voltage from S1 test point to S3 test point on the antenna test section of the AN/TPM-23 with the 300M-A.	300M-A indicates 0 to 0.2 Vac.	Defective synchro transmitter in the XM61 sight; replace sight.	Par. 6-52.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
31	Disconnect the 300M-A from the AN/TPM-23.			
32	Set the 300M-A to read 100 VAC.			
33	Connect the 300M-A across the AMPL ERR SIG test points on the antenna test section of the AN/TPM-23.	300M-A indicates 0 Vac.	Repeat from step 30.	
34	Vary the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 from 0 to 90 degrees.	300M-A indication varies as antenna drives in elevation.	a. Replace the elevation servo electronics assembly (5A2). b. Check continuity through cables W101 and W108; replace if open or shorted.	a. Par. 6-48c (2). b. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
35	Reposition the EL/TRAV POS dial to 0 degrees. **CAUTION** Never connect the AMPLIFIER OUTPUT points on the antenna test section of the AN/TPM-23 to ground.	Antenna returns to zero degrees elevation.	Repeat steps 30 through 35.	
36	Disconnect the 300M-A from the AN/TPM-23.			
37	Set the 300M-A to read 24 Vdc.			
38	Connect the 300M-A across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23.			
39	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to NO LOAD.			
40	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 slowly back and forth past the 0 degree mark.	300M-A indicates voltage changes polarity as dial is rotated past the 0 degree mark.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original:	

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
40 con.		(1) Record maximum value. (2) Subtract 3.5 Vdc from value obtained in step 26. (3) Value obtained in (1) preceding must be greater than value obtained in (2) preceding.	(1) Elevation servo electronics assembly (5A2). (2) Stow control (unit 6). b. Check continuity through cables W101 and W108. Replace if open or shorted.	(1) Par. 6-48c (2). (2) Par. 6-49. b. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
41	Set the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to 0 degrees.			
42	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.	300M-A indicates a maximum reading of 24 Vdc (positive or negative).	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: (1) Elevation servo drive assembly (1A2). (2) Stow control (unit 6). b. Check continuity through cables W101 and W108. Replace if open or shorted.	(1) Par. 6-44d (9). (2) Par. 6-49. b. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
	CAUTION The down electrical limit switch closes at −10 degrees, but the mechanical stop is at −80 degrees. Care must be taken to assure that the antenna reflector does not strike any objects when being driven beyond its down electrical limit.			
43	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to move the antenna to a position just before the electrical limit is reached (−10 degrees; +95 degrees).	Antenna follows the EL/TRAV POS dial.	Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: a. Elevation servo electronics assembly (5A2). b. Power supply (unit 5). c. Elevation servo drive assembly (1A2). d. Antenna (unit 1).	 a. Par. 6-48c (2). b. Par. 6-48. c. Par. 6-44d (9). d. Par. 6-44.
44	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to drive the antenna up into the mechanical stop.	Antenna drives up to mechanical limit and stops.	a. Check limit switch (1A2S1) and replace if defective. If malfunction is not corrected, replace elevation servo drive assembly (1A2). b. Change the elevation servo electronics assembly (5A2). If malfunction is not corrected, reinstall original. c. Change the stow control (unit 6). If malfunction is not corrected, reinstall the original.	a. Fig. 3-71, sheet 2; par. 6-44d (9). b. Par. 6-48c (2). c. Par. 6-49.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
44 con.			d. Check continuity through cables W101 and W108. Replace if open or shorted.	d. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
45	Set the 300M-A to read 10 Vdc and read the voltage across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23 (reduced drive signal).	300M-A indicates +7 Vdc or less.	a. Check the elevation limit switch (1A2S1) and replace if defective. If malfunction is not corrected, replace the elevation servo drive assembly (1A2). b. Replace elevation servo electronics assembly (5A2).	a. Fig. 3-71, sheet 2; par. 6-44d (9). b. Par. 6-48c (2).
46	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to drive the antenna down into the mechanical stop.	300M-A indicates +7 Vdc or less.	a. Check the elevation limit switch (1A2S1) and replace if defective. If malfunction is not corrected, replace the elevation servo drive assembly. b. Replace the elevation servo electronics assembly (5A2).	a. Par. 6-44d (9). b. Par. 6-48c (2).
47	Leave the antenna in the lower mechanical stop.			
48	Connect the 300M-A across the LIM SW and 24V RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates 0 to 0.2 Vdc.	a. 300M-A indicates +24 Vdc or drives slowly within limit: Replace limit switch (1A2S1). If malfunction is not corrected, replace the elevation servo drive assembly (1A2).	a. Par. 6-44d (9).

Table 4-15. *Antenna Positioning Fault Isolation Procedures - Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
48 con.			b. No +24 Vdc; antenna bumps into stop: (1) Check for open cable W108 J1 pin g to power supply (unit 5). Replace cable W108 if open. (2) Replace elevation servo electronics assembly (5A2).	(1) Fig. 3-61 and fig. 3-62, sheet 5. (2) Par. 6-48c (2).
49	Set the 300M-A to read 24 Vdc.			
50	Position the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to 0 degrees.	300M-A indicates approximately +24 Vdc when antenna moves rapidly after passing electrical stop. Antenna stops at zero degrees elevation.	Replace elevation servo drive assembly (1A2).	Par. 6-44d (9).
51	Slowly rotate the EL/TRAV POS dial clockwise until the 300M-A indicates 0 Vdc.	EL/TRAV POS dial reads between 352 and 344 degrees.	Replace the elevation servo drive assembly (1A2).	Par. 6-44d (9).
52	Slowly rotate the EL/TRAV POS dial counterclockwise (past 0 degrees) until the 300M-A indicates 0 Vdc.	EL/TRAV POS dial reads between 96 and 121 degrees.	Replace the elevation servo drive assembly (1A2).	Par. 6-44d (9).
53	Set the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to 0 degrees.	Antenna returns to 0 degrees elevation.		
54	Set the MODE switch on the stow control (unit 6) to STOW.			
55	Disconnect the 300M-A from the AN/TPM-23.			
56	Set the 300M-A to read 100 Vdc.			

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
57	Connect the 300M-A to the TACH FDBK test jacks on the antenna test section of the AN/TPM-23.			
58	Activate the elevation drive by momentary use of the ELEV switch on the stow control (unit 6).	300M-A indicates a voltage as antenna moves; polarity changes with direction of drive.	a. No voltage indicated: (1) Replace motor-generator (1A2MG1). If malfunction is not corrected, replace elevation servo drive assembly (1A2). (2) Check continuity of cable W108 from 1A2MG1 to power supply (unit 5); replace if open or shorted. b. Antenna races: Replace elevation servo drive assembly (1A2). c. Antenna does not move: Replace elevation servo electronics assembly (5A2). If malfunction is not corrected, replace the stow control (unit 6).	(1) Par. 6-44d (9). (2) Fig. 3-61, and fig. 3-62, sheet 5. b. Par. 6-44d (9). c. Pars. 6-48 and 6-49.
59	Disconnect the 300M-A from the AN/TPM-23.			
60	Set the 300M-A to read +24 Vdc.			
61	Connect the 300M-A across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23.			
62	Set the AMPLIFIER OUTPUT switch on the antenna section of the AN/TPM-23 to NO LOAD.			

Table 4-15. *Antenna Positioning Fault Isolation Procedures - Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
63	Activate the elevation drive by momentary use of the ELEV switch on the stow control (unit 6).	300M-A indicates +22 to +28.5 Vdc.	a. 0 volts indicated: (1) Check circuit breaker (5CB3) on the power supply (unit 5). If tripped, reset. If it will not reset, replace power supply (unit 5). (2) Check continuity of cables W101 and W108. Replace if open or shorted. (3) Replace stow control (unit 6). b. Low voltage indicated: Replace the elevation servo electronics assembly (5A2).	(1) Par. 6-48. (2) Figs. 3-54, 3-61, and fig. 3-62, sheet 5. (3) Par. 6-49. b. Par. 6-48c (2).
64	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.			
65	Disconnect the 300M-A from the AN/TPM-23.			
66	Set the MODE switch on the stow control (unit 6) to NORMAL.			
67	Set the λ POT EXCITATION switch on the antenna test section of the AN/TPM-23 to NORM.			
68	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.			
69	Set the MV (muzzle velocity) switch on the sight current generator to 4.			
70	Set the AIR DENSITY switch on the sight current generator to 1.0.			

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
71	Verify that the ballistic data component assembly in the sight current generator is in the 220 position.			
72	Verify that the sight is not caged.			
73	Set the 300M-A to read −15 Vdc.			
74	Connect the 300M-A between the −15 V and RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates −14.8 to −15.2 Vdc.	Perform sight current generator check, steps 1 through 13 and table 4-6. Replace sight current generator if indications are abnormal.	Table 4-6; par. 6-41.
75	Connect the 300M-A between the + λ E EXC and RET test jacks on the antenna section of the AN/TPM-23.	300M-A indicates 0 ±0.10 volts.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: (1) Elevation servo drive assembly (1A2). (2) Stow control (unit 6). b. Check the continuity through cables W107 and W108. Replace if open or shorted. c. Perform the sight current generator check.	 (1) Par. 6-44d (9). (2) Par. 6-49. b. Figs. 3-60, 3-61, and fig. 3-62, sheet 5. c. Table 4-6.
76	Connect the 300M-A between the -λ EXC and RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates −0.1 to +0.1 Vdc.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: (1) Elevation servo drive assembly (1A2).	 (1) Par. 6-44d (9).

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
76 con.			(2) Stow control (unit 6).	(2) Par. 6-49.
			b. Check the continuity through cables W107 and W108. Replace if open or shorted.	b. Figs. 3-60, 3-61, and fig. 3-62, sheet 5.
			c. Perform the sight current generator check.	c. Table 4-6.
77	Connect the 300M-A between the + λE^3 EXC and RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates –0.1 to –0.3 Vdc.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original:	
			(1) Elevation servo drive assembly (1A2).	(1) Par. 6-44d (9).
			(2) Stow control (unit 6).	(2) Par. 6-49.
			b. Check the continuity through cables W107 and W108. Replace if open or shorted.	b. Figs. 3-60, 3-61, and fig. 3-62, sheet 5.
			c. Perform the sight current generator check.	c. Table 4-6.
78	Connect the 300M-A between the – λE^3 EXC and RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates +0.1 to +0.3 Vdc.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original:	
			(1) Elevation servo drive assembly (1A2).	(1) Par. 6-44d (9).
			(2) Stow control (unit 6).	(2) Par. 6-49.
			b. Check the continuity through cables W107 and W108. Replace if open or shorted.	b. Figs. 3-60, 3-61, and fig. 3-62, sheet 5.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

<table>
<tr><th>Step</th><th>Procedure</th><th>Normal indication</th><th>If indication is abnormal</th><th>Reference for abnormal indication</th></tr>
<tr><td>78 con.</td><td></td><td></td><td>c. Perform the sight current generator check.</td><td>c. Table 4-6.</td></tr>
<tr><td>79</td><td>Remove the 300M-A from the AN/TPM-23.</td><td></td><td></td><td></td></tr>
<tr><td>80</td><td>Set the λ POT EXCITATION switch on the antenna test section of the AN/TPM-23 to −15V.</td><td></td><td></td><td></td></tr>
<tr><td>81</td><td>Set the EL/TRAV POS dial to the following listed settings and measure the voltages between the indicated test jacks and the RET test jack:
<table>
<tr><th>EL/TRAV POS dial setting</th><th>300M-A INDICATION
λ ESIG</th><th>λE^2SIG</th><th>λE^3SIG</th></tr>
<tr><td>0°</td><td>0 to −0.05</td><td>0 to 0.125</td><td>0 to 0.125</td></tr>
<tr><td>20°</td><td>−9.2 to −10.0</td><td>−5.85 to −6.45*</td><td>−3.7 to −4.1</td></tr>
<tr><td>340°</td><td>−9.2 to −10.0</td><td>−5.85 to −6.45*</td><td>−3.7 to −4.1</td></tr>
</table>
* The λE^2SIG reading 20° and 340° must be within 200 mV of each other.</td><td></td><td>Replace the elevation servo drive assembly (1A2).</td><td>Par. 6-44d (9).</td></tr>
<tr><td></td><td>Cage the XM61 sight and set the SYSTEM POWER switch on the gunner's control panel to OFF.</td><td>SYSTEM POWER indicator extinguishes.</td><td></td><td></td></tr>
<tr><td>82</td><td>Disconnect the AN/TPM-23 cables from the radar and reinstall the original cables.

NOTE

If the antenna operates in traverse, the fault isolation is complete. If the antenna does not operate properly in traverse, continue with step 83. If elevation fault isolation was performed, proceed to and continue with step 97.</td><td>**CAUTION**

Do not move the antenna manually without electrically releasing the brake.</td><td></td><td></td></tr>
</table>

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
83	Place the AN/TPM-23 on top of the vehicle.			
84	Install the boresight telescope in the radar antenna.			
85	Verify that the sight is mechanically caged.			
86	Verify that all circuit breakers on the radar power supply (unit 5) are depressed.			
87	Set the SYSTEM POWER switch on the gunner's control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.
88	Set the MODE switch on the gunner's control panel to RADAR. **CAUTION** Assure that no one touches any controls or switches while using the boresight telescope.			
89	Sight the boresight crosshairs on a distant aiming point.			
90	Set the SYSTEM POWER switch on the gunner control panel to OFF. **NOTE** Assure that the mount is not moved.	SYSTEM POWER indicator extinguishes.		
91	Connect the AN/TPM-23 to the radar system in accordance with figure 4-12B.			
92	Set the AMPLIFIER OUTPUT switch on the ANTENNA TEST section of the AN/TPM-23 to LOAD.			
93	Set the AMPL ERR SIG switch on the ANTENNA TEST section of the AN/TPM-23 to ON.			

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
94	Set the EL/TRAV POS dial on the ANTENNA TEST section of the AN/TPM-23 to 0 (exactly).			
95	Set the SYSTEM POWER switch on the gunner control panel to ON.	SYSTEM POWER indicator lights.		Table 4-11.
96	Set the MAINT switch on the stow control to ON. **CAUTION** Assure that no one touches any controls or switches while using the boresight telescope.			
97	Look at the distant aiming point (step 89) through the boresight telescope.	Crosshairs have moved less than 10 mils.	AN/TPM-23 requires calibration.	
98	Remove the boresight telescope from the antenna.			
99	Verify that the MODE switch on the stow control (unit 6) is in NORMAL position.			
100	Set the MAINT switch on the stow control (unit 6) to OFF.			
101	Verify that all circuit breakers on the radar power supply (unit 5) are depressed.			
102	Set the λ POT EXCITATION switch on the antenna section of the AN/TPM-23 to OFF.			
103	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to NO LOAD.			
104	Set the AMPL ERR SIG switch on the ANTENNA TEST section of the AN/TPM-23 to OFF.			

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
105	Verify that the STATIC-NORM-TEST switch on the system distribution box is in the STATIC (center position).			
106	Set the MAINT switch on the stow control (unit 6) to ON.			
107	Manually uncage the sight.			
108	Set the 300M-A to read 30 Vdc.			
109	Connect the 300M-A black lead to the 24V RET test jack and the red lead to the BRAKE REL VOLTS test jack on the antenna test section of the AN/TPM-23. **CAUTION** Clockwise rotation of the EL/TRAV POS dial will cause the antenna to rotate to the right.	300M-A indicates +22 to +28.5 Vdc. Record value obtained for future reference.	a. Assure control circuit breaker CB-4 (unit 5) is reset (fig. 6-107). b. Check the following components for continuity and replace as necessary: (1) Stow control (unit 6). (2) Power supply (unit 5). (3) Cable W101.	(1) Fig. 3-71; par. 6-49. (2) Fig. 3-71; par. 6-48. (3) Fig. 3-54, and fig. 3-62, sheet 5.
110	Set the AMPL ERR SIG switch on the ANTENNA TEST SECTION of the AN/TPM-23 to ON.			
111	Set the AMPLIFIER OUTPUT switch on the ANTENNA TEST section of the AN/TPM-23 to LOAD.	Antenna remains at zero degrees traverse angle (along gun line).	Continue with step 112.	
112	Check the voltage from S1 test point to S3 test point on the ANTENNA TEST section of the AN/TPM-23 with the 300M-A.	300M-A indicates 0 to 0.2 Vac.	Defective synchro transmitter in the XM61 sight; replace sight.	Par. 6-52.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
113	Disconnect the 300M-A from the AN/TPM-23.			
114	Set the 300M-A to read 100 Vac.			
115	Connect the 300M-A across the AMPL ERR SIG test points on the antenna test section of the AN/TPM-23. **CAUTION** Never connect the AMPLIFIER TEST points on the antenna test section of the AN/TPM-23 to ground.	300M-A indicates 0 Vac.	Repeat from step 112.	
116	Vary the EL/TRAV POS dial from 0 to 90 degrees.	300M-A indication varies as antenna drives in traverse.	a. Replace the (traverse) servo electronics assembly (5A1). b. Check continuity through cables W101 and W108. Replace if open or shorted.	a. Par. 6-48c (2). b. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
117	Reposition the EL/TRAV POS dial to 0 degrees.	Antenna positions to zero degrees traverse.	Repeat steps 112 through 117.	
118	Disconnect the 300M-A from the AN/TPM-23.			
119	Set the 300M-A to read 24 Vdc.			
120	Connect the 300M-A across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23.			
121	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to NO LOAD.			

Table 4-15. *Antenna Positioning Fault Isolation Procedures - Continued.*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
122	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 slowly back and forth past the 0 degree mark.	300M-A indicates voltage changes polarity as dial is rotated past the 0 degree mark. (1) Record maximum value. (2) Subtract 3.5 Vdc from value obtained in step 109. (3) Value obtained in (1) preceding must be greater than the value obtained in (2) preceding.	a. Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: (1) Traverse servo electronics assembly (5A1). (2) Stow control (unit 6). b. Check continuity through cables W101 and W108. Replace if open or shorted.	 (1) Par. 6-48c (2). (2) Par. 6-49. b. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
123	Set the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 at 0 degrees.			
124	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.			
125	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to move the antenna to a position just before the electrical limit is reached (±25 degrees from the 0 degrees position).	Antenna follows the EL/TRAV POS dial.	Replace the listed components in the order given. If the malfunction is not corrected, reinstall the original: (1) Traverse servo electronics assembly (5A1). (2) Power supply (unit 5). (3) Traverse servo drive assembly (1A3). (4) Antenna (unit 1).	 (1) Par. 6-48c (2). (2) Par. 6-48. (3) Par. 6-44d (10). (4) Par. 6-44.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
126	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 clockwise to drive the antenna into the mechanical stop.	Antenna drives into mechanical limit and stops.	a. Check limit switch (1A3S1) and replace if defective. If malfunction is not corrected, replace traverse servo drive assembly (1A1). b. Replace the traverse servo electronics assembly (5A1). If malfunction is not corrected, reinstall original. c. Replace the stow control (unit 6). If malfunction is not corrected, reinstall the original. d. Check continuity through cables W101 and W108. Replace if open or shorted.	a. Fig. 3-71, sheet 2; par. 6-44d (10). b. Par. 6-48c (2). c. Par. 6-49. d. Figs. 3-54, 3-61, and fig. 3-62, sheet 5.
127	Set the 300M-A to read 10 Vdc and read the voltage across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23 (reduced drive signal).	300M-A indicates +7 Vdc or less.	a. Check the traverse limit switch (1A3S1) and replace if defective. If malfunction is not corrected, replace the traverse servo drive assembly (1A1). b. Replace the traverse servo electronics assembly (5A1).	a. Fig. 3-71, sheet 2; par. 6-44d (10). b. Par. 6-48c (2).
128	Rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 counterclockwise to drive the antenna left into the mechanical stop.	300M-A indicates +7 Vdc or less.	a. Check the traverse limit switch (1A3S1) and replace if defective. If malfunction is not corrected, replace the traverse servo drive assembly (1A1).	a. Fig. 3-71, sheet 2; par. 6-44d (10).

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
128 con.			b. Replace the traverse servo electronics assembly (5A1).	b. Par. 6-48c (2).
129	Leave the antenna in the left mechanical stop.			
130	Connect the 300M-A across the LIM SW and RET test jacks on the antenna test section of the AN/TPM-23.	300M-A indicates 0 to 0.2 Vdc.	a. 300M-A indicates +24 Vdc or drives slowly within the limits: Check limit switch (1A3S1) and replace if defective. If malfunction is not corrected, replace the traverse servo drive assembly (1A3). b. No +24 Vdc; antenna bumps into stop: (1) Check for open cable W108 to power supply (unit 5). Replace if open. (2) Replace traverse servo electronics assembly (5A1).	a. Par. 6-44d (10). (1) Fig. 3-61, and fig. 3-62, sheet 5. (2) Par. 6-48c (2).
131	Set the 300M-A to read 24 Vdc.			
132	Position the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 to 0 degrees.	300M-A indicates approximately 24 Vdc as antenna moves rapidly from mechanical stop. Antenna stops at zero degrees traverse.	Replace the traverse servo drive assembly (1A3).	Par. 6-44d (10).
133	Slowly rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 clockwise until the 300M-A indicates 0 Vdc.	EL/TRAV POS dial indicates from 324.5° to 329°.	Replace the traverse servo drive assembly (1A3).	Par. 6-44d (10).

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
134	Slowly rotate the EL/TRAV POS dial on the antenna test section of the AN/TPM-23 counterclockwise (past 0°) until the 300M-A indicates 0 Vdc.	EL/TRAV POS dial indicates from 31° to 35.5°	Replace the traverse servo drive assembly (1A3).	Par. 6-44d (10).
135	Set the MODE switch on the stow control (unit 6) to STOW.			
136	Disconnect the 300M-A from the AN/TPM-23.			
137	Set the 300M-A to read 100 Vdc.			
138	Connect the 300M-A to the TACH FDBK test jacks on the antenna test section of the AN/TPM-23.			
139	Activate the traverse drive by momentary use of the TRAV switch on the stow control (unit 6).	300M-A indicates a voltage as antenna moves; polarity changes with direction of drive.	a. No voltage indicated: (1) Check motor-generator (1A3MG1) and replace if defective. If malfunction is not corrected, replace the traverse servo drive assembly (1A3). (2) Check continuity of the cable W107 from 1A3MG1 to power supply (unit 5). Replace if open or shorted. b. Antenna races: Replace traverse servo drive assembly (1A3). c. Antenna does not move: Replace traverse servo electronics assembly (5A1). If malfunction is not corrected, replace the stow control (unit 6).	(1) Fig. 3-71, sheet 2; par. 6-44d (10). (2) Fig. 3-60 and fig. 3-62, sheet 5. b. Par. 6-44d (10). c. Pars. 6-48c (2) and 6-49.

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
140	Disconnect the 300M-A from the AN/TPM-23.			
141	Set the 300M-A to read +24 Vdc.			
142	Connect the 300M-A across the AMPLIFIER OUTPUT test jacks on the antenna test section of the AN/TPM-23.			
143	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to NO LOAD.			
144	Activate the traverse drive by momentary use of the TRAV switch on the stow control (unit 6).	300M-A indicates +22 to +28.5 Vdc.	a. 0 volts indicated: (1) Check circuit breakers on the power supply (unit 5). If tripped, reset. If circuit breaker(s) will not reset, replace power supply (unit 5). (2) Check continuity of cables W101 and W107. Replace if open or shorted. (3) Replace stow control (unit 6). b. Low voltage indicated: Replace the traverse servo electronics assembly (5A1).	(1) Par. 6-48. (2) Figs. 3-54, 3-60, and fig. 3-62, sheet 5. (3) Par. 6-49. b. Par. 6-48c (2).
145	Set the AMPLIFIER OUTPUT switch on the antenna test section of the AN/TPM-23 to LOAD.			
146	Actuate the traverse drive by momentary use of the TRAV switch on the stow control (unit 6).	300M-A indicates a maximum of approximately 4 Vdc (2-3 volts normal) until a limit is reached then drops to between 0.5 and 2.0 Vdc.		

Table 4-15. Antenna Positioning Fault Isolation Procedures - Continued.

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
147	Set the MODE switch on the stow control (unit 6) to NORMAL.			
148	Set the λ POT EXCITATION switch on the antenna test section of the AN/TPM-23 to NORM.			
149	Connect the 300M-A between the –15V and RET test jacks on the antenna test sections of the AN/TPM-23.	300M-A indicates –14.8 to –15.2 Vdc.		
150	Set the EL/TRAV POS dial to the following listed setting and measure the voltages between the λ^2 SIG and RET test jacks on the antenna test section of the AN/TPM-23. EL/TRAV POS dial setting — Indicated 300M-A reading 0° — 0 to –0.05 20° — –5.35 to –6.15 340° — –5.35 to –6.15		λ^2 function potentiometer (1A3R1) defective. Replace the traverse servo drive assembly (1A3).	Par. 6-44d (10).
151	Cage the XM61 sight and set the SYSTEM POWER switch on the gunner's control panel to OFF.	SYSTEM POWER indicator extinguishes.		
152	Remove the AN/TPM-23 cables from the radar and reinstall all system cables.			

CHAPTER 5
FAULT ISOLATION OF MECHANICAL COMPONENTS

5-1. General

This chapter provides procedures and information to aid in the fault isolation of the mechanical portions of the XM163 system. Most mechanical failures occur during the operation of the weapon system and leave no question as to the location of the malfunction. Care should be taken when analyzing a malfunction, for although the apparent damage may have resulted from a visible failure, the actual cause may require closer investigation.

WARNING

When a system has had a sudden stoppage, assure sufficient time has elapsed (approximately 30 minutes) to permit the barrels to cool, eliminating the danger of a cook-off. Permit no one to enter the area in front of the barrels until the weapon has been cleared. Verify that SYSTEM and GUN POWER switches are in the OFF position and cable W3 is disconnected from the firing contact assembly before proceeding with fault isolation.

NOTE

When the cable is disconnected from the firing contact assembly it should be secured to the gun saddle assembly using Strapping 5340-081-5169 or 5340-182-4682.

5-2. Checkout/Fault Isolation Procedures

Checkout/fault isolation procedures for mechanical components are contained in table 5-1. These procedures provide a checkout of the mechanical operation of the cannon and ammunition storage and feed group. These procedures when performed in sequence aid in the location of a malfunction without causing additional damage to equipment.

a. If an abnormal indication is obtained for any step, additional information is provided in the "If indication is abnormal" column to enable identification of the most likely cause of the malfunction. References are made in the "Reference for abnormal indication" column to the appropriate adjustment or repair procedures and illustrations that will be of use in identifying and correcting the malfunction.

b. In some cases, in which a more extensive fault isolation procedure is required to identify the malfunction, reference is made to table 5-2. This table provides detailed fault isolation procedures for further isolation of a malfunction. Where a systematic fault isolation procedure becomes unnecessary, reference is made to the fault isolation tables. (See tables 5-3 and 5-4.)

5-3. Fault Isolation

The fault isolation tables provide a listing of malfunctions, the probable causes of the malfunction, and the corrective action to be taken for each probable cause. Where systematic fault isolation is not required, the use of these tables will enable the user to rapidly detect and correct many malfunctions.

5-4. Azimuth and Elevation Drive Assembly Fault Isolation

If a mechanical failure in the azimuth or elevation drive assemblies is suspected, attempt to drive the mount in the particular direction suspected. If the motor runs but the mount does not rotate, replace the drive assembly. If the motor does not run, perform the electrical checks provided in table 4-2. If no electrical malfunction exists, replace the motor.

Table 5-1. Checkout/Fault Isolation of Mechanical Components

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Visually inspect chutes, cannon, conveyor assembly, declutching feeder, conveyor elements and drum drive assembly.	No visible damage.	If chutes defective, repair chutes.	Para 6-29.
			If cannon is defective, repair or replace cannon.	Para 6-4 and table 6-2.
			If conveyor assembly defective, repair or replace.	Para 6-24.
			If declutching feeder lock pins defective, replace.	Para 6-21.
			If declutching feeder defective, replace.	Para 6-21.
			If any conveyor elements are broken, stretched or deformed, replace all elements.	Para 6-30.
			If drum drive assembly defective, repair or notify direct support maintenance.	Para 6-27.
2	Hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position. Manually rotate cannon.	Clearing solenoid arm moves to the rear.	Perform checks in table 4-4 to assure proper electrical operation. During performance of step 64, besides the indications specified, also observe the following: when switches are released, K11 ACT on AN/MWM-2 lights for approximately 1.5 seconds after which K11 ACT goes out and K11 OUT indicator lights. If electrical operation correct, replace declutching feeder.	Table 4-4, step 64.
		Cannon can be rotated.	Proceed to mechanical fault isolation table 5-2, step 1.	N/A

Table 5-1. Checkout/Fault Isolation of Mechanical Components - Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
3	Hold BRAKE-CLEAR AND BRAKE switch in the BRAKE position. Manually rotate cannon until six rounds are ejected.	Cannon and drum components rotate. Rounds are fed into and ejected from cannon.	a. If cannon does not rotate, proceed to mechanical fault isolation table 5-2, step 2.	N/A
			b. If cannon rotates a partial revolution, check feeder to gun timing. Assure drum drive shift pin is in F position.	TM 9-2350-300-10
			c. If timing and shift pin position correct, inspect transfer drive assembly, extension shaft and drum drive assembly. Replace any defective component.	Pars. 6-23 and 6-27.
			d. If rounds are not fed into cannon, inspect declutching feeder and conveyor elements. Replace declutching feeder if defective. Replace all conveyor elements if any are defective.	Pars. 6-1 and 6-30.
4	Set SYSTEM POWER switch to ON, clear the cannon while holding the GUN CLEAR switch in the OPERATOR position and squeezing an action switch.	Cannon clears.	a. If gun drive motor runs but cannon does not rotate, repair gun drive assembly.	Par. 6-13.
			b. If gun drive motor does not run, perform checks in table 4-4 to isolate electrical malfunction. During performance of step 64,	Table 4-4, step 64.

Table 5-1. Checkout/Fault Isolation of Mechanical Components - Continued

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
4 con.			besides the indicators specified, also observe the following: during the time that the trigger switch is pressed, the K10 ACT light on the AN/MWM-2 is lit. After trigger is released, K10 ACT goes out and K10 OUT lights.	
			c. If there is no electrical malfunction, replace gun drive assembly.	Par. 6-13.

Table 5-2. *Fault Isolation of Mechanical Components*

Step	Procedure	Normal indication	If indication is abnormal	Reference for abnormal indication
1	Remove declutching feeder from cannon. Hold BRAKE-CLEAR AND BRAKE switch to BRAKE position and manually rotate cannon.	Cannon rotates.	Proceed to step 2.	Fault isolate cannon (table 5-3). Repair or replace as necessary.
2	Place drum drive shift pin in the N position. Place the conveyor assembly in the load position. (If conveyor assembly cannot be placed in the load position, remove the exit unit from the drum assembly.)	a. Drum assembly components rotate with exit unit installed.	a. Inspect declutching feeder, feed and return chutes, and conveyor assembly for jam. If jam cannot be cleared, repair or replace components as necessary.	a. Inspect drum assembly for jam. If jam cannot be cleared, notify direct support maintenance.
	Using hand crank, rotate drum assembly components.	b. Drum assembly components rotate with exit unit removed.	b. Inspect declutching feeder, feed and return chute, conveyor assembly, and exit unit for jam. If jam cannot be cleared, repair or replace components as necessary.	b. Inspect drum assembly for jam. If jam cannot be cleared, notify direct support maintenance.

Table 5-3. Cannon Fault Isolation.

Step	Malfunction	Probable cause	Corrective action
1	Cannon cannot be rotated manually with BRAKE-CLEAR AND BRAKE switch in BRAKE position (feeder removed, timing pin retracted and brake solenoid energized).	a. Powder under locking block. b. Bent guide bar. c. Breech bolt assemblies improperly installed. d. Round jammed in cannon. e. Broken or loose locking or unlocking cams. f. Rear housing sprung or damaged. g. Gun drive assembly brakes defective. h. Index pin assembly jammed.	a. Notify direct support maintenance. b. Replace guide bar (par. 6-14). c. Install breech bolt assemblies correctly (TM 9-2350-300-10). d. Remove round and check system for other damage. e. Replace cannon (par. 6-4). f. Replace cannon (par. 6-4). g. Replace gun drive assembly (par. 6-13). h. Replace index pin assembly (par. 6-4).
2	Cannon fails to rotate when power is applied.	a. Gun drive motor defective. b. Gun drive pins sheared.	a. Replace gun drive assembly (par. 6-13). b. Replace pins in gun drive assembly (par. 6-13).
3	Failure to extract.	a. Broken or damaged breech bolt assembly. b. Cartridge case separation.	a. Replace breech bolt assembly (TM 9-2350-300-10). b. Inspect complete cannon if damaged, and repair or replace as necessary.
4	Failure to eject.	a. Damaged breech bolt assembly. b. Damaged guide bar. c. Housing assembly damaged. d. Damaged case (ejection) chute assembly.	a. Replace breech bolt assembly (TM 9-2350-300-10). b. Replace guide bar (par. 6-14). c. Replace cannon (par. 6-4). d. Replace case chute assembly (par. 6-4).
5	Slow or erratic firing.	a. Mount batteries voltage low. b. Defective feed system. c. Defective gun drive assembly brake. d. Cannon not lubricated. e. Damaged rotor. f. Damaged firing cam. g. Damage to housing assembly. h. Breech bolt assembly insulation defective. i. Dirty drum assembly.	a. Charge batteries (par. 6-64 or 6-65). b. Check linkless feed group. c. Replace gun drive assembly (par. 6-13). d. Inspect and lubricate (LO 9-2350-300-10). e. Replace cannon (par. 6-4). f. Replace firing contact assembly (par. 6-12). g. Replace cannon (par. 6-4). h. Repair breech bolt assembly (par. 6-8). i. Notify direct support maintenance.
6	Failure to fire.	a. Worn, damaged, or improperly assembled firing contact assembly. b. Improperly assembled breech bolt assemblies.	a. Replace firing contact assembly (par. 6-12). b. Assemble correctly (par. 6-8).

Table 5-3. Cannon Fault Isolation - Continued.

Step	Malfunction	Probable cause	Corrective action
6 con.		c. Worn firing contact cam. d. Warped housing, firing contact cam out of alignment.	c. Replace firing contact assembly (par. 6-12). d. Replace cannon (par. 6-4).
7	Erratic dispersion.	a. Recoil adapters improperly mounted. b. End play in recoil adapters. c. Muzzle clamp defective. d. Muzzle clamp lock nut not tightened. e. Center clamp assembly not in place. f. Recoil adapters not secured to firing mount. g. Loose gun mounting ball. h. Loose cannon end plate.	a. Torque bolts to specified values (par. 6-7). b. Replace recoil adapters in pairs (par. 6-7). c. Replace muzzle clamp (par. 6-5). d. Torque to specified value (par. 6-5). e. Install center clamp assembly correctly (par. 6-5). f. Inspect and adjust (torque) or replace recoil adapters (par. 6-7). g. Tighten gun mounting ball (par. 6-4). h. Tighten grooved coupling clamp (par. 6-9).

Table 5-4. Ammunition Storage and Feed Group Fault Isolation.

Step	Malfunction	Probable cause	Corrective action
1	Declutching feeder does not feed rounds to cannon.	a. Declutching feeder and cannon not properly timed. b. Declutching feeder defective.	a. Retime declutching feeder to cannon (par. 6-4). Readjust slack point (TM 9-2350-300-10). b. Replace declutching feeder (par. 6-21).
2	Elements do not accept or feed rounds properly.	a. Conveyor not properly timed. b. Elements stretched or deformed.	a. Time conveyor to exit unit (TM 9-2350-300-10). b. Replace all elements (par. 6-30).
3	Rounds will not enter exit unit from drum.	Drum and exit unit not properly timed.	Retime exit unit to drum (par. 6-25).
4	Rounds will not enter drum from exit unit.	a. Drum and exit unit not properly timed. b. Drum full switch activated.	a. Retime exit unit to drum (par. 6-25). b. If drum not full, empty drum completely and reload (TM 9-2350-300-10).
5	Loading motor runs but drum components do not rotate.	a. Drum drive assembly shift pin not in L position. b. Defective or improperly adjusted clutch.	a. Place drum drive assembly shift pin in L position (fig. 6-38). b. Notify direct support maintenance.
6	Loading motor does not run.	a. Conveyor unit not in load position. b. No power.	a. Place conveyor unit in load position (TM 9-2350-300-10). b. Check CB2 on distribution box and reset if open. Disconnect connector W4P5 from drum drive motor and (with 300 M-A) check for 24 Vdc between connector pins A (plus) and D (ground), and between pins B (plus) and D (ground) with drum drive switch in ON position. If voltage is present, replace drum drive motor (par. 6-27). If voltage is not present, check continuity of cable W4 (figs. 3-37 and 3-41). If cable is good, replace distribution box (par. 6-42).
7	Elements stretched or deformed.	a. Defective transfer drive assembly. b. Broken extension shaft.	a. Replace transfer drive assembly (par. 6-23), and replace all elements (par. 6-30). Retime system. b. Replace extension shaft (par. 6-22), replace all elements (par. 6-30), and retime system.

Table 5-4. Ammunition Storage and Feed Group Fault Isolation - Continued.

Step	Malfunction	Probable cause	Corrective action
7 con.		c. Drum drive assembly defective. d. Defective right angle drive on declutching feeder.	c. Notify direct support maintenance. d. Replace declutching feeder (par. 6-21).

CHAPTER 6
REPAIR PROCEDURES

Section I. GENERAL

6-1. Repair Responsibilities.

Repair at the organizational level consists of replacing damaged or malfunctioning components found during inspection and checkout/fault isolation procedures. Removal of major assemblies, subassemblies, or components is to be performed only to the extent necessary to accomplish the required repairs. Refer to the Maintenance Allocation Chart (MAC) in appendix B to determine the level of responsibility for repairs. Instructions for removal and replacement of items which have no repair parts maintenance allowance are not given, unless such items must be removed for repair and replacement of another item.

6-2. Removal of Major Components.

Of the four major components comprising the Self-Propelled 20-MM Antiaircraft Artillery Gun XM163 (less XM741 chassis), three may be removed and installed by organizational maintenance personnel. Table 6-1 lists these components and provides a guide to their repair and service procedures. Table 6-2 is a guide to safety-wired components.

Table 6-1. Guide to Repair of Major Components.

Components	Repair instructions	Service instructions
Antiaircraft Gun Cannon, 20-MM, XM168	Par. 6-4	
Automatic Lead Computing Sight XM61	Par. 6-52	Pars. 6-53 and 6-54.
Radar Set AN/VPS-2	Par. 6-43	

Table 6-2. Guide to Safety-Wired Components.

Component	Maintenance responsibility
Cannon	DS/GS
Rotor front track bolts (large)	DS/GS
Rotor front track bolts (small)	DS/GS
Rotor front track screw	DS/GS
Rotor center track bolts	DS/GS
Removable track spacer bolts	DS/GS
Rotor gear cap screws	DS/GS
Lock cam mounting bolts	DS/GS
Recoil adapter spindle retainer	DS/GS
Index pin assembly	Organizational
Chute adapter assembly mounting screws	Organizational
Firing contact assembly mounting cap screws	Organizational
Gun drive assembly	
Gear cluster assembly retainer screws	Organizational
Cable connector mounting screws	Organizational
Motor access cover cap screws	Organizational
Cable (W3P3)	Organizational

Table 6-2. Guide to Safety-Wired Components - Continued

Component	Maintenance responsibility
Mount	
Declutching feeder assembly	
Repositioner guide mounting screws	DS/GS
Lock pin assemblies	Organizational
Flexible drive shaft (2 ends)	Organizational
Elevation drive motor	
Access cover cap screws	Organizational
Cable connector mounting screws	Organizational
Azimuth drive motors	
Access cover cap screws	Organizational
Cable connector mounting screws	Organizational
Drum drive assembly	
Loading motor cable connector mounting screws	Organizational
Loading motor access cover cap screws	Organizational
Rounds counter assembly cover screws	Organizational
Slip ring assembly (if applicable)	
Cable (A9P7)	Organizational
Fire control equipment	
XM164 telescope mount attaching screws	DS/GS
AN/TVS-2B night sight mount attaching screws	DS/GS

Section II. REPAIR OF CANNON XM168

6-3. General.

Repair of the cannon consists of replacing damaged or malfunctioning parts or components found during inspection and checkout/fault isolation procedures. Instructions for repairing the XM168 cannon at the organizational level are given in the following paragraphs. Table 6-3 lists the components of the cannon that are replaceable at the organizational level, and provides a guide to the location of instructions for each repair function. Where instructions are not given, the repair procedures are obvious. Cannon components will be subjected to inspection each time they are removed for corrective maintenance, or are suspected of improper operation. Inspection will be applied to all parts involved in a mechanical stoppage of the cannon. Criteria for determining the acceptability or nonacceptability of each cannon component that is replaceable by organizational maintenance personnel follow. If a component exhibits one or more of the conditions listed, replace it.

Table 6-3. Guide to Repair of Cannon XM168.

Component	Repair instructions
Muzzle clamp assembly and center clamp assembly	Par. 6-5
Barrels	Par. 6-6
Recoil adapters	Par. 6-7
Breech bolt assemblies	Par. 6-8
Rotor assembly	Par. 6-9
Chute adapter assembly	Par. 6-10
Housing cover assembly	Par. 6-11
Firing contact assembly	Par. 6-12
Gun drive assembly	Par. 6-13

6-4. XM168 Cannon Removal and Installation.

Partial disassembly is necessary prior to removal or installation of the XM168 cannon.

a. Removal.

(1) Assure GUN POWER switch (fig. 6-1) is set to OFF.

(2) Position the cannon over the rear of the chassis.

(3) Set SYSTEM POWER switch to OFF.

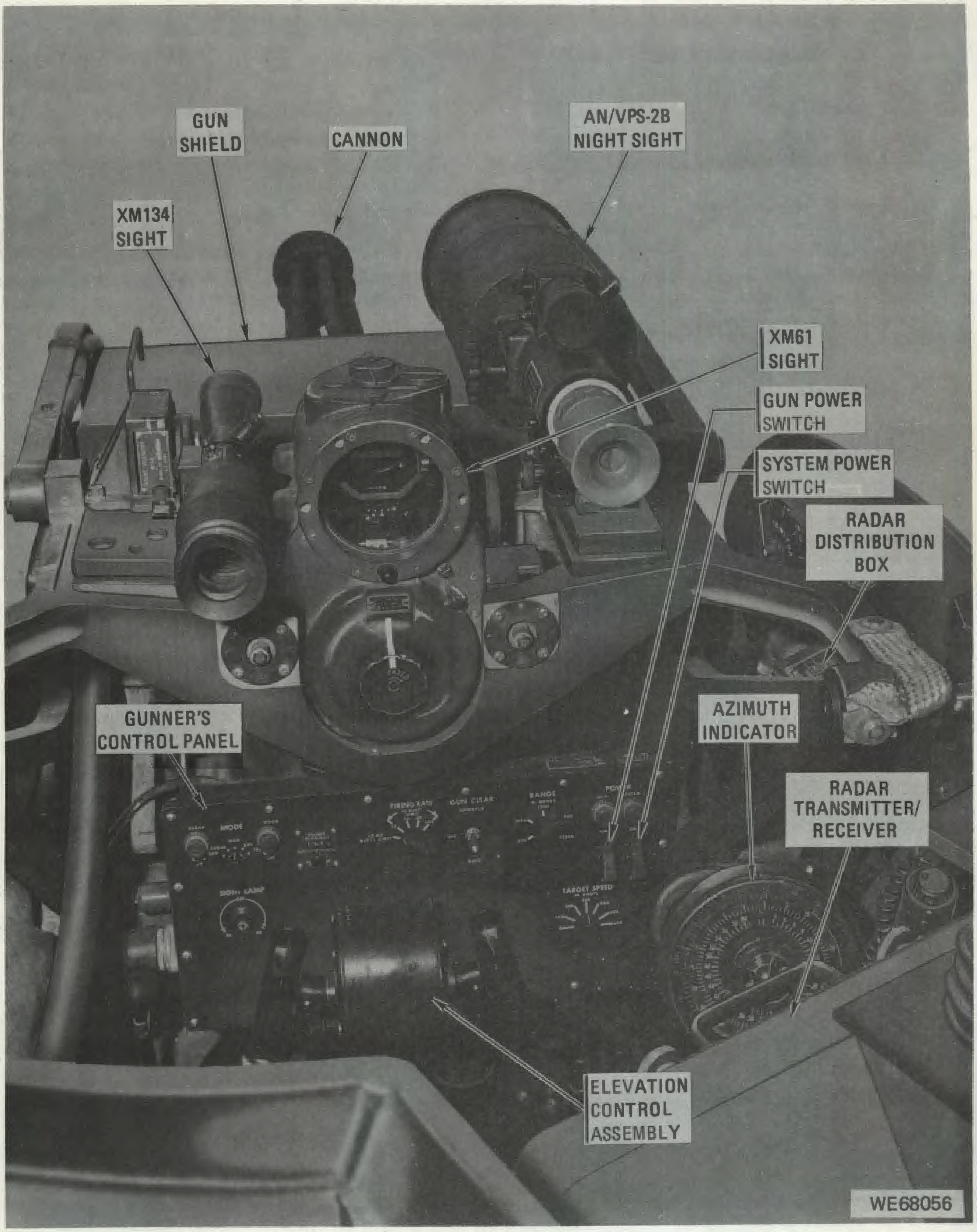


Figure 6-1. XM157 mount, interior view showing gunner control panel.

WARNING

The following procedure assumes that in the event of a firing stoppage, sufficient time has elapsed to permit the cannon to cool, eliminating danger of a cook-off.

(4) Set the distribution box NORM-STATIC-TEST switch to STATIC and remove arming connector (fig. 6-2).

(5) Disconnect firing voltage connector W3P2 from the firing contact assembly (fig. 6-3).

WARNING

If cannon barrel cluster cannot be rotated in the following steps, the cannon must be assumed to contain live rounds.

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position longer than 10 seconds during any one-minute interval.

(6) Hold BRAKE-CLEAR AND BRAKE switch at CLEAR AND BRAKE and rotate barrel cluster in firing direction as indicated on rotation plate (fig. 6-4) until all rounds have been ejected. Release BRAKE-CLEAR AND BRAKE switch.

(7) Release gun shield guide-release pins (fig. 6-3), lift rear latches, and remove gun shield.

(8) If possible, time declutching feeder by holding BRAKE-CLEAR AND BRAKE switch at CLEAR AND BRAKE, pressing on feeder index pin (fig. 6-4), and rotating barrel cluster until index pin drops into a timing hole.

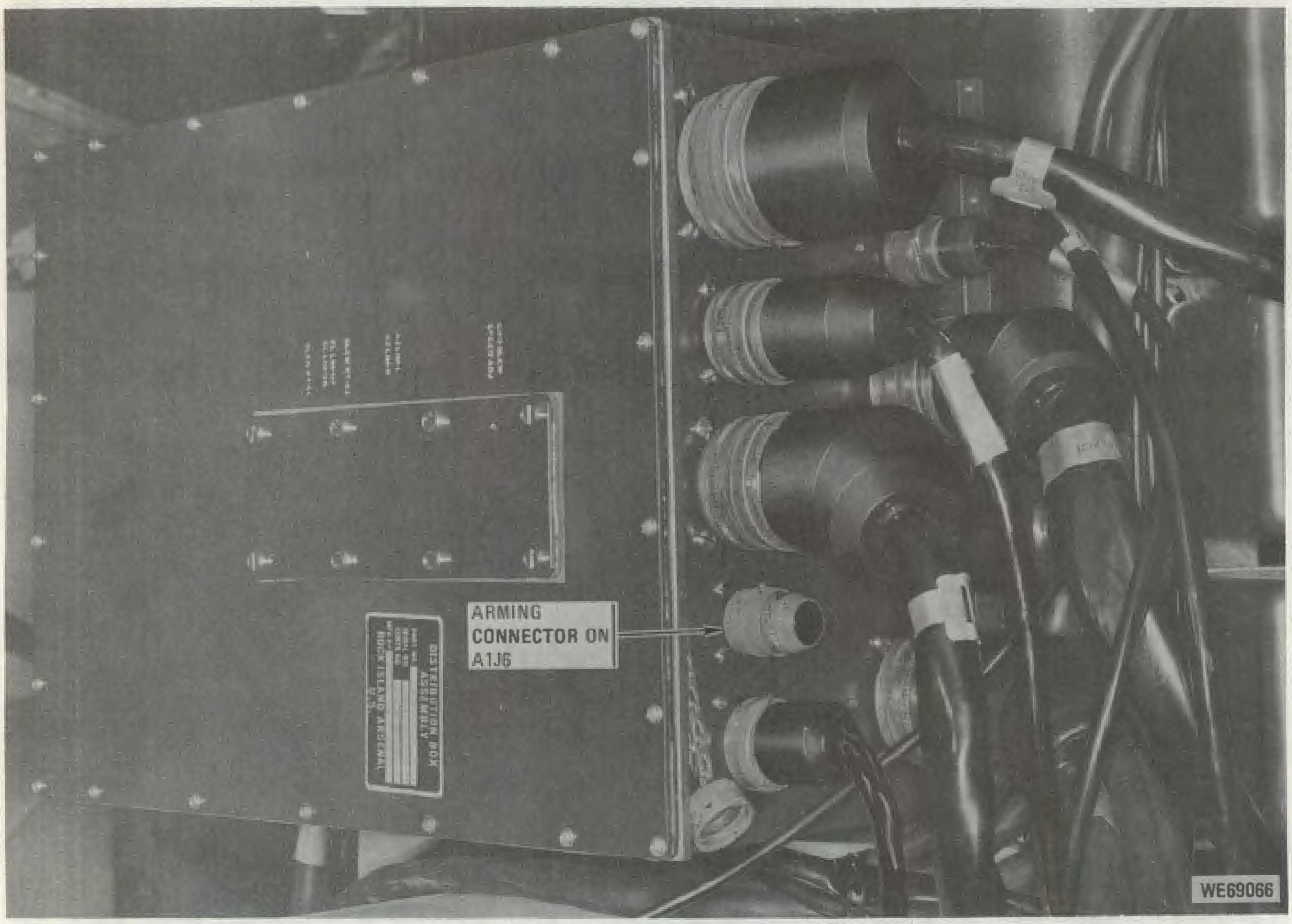


Figure 6-2. Distribution box exterior view showing location of arming connector.

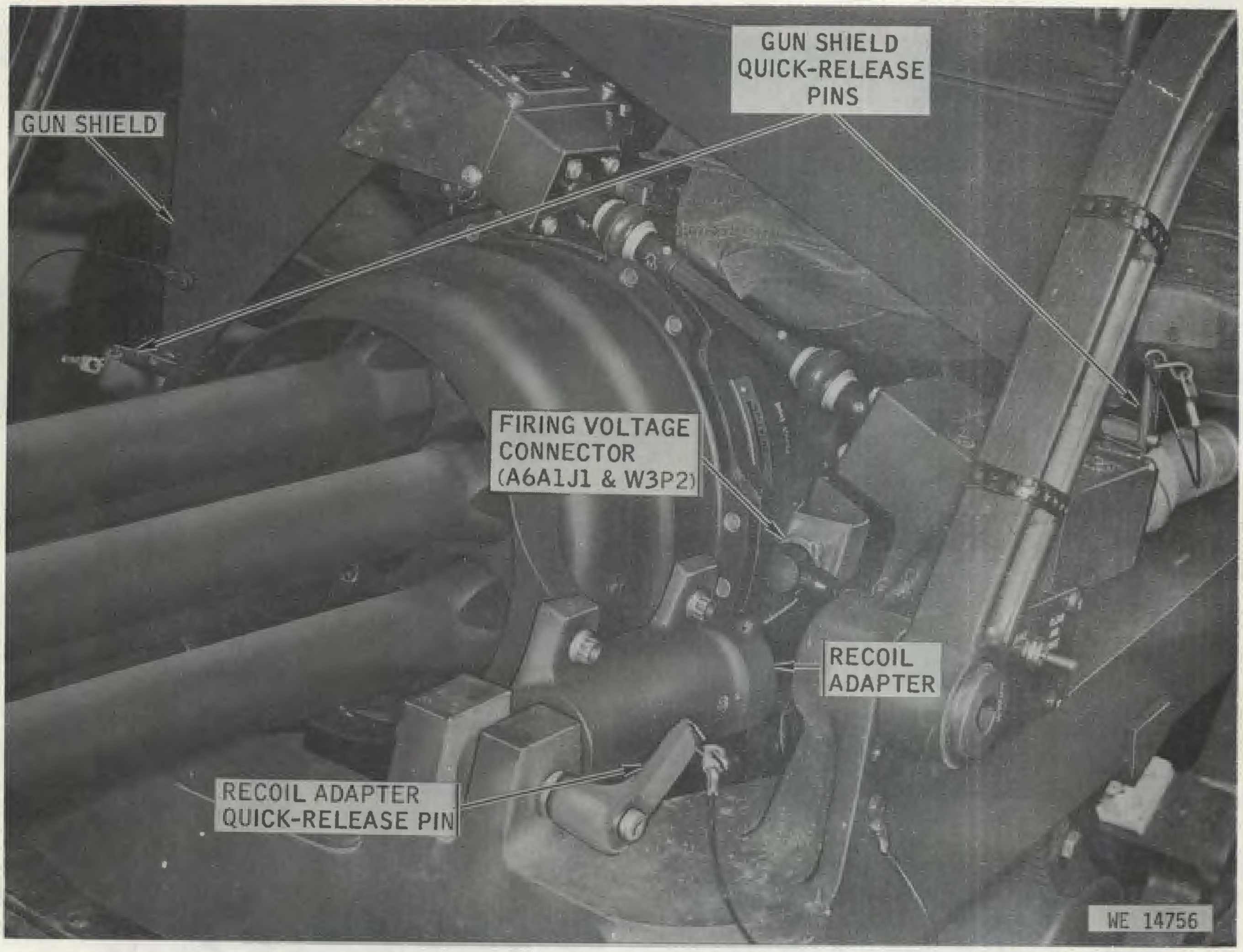


Figure 6-3. XM168 cannon and XM157 mount, front view, parts location.

(9) Disconnect W3P4 from declutching feeder (fig. 6-5).

(10) Remove declutching feeder lock pins (fig. 6-6).

(11) Loosen extension shaft setscrew (fig. 6-6), lift front end of feeder, disconnect extension shaft, and lift feeder, extension shaft, and attached chuting off cannon housing. Pull removed components back under the linkage assembly.

(12) Manually release elevation drive motor brake (fig. 6-5), elevate the cannon to the upper limit, and reapply the brake.

(13) Disconnect W3P3 from gun drive assembly (fig. 6-7).

(14) Unbolt and remove gun drive assembly and grounding strap (figs. 6-7 and 6-8).

(15) Remove case chute assembly and chute adapter assembly (fig. 6-5).

(16) Manually release elevation drive motor brake, lower cannon to approximately horizontal, and reapply brake.

(17) Remove muzzle clamp and center clamp assemblies. (Refer to para. 6-5a.)

(18) Remove barrels. (Refer to para. 6-6a.)

(19) Remove recoil adapter quick-release pins (fig. 6-9).

WARNING

The remaining portion of the disassembled cannon weighs approximately 150 pounds. The next step should be performed by two men.

(20) Move cannon forward until end plate is clear of mounting ball, and lift cannon clear of saddle assembly.

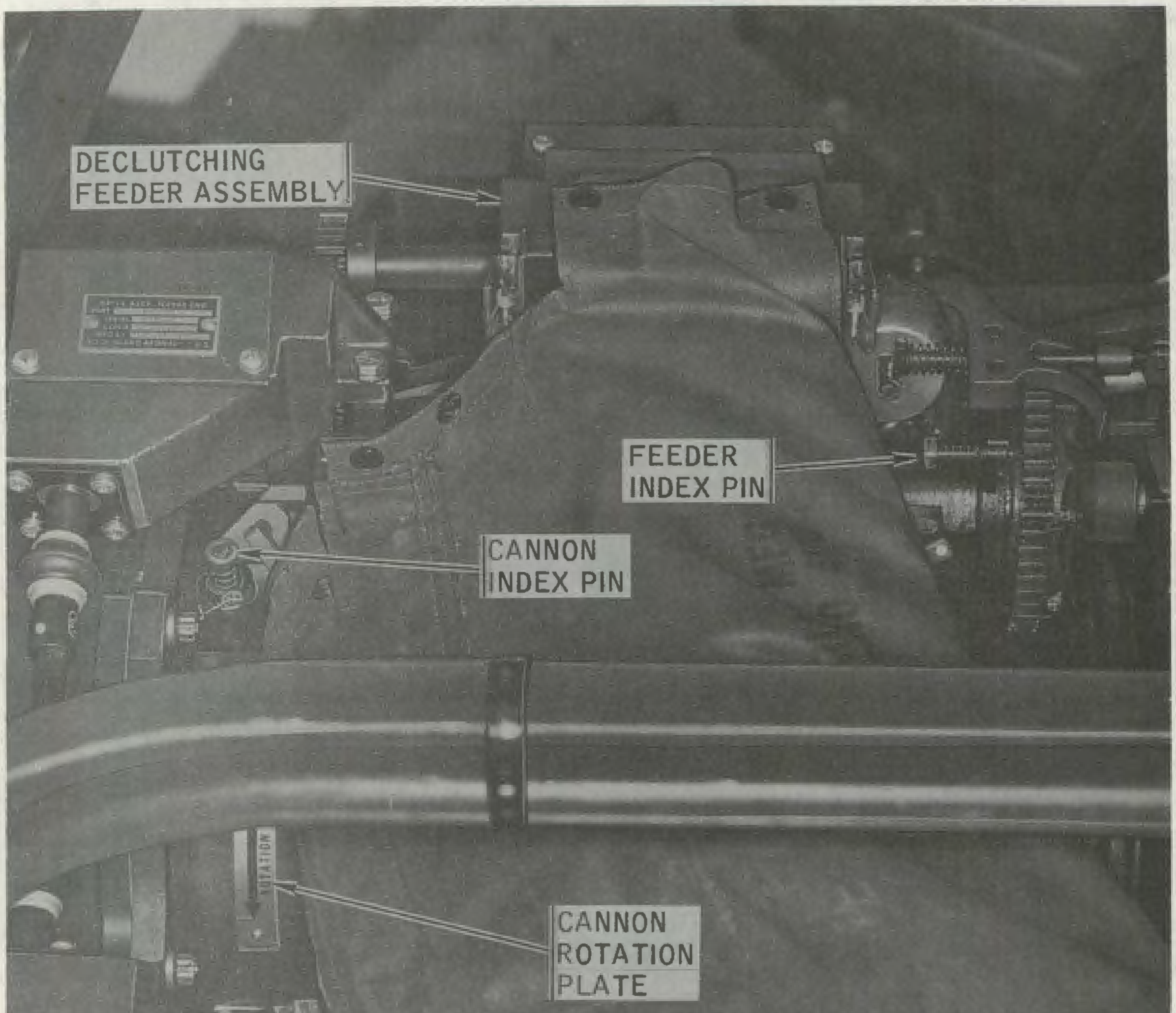


Figure 6-4. XM168 cannon and XM157 mount, front view, parts location.

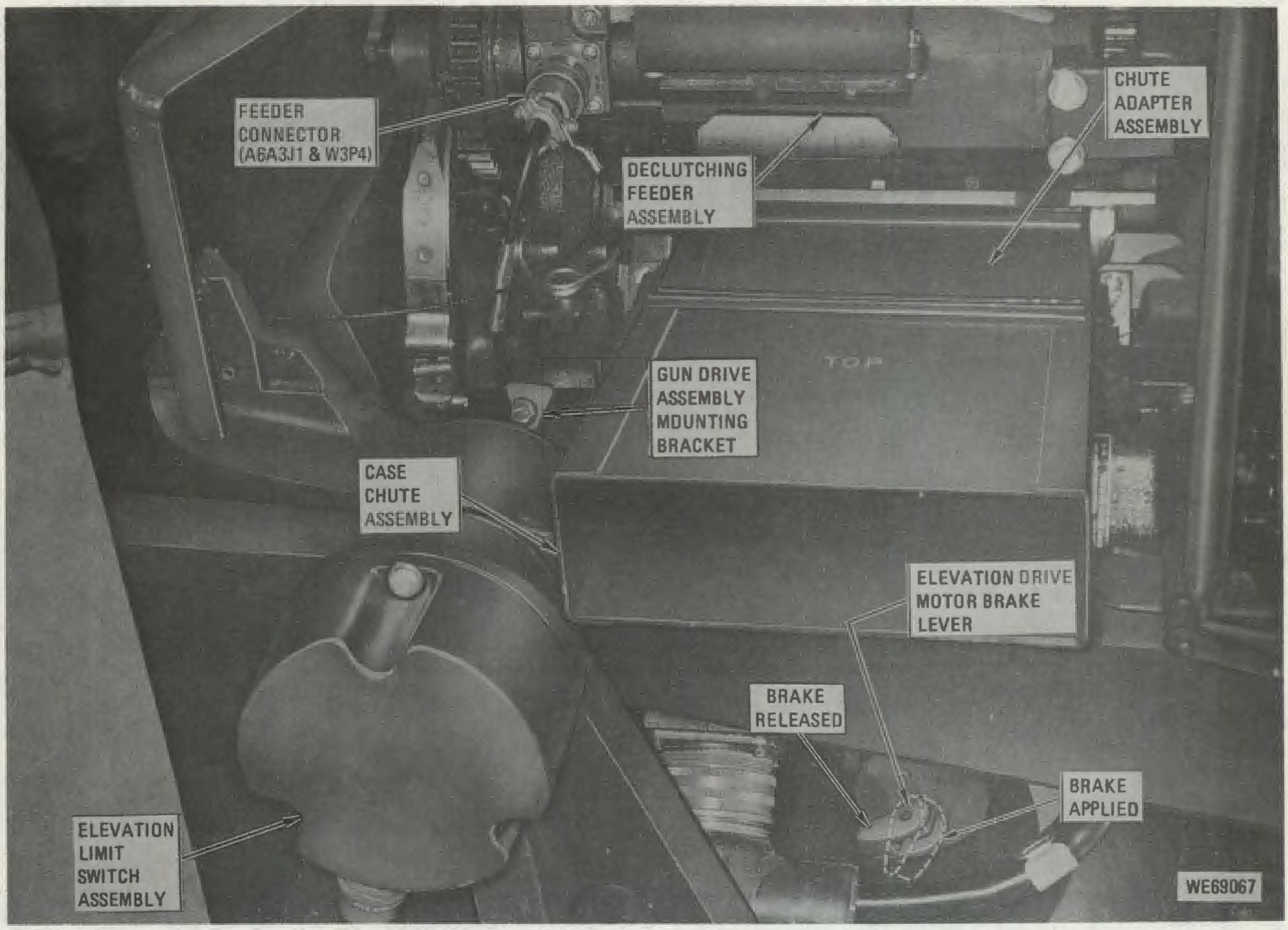


Figure 6-5. XM157 mount, right front view, parts location.

CAUTION

Prior to installing declutching feeder, assure that cannon is in a timed position by rotating barrels in firing direction until cannon index pin (fig. 6-4) can be depressed. Install the timed feeder while depressing the feeder index pin.

b. Installation. Installation is the reverse of removal. Immediately after attaching the declutching feeder extension shaft to the transfer drive assembly, perform after-installation check, in c. following.

c. After-Installation Check.

(1) Verify the following equipment conditions:

(a) Firing voltage connector W3P2 (fig. 6-3) is disconnected.

(b) Gun drive assembly brakes are on and gun motor cable W3P3 (fig. 6-7) is connected.

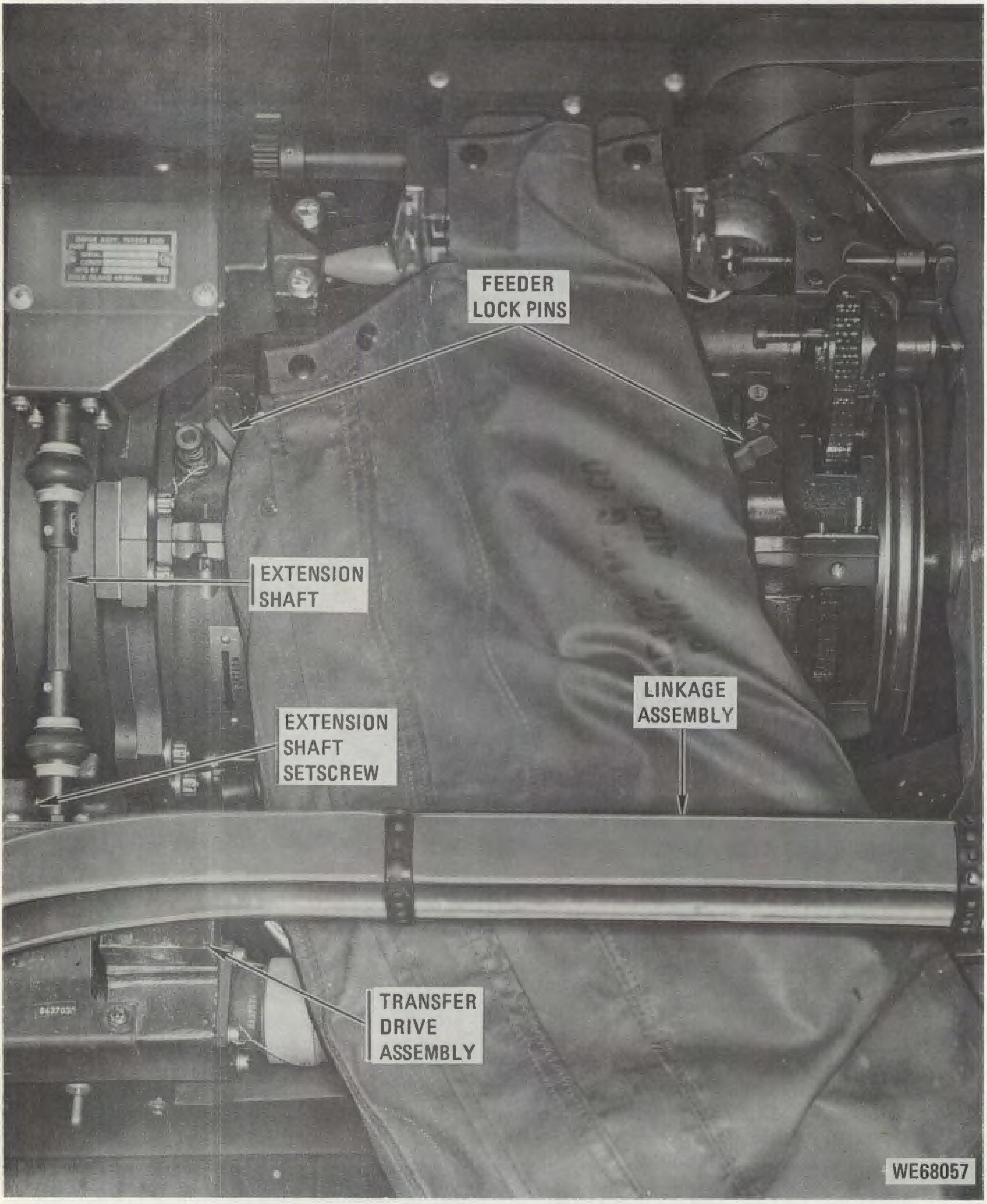


Figure 6-6. XM157 mount, top front view, parts location.

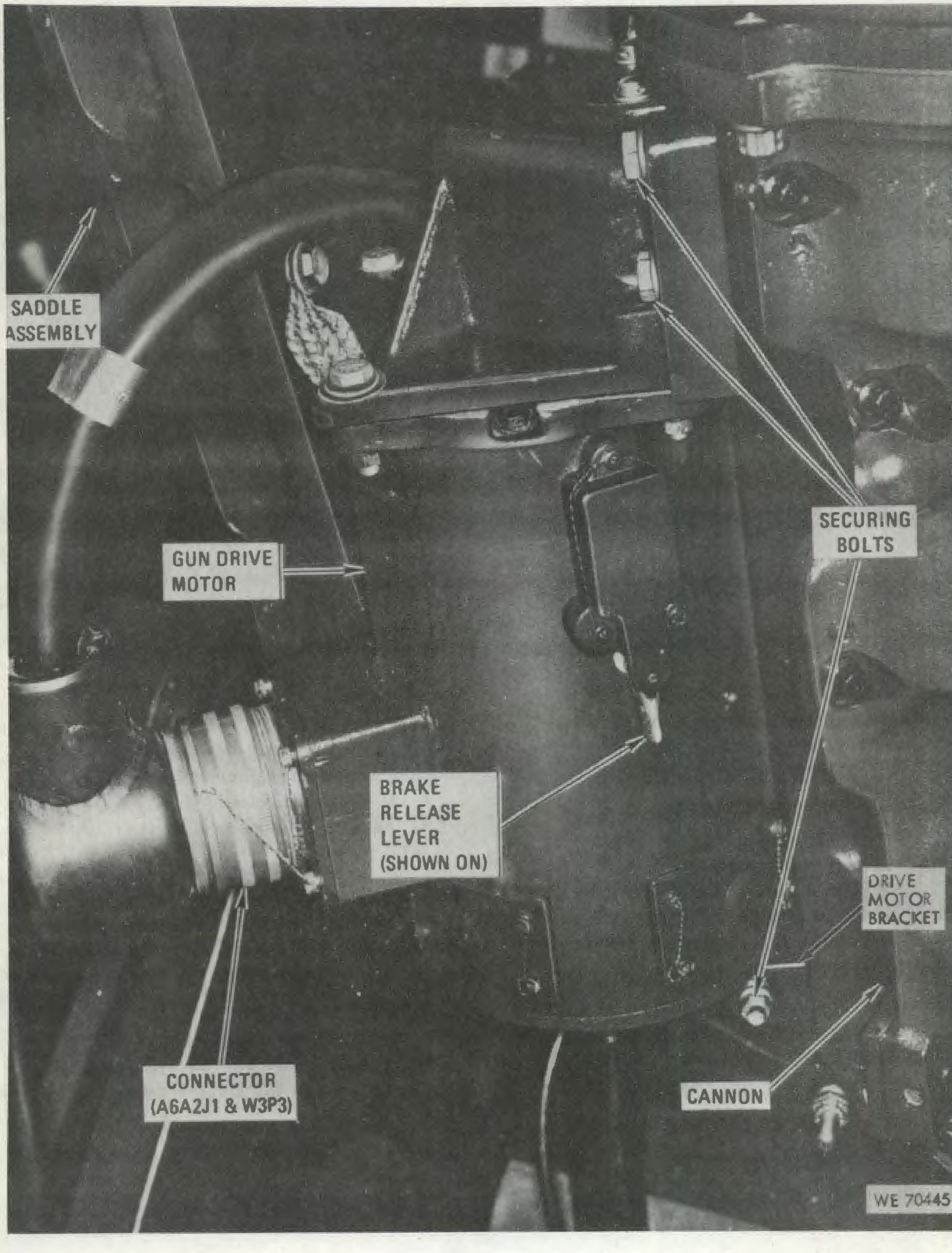


Figure 6-7. Gun drive assembly, bottom view, parts location.

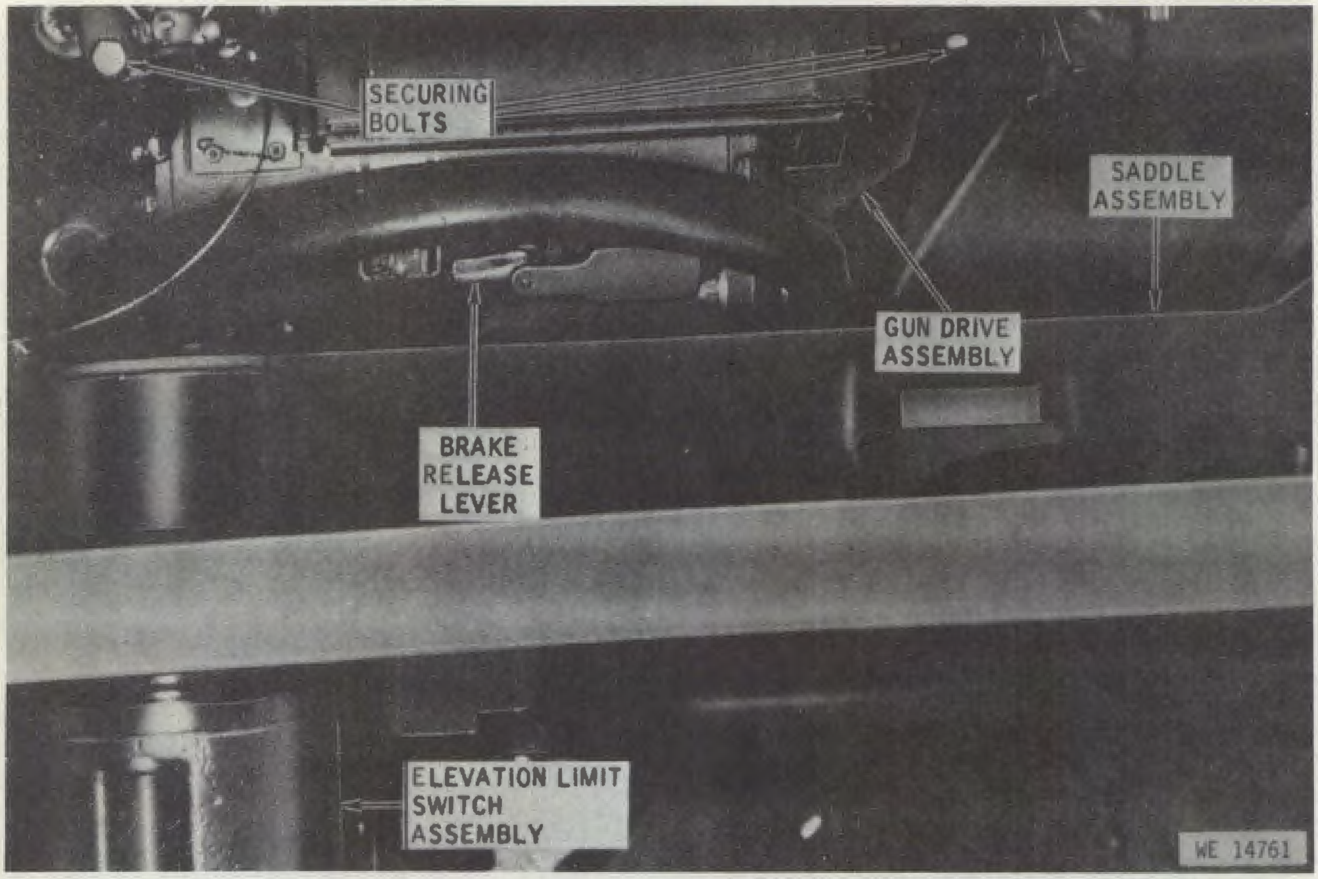


Figure 6-8. XM157 mount, top front view showing gun drive assembly.

(c) Conveyor assembly (10, fig. 6-10) is in firing position (down and locked).

(d) Drum drive assembly shift pin (1, fig. 6-10) at F.

CAUTION

Do not hold BRAKE-CLEAR AND BRAKE switch in the CLEAR AND BRAKE position longer than 10 seconds during any one-minute interval.

(2) Hold BRAKE-CLEAR AND BRAKE switch in BRAKE position and quickly rotate barrels in the firing direction until 10 rounds have been cycled through the cannon. Release the switch.

(3) Hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position and rotate barrels until gun is cleared.

(4) Safety-wire feeder lock pins (fig. 6-6) by inserting wire through hole in lower tip of feeder lock pin. Wrap at least three turns of wire between the hole in the pin and the mounting lug of the housing. Use wire twist method to secure ends of wire. Each feeder lock pin will be secured independently. Tighten set screws on extension shaft.

(5) Assure that firing voltage connector W3P2 (fig. 6-3) is not connected to firing contact assembly.

(6) Install gun shield.

(7) Assure that W3P3 is securely connected to the gun drive assembly, and safety wire in position (fig. 6-7).

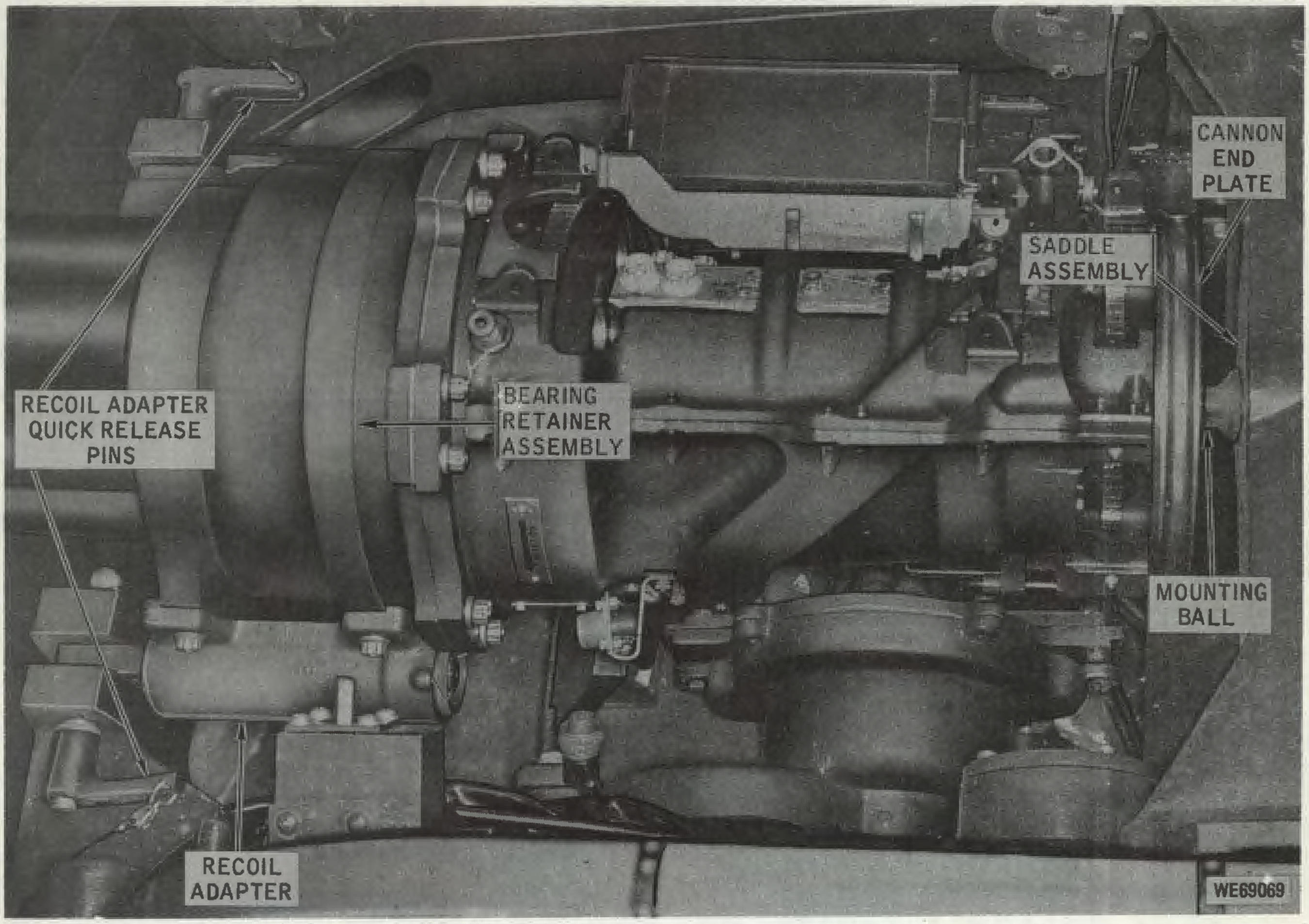
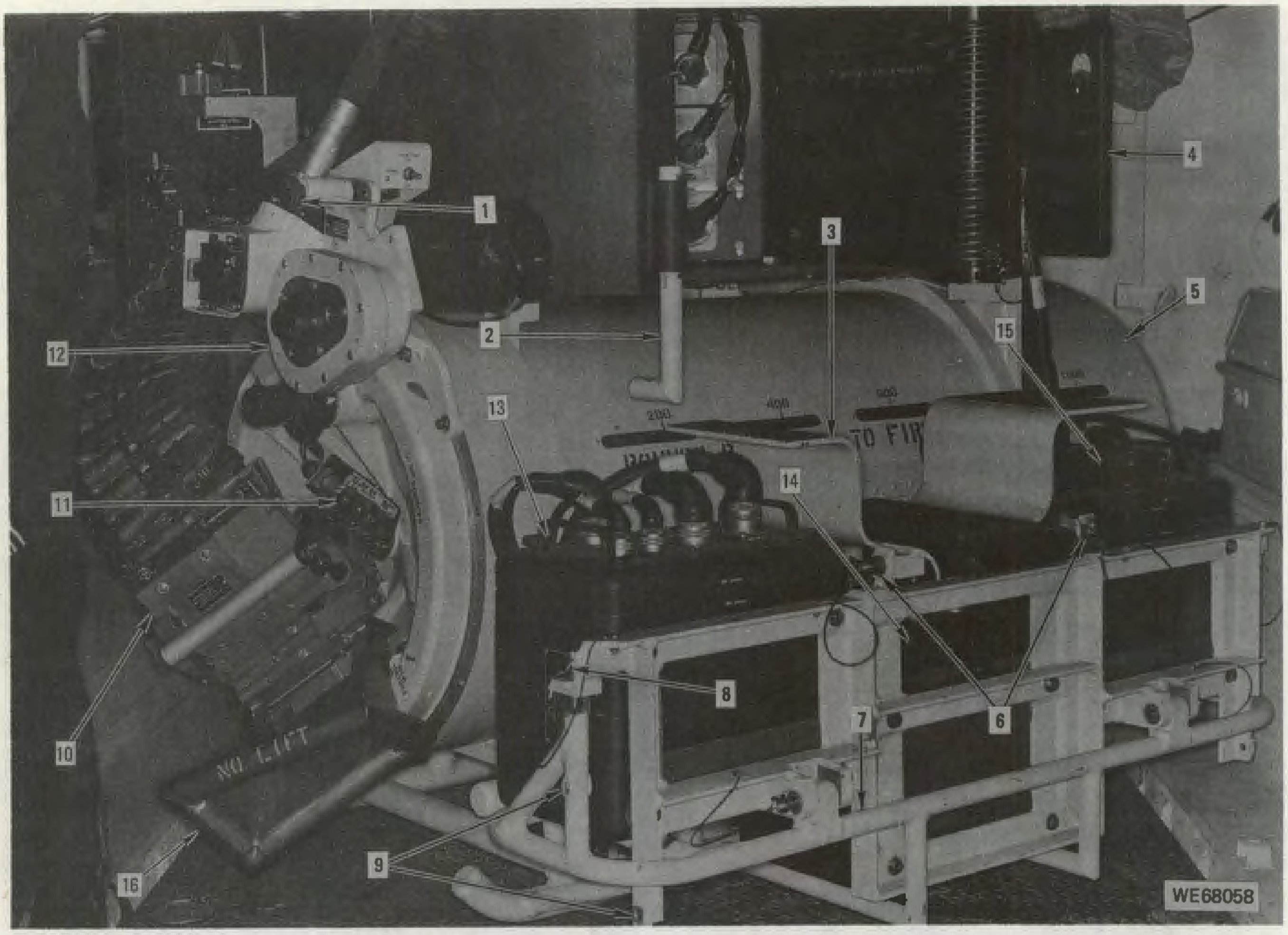


Figure 6-9. XM168 cannon, top view, with feeder removed and parts location.



1 Shift pin handle
2 Step retainer
3 Step
4 Distribution box
5 Ammunition drum assembly
6 Step quick-release pins
7 Rack
8 Rack-retaining quick release pin
9 Horizontal holding holes
10 Conveyor assembly (shown in firing position)
11 Conveyor detection assembly
12 Drum drive assembly
13 Radar receiver
14 Radar range computer
15 Radar power supply
16 Loading chute assembly

Figure 6-10. XM157 mount, view below chassis deck, parts location.

6-5. Muzzle Clamp Assembly and Center Clamp Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected from A1J6 on distribution box.

(3) Remove cotter pin from center clamp (fig. 6-12) and rotate locking disk in clockwise direction (as seen from muzzle) until it disengages barrels (fig. 6-13).

(4) Drive center clamp forward approximately one inch.

(5) Loosen muzzle clamp locking bolt (fig. 6-14) and disengage locating pin on triangular locking plate from hole in front plate.

(6) Rotate triangular locking plate clockwise (as seen from muzzle) until it is free of barrels, and remove muzzle clamp.

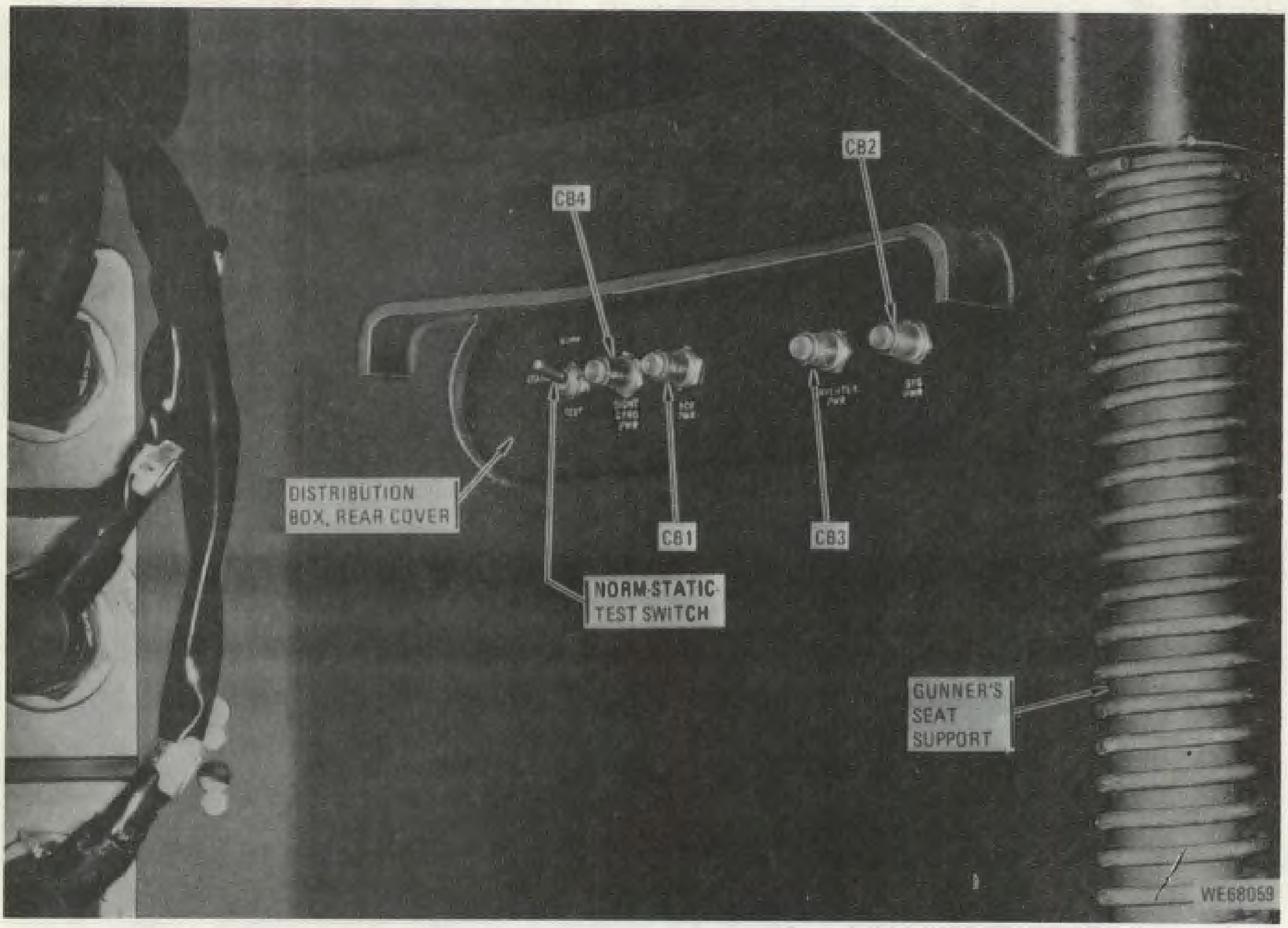


Figure 6-11. XM157 mount, interior view showing location of distribution box NORM-STATIC-TEST switch and circuit breakers.

(7) Remove center clamp.

b. Inspection.

(1) *Inspection of muzzle clamp assembly.* Inspect the muzzle clamp assembly for the presence of any of the following conditions:

(a) Damaged clamp or broken welds.

(b) Damaged threads on bolt.

(c) Damaged threads or lugs on locking plate.

(d) Bent or missing pin on locking plate.

(e) Defective self-locking feature of locking plate.

(2) *Inspection of center clamp assembly.* Inspect the center clamp assembly for the presence of any of the following conditions:

(a) Bent or damaged barrel locking lugs on body.

(b) Cracked or distorted locking disk.

(c) Defective locking feature of locking disk.

(d) Missing or damaged spring pin.

(e) Missing or damaged retaining ring.

c. Installation.

(1) Position the center clamp approximately one inch forward of its normal location on barrels.

(2) Position muzzle clamp on barrels and slide it rearward until it hits a positive stop.

(3) Rotate muzzle clamp triangular locking plate counterclockwise until pin on locking plate is aligned with locating hole in front plate of muzzle clamp (fig. 6-14).

CAUTION

In step (4) following, torque against the gun drive motor brake only. Do not use any auxiliary means of retaining cannon to reach torque requirement.

(4) Torque muzzle clamp bolt to 650 inch-pounds.

(5) Secure clamp in position by turning locking disk counterclockwise (as viewed from muzzle) until it reaches the locked position (holes in locking disk and clamp body aligned). See fig. 6-13.

(6) Replace cotter pin.

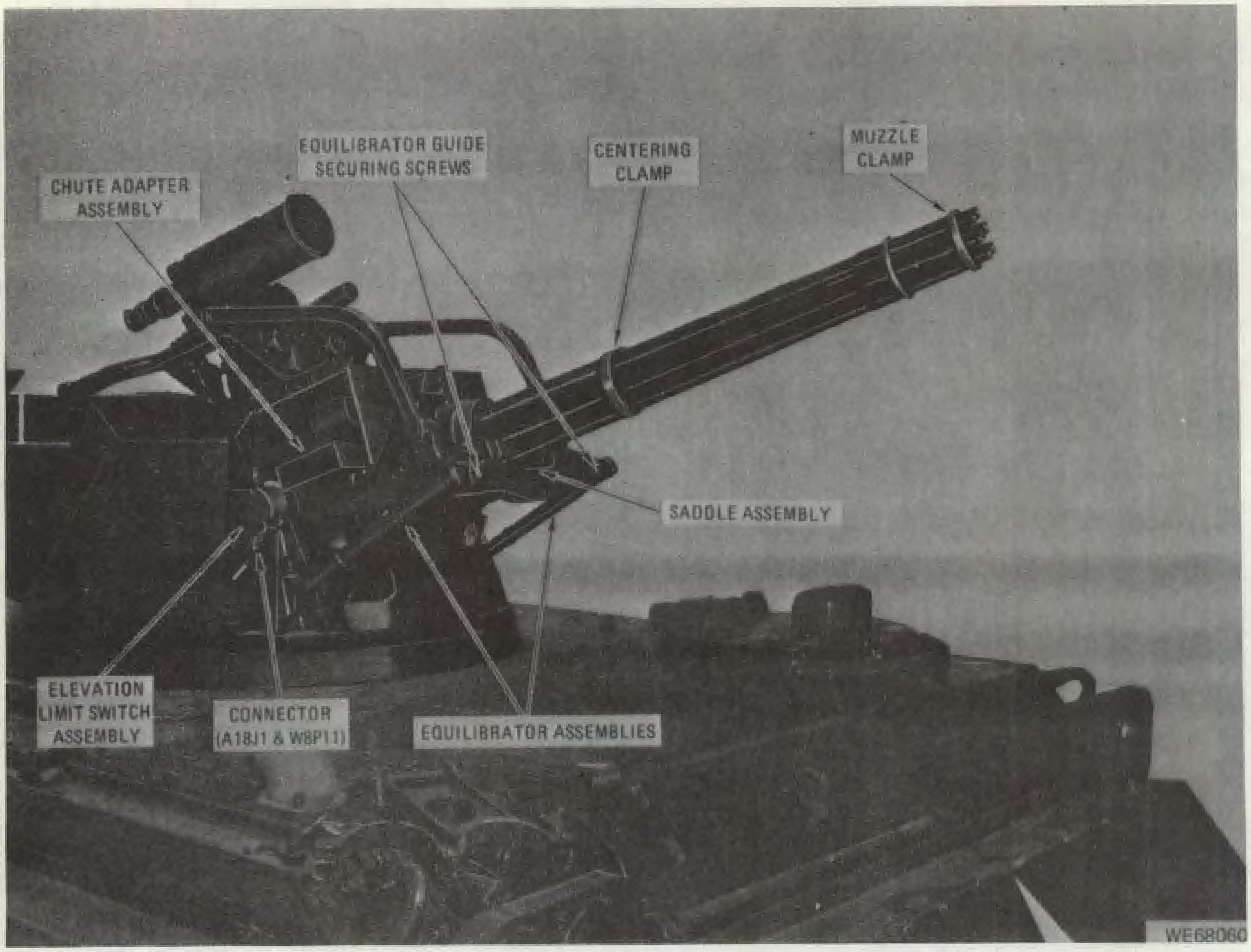


Figure 6-12. XM168 cannon and XM157 mount, right front view, parts location.

NOTE

There are two muzzle clamps: one, for antiaircraft, holds the barrels in a slightly elliptical configuration; the other, for ground role, holds the barrels in a round configuration. Maintenance is identical for both muzzle clamps.

6-6. Barrels.

a. Removal.

(1) Remove muzzle clamp and center clamp as instructed in paragraph 6-5 *a* preceding.

(2) Twist each barrel approximately 60 degrees in either direction, and pull out of cannon rotor.

b. Inspection. Inspect the barrels for the presence of any of the following conditions:

(1) Damaged locking lugs or flanges.

(2) Cracks or bulges.

c. Installation. Install barrels in reverse of removal; install muzzle clamps as instructed in paragraph 6-5 *c*.

6-7. Recoil Adapters.

NOTE

Recoil adapters are to be replaced in pairs only.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch at STATIC position, and verify that arming connector (fig. 6-2) is disconnected from A1J6 on distribution box.

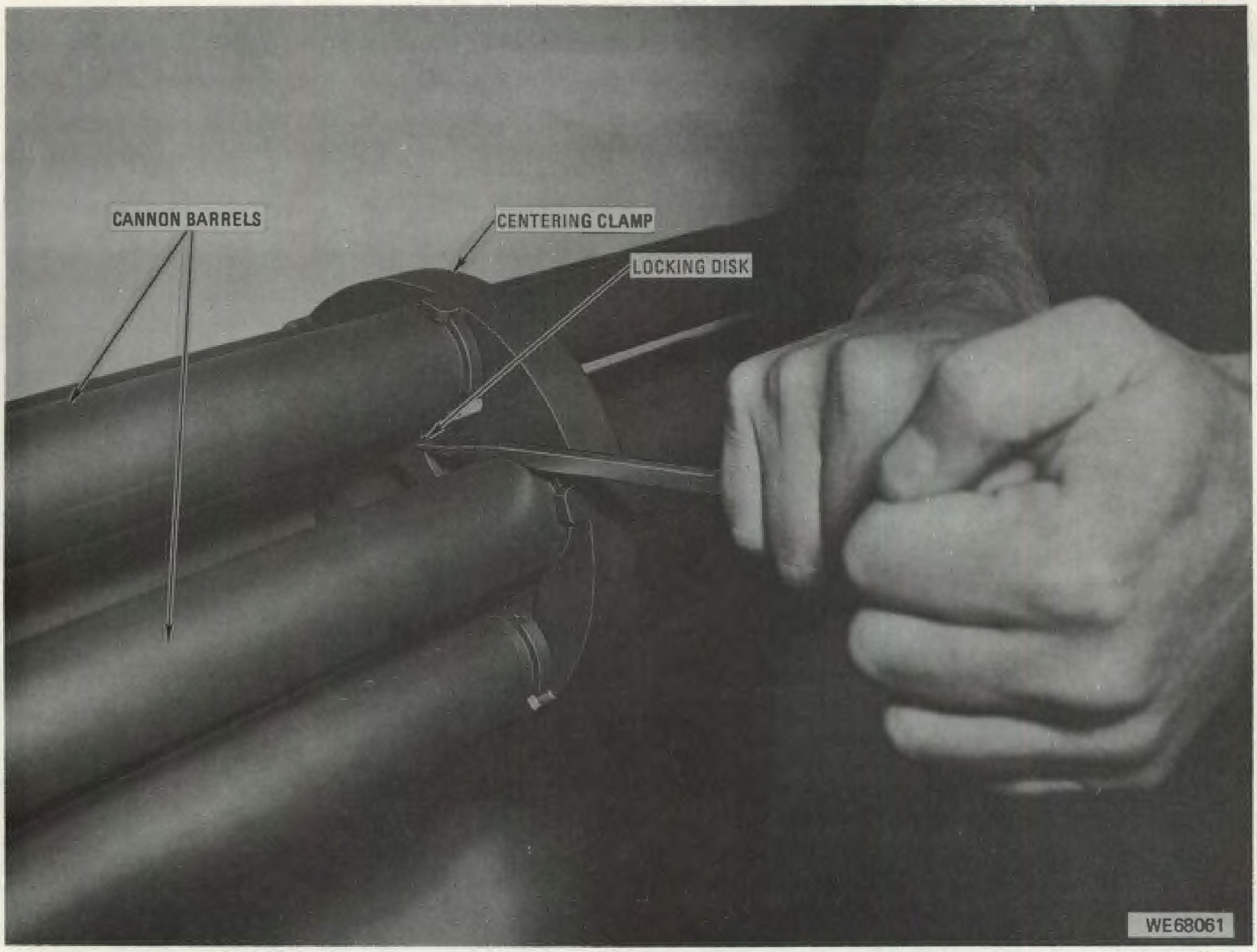


Figure 6-13. Center clamp assembly, details of removal and installation.

(3) Remove gun shield (fig. 6-3).

(4) Release brake on elevation drive motor, manually depress cannon to approximately 0 degrees, and reapply brake. (See fig. 6-5.)

(5) Remove the two quick-release pins securing recoil adapter to saddle assembly (fig. 6-3).

(6) Manually raise the muzzle of the cannon until recoil adapters are free of saddle assembly, and place an ammunition can, or other solid object of approximately the same size, below cannon barrels just forward of saddle assembly. Rest cannon on can or other object.

(7) Remove bolts securing recoil adapters to cannon bearing retainer, and remove recoil adapters. (See fig. 6-9.)

b. Inspection. Inspect the recoil adapters for the presence of any of the following conditions:

(1) Elongation of mounting holes.

(2) Damaged housing.

(3) Assure there is no free forward movement of mounting spindle.

c. Installation. Installation procedures are the reverse of those for removal. Torque bolts to 250 to 300 inch-pounds.

6-8. Breech Bolt Assemblies.

NOTE

If breech bolt assembly has been rebuilt (as evidenced by "1" stamped on bolt body), replace with a new breech bolt assembly.

a. Removal. Refer to TM 9-2350-300-10 for instructions for removing breech bolt assemblies from XM168 cannon.

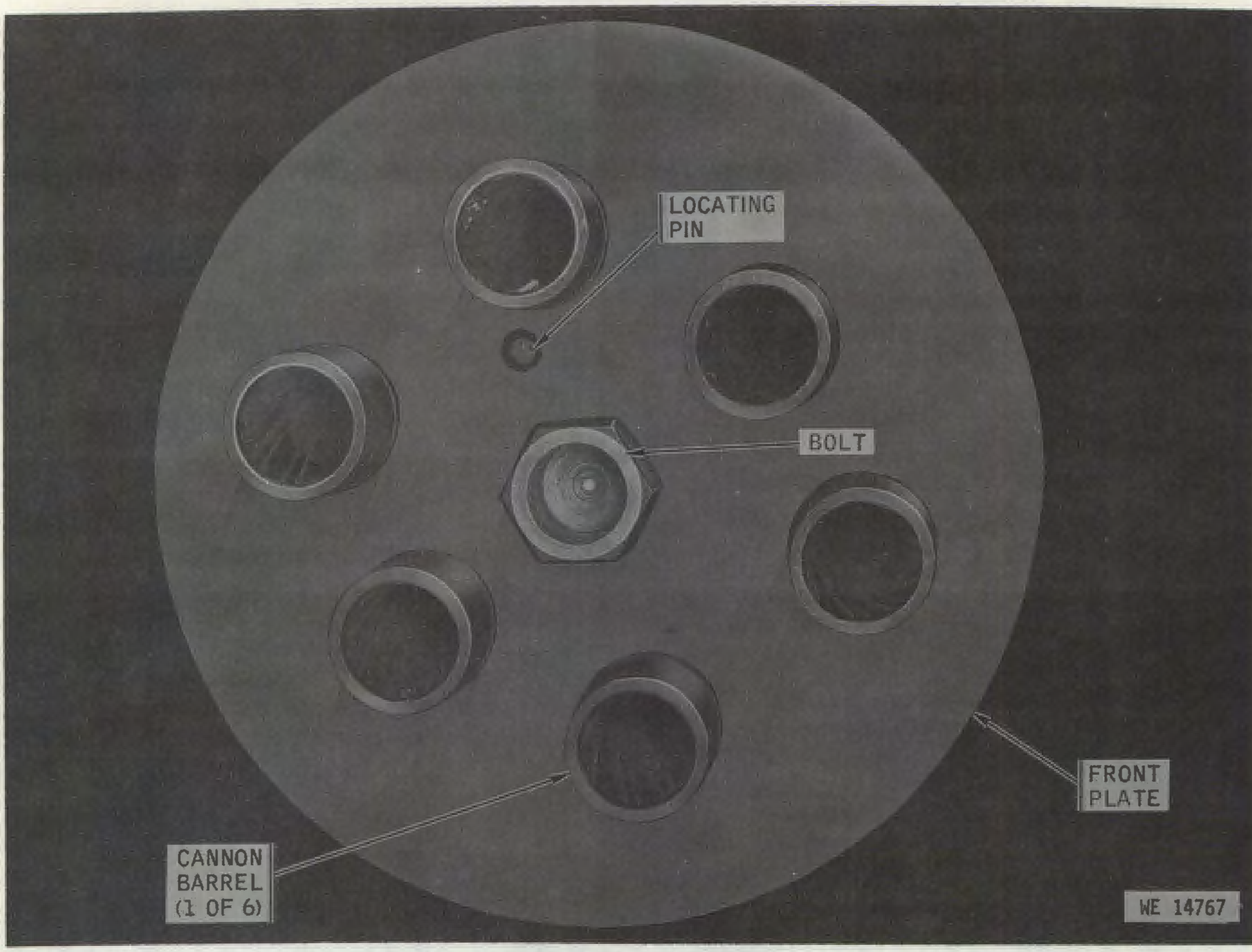


Figure 6-14. Muzzle clamp assembly, parts location.

b. Inspection. Inspect the breech bolt assemblies for the presence of any of the following conditions:

(1) Roller damaged or cannot be spun freely on shaft.

(2) Burrs on shaft assembly.

(3) Cracks in shaft, or spreading of shaft forks.

(4) Elongation of holes in bolt body.

(5) Burrs, chips, or cracks in extractor lips.

(6) Burrs on bolt body trackways.

(7) Burrs or cracking on shoulder of locking block.

(8) Insulators cracked or broken.

(9) Greater than 2.5 ohms between firing pin and firing pin cam when cam is depressed (indicates open circuit).

(10) Less than 500k ohms between firing pin cam and bolt body (indicates short circuit).

c. Disassembly.

(1) Using pin punch, carefully drive pin (10, fig. 6-15) from body (7) and remove shaft assembly (5) and locking block (9).

(2) Strike rear of bolt assembly sharply on a wooden block to dislodge stop (1) from its recess in the bolt.

(3) Pull up and remove cam (6).

(4) Strike rear of bolt assembly on a wooden block to dislodge firing pin (2) and remove pin and spring (3).

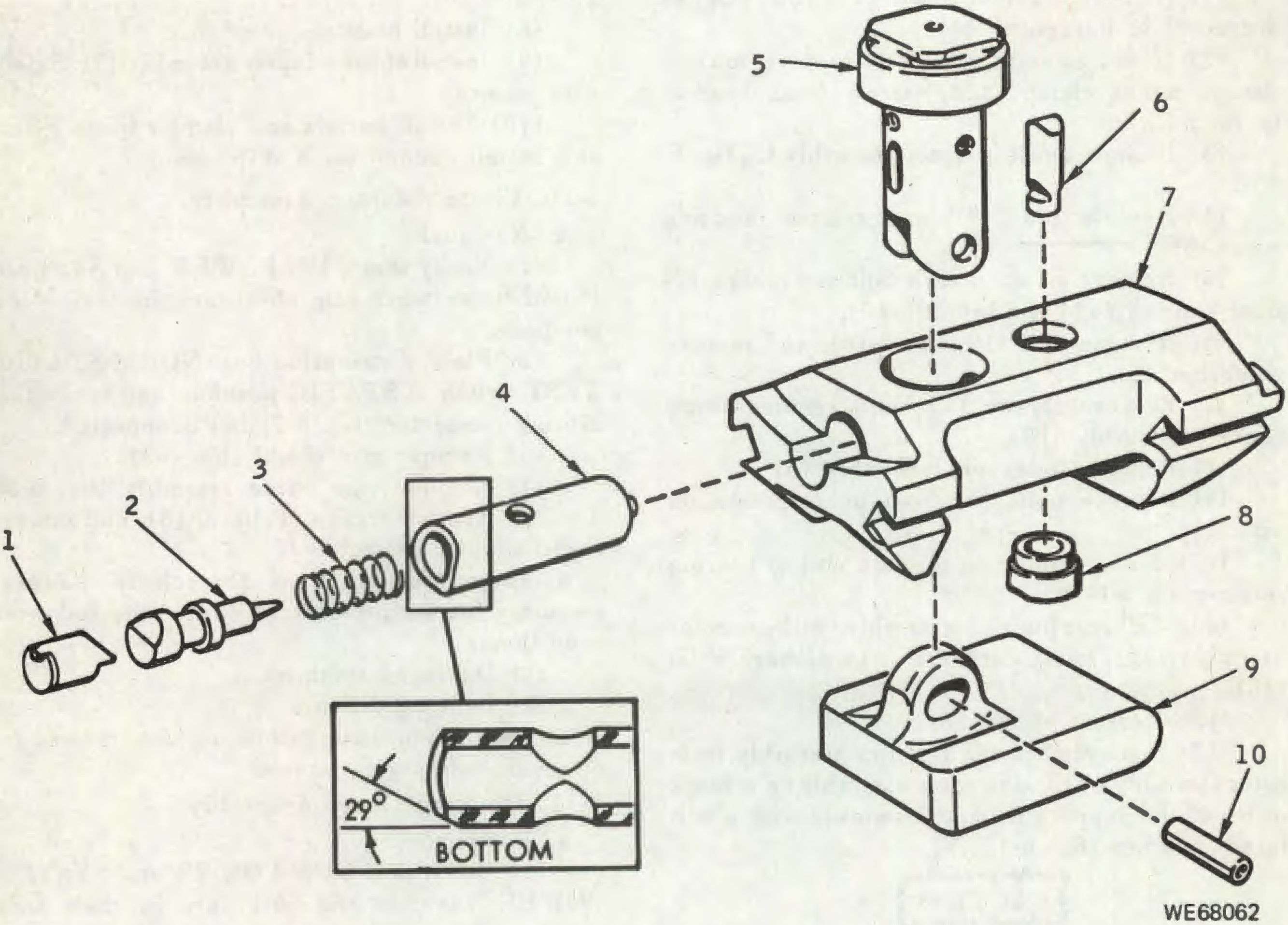
(5) Remove insulators (4 and 8) from body (7).

d. Assembly.

(1) Insert insulator (8, fig. 6-15) into body (7).

(2) Insert insulator (4) in body so that 29 degree chamfer on end of insulator is facing bottom of body.

(3) Insert spring (3) in insulator (4).



1 Contact stop
2 Firing pin
3 Spring
4 Insulator
5 Shaft assembly
6 Cam
7 Body
8 Insulator
9 Locking block
10 Pin

Figure 6-15. Breech bolt assembly, exploded view.

(4) Insert firing pin (2) in insulator (4) with chamferred edge up.

(5) Insert cam (6), with "V" slot toward rear of body. Using pin punch press forward on the firing pin (2) while pressing down on cam (6) until firing pin is secured in place.

(6) Insert contact stop (1), with the small projection up and facing rear of body. Depress cam (6), push stop (1) toward front of body and release cam (6).

(7) Lubricate lobe on block (9), shaft assembly (5), and the shaft assembly hole in body (7) with LSA-T.

(8) Insert shaft assembly (5) in body.

(9) Engage block (9) with fork on bottom of shaft assembly (5), align pin holes, and install pin (10). Check that block moves freely after installing pin.

(10) Stamp top of bolt body with a "1" at 36,000-round repair.

***e. Installation.* Refer to TM 9-2350-300-10 for instructions for installing breech bolt assemblies in XM168 cannon.**

6-9. Rotor Assembly.

NOTE

The rotor is to be removed for cleaning only.

a. Removal.

(1) Remove cannon from XM163 gun as instructed in paragraph 6-4.

(2) If not already removed, remove muzzle clamp, center clamp, and barrels from cannon (para. 6-5).

(3) Remove chute adapter assembly (2, fig. 6-16).

(4) Remove pins (9), and remove housing cover (8).

(5) Remove all six breech bolt assemblies (7) from cannon (TM 9-2350-300-10).

(6) Remove pins (19, fig. 6-16), and remove guide bar (3).

(7) Remove screws (11) and remove firing contact assembly (10).

(8) Remove index pin assembly (6).

(9) Remove bolts (5) from bearing retainer assembly.

(10) Stand cannon on forward end of bearing retainer assembly.

(11) Lift rear housing assembly (4) from rotor assembly (12), being careful not to damage shim (18).

(12) Remove shim (18).

(13) Separate bearing retainer assembly from rotor assembly by placing rotor assembly on a block of wood and tapping retainer assembly with a soft faced hammer (fig. 6-17A).

CAUTION

Indiscriminate use of cleaning solvent may damage lubricant in bearings.

b. Installation.

(1) Position bearing retainer assembly on rotor assembly, and seat in place by tapping upward around the retainer with a soft faced hammer (fig. 6-17B).

(2) Position shim removed in (12) preceding, on bearing retainer assembly, and place rear housing assembly over rotor assembly.

NOTE

If shim has been damaged, cannon must be returned to direct support maintenance for selection of a replacement. Shims are not interchangeable between cannons.

(3) Secure rear housing assembly to bearing retainer assembly with bolts removed in paragraph a preceding. Torque bolts to between 250 and 300 inch-pounds.

(4) Install index pin assembly (6, fig. 6-16), and safety-wire.

(5) Install firing contact assembly (10). Torque screws to between 23 and 32 inch-pounds. Safety-wire screws.

(6) Install guide bar (3) and secure with pins (19).

(7) Install breech bolt assemblies (TM 9-2350-300-10).

(8) Install housing cover (8).

(9) Install chute adapter assembly (2). Safety-wire screws.

(10) Install barrels and clamps (para 6-5c.), and install cannon on XM163 gun.

6-10. Chute Adapter Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove gun shield (fig. 6-3).

(4) Remove case chute assembly (fig. 6-5).

(5) Remove screws (1, fig. 6-16), and remove chute adapter assembly (2).

b. Inspection. Inspect the chute adapter assembly for the presence of any of the following conditions:

(1) Damaged retainers.

(2) Bent condition.

c. Installation. Installation is the reverse of removal. Safety-wire screws.

6-11. Housing Cover Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Release brake on elevation drive motor, manually elevate cannon to its upper limit, and reapply brake (fig. 6-5).

(4) Remove pins (9, fig. 6-16) and remove housing cover (8).

b. Inspection. Inspect the housing cover assembly for the presence of any of the following conditions:

(1) Loose rivets.

(2) Bent cover securing pins.

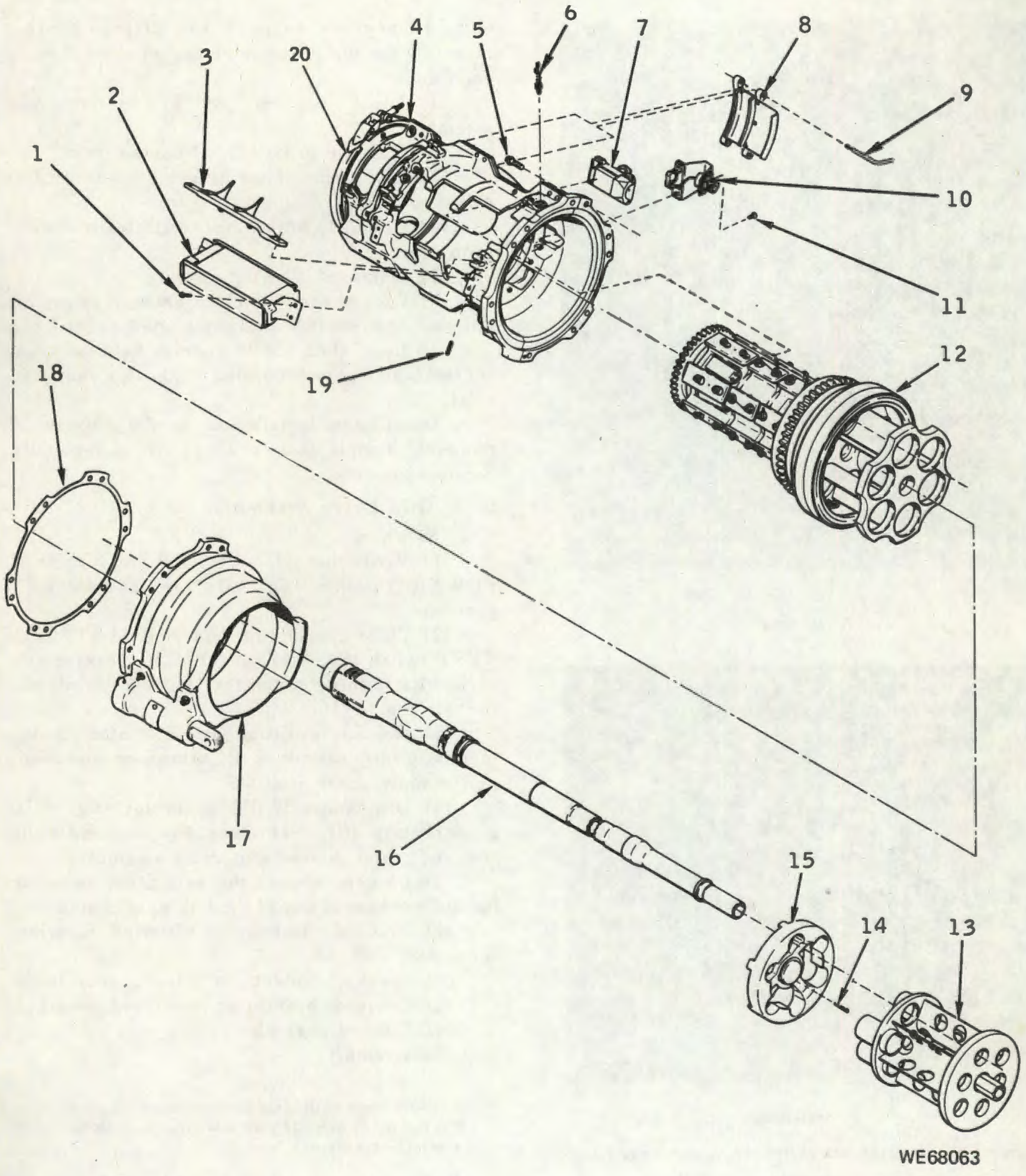
c. Installation. Installation is the reverse of removal.

6-12. Firing Contact Assembly.

a. Removal.

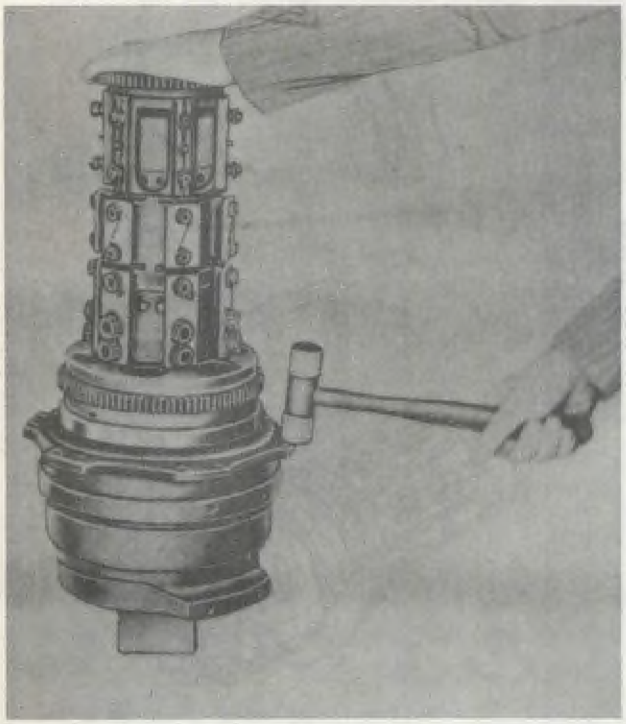
(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch at STATIC position (fig. 6-11), and verify that arming connector (fig. 6-2) is disconnected.

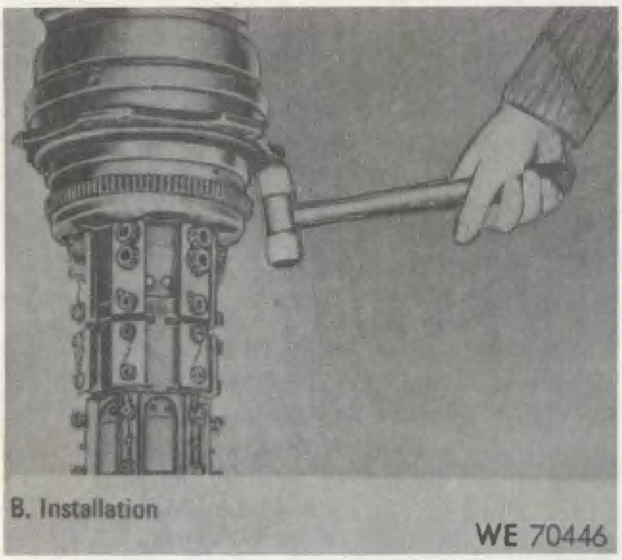


1 Screw	8 Housing cover	15 Centering clamp assembly
2 Chute adapter assembly	9 Pin	16 Barrel
3 Guide bar	10 Firing contact assembly	17 Bearing retainer assembly
4 Rear housing assembly	11 Screw	18 Shim
5 Bolt	12 Rotor assembly	19 Pin
6 Index pin assembly	13 Muzzle clamp assembly	20 Clamp
7 Breech bolt assembly	14 Cotter pin	

Figure 6-16. XM168 cannon, exploded view.



A. *Removal*



B. Installation

Figure 6-17. Removal/installation of rotor bearing retainer assembly.

(3) Release brake on elevation drive motor, manually elevate cannon to its upper limit, and reapply brake (fig. 6-5).

(4) Remove screws, (11, fig. 6-16), and remove firing contact assembly (10).

b. Inspection. Inspect the firing contact assembly for the presence of any of the following conditions:

(1) Loose contact pin in contact cam assembly.

(2) Damage to bottom of contact cam.

(3) Elongation of spring pin holes in contact cam.

(4) Cracked, broken, or distroted electrical connector.

(5) Damaged sleeving on wire.

(6) Greater than 2.5 ohms between connector pin and cam contact (indicates open circuit).

(7) Less than 500k ohms between cam contact and contact housing (indicates short circuit).

c. Installation. Installation is the reverse of removal. Torque screws 23 to 32 inch-pounds. Safety-wire screws.

6-13. Gun Drive Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position and verify that arming connector (fig. 6-2) is disconnected from A1J6.

(3) Release elevation drive motor brake, manually raise cannon to its maximum elevation, and reapply brake (fig. 6-5).

(4) Disconnect W3P3 connector (fig. 6-7), ground strap (fig. 6-18), and five securing bolts (fig. 6-7), and remove gun drive assembly.

b. Inspection. Inspect the gun drive assembly for the presence of any of the following conditions:

(1) Cracked, broken, or distorted electrical connector.

(2) Cracked, broken, or missing gear teeth.

(3) Cracked, broken, or punctured housings.

(4) Sheared gear pins.

c. Disassembly.

NOTE

Disassembly is authorized for replacement of pins (7, fig. 6-19) only. If pins are sheared, perform the following steps:

(1) Remove screws (8) and washers (9) securing retainer (10) to gear housing, and remove retainer.

(2) Remove shaft (11) and slide out gear cluster (3) and bearing washers (2).

(3) Separate gear cluster by removing pins (7) and separate gears (5 and 6).

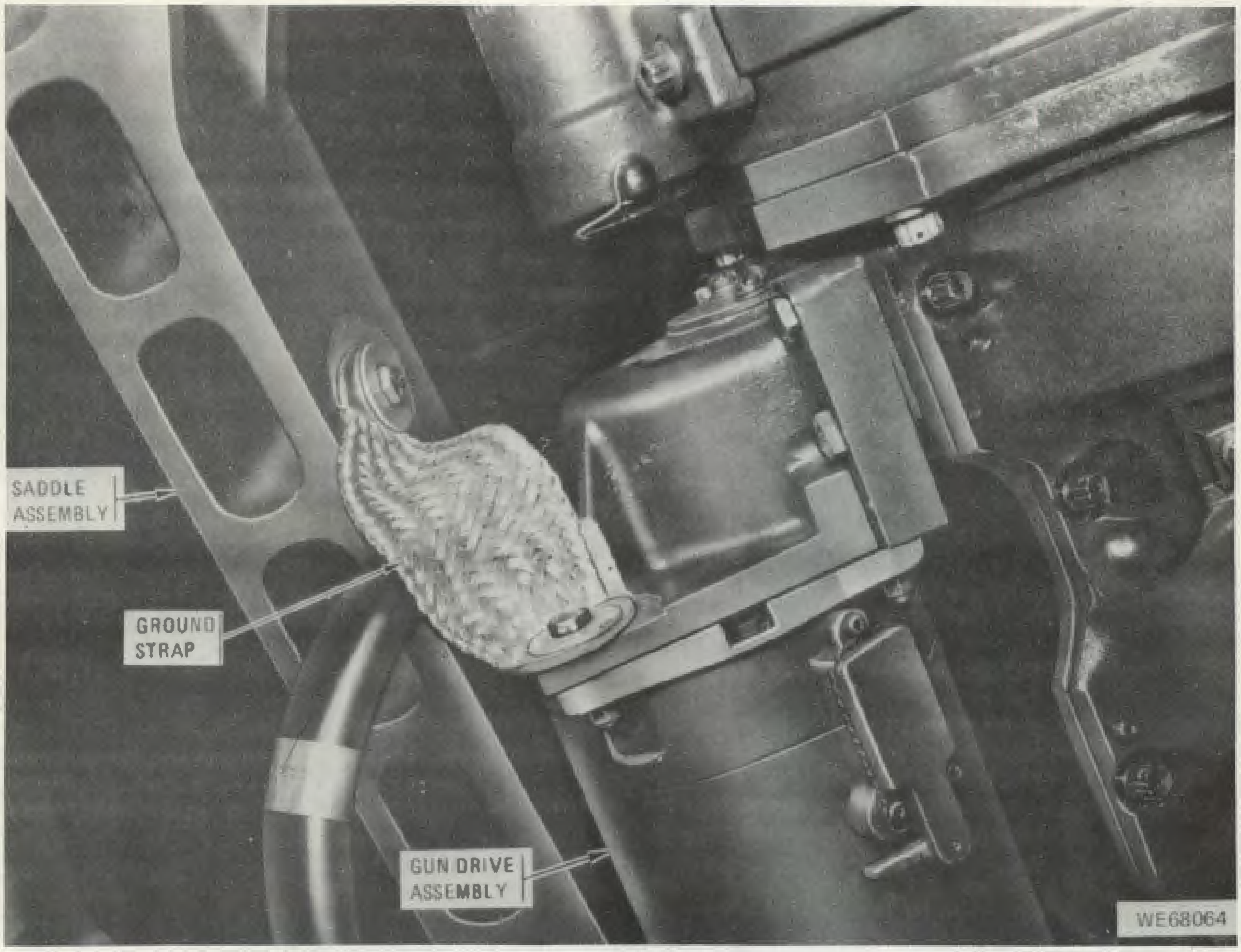


Figure 6-18. Ground strap between saddle assembly and gun drive assembly.

d. Assembly.

NOTE

In step (1) following, assure the wide flanges on gears 5 and 6 are facing each other for assembly.

(1) Align the four pin holes in gears (5 and 6, fig. 6-19) and start all four pins (7) into both gears.

(2) Press pins into gears and then drive each pin below the face of the gears, assuring that pins do not protrude from either gear's outer face.

(3) Install the gear cluster (3) and washers (2) into gear housing, and secure with shaft (11).

(4) Secure shaft in gear housing with retainer (10), washers (9), and screws (8).

(5) Apply permatex (FSN 8030-252-3391) to mating surfaces of gun drive motor (1) and gear housing (14) before assembly. After assembling the housing to the motor, fill the four slotted areas (fig. 6-19) with permatex to assure a seal.

CAUTION

If the bottom drive motor bracket (fig. 6-7) is removed or replaced, make sure it is properly reinstalled. The wide portion (containing the part number) of the bracket must be installed toward the mount to assure proper alignment of the gun drive assembly.

e. Installation. Installation is the reverse of removal. Safety-wire screws and connector.

6-14. Guide Bar.

a. Removal.

(1) Remove declutching feeder by performing (1) through (11) of paragraph 6-4a.

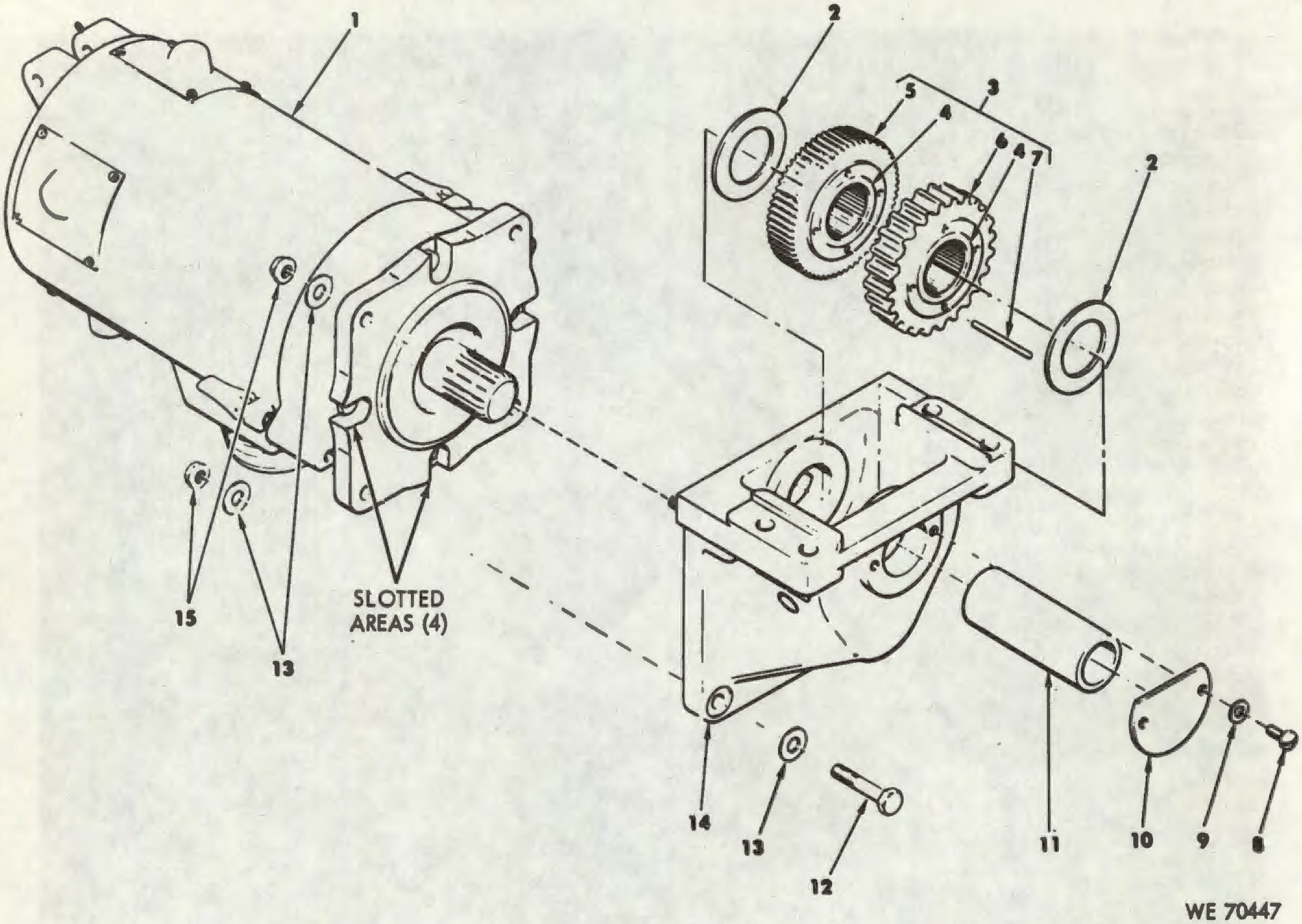
(2) Remove the two guide bar pins (19, fig. 6-16), and remove the guide bar (3).

b. Inspection.

Inspect guide bar and guide bar pins for cracks, breaks, or distortion.

c. Installation.

Installation is the reverse of removal.



1 Motor	6 Gear	11 Shaft
2 Washer	7 Pin	12 Bolt
3 Gear cluster	8 Screw	13 Washer
4 Bearing	9 Washer	14 Gear housing
5 Gear	10 Retainer	15 Nut

Figure 6-19. Gun drive assembly, exploded view.

Section III. REPAIR OF MOUNT XM157

6-15. General.

Repair of the mount consists of replacing damaged or malfunctioning parts or components found during inspection and checkout/fault isolation procedures. Instructions for repairing the XM157 mount at the organizational level are given in the following paragraphs. Table 6-4 lists the components of the mount that are replaceable or reparable at the organizational level, and provides a guide to the location of instructions for each repair function. Where repair instructions are not given, the repair procedures are obvious by reference to the illustration (note table 6-4, "Reference figure" column).Whenever an electrical or electronic component is replaced, the appropriate system checks will be performed to assure proper adjustment and operation. The system interconnection diagram (fig. 3-38) provides reference for proper connection of electrical plugs and jacks. Mount components will be subjected to inspection each time they are removed for corrective maintenance, or are suspected of improper operation. Inspection consists of examining components to detect mechanical or electrical failure, or loose or missing parts.

6-16. Azimuth Drive Assembly.

a. Removal.

(1) Verify that distribution box arming connector (fig. 6-2) is disconnected.

(2) Place cannon in travel lock.

(3) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

Table 6-4. Guide to Repair of M157 Mount

Component	Repair instructions	Reference figure
Azimuth Drive Assembly	Para 6-16	Fig. 6-22
Azimuth Drive Motors		Fig. 6-23
Azimuth Tachometer		Fig. 6-23
Elevation Drive Assembly	Para 6-17	Fig. 6-24
Elevation Drive Motors		Fig. 6-26
Elevation Tachometer		Fig. 6-26
Azimuth Switch Assembly	Para 6-18	Fig. 6-27
Gun Position Switch	Para 6-19	Fig. 6-28
Brake and Clear Switch		Fig. 6-4
Foot Switch Assembly	Para 6-20	Fig. 6-22
Declutching Feeder	Para 6-21	Fig. 6-4
Extension Shaft	Para 6-22	Fig. 6-6
Transfer Drive Assembly	Para 6-23	Fig. 6-33
Flexible Drive Shaft		Figs. 6-33 and 6-42
Conveyor Assembly	Para 6-24	Fig. 6-34
Exit Unit Assembly	Para 6-25	Fig. 6-34
Conveyor Detection Assembly	Para 6-26	Fig. 6-34
Drum Drive Assembly	Para 6-27	Fig. 6-42
Drum Drive Motor		Fig. 6-43
Loading Switch Assembly	Para 6-28	Fig. 6-43
Loading Chute Assembly		Figs. 6-10 and 6-34
Conveyor Chuting Assemblies	Para 6-29	Fig. 6-48
Conveyor Elements	Para 6-30	Fig. 6-37
Elevation Potentiometer Assembly	Para 6-31	Fig. 6-52
Elevation Limit Switch Assembly	Para 6-32	Fig. 6-5
Equilibrator Assemblies	Para 6-33	Figs. 6-12 and 6-52
Sight Mountings and Support Shafts	Para 6-34	Fig. 6-67
Saddle Assembly	Para 6-35	Fig. 6-12
Slip Ring Assembly	Para 6-36	Fig. 6-87
Azimuth Indicator	Para 6-37	Fig. 6-1
Control Assembly	Para 6-38	Fig. 6-76
Elevation Control Assembly	Para 6-39	Fig. 6-76
Control Panel Assembly	Para 6-40	Fig. 6-76
Sight Current Generator	Para 6-41	Figs. 6-79 and 6-80
Sight Current Generator Resilient Mounts		Fig. 6-47
Distribution Box	Para 6-42	Fig. 6-58
Servo Amplifiers		Fig. 6-87
Inverter		Fig. 6-87
Batteries		Figs. 6-87 and 6-88
Gunner's Seat Assembly		Figs. 6-20 and 6-21
Gunner's Seat Backrest		Fig. 6-89
Ground Straps		Figs. 6-7, 6-66, 6-79, 6-90, 6-91, 6-92, and 6-93.
Radar Linkage Assembly	Para 6-44	Fig. 6-66
Cables	Para 6-67	

(4) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position.

(5) Press gunner's seat pivot knob (fig. 6-20) and rotate seat assembly clockwise to limit. Remove seat assembly quick-release pin (fig. 6-21), open hinge plate, slide bearing off seat support tube, and remove gunner's seat assembly.

CAUTION

Do not apply power to system while azimuth drive motor is disconnected.

Figure 6-20. Gunner's seat assembly, controls.

NOTE

Refer to figure 6-22 when performing the following procedures, unless otherwise noted.

(6) Disconnect cable connector W8P7 (15, fig. 6-22) from azimuth tachometer.

(7) Disconnect cable connectors W8P8 and W8P9 from azimuth drive motors (10).

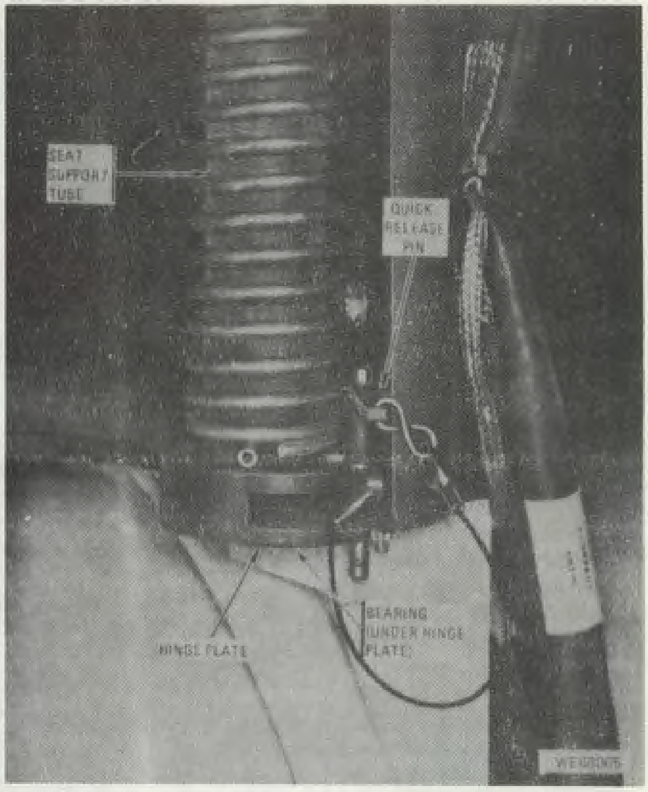


Figure 6-21. Gunner's seat assembly, removal/installation details.

NOTE

To reduce weight of assembly, drive motors (10, fig 6-23) may be removed before proceeding further. If drive motors remain attached, release brakes.

(8) Remove plate securing screws (16, fig. 6-22), and remove plate (13).

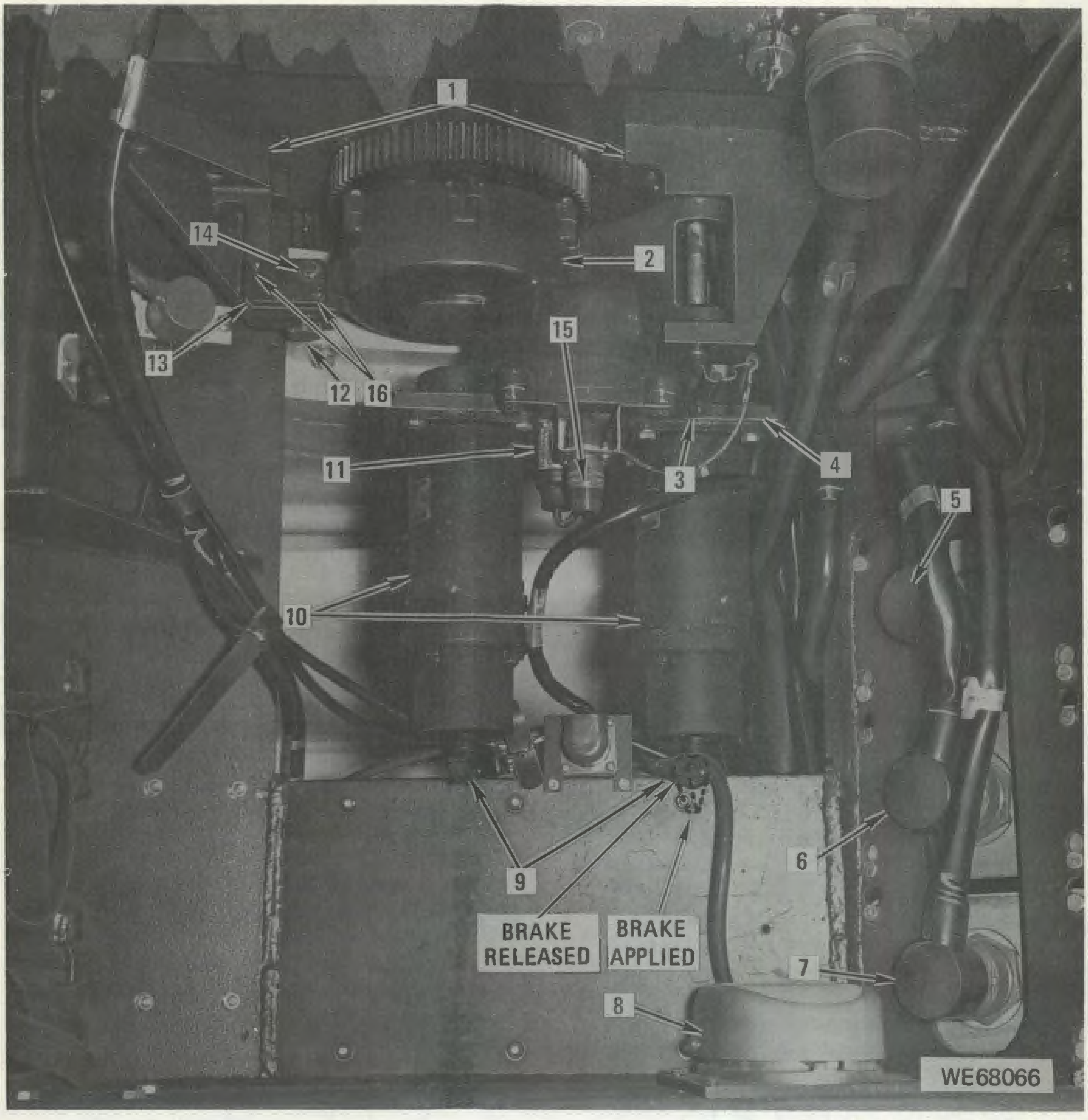
(9) Remove bolt (12) securing azimuth drive assembly to bracket.

(10) Remove quick-release pin (3) securing azimuth drive assembly to other bracket.

CAUTION

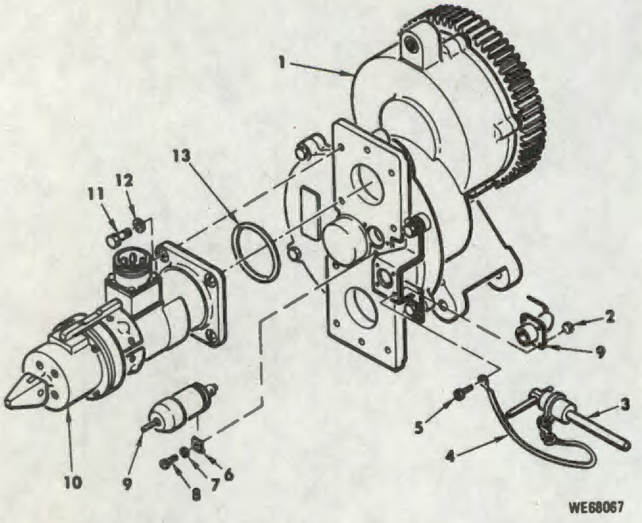
Azimuth drive assembly (with motors attached) weighs approximately 45 pounds. Two men should be used to perform the following operation.

(11) Remove azimuth drive assembly by pushing quick-release pin end of assembly away from center of mount with one hand, and simultaneously pulling gear end of assembly in toward center of mount with other hand.



1 Mounting brackets
2 Azimuth drive assembly
3 Quick-release pin
4 Mounting plate
5 Azimuth amplifier no. 1 connector (A15A1J1 & W8P3)
6 Azimuth amplifier no. 2 connector (A15A2J1 & W8P2)
7 Elevation amplifier connector (A15A3J1 & W8P4)
8 Foot switch assembly
9 Brake release levers (shown in off position)
11 Tachometer
12 Securing bolt
13 Plate
14 Adjusting bolt
15 Tachometer connector
16 Plate-securing screws

Figure 6-22. Azimuth drive assembly, removal/installation details.



1 Azimuth drive assembly
2 Nut
3 Quick-release pin
4 Safety cable
5 Screw
6 Clamp
7 Washer
8 Screw
9 Azimuth tachometer and connector (supplier with tachometer)
10 Azimuth drive motor
11 Bolt
12 Washer
13 Packing (O-ring)

Figure 6-23. Azimuth drive assembly and azimuth drive motors, exploded view.

b. Inspection. Inspect the azimuth drive assembly (fig. 6-23), azimuth drive motors and tachometer, for the presence of any of the following conditions:

(1) Cracked, broken, or distorted electrical connectors.

(2) Cracked, broken, or missing gear teeth.

(3) Cracked, broken, or punctured housings.

(4) Binding of motors or tachometer.

c. Installation.

(1) Verify that drive motor brakes are released.

(2) Install drive assembly by reversing the procedures followed for removal. Do not tighten securing or adjusting bolts, and assure that bolts do not protrude to the extent that plate securing screws (16, fig. 6-22) cannot be tightened.

(3) After connecting motor and tachometer cable connectors, torque adjusting bolt (14, fig. 6-22) to 10 inch-pounds.

(4) Remove cannon from travel lock and rotate mount 360 degrees manually to verify that drive does not bind. If drive does bind, loosen adjusting bolt and retorque to 10-inch-pounds at point of bind.

(5) Install boresight kit muzzle adapter in a cannon barrel, and mount mandril and elbow telescope in adapter. Position the cannon at approximately 0 degrees elevation, and select an aiming point 1000 inches or more from cannon.

(6) Apply both azimuth drive motor brakes manually. Manually move cannon to limit of travel in azimuth, first in one direction, then in the other direction, while looking through telescope. Total travel must be less than 4 mils (slightly less than one small scale division on elbow telescope reticle).

(7) If travel is over 4 mils, increase torque in 5 inch-pound increments, not to exceed 25 inch-pounds, and repeat (4) through (7) preceding. If travel cannot be brought within 4-mil limit, replace azimuth drive assembly.

(8) If travel is within 4-mil limit, tighten securing bolt (12, fig. 6-22) and remove boresight kit muzzle adapter, mandril, and elbow telescope from cannon barrel.

(9) Reinstall gunner's seat.

6-17. Elevation Drive Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Release elevation drive motor brake (fig. 6-5) and manually raise cannon to maximum elevation, and reapply brake. Secure cannon in this position with rope tied between muzzle clamp and chassis lifting eyes behind cannon.

NOTE

Refer to figure 6-24 when performing the following procedures, unless otherwise noted.

(4) Remove forward upper shield (13, fig. 6-24) from turret subassembly (7).

CAUTION

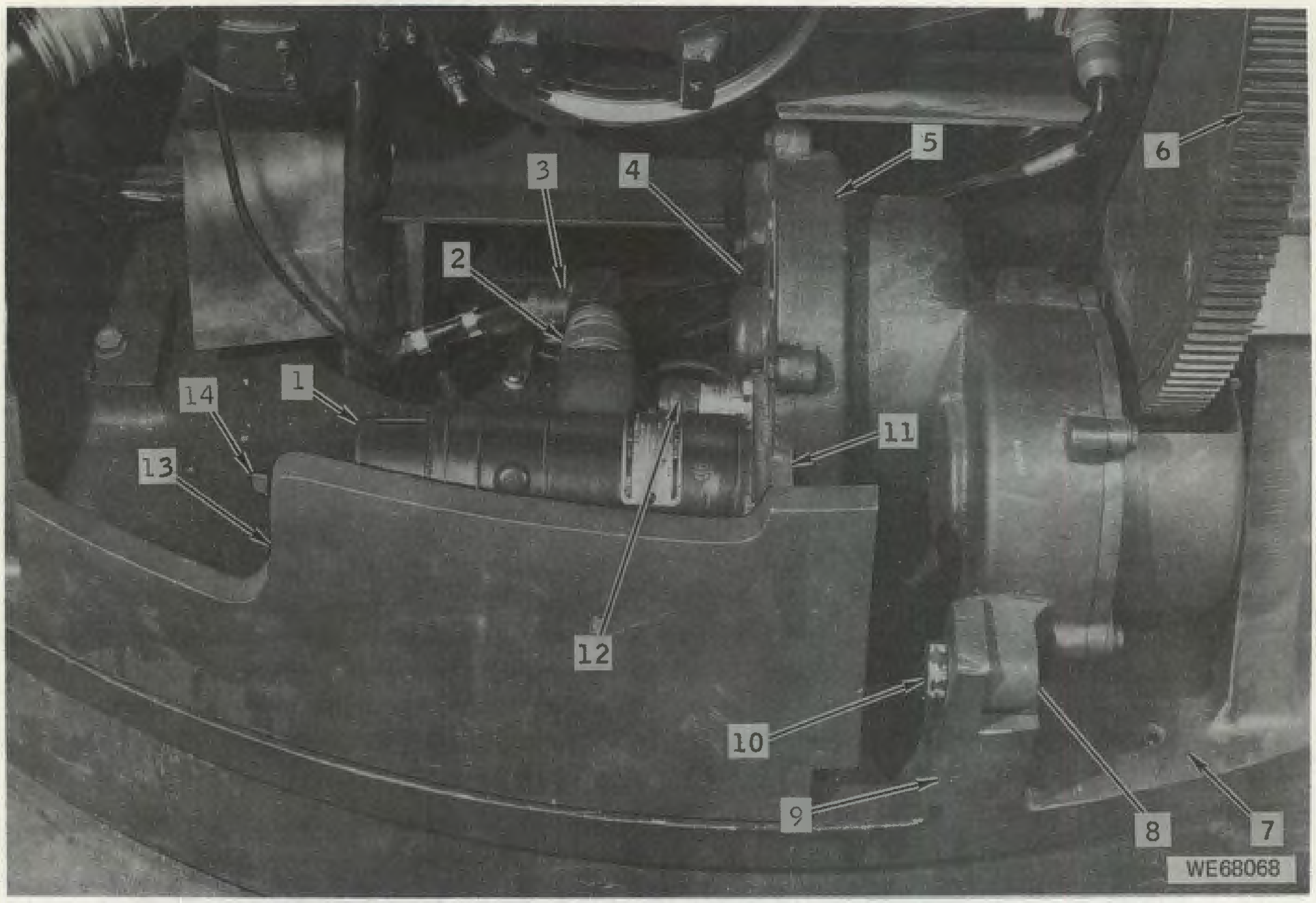
Do not apply power to system while elevation drive motor is disconnected.

(5) Remove cable clamp (3) screw.

(6) Disconnect cable connector W8P6 from elevation tachometer (12).

(7) Disconnect cable connector W8P5 (2) from elevation drive motor (1).

(8) Loosen bolt (10) to back off adjusting screw (8), and remove bolt (10) securing elevation drive assembly (5) to front bracket (9).



1 Elevation drive motor
2 Connector (A16A1J1 & W8P5)
3 Cable clamp
4 Shouldered shaft (hidden)
5 Elevation drive assembly
6 Sector gear
7 Turret subassembly
8 Adjusting screw (hidden)
9 Front bracket
10 Securing bolt
11 Motor mounting plate
12 Tachometer (A16A2G1)
13 Forward upper shield
14 Brake release lever

Figure 6-24. Elevation drive assembly, removal/installation details.

NOTE

Access to the shouldered shaft socket-head screw in the following steps can be gained from the gunner's seat.

(9) Using a socket-head screw key, loosen setscrew that retains shouldered shaft (fig. 6-25).

NOTE

The following step may be facilitated by using a 3-foot by 3/8-inch brass-tipped steel bar.

(10) Drive shouldered shaft (fig. 6-25) outward until it is clear of elevation drive assembly rear bracket.

(11) Release brake (fig. 6-5) on elevation drive motor and pull elevation drive assembly (5, fig. 6-24) forward and upward, working it to clear front bracket and sector gear (6).

b. Inspection. Inspect the elevation drive assembly (fig. 6-26), elevation motor and tachometer, for the presence of any of the following conditions:

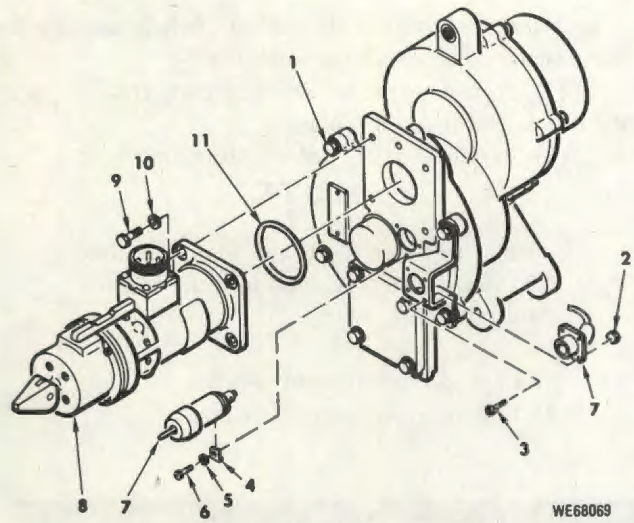
(1) Cracked, broken, or distorted electrical connectors.

(2) Cracked, broken, or missing gear teeth.

(3) Cracked, broken, or punctured housings.

(4) Binding of motors or tachometer.

Figure 6-25. Shouldered shaft, removal/installation details.



1 Elevation drive assembly
2 Nut
3 Screw
4 Clamp
5 Washer
6 Screw
7 Elevation tachometer and connector (supplied with tachometer)
8 Elevation drive motor
9 Bolt
10 Washer
11 Packing (O-ring)

Figure 6-26. Elevation drive assembly and elevation drive motor, exploded view.

c. *Installation.*

(1) Verify that drive motor brake is released.

NOTE

Refer to figure 6-24 when performing the following procedures unless otherwise noted.

(2) Position elevation drive assembly (5, fig. 6-24) under saddle assembly sector gear (6), and push back until threaded hole in elevation drive assembly housing is aligned with hole in front mounting bracket (9), and gears mate.

(3) Drive shouldered shaft back into position and secure with setscrew (fig. 6-25).

(4) Turn adjusting screw (8, fig. 6-24) until elevation drive assembly gear is snug against saddle assembly sector gear (6).

(5) Apply elevation drive motor brake.

(6) Connect cable clamp to elevation tachometer and elevation motor. Install cable clamp.

(7) Remove rope securing cannon in elevated position.

(8) Release elevation drive motor brake. Lower and raise cannon to check for binding or excessive looseness of mating. Reapply brake.

(9) Install boresight kit muzzle adapter in a cannon barrel, and mount mandril and elbow telescope in adapter. Position the cannon at approximately 0 degrees elevation, and select an aiming point 1000 inches or more from cannon.

(10) Apply elevation drive motor brake manually. Move cannon to limit of travel in elevation and depression, first in one direction, then in the other direction, while looking through telescope. Total travel must be less than 4 mils (slightly less than one small scale division on elbow telescope reticle).

(11) If travel is over 4 mils, tighten adjusting screw until noticeable difference in force is required and then turn one more half turn. If travel is not brought within 4-mil limit, replace elevation drive assembly.

(12) If travel is within 4-mil limit, tighten securing bolt (10, fig. 6-24).

(13) Install forward upper shield (13).

6-18. Azimuth Switch Assembly.

a. *Removal.*

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect cable connector (W8P10) from azimuth switch assembly connector (A19J1) (fig. 6-27).

(4) Remove azimuth switch assembly (A19J1) connector bracket (fig. 6-27).

(5) Remove both switch mounting brackets from turret subassembly wall, being sure to note and record the location and size of each shim (fig. 6-27).

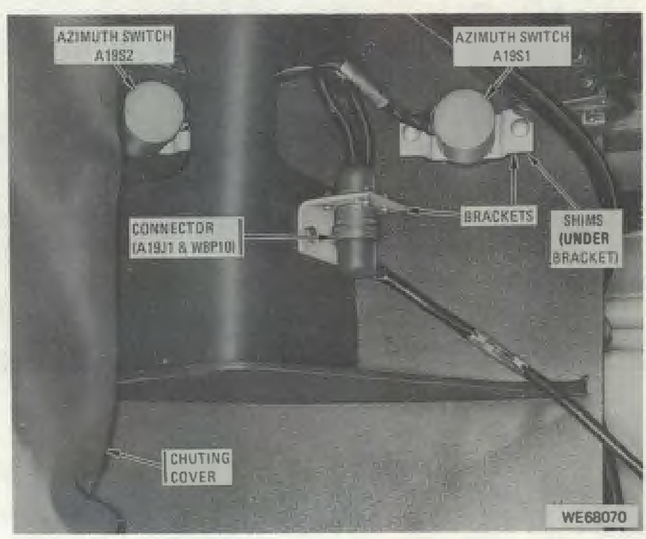


Figure 6-27. Turret subassembly, interior view showing azimuth switch assembly.

NOTE

Refer to figure 6-28 to identify switch components and remove azimuth switches (A19S1 and A19S2) as outlined in the procedures that follow.

(6) Force spring clips (7, fig. 6-28) off switches (4 and 5) and roller guides (6).

(7) Unscrew roller guides and remove from switches.

(8) Remove hex nuts (9) securing switches to brackets, and separate brackets and switches.

(9) Separate bracket from A19J1 connector.

b. Inspection. Inspect the azimuth switch assembly for the presence of the following conditions:

(1) Broken, bent, or damaged pins, cracked insert, and dirt or corrosion on connector.

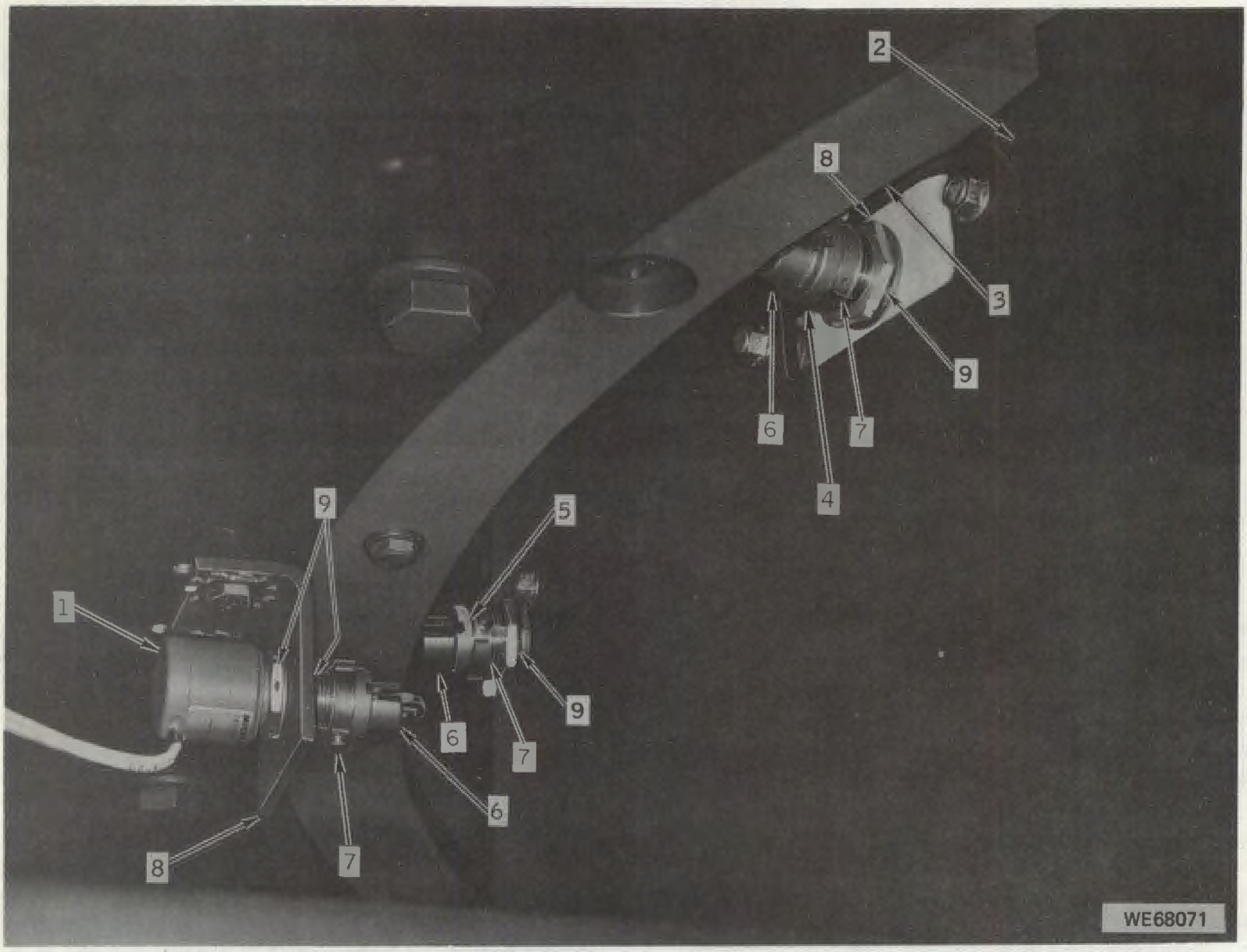
(2) Abrasions or cracked insulation on wiring.

NOTE

Refer to figure 6-29, and use ohmmeter to verify switch actuations in the following procedure.

(3) Improper operation of switches.

(4) Rollers for flat spots or binding.



1 Gun position switch
2 Turret subassembly
3 Switch actuating bar
4 Azimuth switch A19S2
5 Azimuth switch A19S1
6 Roller guide
7 Spring clip
8 Bracket
9 Hex nuts

Figure 6-28. Azimuth switches and gun position switch, removal/installation details.

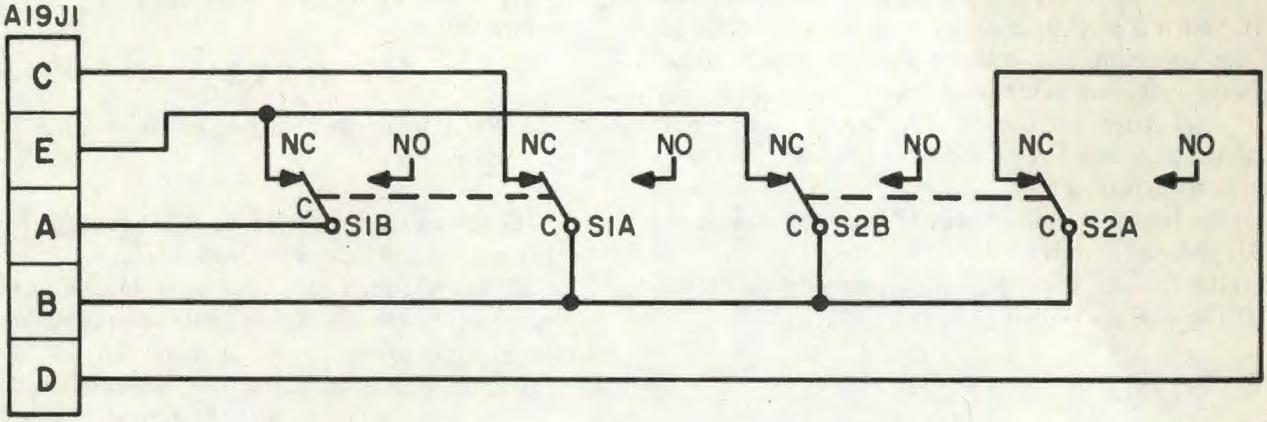


Figure 6-29. Azimuth switch assembly, schematic diagram.

c. *Installation.*

NOTE

Refer to figure 6-28 to identify switch components.

(1) Install bracket on switch connector A19J1 (fig. 6-27).

(2) Remove spring clip (7, fig. 6-28), roller guide (6), one hex nut (9), and lockwasher from each switch.

(3) Insert each switch into opening in respective bracket and secure it with lockwasher and hex nut. Secure switch in its maximum retracted position within the bracket.

(4) Screw roller guide (6) onto end of each switch and keep turning it by hand until snug. Do not install spring clip (7) at this time.

(5) Check that mount is positioned so that neither switch actuating bar (3) is opposite switch mounting holes in turret subassembly wall.

(6) Refer to figure 6-29, and use ohmmeter to identify each switch.

(7) Position each bracket and switch on wall of turret subassembly with switch A19S1 on right (fig. 6-27). Position shims in proper locations, and install bracket.

(8) Adjust the actuating point of each switch as follows:

(a) With switch roller horizontal, rotate mount until switch roller is aligned with the maximum cam surface of the actuating bar (fig. 6-30A).

(b) Adjust switch hex nuts on each side of mounting bracket until switch roller just touches the maximum cam surface. Then adjust switch further toward cam by making three complete revolutions of the hex nuts. Refer to figure 6-29 and use an ohmmeter to verify switch actuation. Assure that switch has sufficient overtravel. Insert the flat of a screwdriver blade between the switch roller and cam surface. If screwdriver blade raises the roller, there is sufficient overtravel.

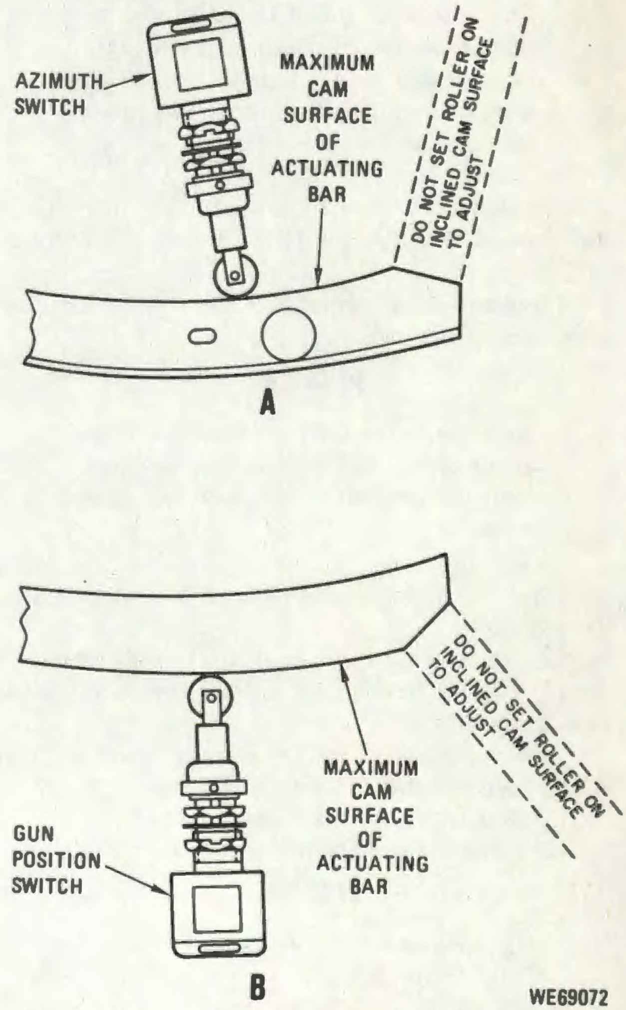


Figure 6-30. Actuating point of azimuth switches on maximum cam surface of switch actuating bar.

(c) Tighten hex nuts and install spring clips (7, fig. 6-28). Switch is properly installed when roller is horizontal and pin on spring clip enters keyway in switch body. (Keyways on the two switches are toward each other.)

(d) Refer to figure 6-30A; use ohmmeter and verify that each switch remains actuated over the full travel range on the actuating bars.

(9) Install azimuth switch assembly connector (A19J1) bracket to turret.

(10) Connect azimuth switch assembly connector A19J1 (fig. 6-27) to W8P10.

6-19. Gun Position Switch.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

NOTE

Chassis terminal board TB1 is located on the interior top of the chassis, to the rear of the mount. Chassis terminal board TB2 is located on the left of the chassis above the oddment bin.

(3) Disconnect switch leads 1(1-20) and 3(3-20) from chassis terminal board TB1, and switch lead 2(2-20) from TB2.

(4) Remove leads from cable channels in chassis and remove clamp from leads.

NOTE

Refer to figure 6-28 to identify switch components, and remove gun position switch as outlined in the procedures that follow.

(5) Force spring clips (7, fig. 6-28) off switch (1) roller guide (6).

(6) Unscrew roller guide and remove from switch.

(7) Remove hex nut (9) securing switch to bracket, and remove switch.

b. Inspection. Inspect the gun position switch assembly for the presence of the following conditions:

(1) Broken, bent, or damaged terminal lugs.

(2) Abrasions or cracked insulation on wiring.

NOTE

Use ohmmeter to verify switch actuation in the following step.

(3) Improper operation of switch.

(4) Rollers for flat spots or binding.

c. Installation.

NOTE

Refer to figure 6-28 to identify switch components.

(1) Remove spring clip (7, fig. 6-28), roller guide (6), one hex nut (9), and lockwasher from switch.

(2) Insert switch into opening in bracket (8) and secure it with lockwasher and hex nut. Secure switch in its maximum retracted position within the bracket.

(3) Adjust the switch actuation point as follows:

(a) With switch roller horizontal, rotate the mount until switch roller is approximately centered on the cam.

CAUTION

Do not set roller on the inclined edge of the cam to adjust switch. Refer to figure 6-30B.

(b) Adjust switch hex nuts on each side of mounting bracket until switch roller just touches the cam surface. Then adjust switch further toward cam by making three complete revolutions of the hex nuts. Assure that switch has sufficient overtravel. Insert the flat of a screwdriver blade between the switch roller and cam surface. If screwdriver blade raises the roller, there is sufficient overtravel.

(c) Tighten hex nuts and install roller guide and spring clip. Switch is properly installed when roller is horizontal and pin on spring clip enters keyway in bottom of switch body.

(d) Verify that switch remains actuated over the full travel range of the actuating bar.

NOTE

TB1 is located on the interior top of the chassis, to the rear of the mount. Terminals are numbered from the right side of the chassis to the left. TB2 is located on the left of the chassis above the oddment bin. Terminals are numbered from the front of the chassis to the rear.

(4) Route leads through chassis cable channels and install clamps. Connect as follows:

(a) Switch lead 1 (1-20) to TB1-2

(b) Switch lead 2 (2-20) to TB2-3

(c) Switch lead 3 (3-20) to TB1-1

(5) Verify correct installation of switch by connecting ohmmeter between TB1-1 and TB1-2. Com-

mander's hatch must be open. Rotate mount to actuate switch. Ohmmeter should indicate continuity with switch actuated.

6-20. Foot Switch Assembly.

Repair of the foot switch assembly consists of replacing the cable assembly (and cable assembly lugs). The foot switch assembly must be removed from the mount prior to repair.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect foot switch connector A24JP1 from sight current generator assembly connector A21J5 (3, fig. 6-79).

(4) Remove foot switch assembly (8, fig. 6-22).

b. Inspection. Inspect the foot switch assembly for the presence of the following conditions:

(1) Broken, bent, or damaged pins on connector.

(2) Abrasions or cracked insulation on wiring.

(3) Cracks, breaks, or punctures in housing.

NOTE

Use ohmmeter to verify switch actuation in the following procedure.

(4) Improper operation of switch.

c. Disassembly. To remove foot switch assembly cable assembly, proceed as follows:

NOTE

Refer to figure 6-31 when performing the following procedures.

(1) Remove hinge screws (1, fig. 6-31) and lock washers (2) securing foot plate (3) on switch assembly, and remove foot plate.

(2) Remove four screws (4) securing cover (5) on switch assembly housing (7).

(3) Being careful not to damage O-ring (6) under cover, gently insert screwdriver between cover and housing. Twist screwdriver to release cover. Remove cover and O-ring.

(4) Remove screws (8) and terminal locks (9) securing cable lugs (14) to switch terminals and disconnect cable lugs. Save screws (8) and terminal locks (9).

(5) Loosen and remove seal nut (10) securing cable assembly (15) to switch housing. Gently pull cable out of housing, retaining any ring or seal that may drop off cable.

(6) Slide remaining rings, seal, and seal nut off cable and discard cable only.

d. Assembly. To install foot switch assembly cable assembly, proceed as follows:

NOTE

Refer to figure 6-31 when performing the following procedures.

(1) Strip outer insulation of cable back approximately one inch from end.

(2) Strip insulation from each lead as required, and install a terminal lug (14, fig. 6-31) on each. Crimp lugs in place.

(3) Slide seal nut (10), outer (thick) ring (11), rubber seal (12), and inner (thin) ring (13) over end of cable in order shown in figure 6-31.

(4) Insert end of cable into opening in switch assembly housing and position cable so that outer insulation shows flush to 1/8-inch on inside of switch assembly housing.

(5) While holding cable to prevent movement, push rings, seal, and seal nut into opening in switch assembly housing. Tighten seal nut.

(6) Place cable lug that is crimped to white lead into a terminal lock (9) and secure to COM terminal of switch with screw (8).

(7) Place cable lug that is crimped to black lead into a terminal lock and secure to N.O. terminal of switch with screw.

(8) Position O-ring (6) in switch cover (5) well, and press cover onto switch housing (7), being careful to avoid damaging O-ring. Secure cover with four screws (4).

(9) Position foot plate (3) over switch assembly housing and align the two holes in foot plate with those in housing. Secure foot plate to switch assembly housing with lockwashers (2) and hinge screws (1).

e. Installation. Installation is the reverse of removal.

6-21. Declutching Feeder Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove gun shield (fig. 6-3).

(4) Disconnect cable connector W3P4 from declutching feeder assembly (fig. 6-5).

(5) Remove chuting cover and disconnect return chute from feeder.

NOTE

It may be necessary to remove upper chuting support bracket (outer half) to compress chuting segments (see fig. 6-46).

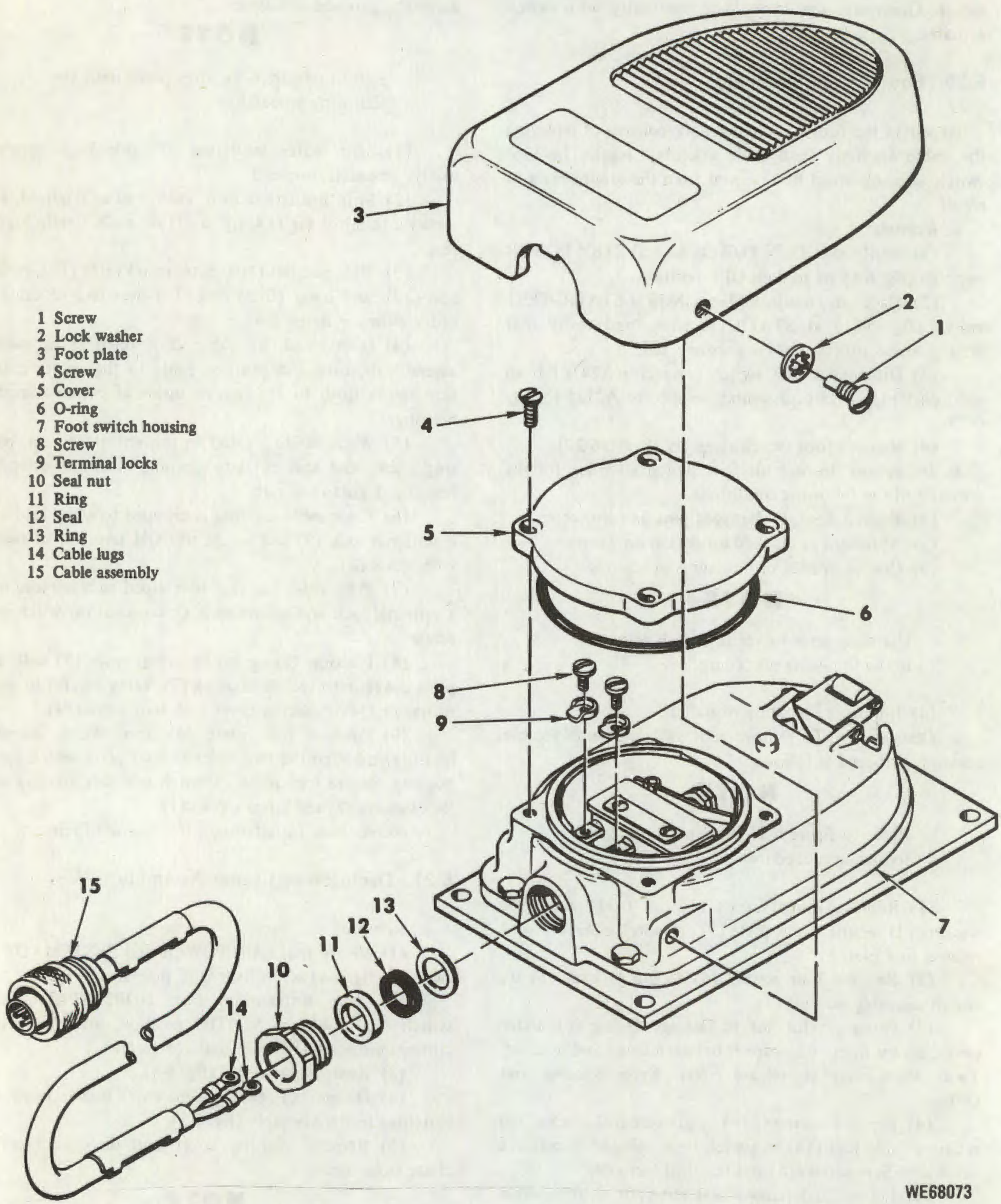


Figure 6-31. Foot switch assembly, exploded view.

(6) Compress chuting segments to gain access to conveyor elements. Separate conveyor element belt by rotating one element 180 degrees, and separating it from adjoining element.

(7) Turn first conveyor element in return chute 90 degrees to hold elements in return chute.

(8) Disconnect feed chute from declutching feeder.

(9) Compress chuting segments and remove four adjacent rounds.

NOTE

It may be necessary to place shift pin handle at N and rotate knurled knob on takeoff gear in feed direction to provide access to four rounds.

(10) Place a large screwdriver through the chute so that movement of the belt is prevented.

(11) Separate conveyor belt.

(12) Remove two feeder lock pins securing declutching feeder assembly to cannon housing (fig. 6-6).

(13) Remove declutching feeder.

WARNING

When expelling rounds from feeder, do not permit rounds to drop on floor.

CAUTION

When removing elements and rounds from feeder assure that there is a round in each element.

(14) While maintaining tension on element belt, manually rotate feeder gear to expel rounds and elements from declutching feeder. Count the elements expelled and record this quantity for use during installation of feeder.

b. Inspection. Inspect the declutching feeder assembly for the presence of the following conditions:

(1) Cracked, broken, or missing gear teeth.

(2) Cracks, burrs, or signs of physical damage on sprockets.

(3) Broken, bent, or damaged pins on connector.

(4) Cracks, breaks, dents or distortion in housing.

(5) Damage of solenoid.

c. Installation.

(1) Assemble into a belt the same quantity of conveyor elements as were removed in a.(14) preceding. Install a round of ammunition in each element.

CAUTION

Immobilize small-loop end of leading element, or exercise extreme caution to prevent it from turning during the performance of (2) and (3) following.

(2) Insert leading (small-loop) end of belt into feeder and rotate feeder gear until first round has been ejected.

(3) Continue rotating feeder gear, ejecting one or two additional rounds and guiding empty elements out of feeder, until access to leading element is obtained with feeder timed. (See fig. 6-32.)

(4) Verify that cannon is timed.

(5) With feeder index pin in timing hole, slide extension shaft over feeder drive shaft, and engage feeder mounting lugs with cannon mounting lugs. Install feeder mounting pins and check cannon and feeder timing (without rotating feeder or cannon). Safety-wire feeder lock pins (para. 6-4c.(4)).

NOTE

The setscrews on the transfer drive end of the extension shaft should be checked for tightness.

(6) Connect first conveyor element in feed chute to last conveyor element of short belt in feeder. Replace rounds after elements have been joined.

(7) Remove screwdriver securing rounds and elements in feed chute.

(8) Connect feed chute to declutching feeder assembly.

(9) Connect conveyor elements from return side of feeder to elements in return chute.

(10) Connect return chute to declutching feeder assembly.

CAUTION

Verify that both the feed and the return chutes are securely attached to the declutching feeder.

NOTE

If upper chuting support bracket was removed, reinstall (see fig. 6-46).

(11) Secure chuting cover to declutching feeder assembly.

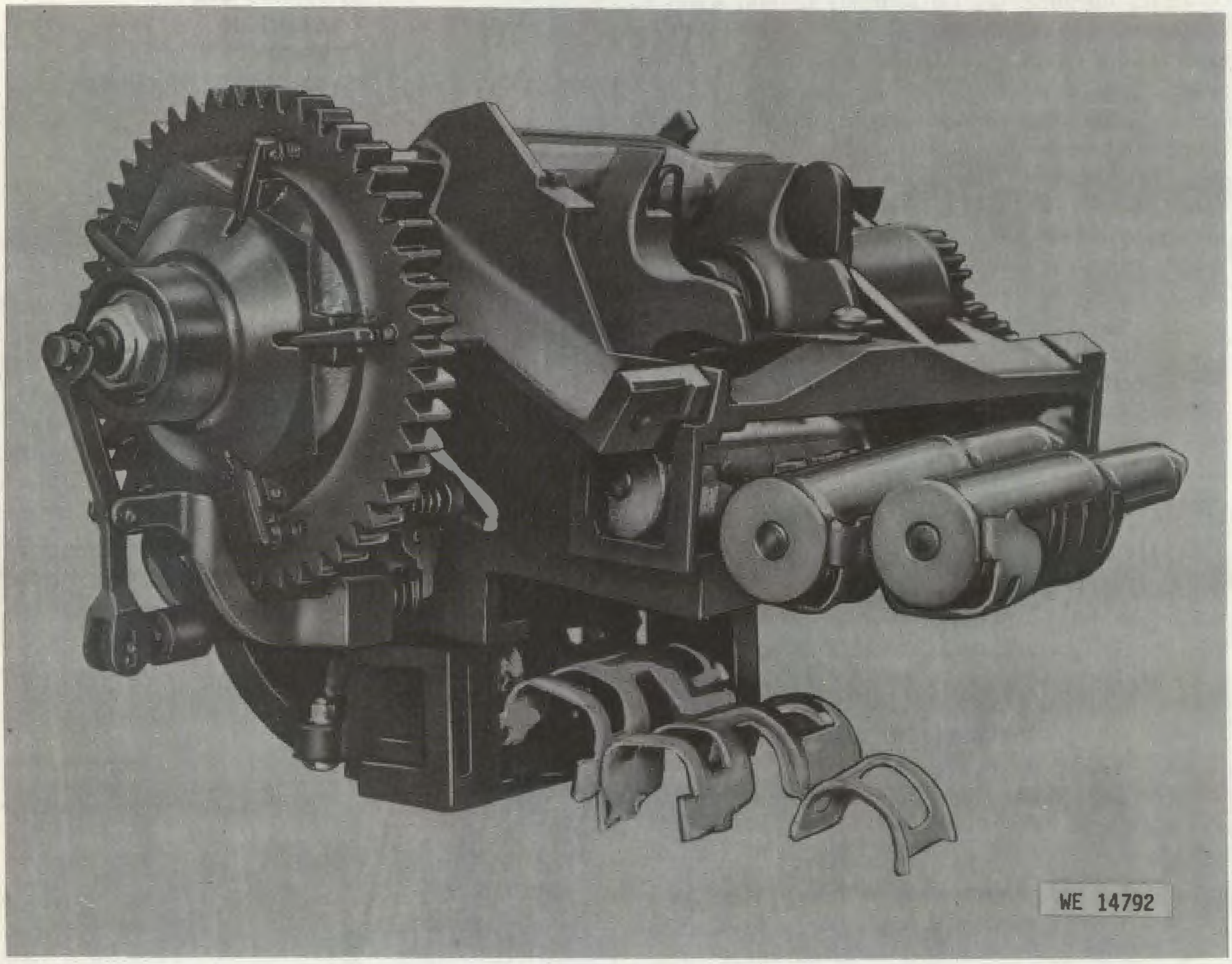


Figure 6-32. Loading declutching feeder assembly.

(12) Connect cable connector W3P4 to declutching feeder assembly.

(13) Verify that shift pin is at F.

(14) Set BRAKE-CLEAR AND BRAKE switch (fig. 6-4) to BRAKE and quickly cycle six rounds to verify timing.

(15) Set BRAKE-CLEAR AND BRAKE switch at CLEAR AND BRAKE, and manually clear cannon.

(16) Check feed chute slack point (TM 9-2350-300-10).

(17) Install gun shield.

6-22. Extension Shaft.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove gun shield (fig. 6-3).

(4) Time declutching feeder by holding BRAKE-CLEAR AND BRAKE switch at CLEAR AND BRAKE position, pressing on feeder index pin, and rotating cannon barrels until index pin drops into timing hole (fig. 6-4). Release index pin.

(5) Remove two feeder lock pins securing declutching feeder assembly to cannon housing (fig. 6-6). Loosen setscrew securing extension shaft to transfer drive assembly.

(6) While holding index pin in timing hole, lift front end of feeder, disconnect extension shaft from transfer drive assembly, and slide extension shaft off feeder drive shaft. Reposition feeder.

b. Inspection. Inspect the extension shaft for bent or cracked condition, or for damaged screw hole threads. Inspect extension shaft setscrew for damage.

Inspect rubber boot on extension shaft for rupture. If the boot is only slightly ruptured, check the U-joint daily and add LSA periodically, as required, to prevent the assembly from becoming dry. If the opening allows the grease to become contaminated with dirt, sand, etc., flush out the contaminated grease, refill with LSA, continue to operate and inspect as above. If the boot is damaged to the extent that it cannot retain grease and the boot is badly frayed, clean the U-joint and coat with LSA. Cut away protruding portions of boot. Continue to clean and lubricate U-joint as necessary to maintain a relatively clean operating joint.

c. Installation.

(1) Slide setscrew end of extension shaft onto transfer drive assembly shaft (fig. 6-6).

CAUTION

Feeder must be in timed position when performing the following procedure.

(2) While holding feeder index pin in timing hole, lift front end of feeder and attach extension shaft to feeder drive shaft. Reposition feeder.

(3) Secure feeder to cannon housing and tighten extension shaft setscrew (fig. 6-6).

(4) Install gun shield.

6-23. Transfer Drive Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove gun shield (fig. 6-3).

(4) Loosen extension shaft setscrew securing extension shaft to transfer drive assembly (fig. 6-6).

(5) Disconnect flexible drive shaft (fig. 6-33).

(6) Disconnect cable connector W3P5 from BRAKE-CLEAR AND BRAKE switch mounting bracket (fig. 6-33).

(7) Manually release elevation drive motor brake (fig. 6-5) and raise muzzle of cannon to approximately 40 degrees elevation. Reapply brake.

(8) Remove BRAKE-CLEAR AND BRAKE switch mounting bracket (fig. 6-33).

(9) Remove transfer drive assembly.

b. Inspection. Inspect the transfer drive assembly for the presence of the following conditions:

(1) Cracks, breaks, dents, or distortion in housing.

(2) Binding.

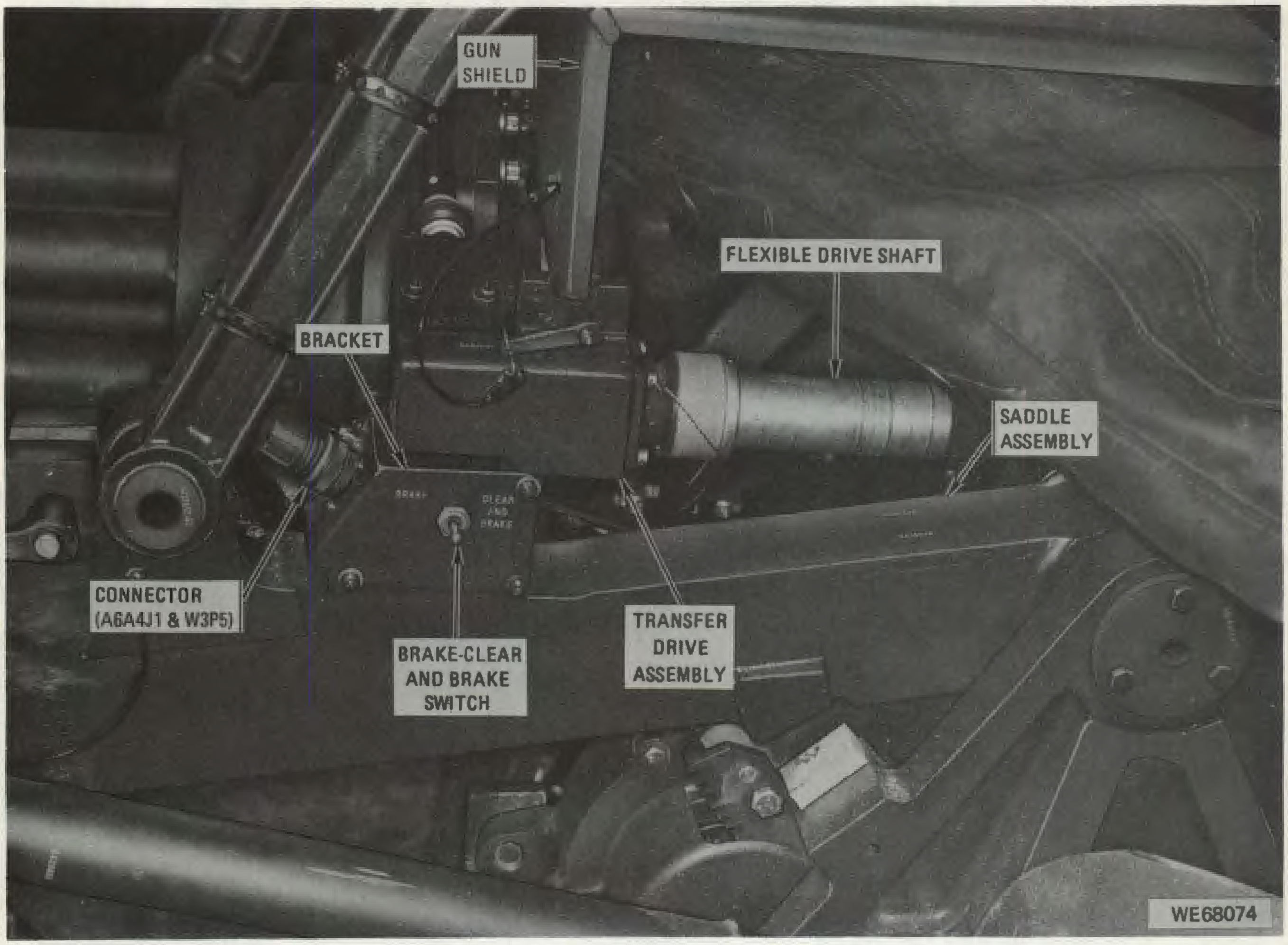


Figure 6-33. XM157 mount, left front view, parts location.

c. Installation.

(1) Position transfer drive assembly (with extension shaft attached) on saddle assembly, sliding extension shaft over feeder drive shaft (fig. 6-6). Secure transfer drive assembly.

(2) Install BRAKE-CLEAR AND BRAKE switch mounting bracket on transfer drive assembly housing (fig. 6-33).

(3) Manually release elevation drive motor brake (fig. 6-5) and lower cannon until it is approximately horizontal. Reapply brake.

(4) Connect cable connector W3P5 to BRAKE-CLEAR AND BRAKE switch (fig. 6-33).

(5) Connect flexible drive shaft (fig. 6-33) to transfer drive assembly, and safety-wire.

(6) Tighten setscrew securing extension shaft to transfer drive assembly.

(7) Install gun shield.

(8) Check feed chute slack point (TM 9-2350-300-10).

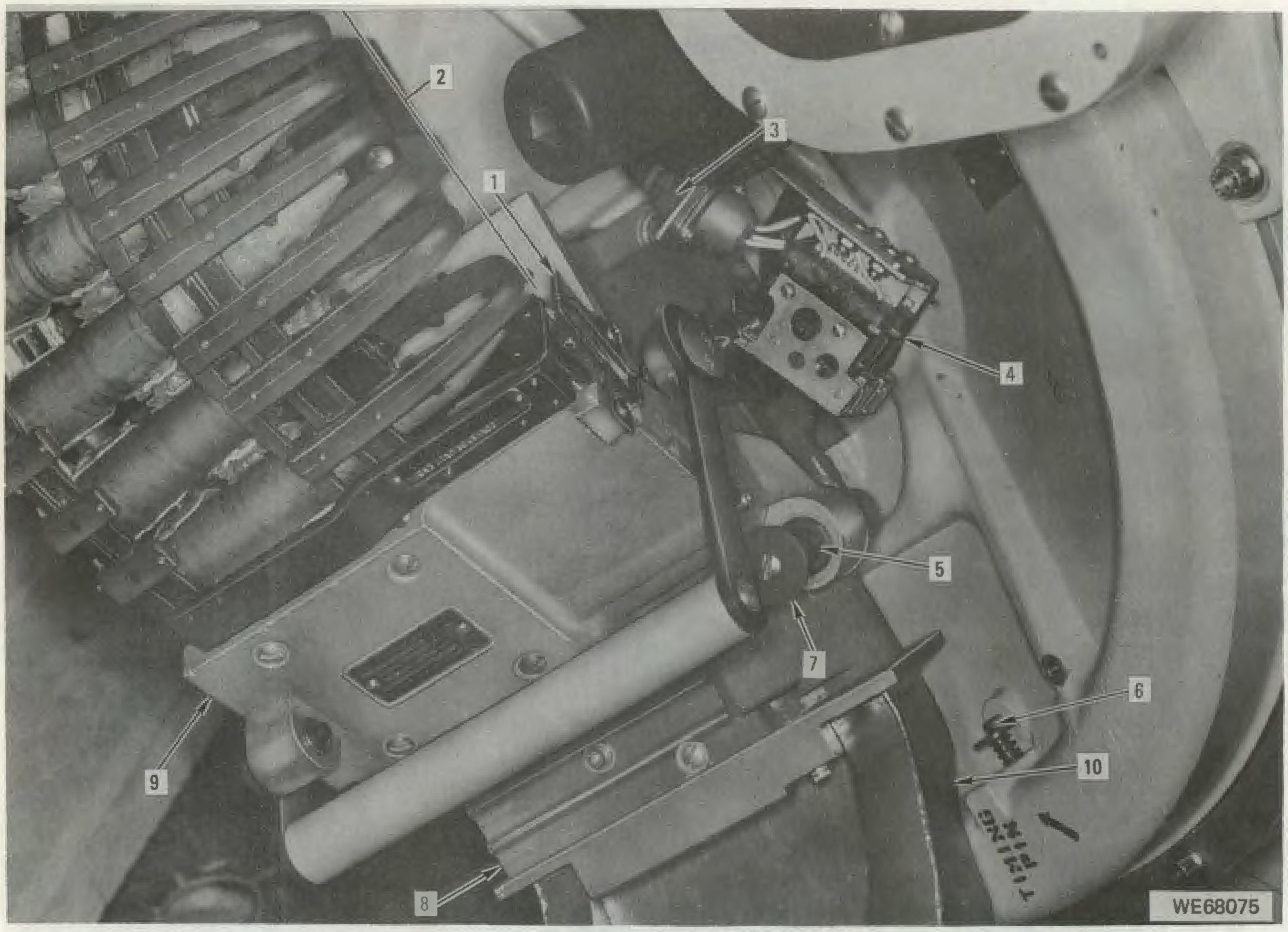
6-24. Conveyor Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect feed chute from conveyor assembly (fig. 6-34).



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

Figure 6-34. Drum assembly, end view showing conveyor assembly and conveyor detection assembly.

(4) Compress chuting segments and remove three adjacent rounds.

(5) Rotate empty element 180 degrees, and separate conveyor element belt.

(6) Disconnect return chute from conveyor assembly.

(7) Compress chuting segments to gain access to conveyor elements. Separate conveyor element belt.

(8) Place a screwdriver between the chuting spaces and through a conveyor element to hold belt of elements in return chute.

(9) Unlock conveyor handle by depressing handle lock button and raising handle. Remove stops from ends of two positioning rails on exit unit (fig. 6-35).

CAUTION

When removing conveyor assembly, be careful to avoid damaging conveyor detection assembly (4, fig. 6-34).

(10) Slide conveyor assembly off positioning rails.

(11) Disengage conveyor timing lock from conveyor gear and hold timing lock in disengaged position (fig. 6-35).

WARNING

When expelling rounds from conveyor assembly, do not permit rounds to drop on floor.

(12) While maintaining tension on element belt, manually rotate conveyor gear to expel rounds and elements from conveyor assembly. Count the elements expelled and record this quantity for use during installation of conveyor assembly.

b. Inspection. Inspect the conveyor assembly for the presence of the following conditions:

(1) Cracked, broken, or missing gear teeth.

(2) Cracks, burrs, or signs of physical damage to sprockets.

(3) Cracks, breaks, dents, or distortion in housing.

(4) Freedom of movement and ease of engagement of handle.

(5) Freedom of movement and spring return action of timing lock.

(6) Damaged or bent gun chute retainer and conveyor plate (fig. 6-36).

c. Replacement of Gun Chute Retainer and Conveyor Plate. Refer to figure 6-36 and replace gun chute retainer or conveyor plate as necessary.

d. Installation.

(1) Assemble into a belt the same quantity of conveyor elements as were expelled from the conveyor assembly in a(12) preceding. (See fig. 6-37.)

(2) Insert the leading (small-loop) end of the belt into the element return opening of the conveyor assembly, pull back the timing lock and rotate the conveyor gear until the sprockets have engaged the leading element (fig. 6-35).

(3) Continue rotating the conveyor gear while manually feeding rounds into the rounds opening of the conveyor assembly until the leading element has emerged from the feed opening of the conveyor assembly.

(4) Position the conveyor gear so that a tooth marked with a white arrow is opposite the timing lock (fig. 6-35). Release timing lock.

(5) If first element to emerge from conveyor assembly contains a round of ammunition, remove this round.

(6) Check that handle of conveyor assembly is in unlocked position.

CAUTION

When installing conveyor assembly, be careful to avoid damaging conveyor detection assembly (4, fig. 6-34).

(7) Position conveyor assembly on rails of exit unit assembly.

(8) Install stops (fig. 6-35) on exit unit positioning rails.

(9) Assure drum and exit unit are timed (TM 9-2350-300-10).

(10) Slide conveyor assembly down to fully-closed (firing) position, and lock.

(11) Connect first conveyor element in return chute to last conveyor element in conveyor assembly element return opening (fig. 6-37).

(12) Connect return chute to conveyor assembly.

(13) Remove screwdriver (if any) retaining rounds and elements in feed chute.

(14) Connect last conveyor element in feed chute to first conveyor element in feed opening of conveyor assembly, first removing any rounds necessary to facilitate the connection.

(15) Load all empty elements in feed chute with rounds of ammunition.

(16) Connect feed chute to conveyor assembly.

(17) Check feed chute slack point (TM 9-2350-300-10).

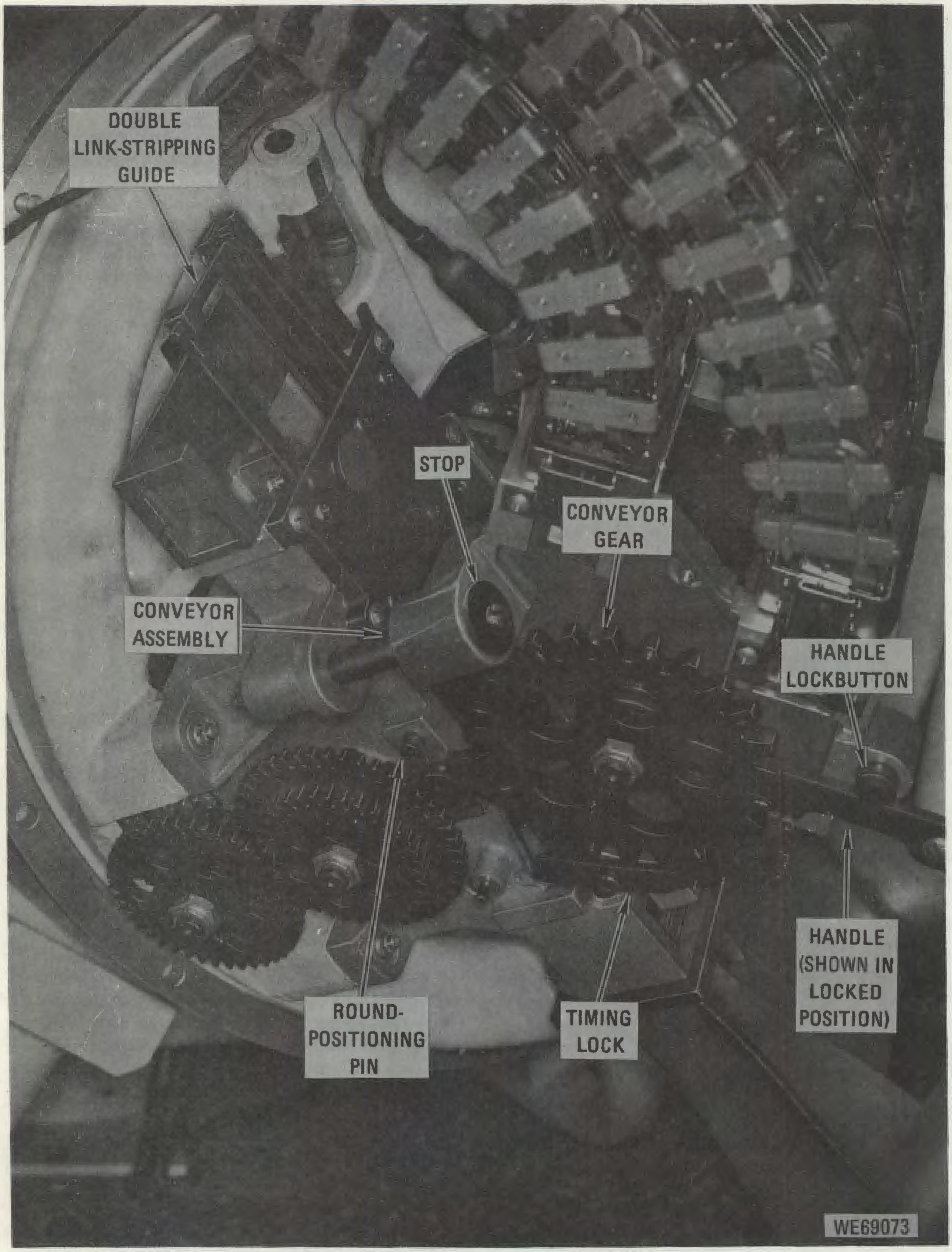


Figure 6-35. Drum assembly, end view showing conveyor assembly controls.

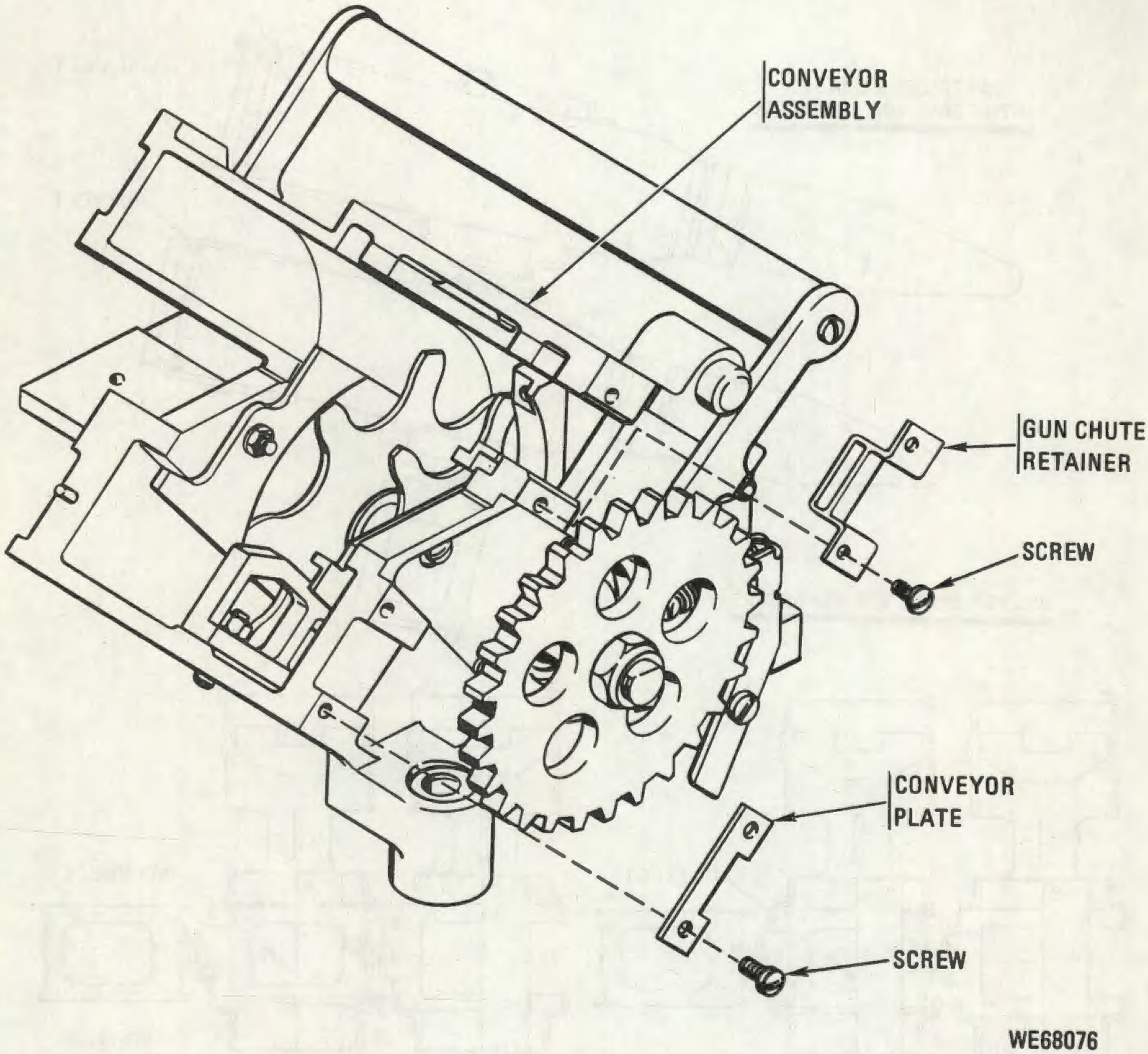


Figure 6-36. Conveyor assembly, exploded view.

6-25. Exit Unit Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) On drum drive assembly (fig. 6-38), place shift pin at N (neutral).

(4) Time conveyor assembly (TM 9-2350-300-10).

(5) Unlock conveyor handle by depressing handle lock button and raising handle. Remove stops from ends of two positioning rails on exit unit (7, fig. 6-35).

CAUTION

When removing conveyor assembly, be careful to avoid damaging conveyor detection assembly.

(6) Lift conveyor assembly off positioning rails. Tie conveyor assembly and attached chuting back out of the work area.

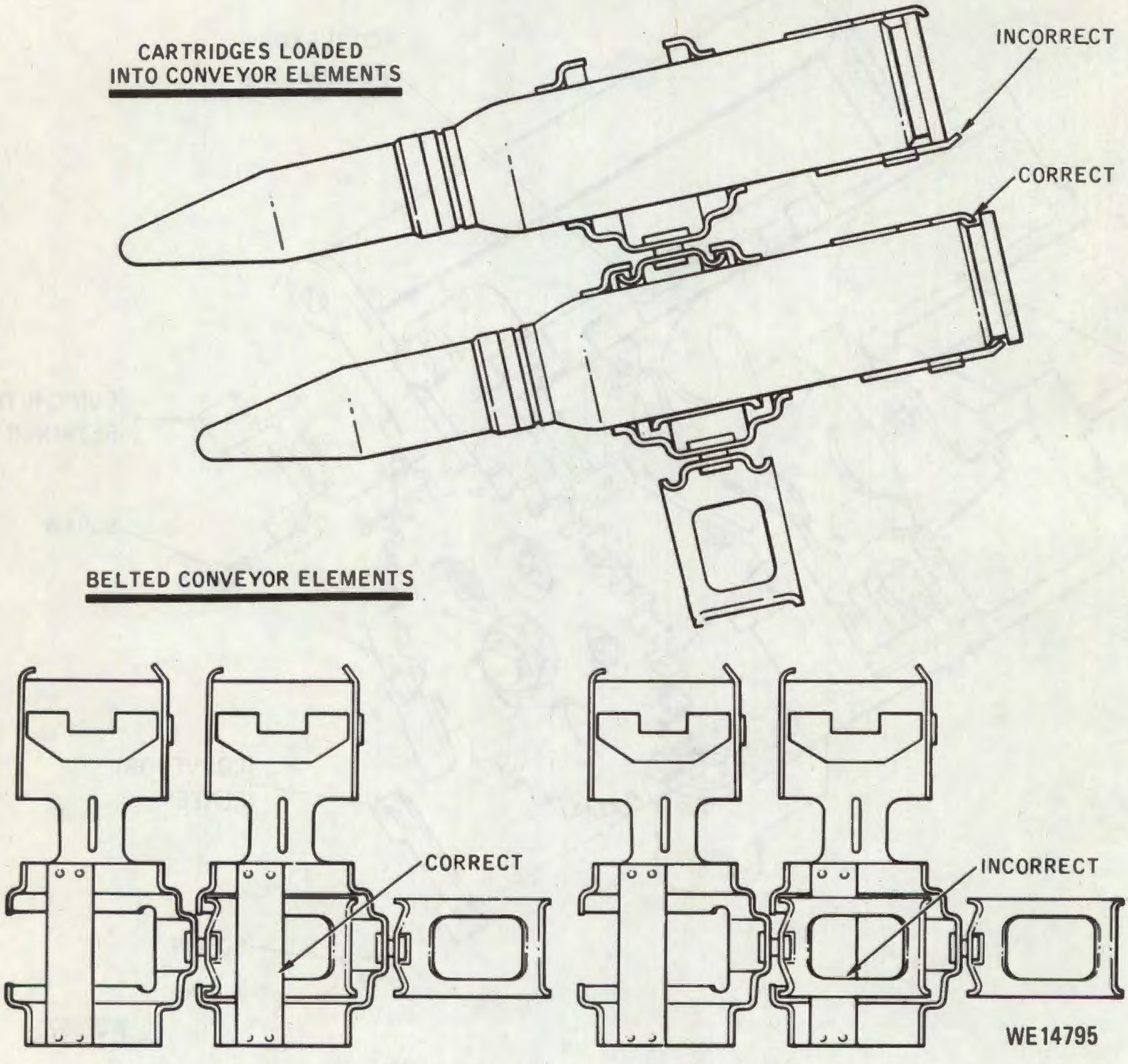


Figure 6-37. Conveyor elements and rounds, correct and incorrect assembly.

(7) If there are any rounds in exit unit, turn knurled knob on takeoff gear (fig. 6-38) in loading (counterclockwise) direction until all rounds have been moved into drum.

CAUTION

When performing following step, be careful not to damage conveyor detection assembly.

(8) Remove two bolts (3), two nuts (5), and four washers (2 and 6), and remove exit unit assembly (7, fig. 6-39).

(9) Remove loading chute (4) from exit unit assembly.

b. Inspection. Inspect exit unit assembly for bent, broken, or cracked sprockets, stripping guide, and housing.

c. Installation.

(1) Install loading chute on exit unit assembly.

NOTE

The following step is for a partially filled drum. For timing an empty drum refer to TM 9-2350-300-10. Set shift pin to L after timing.

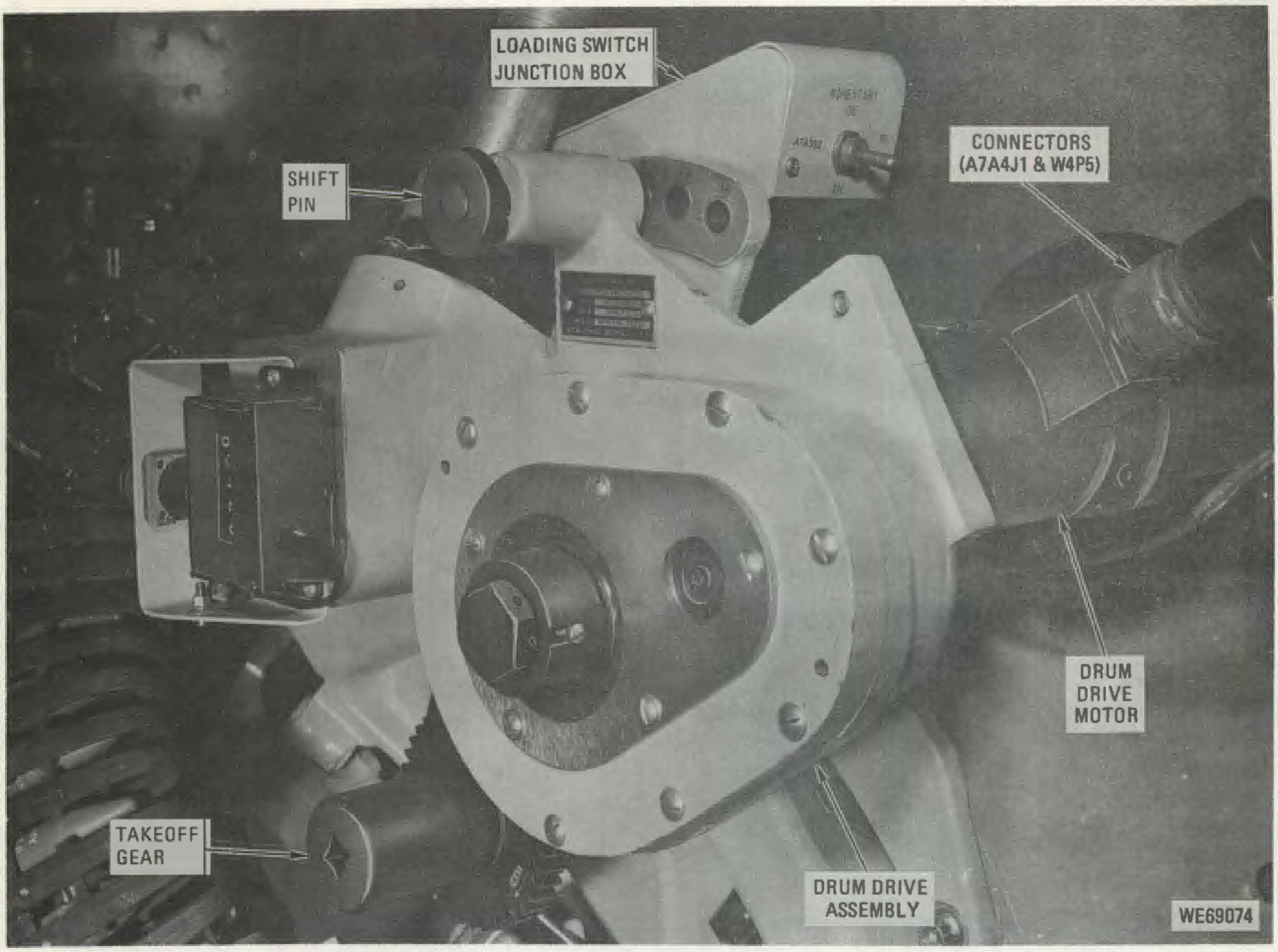


Figure 6-38. Drum drive assembly and drum drive motor, parts location.

(2) Verify that shift pin (fig. 6-38) is at N position, and rotate takeoff gear clockwise until drum timing pin (6, fig. 6-34) can be engaged into timing hole. Place shift pin at L and release timing pin.

(3) On exit unit assembly, press on timing pin (fig. 6-40) and rotate exit unit drive gear until timing pin engages timing hole in sprocket.

(4) While holding exit unit assembly in the timed position, install exit unit assembly on drum exit cover, being careful not to damage conveyor detection assembly.

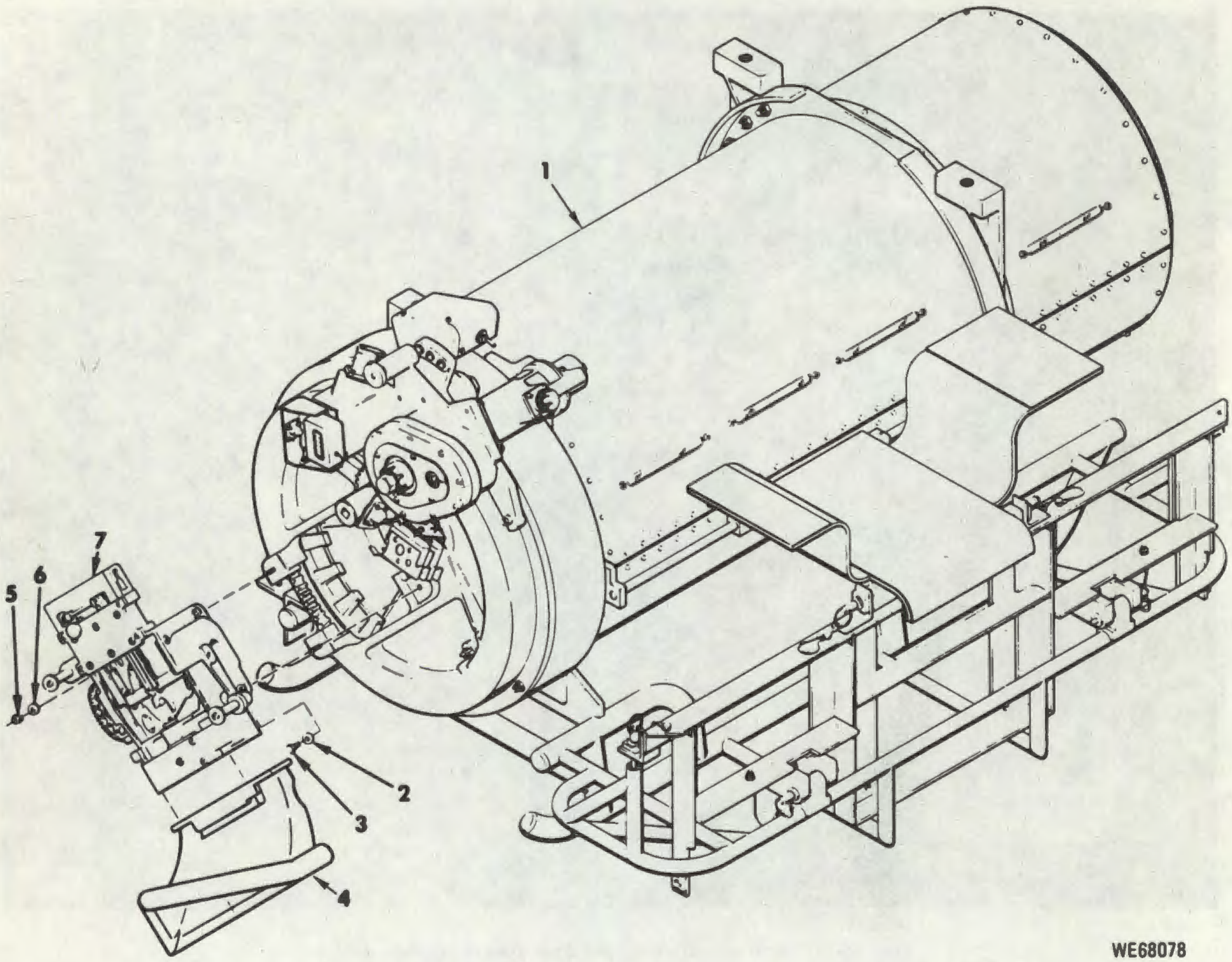
(5) Place shift pin at N (neutral). Recheck timing of drum and exit unit after installation is completed and assure that both timing pins are disengaged or released.

NOTE

If drum is empty, perform (6) following and omit (7); if drum contains ammunition, omit (6) and proceed to (7).

(6) If drum is empty, check that exit unit and drum are properly timed by placing a round in exit unit sprockets and rotating drum takeoff gear (fig. 6-38) in loading (counterclockwise) direction to move round into drum. Round should transfer smoothly, without catching or binding. Depress round-positioning pin (fig. 6-35) on exit unit and turn takeoff gear in firing (clockwise) direction until round has backed out of drum and is against round-positioning pin. Release round-positioning pin and turn takeoff gear counterclockwise until round-positioning pin is released and drum timing pin can be depressed. Release timing pin. Assure timing pin is released, and cycle round out of exit unit.

(7) If drum contains ammunition, turn takeoff gear in firing direction (clockwise) while holding round-positioning pin depressed until first round is against pin. Release round-positioning pin. While applying pressure to drum timing pin, rotate takeoff gear in counterclockwise direc-



1 Drum assembly
2 Washer
3 Bolt
4 Loading chute assembly
5 Nut
6 Washer
7 Exit unit assembly

Figure 6-39. Exit unit assembly, details of removal and installation.

tion until timing pin can be depressed and round positioning pin releases. Release pin and assure that both pins release. Check that drum timing pin can be depressed.

(8) Install conveyor assembly and stops (fig. 6-36).

(9) Set drum drive assembly shift pin to F position.

6-26. Conveyor Detection Assembly.

Repair of the conveyor detection assembly consists of replacing the detection switch assembly or either of the switch actuators. It is not necessary to remove the entire conveyor detection assembly prior to accomplishing repairs.

a. Removal of Detection Switch Assembly and Switch Actuators.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Set drum drive assembly shift pin to N.

(4) Time and unlock conveyor assembly.

(5) Remove exit unit positioning rail stops (fig. 6-35).

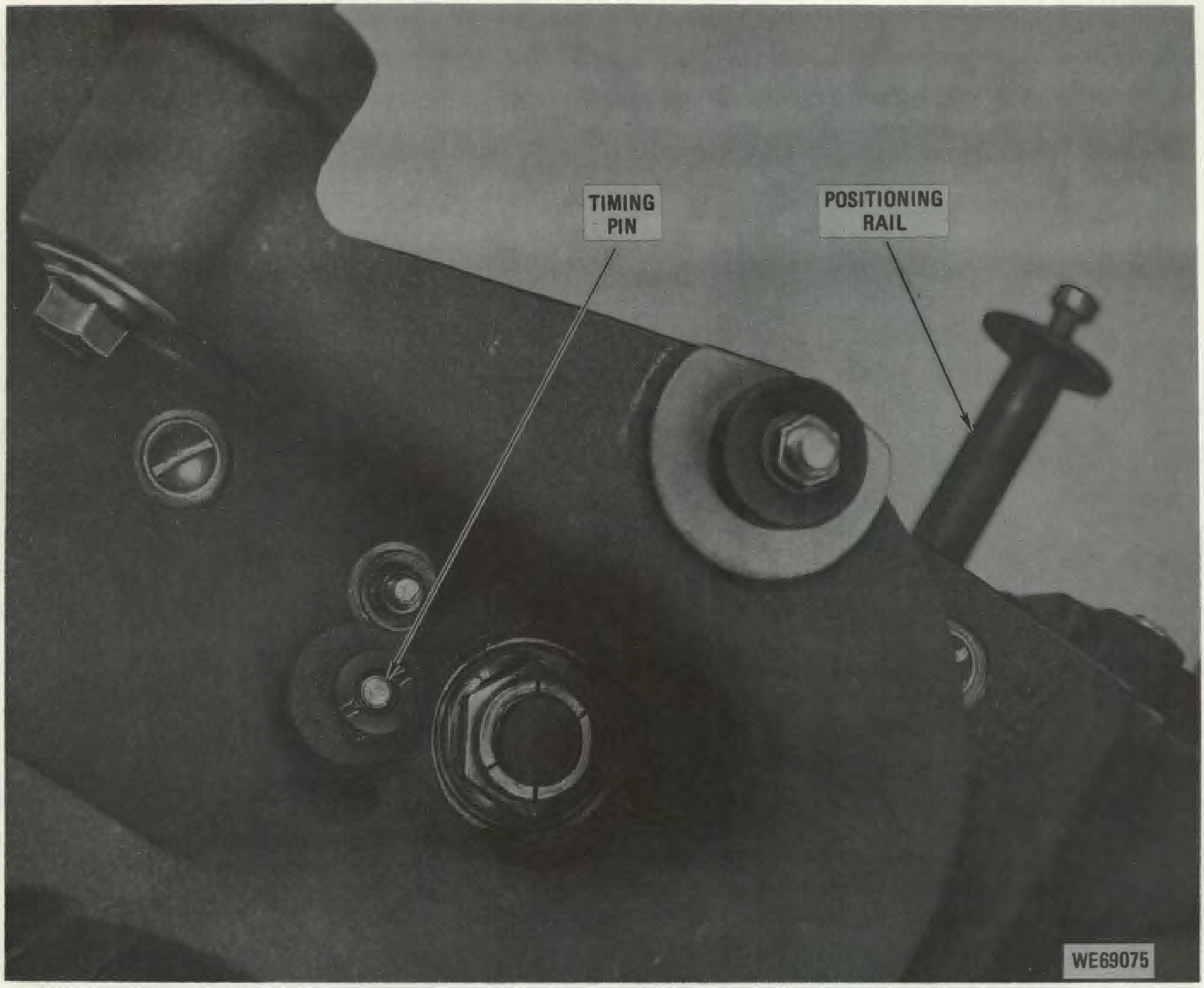


Figure 6-40. Exit unit assembly and drum drive motor, parts location.

CAUTION

When performing the following procedure, be careful not to damage conveyor detection assembly.

(6) Lift conveyor assembly off exit unit positioning rails (fig. 6-35).

(7) Tie conveyor assembly and attached chuting back out of work area.

(8) Disconnect W4P3 cable connector (3, fig. 6-34) from conveyor detection assembly.

NOTE

Refer to figure 6-41 to identify assembly components.

(9) Using a 7/32-inch open-end wrench and an offset crosshead screwdriver, remove screws (2, fig. 6-41) and nuts (7), securing outer switch mounting bracket (8) to conveyor detection assembly bracket (1).

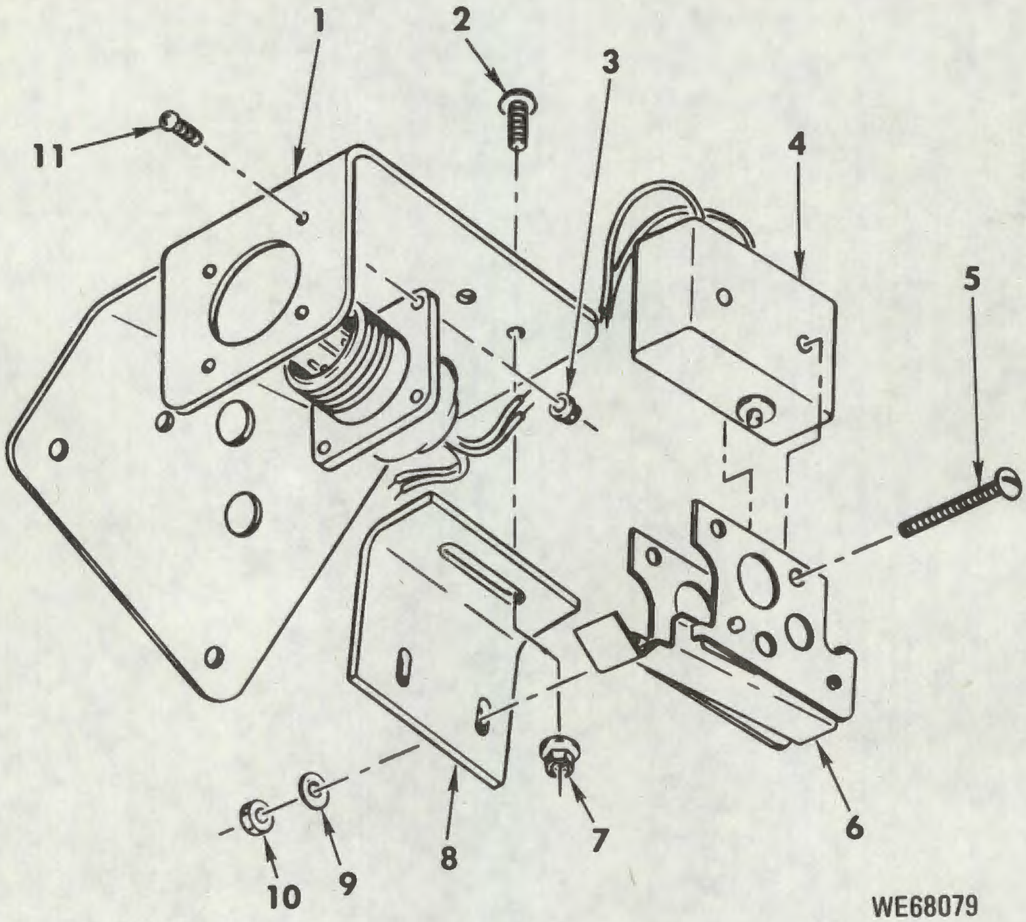
(10) Repeat preceding procedure for inner switch mounting bracket.

(11) Remove screws (11) and nuts (3), securing detection switch assembly connector to conveyor detection assembly bracket, and remove detection switch assembly (4), switch actuators (6), and switch mounting brackets (8).

(12) Remove screws (5), nuts (10), and washers (9), and separate switch mounting brackets and switch actuators from detection switch assembly.

b. Inspection. Inspect the conveyor detection assembly for the presence of the following conditions:

(1) Cracked, broken, bent brackets or actuators.



1 Conveyor detection assembly bracket	4 Detection switch assembly	8 Switch mounting bracket
2 Screw	5 Screw	9 Washer
3 Nut	6 Switch actuator	10 Nut
	7 Nut	11 Screw

Figure 6-41. Conveyor detection assembly, exploded view.

(2) Broken, bent, or damaged connector pins.

(3) Damage of switches.

(4) Freedom of movement and spring return action of actuators.

(5) Abrasions or cracked insulation on wiring.

c. *Installation of Detection Switch Assembly and Switch Actuators.*

(1) Loosely assemble detection switch assembly (4, fig. 6-41), switch actuators (6), and switch mounting brackets (8) with screws (5), nuts (10), and washers (9).

(2) Install detection switch assembly connector in conveyor detection assembly mounting bracket (1, fig. 6-41).

(3) Determine which switch will be mounted at inner (A7A2S1) position by actuating either switch and checking for continuity between pins A and B of connector. Mark switch that displays continuity between these two pins for installation at inner position.

(4) Position mounting bracket of switch marked in previous procedure against conveyor detection assembly bracket at inner position, and secure so that lower edge of flange on switch mounting bracket is aligned with edge of conveyor detection assembly bracket.

(5) Adjust position of switch and actuator on switch mounting bracket so that actuator is barely above housing of exit unit assembly. Secure switch and actuator.

(6) Slide conveyor assembly onto exit unit rails using caution to avoid damage to outer switch (A7A2S2) and push down to firing position. Lock conveyor assembly in firing position, and verify that inner switch is actuated by checking for continuity between pins A and B of connector. If switch does not actuate, remove conveyor assembly and outer switch, and readjust position of inner switch or mounting bracket as necessary.

(7) Position mounting bracket of outer switch (A7A2S2) and actuator all the way to the left in bracket

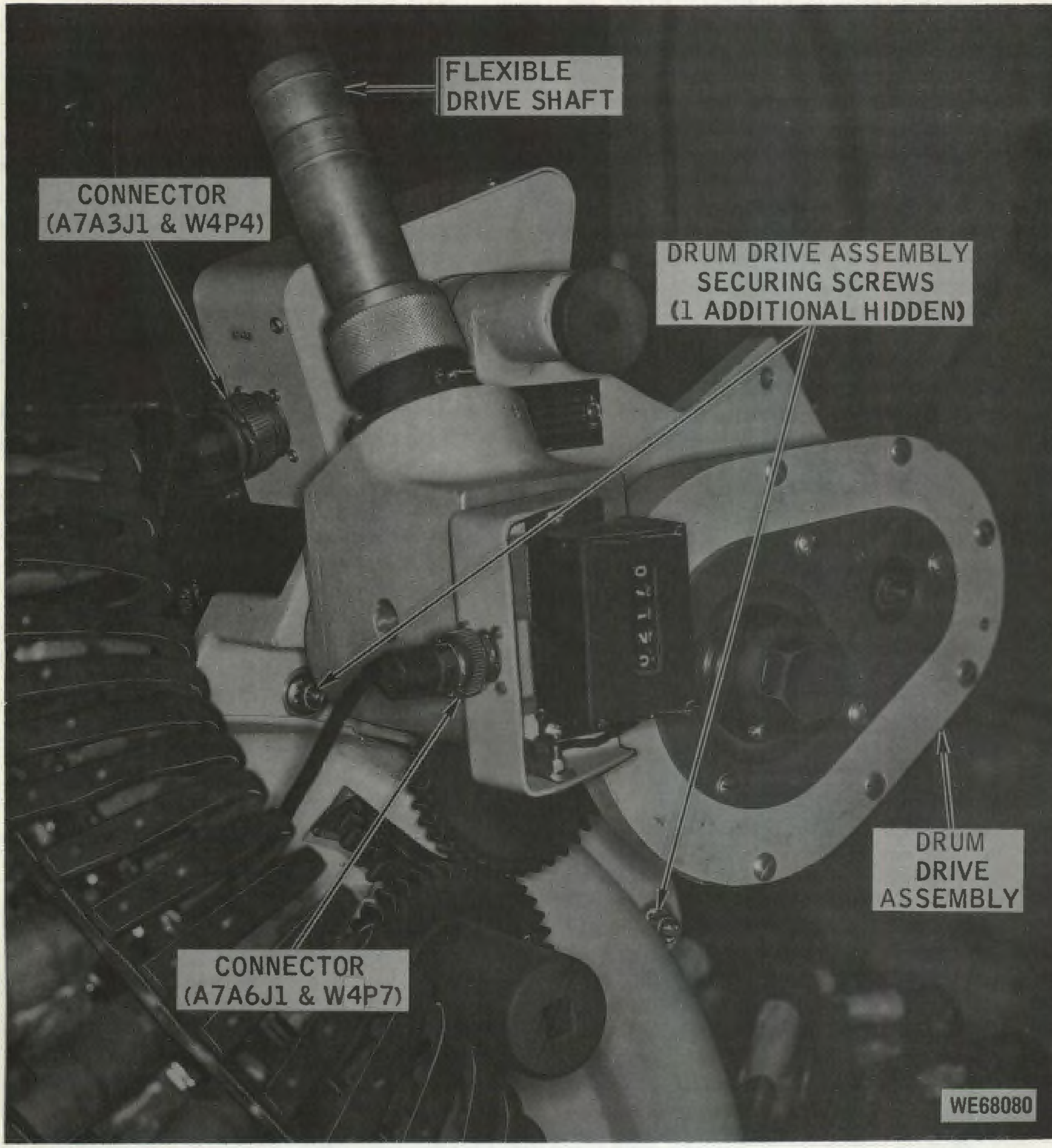


Figure 6-42. Drum drive assembly, removal/installation details.

and just above exit unit housing, and secure. Verify switch is not actuated (no continuity between C and D on connector).

(8) Unlock and raise conveyor assembly on exit unit rails and install rail stops.

(9) Lock conveyor unit in loading position and verify that outer switch is actuated by checking for continuity between pins C and D of connector. If switch does not actuate, remove conveyor assembly and readjust position of outer switch or mounting bracket, as necessary.

(10) Connect cable assembly connector W4P3 (3, fig. 6-34) to conveyor detection assembly.

(11) Verify timing of conveyor assembly and drum (TM 9-2350-300-10). Insert pin into F position.

6-27. Drum Drive Assembly.

NOTE

If only drum drive motor is to be replaced, proceed to paragraph c.(2) following.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) On drum drive assembly (fig. 6-38), place shift pin at N (neutral).

WARNING

When disconnecting flexible drive shaft from drum drive assembly, the core of the shaft may slip out rapidly and could cause injury to nearby personnel.

(4) Separate flexible drive shaft from drum drive assembly (fig. 6-42), taking care that core of shaft does not slip out.

(5) Disconnect cable connectors W4P4, W4P5, and W4P7 (figs. 6-42 and 6-38) from drum drive assembly and loading motor.

(6) While supporting drum drive assembly, remove three bolts securing it to drum, and remove drive assembly from drum (fig. 6-42).

b. Inspection. Inspect the drum drive assembly for the presence of the following conditions:

(1) Broken, bent, or damaged connector pins.

(2) Cracked, broken, or missing gear teeth.

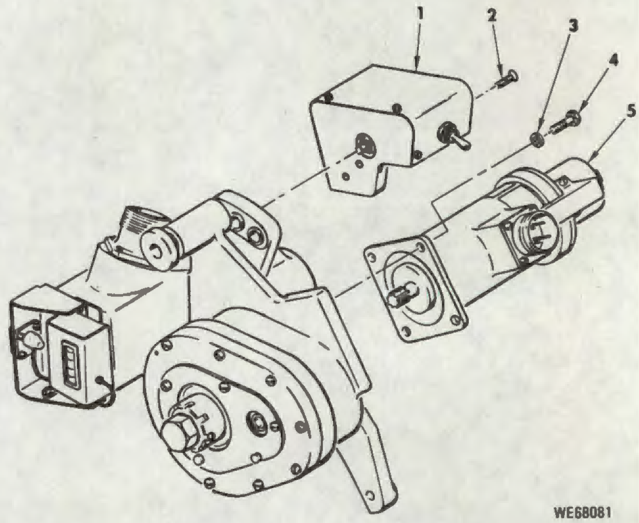
(3) Cracks, breaks, dents, or distortion in housing.

(4) Freedom of movement of gears.

c. Disassembly.

NOTE

Refer to figure 6-43 to identify assembly components.



1 Loading switch assembly
2 Screw
3 Washer
4 Bolt
5 Drum drive motor

Figure 6-43. Drum drive assembly, exploded view.

(1) Remove two screws (2) and remove loading switch assembly (1).

NOTE

If drum drive motor only is to be replaced, it is not necessary to remove the drum drive assembly. Disconnect W4P5 and proceed with (2) following.

(2) Remove four bolts (4) and washers (3), and remove drum drive motor (5).

d. Assembly. Assembly is the reverse of disassembly.

e. Installation. Installation is the reverse of removal.

6-28. Loading Switch Assembly.

Repair of the loading switch assembly consists of replacing the loading switch subassembly or the loading switch actuator. The drum drive assembly must be removed from the drum assembly prior to accomplishing either of these repairs.

a. Removal.

(1) Remove drum drive assembly as instructed in paragraph 6-27a. preceding.

(2) Remove loading switch assembly (1, fig. 6-43) from drum drive assembly.

b. Inspection. Inspect the loading switch assembly for the presence of the following conditions:

(1) Broken, bent, or damaged connector pins.

(2) Cracks, breaks, dents, or distortion in housing.

(3) Damage of switch.

(4) Freedom of movement of switch actuator.

(5) Abrasions or cracked insulation in wiring.

c. Disassembly.

NOTE

Refer to figure 6-44 to identify loading switch assembly components.

(1) Remove screws (10, fig. 6-44) and release cover (8) from plate (1).

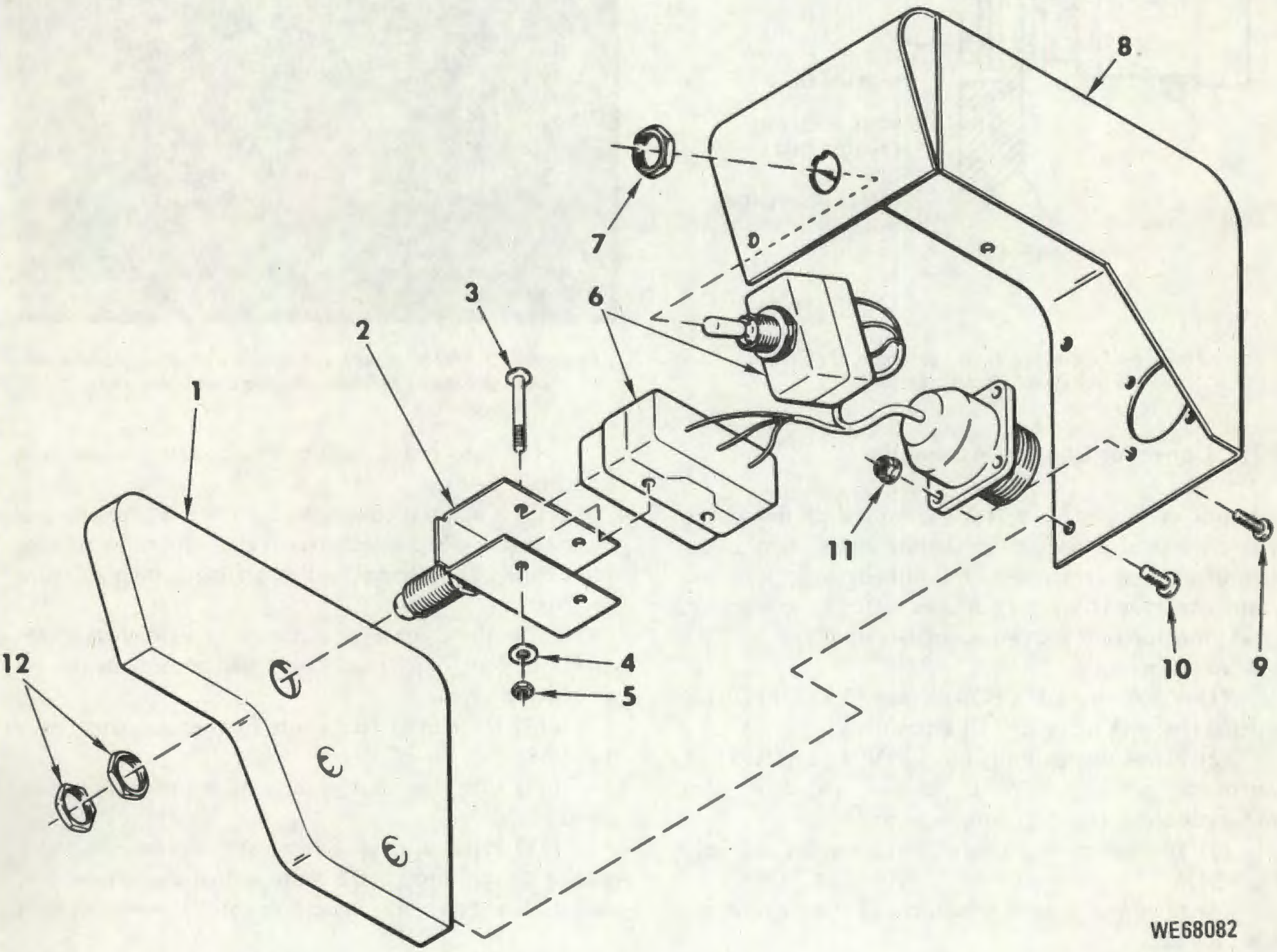
(2) Remove nuts (12) and remove switch actuator (2) from plate.

(3) Remove nut (7) and remove toggle switch portion of switch subassembly (6) from cover.

(4) Remove screws (9) and nuts (11) and remove connector portion of switch subassembly.

(5) Remove screw (3), washer (4), and nut (5), and remove switch actuator (2) from switch subassembly (6).

d. Assembly. Assembly is the reverse of disassembly. When assembling the switch actuator (2, fig. 6-44) in plate (1), adjust mounting nuts (12) so that end of threaded actuator shaft is flush with face of plate as shown in figure



1 Plate	4 Washer	7 Nut	10 Screw
2 Switch actuator	5 Nut	8 Cover	11 Nut
3 Screw	6 Switch subassembly	9 Screw	12 Nut

Figure 6-44. Loading switch assembly, exploded view.

6-45. Install plate on drive assembly. Install toggle switch in cover so that momentary on (spring-loaded on point) position is up.

e. Installation. Installation is the reverse of removal.

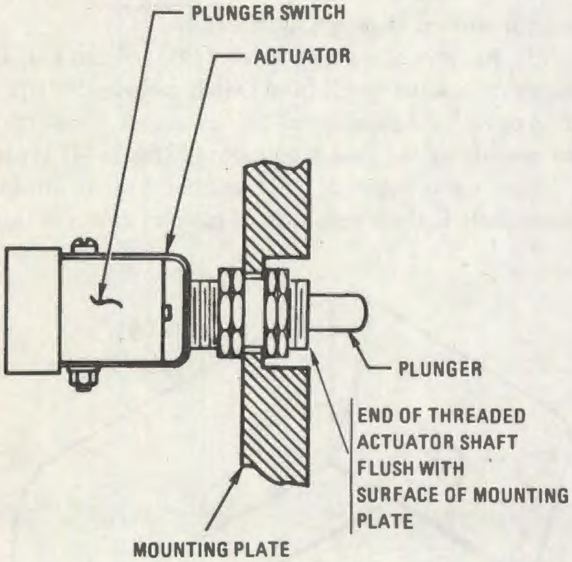


Figure 6-45. Loading switch assembly, shift pin plunger switch, installation details.

6-29. Conveyor Chuting Assemblies.

Repair of the feed and return conveyor chuting assemblies consists of replacing the chuting end section assemblies or chuting center sections. Although the feed and return conveyor chuting assemblies differ in appearance, repair procedures for the two assemblies are the same.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect feed chute from conveyor assembly (fig. 6-34).

(4) Compress chuting segments and remove three adjacent rounds.

(5) Rotate one empty element 180 degrees, and separate conveyor element belt.

(6) Disconnect return chute from conveyor assembly.

(7) Separate return chute conveyor element belt.

(8) Remove gun shield (fig. 6-3).

(9) Remove canvas upper chute cover from chuting between declutching feeder and upper chuting support bracket (fig. 6-46). Remove canvas lower chute cover from chuting between upper chuting support bracket and lower chuting support bracket (fig. 6-47).

Figure 6-46. XM157 mount, top left view showing location of chuting support brackets (chuting covers removed).

(10) Disconnect return chute from declutching feeder (fig. 6-48).

(11) Compress chuting sections to gain access to conveyor elements. Separate conveyor element belt by rotating one element 180 degrees, and separating it from adjoining element.

(12) Allow conveyor elements to slide down return chute to floor of chassis. Count and record number of elements removed.

(13) Disconnect feed chute from declutching feeder (fig. 6-48).

(14) Compress chuting sections and remove four adjacent rounds.

(15) Place a large screwdriver, or other suitable holding device, through the chute so that the element belt cannot slide down the chute. Separate conveyor element belt.

(16) Remove screwdriver (or other holding device) and pull belt of rounds and elements out of feed chute onto top deck of chassis. Count and record number of elements removed.

(17) Remove outer half of upper chuting support bracket (fig. 6-46).

(18) Remove upper half of lower chuting support bracket (fig. 6-47).

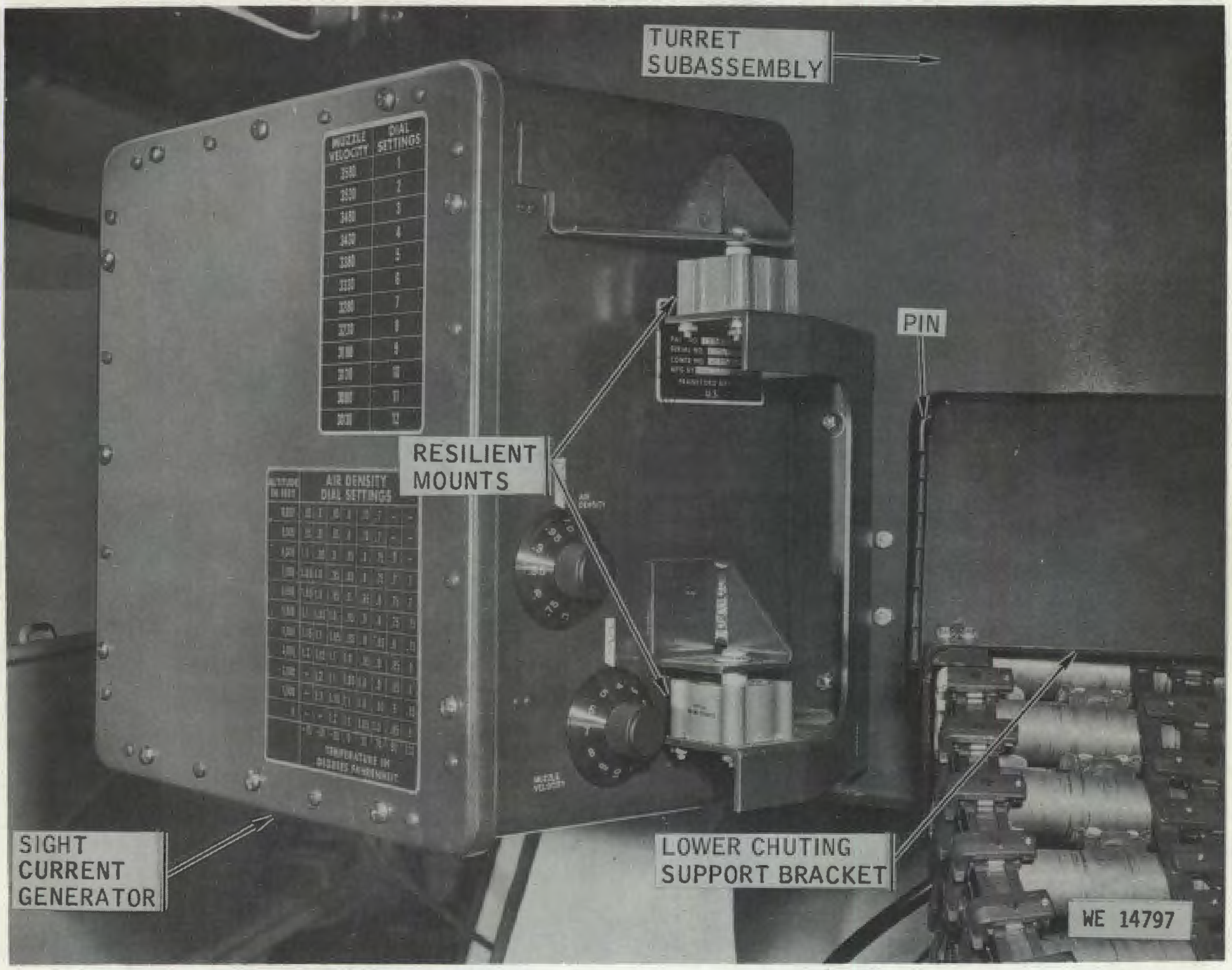


Figure 6-47. Turret subassembly, exterior view showing lower chuting support bracket and sight current generator mountings.

(19) Remove chutes.

b. Inspection. Inspect the conveyor chuting assemblies chute sections for burrs, breaks, and proper interconnection. Inspect the chuting end assembly fittings for freedom of movement and spring return action.

c. Disassembly.

NOTE

Refer to figure 6-49 for identification of chute section components.

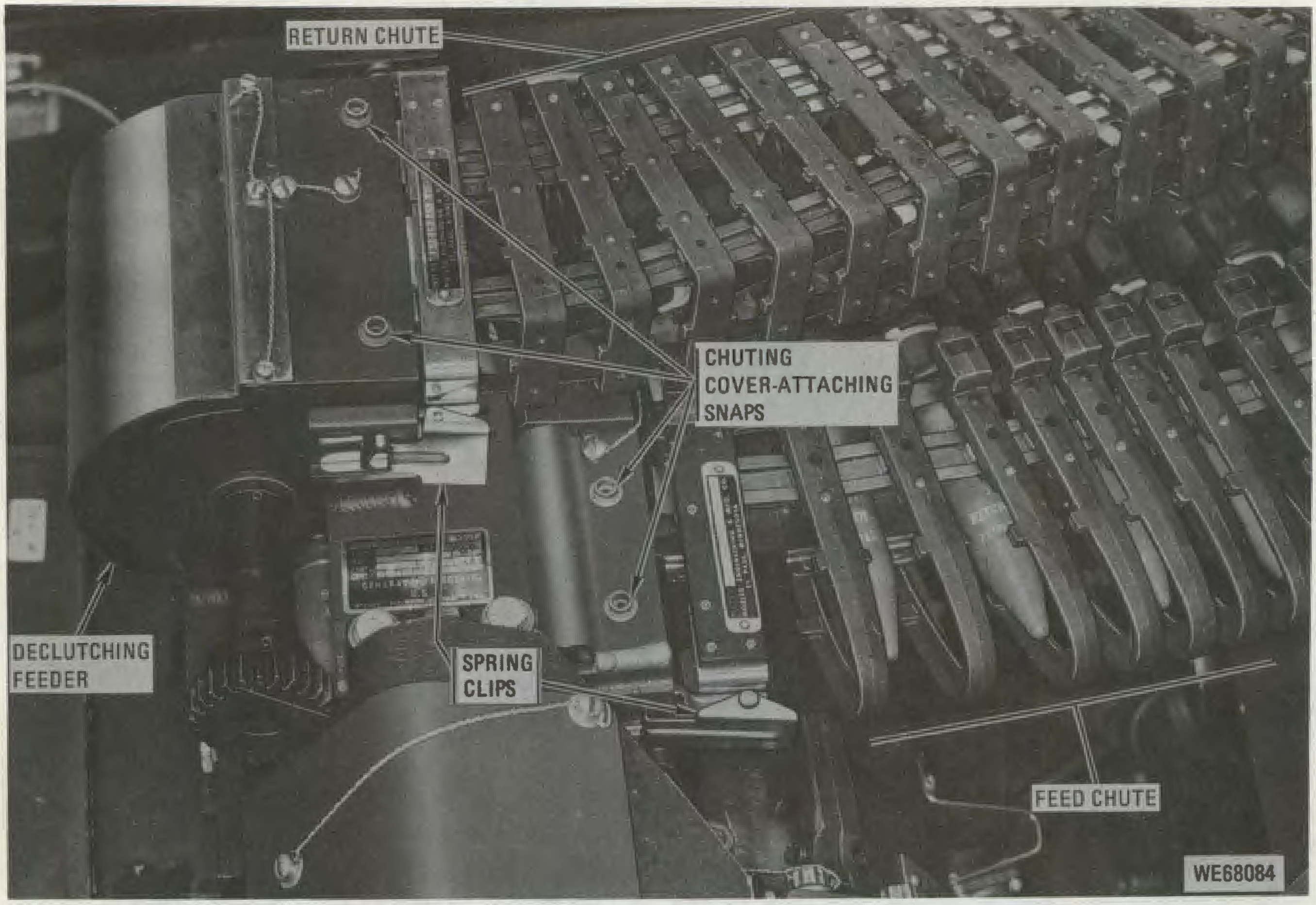


Figure 6-48. Chuting attachment details, declutching feeder end (chuting covers removed).

(1) Place chute, open side up, on clean workbench. Orient chute so that direction of ammunition flow is from left to right (1, fig. 6-50).

(2) On either side of chuting section to be removed, extend approximately a half-dozen chuting sections to their full lengths.

NOTE

If section to be removed is an end section, or if there are fewer than a half-dozen sections between section to be removed and end of chute, extend a half-dozen sections on one side only and extend as many as possible on other side.

(3) While looking into inspection hole of section immediately to left of section to be removed, slowly push this section and one to be removed together until crossbar of link connecting these two sections can be seen passing across center of inspection hole (2, fig. 6-50).

NOTE

If crossbar of link still has not passed center of hole when sections are tight together, hold sections in this position and move link into desired (fully left) position by pushing on end of link with awl or other sharp instrument inserted behind upper right corner of section to be removed (3, fig. 6-50).

(4) With link held in position so that crossbar remains at left of center of inspection hole, insert pointed end of awl or other sharp instrument into inspection hole and press down firmly on right-hand tab of link holder (4, fig. 6-50).

(5) While holding tab depressed, move the two sections apart so that link crossbar slides over tab and holds it down (5; fig. 6-50). Check that crossbar is still holding down tab.

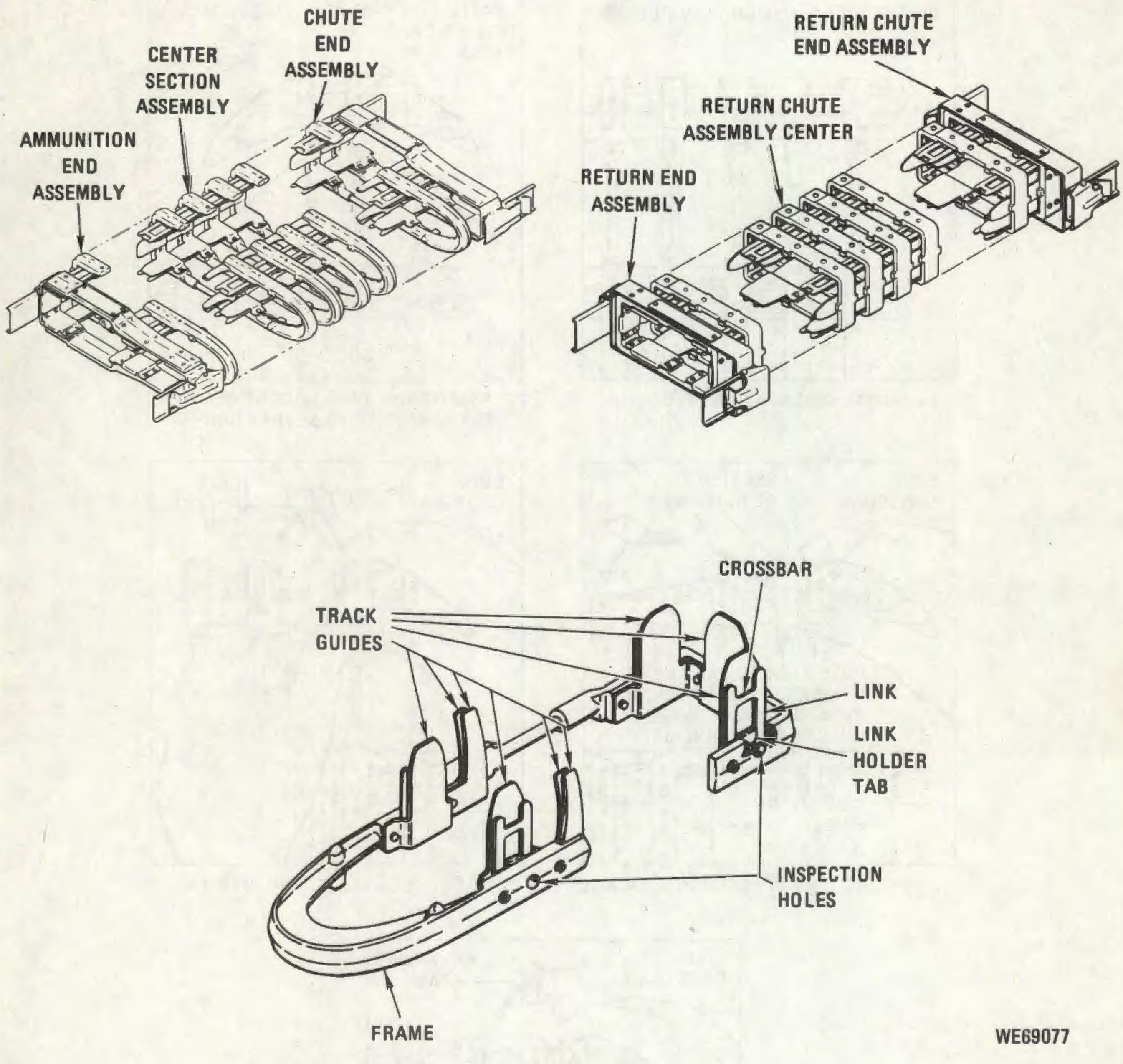


Figure 6-49. Conveyor chuting section component identification.

(6) Repeat (3) through (5) for each of the remaining three links connecting the two sections.

(7) Pull section to be removed free of adjacent section.

(8) Repeat (2) through (7) at other end of section (or sections) to be removed. Remove section (or sections) from chute.

d. Assembly.

NOTE

Refer to figure 6-49 for identification of chute section components.

(1) Place chuting sections to be joined, open sides up, on clean workbench. Orient sections so that direction of ammunition flow is from left to right. Extend each section to its full length.

(2) Place end of each track guide (fig. 6-49) protruding from chuting section on right under end of corresponding track guide on chuting section at left so that guides overlap each other (fig. 6-51).

(3) Place end of each link protruding from chuting section on right into position under frame of section at left so that crossbar of each link is inserted between section frame and tab of link holder.

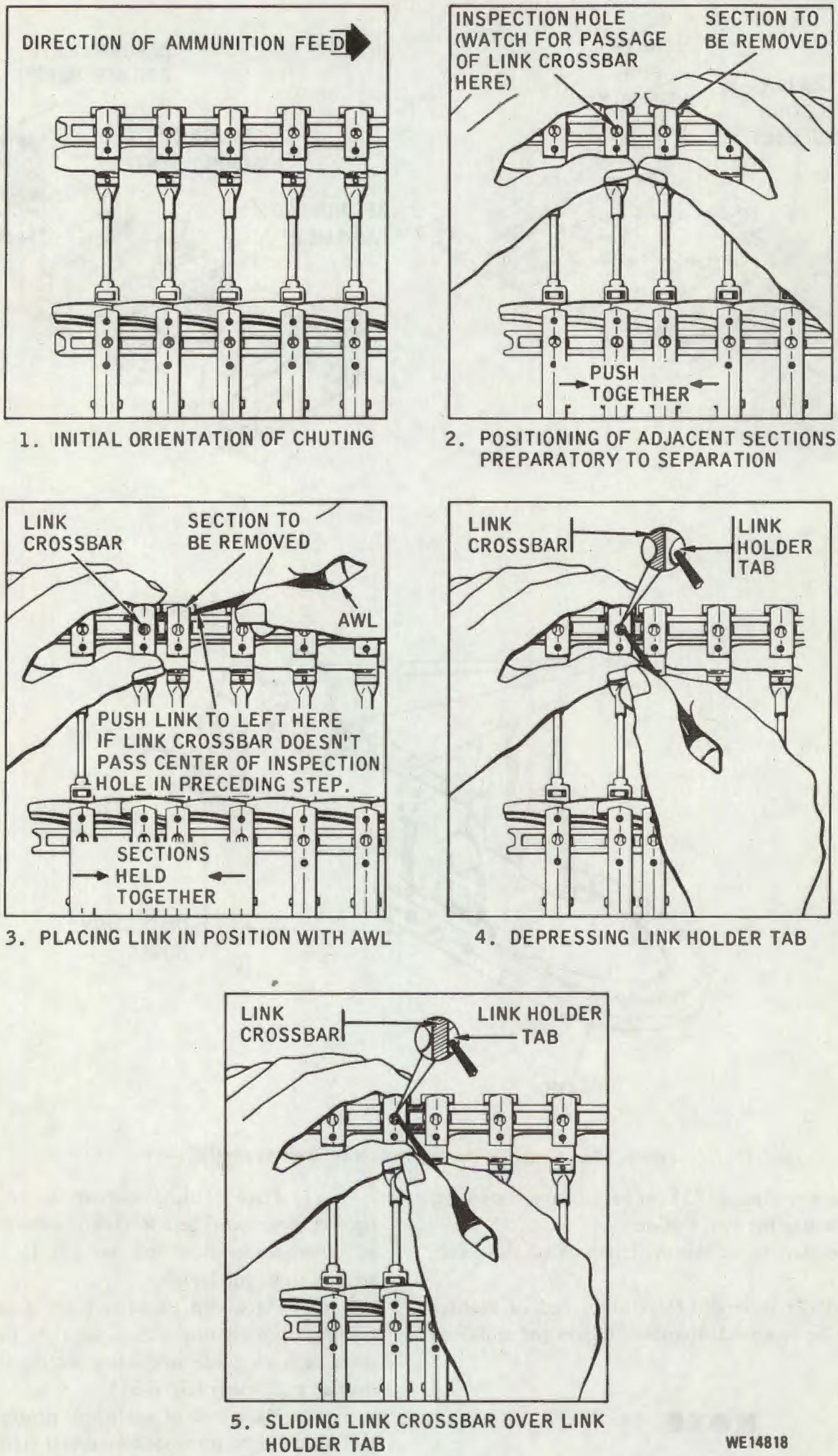


Figure 6-50. Conveyor chuting sections, details of disassembly.

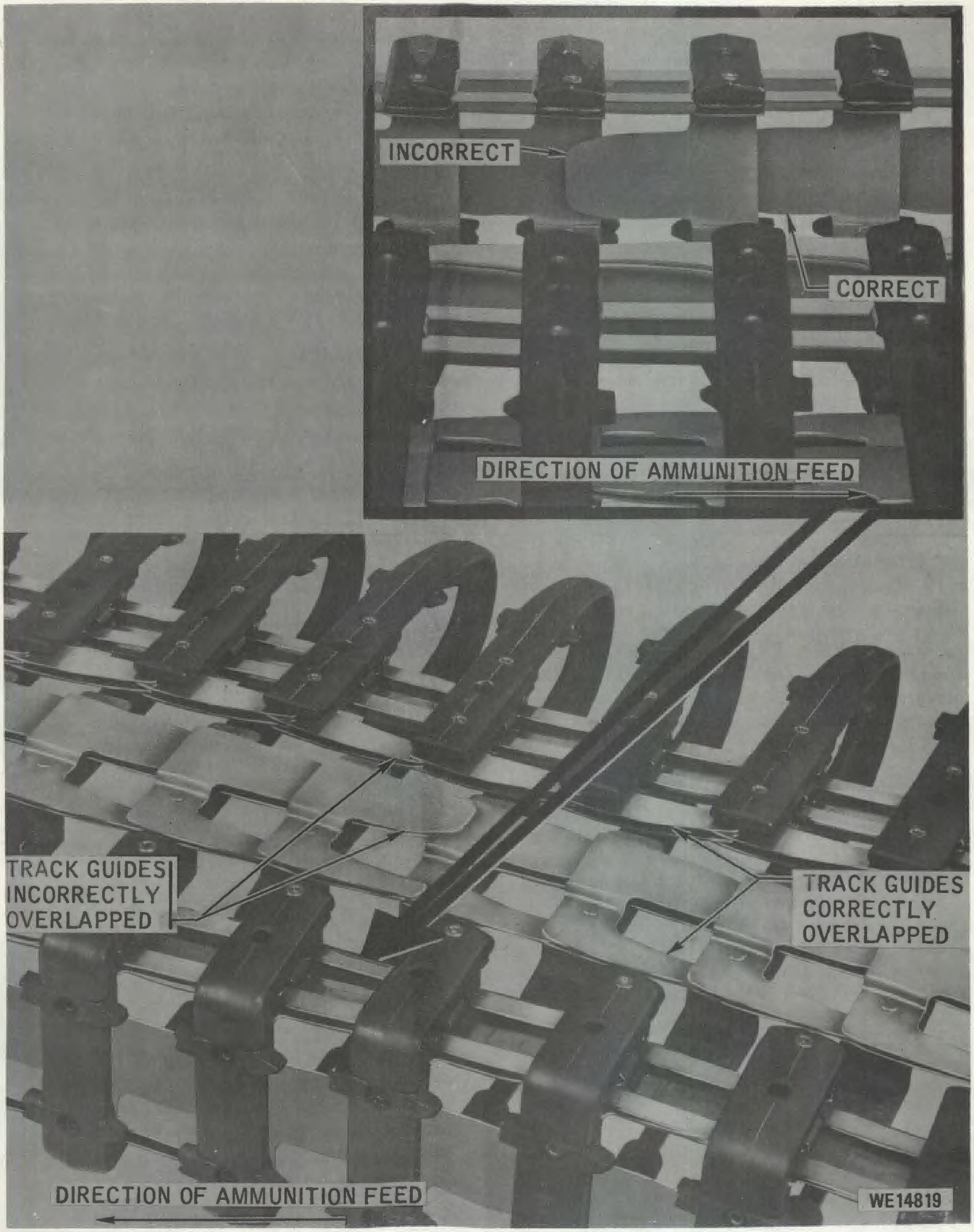


Figure 6-51. Conveyor chuting sections, details of assembly.

(4) Push the two sections together.

(5) While holding the two sections together, look into each of the four inspection holes and check that the crossbar of each link has passed completely over the right-hand tab of the link holder and snapped into position.

(6) If any of the four links has not snapped into position, move it into place by inserting awl or other sharp instrument behind right corner of right-hand section frame and pushing on end of link.

CAUTION

Incorrect attachment of adjoining sections of chuting can cause sudden stoppage of the feed system, resulting in damage to the chuting and other components.

(7) Pull the sections in opposite directions and check engagement of links in link holders. Reinsert any link that pulls free. Also, check that track guides are properly overlapped.

e. Installation.

(1) Assemble the total quantity of conveyor elements recorded in a(12) and a(16) preceding into 10- or 12-element sections, connecting elements as shown in figure 6-37. Check assembled conveyor elements by correctly placing a single round, in turn, into each element and then attempting to rotate round in element. If round cannot be rotated easily in all conveyor elements, replace the conveyor elements in which tightness is noted.

(2) Install return chute in upper and lower chute supports with red end of chute toward declutching feeder and green end of chute toward conveyor assembly.

(3) Assemble a belt consisting of the same number of elements as were previously removed from the return chute (para. 6-29a(12)).

(4) Load belt, small loop end first, into the top end of the return chute. Hold the top (red) end of the chute in a vertical position and feed in elements until an element appears at the lower (green) end. Turn the last element in the belt 90 degrees so that it rests across the top end of the chute.

(5) At lower (green) end of return chute, compress chuting segments. Connect first conveyor element in return chute to last conveyor element in element return opening of conveyor assembly. Connect return chute to conveyor assembly.

(6) Install feed chute in upper and lower chute supports with red end of chute toward declutching feeder and green end of chute toward conveyor assembly. Do not secure removable sections on chute supports at this time.

(7) Thread a wire or small-diameter cable through the feed chute.

(8) Assemble a belt that contains the same number of elements as were previously removed from the feed chute (para. 6-29a(16)).

CAUTION

Rounds that are not properly inserted into elements may cause a jam in feed system, resulting in damage to feed system or cannon.

(9) Load rounds into all elements in belt, assuring that rounds are properly inserted into elements as shown in figure 6-37.

(10) Tie end of wire or cable extending from lower (green) end of feed chute to leading (small loop) end of belt just assembled.

(11) Pull loaded conveyor elements up through feed chute until elements appear at top of chute. Insert large screwdriver, or other holding device, through chute to prevent belt from sliding down chute.

(12) Compress feed chute segments at conveyor assembly end and remove first two rounds.

(13) Connect last element in belt to first element in feed opening of conveyor assembly, removing an additional round, if necessary. After making connection, fill all empty elements with rounds.

CAUTION

Be certain that each conveyor element in feed chute contains a round. Empty elements in feed chute may twist out of control, causing a jam and thus damaging the equipment.

(14) Connect feed chute to conveyor assembly (fig. 6-34).

(15) Position feed and return chutes so that locking blocks in lower support and locking tabs in upper chute are between the light green loops of the chutes. Install removable sections of supports.

CAUTION

Be certain that each conveyor element in feed chute contains a round. Empty elements in feed chute may twist out of control, causing a jam and thus damaging the equipment.

(16) Untie wire or cable tied to element belt in feed chute. Connect first element in feed chute to last element in feed opening of declutching feeder, removing additional

rounds, if necessary. Remove screwdriver or other holding device from chute, and fill all empty elements with rounds.

(17) Connect feed chute to declutching feeder assembly (fig. 6-48).

(18) Connect last conveyor element in return chute to first conveyor element in return opening of feeder. Connect return chute to declutching feeder assembly (fig. 6-48).

(19) Verify that there are at least 200 rounds remaining in ammunition drum. Refer to TM 9-2350-300-10 for ammunition loading procedures.

(20) Check that slack point in feed chute is properly located and adjust slack point as necessary (TM 9-2350-300-10).

(21) Assure that the drum drive assembly (fig. 6-38) shift pin in set to F (fire).

(22) Mark first conveyor element coming out of declutching feeder assembly.

CAUTION

Manual release of gun brakes is mandatory in the following procedure. Extended application of power to gun brake solenoid and declutching feeder solenoid will cause damage (fig. 6-7).

(23) Manually release both gun drive motor brakes.

(24) Rotate cannon in firing direction and count number of conveyor elements coming out of declutching feeder until marked conveyor element returns to its original position. The number of elements should be 123. If number of elements is not as specified, disconnect return chute from declutching feeder and add or remove elements as required. Reconnect return chute.

(25) Apply both gun drive motor brakes.

(26) Set BRAKE-CLEAR AND BRAKE switch (fig. 6-33) at BRAKE AND CLEAR, and clear cannon.

(27) Secure chute covers.

(28) Install gun shield.

6-30. Conveyor Elements.

a. Removal.

(1) Time conveyor assembly (TM 9-2350-300-10) and remove it (fig. 6-35). Remove and count conveyor elements in conveyor assembly as instructed in paragraph 6-24a, (1) through (12). Record the number of elements removed from conveyor assembly.

(2) Remove gun shield and declutching feeder assembly (fig. 6-4). Remove and count conveyor elements in declutching feeder as instructed in paragraph 6-21a, (1) through (13). Record the number of elements removed from declutching feeder.

(3) Remove and count conveyor elements in conveyor feed and return chuting assemblies as instructed in paragraph 6-29a, (9), (12), and (16). Record the number of elements removed from each chute assembly.

b. Inspection. Inspect the conveyor elements for burrs, cracks, or distortion.

c. Installation.

NOTE

When replacing conveyor elements, the entire set of elements is to be replaced.

(1) Install conveyor elements in conveyor assembly and install conveyor assembly as instructed in paragraph 6-24d, (1) through (9).

(2) Install conveyor elements in declutching feeder assembly and install declutching feeder as instructed in paragraph 6-21c, (1) through (5).

(3) Assemble the total quantity of conveyor elements recorded in paragraph 6-30a(3) preceding into 10- or 12-element sections, connecting elements as shown in figure 6-37. Check assembled conveyor elements by correctly placing a single round, in turn, into each element and then attempting to rotate round in element. If round cannot be rotated easily in all conveyor elements, replace the conveyor elements in which tightness is noted.

(4) Assemble a belt consisting of the same number of elements as were previously removed from the return chute (para. 6-29a(12)).

(5) Load belt, small loop end first, into the top end of the return chute. Hold the top (red) end of the chute in a vertical position and feed in elements until an element appears at the lower (green) end. Turn the last element in the belt 90 degrees so that it rests across the top end of the chute.

(6) At lower (green) end of return chute, compress chuting segments. Connect first conveyor element in return chute to last conveyor element in element return opening of conveyor assembly. Connect return chute to conveyor assembly.

(7) Thread a wire or small-diameter cable through the feed chute.

(8) Assemble a belt that contains the same number of elements as were previously removed from the feed chute (para. 6-29a(16)).

CAUTION

Rounds that are not properly inserted into elements may cause a jam in feed system, resulting in damage to feed system or cannon.

(9) Load rounds into all elements in belt, assuring that rounds are properly inserted into elements as shown in figure 6-37.

(10) Tie end of wire or cable extending from lower (green) end of feed chute to leading (small loop) end of belt just assembled.

(11) Pull loaded conveyor elements up through feed chute until elements appear at top of chute. Insert large screwdriver, or other holding device, through chute to prevent belt from sliding down chute.

(12) Compress feed chute segments at conveyor assembly end and remove first two rounds.

(13) Connect last element in belt to first element in feed opening of conveyor assembly, removing an additional round, if necessary. After making connection, fill all empty elements with rounds.

CAUTION

Be certain that each conveyor element in feed chute contains a round. Empty elements in feed chute may twist out of control, causing a jam and thus damaging the equipment.

(14) Connect feed chute to conveyor assembly (fig. 6-34).

CAUTION

Be certain that each conveyor element in feed chute contains a round. Empty elements in feed chute may twist out of control, causing a jam and thus damaging the equipment.

(15) Untie wire or cable tied to element belt in feed chute. Connect first element in feed chute to last element in feed opening of declutching feeder, removing additional rounds, if necessary. Remove screwdriver or other holding device from chute, and fill all empty elements with rounds.

(16) Connect feed chute to declutching feeder assembly (fig. 6-48).

(17) Connect last conveyor element in return chute to first conveyor element in return opening of feeder. Connect return chute to declutching feeder assembly (fig. 6-48).

NOTE

If upper support bracket was removed, reinstall it (see fig. 6-46).

(18) Verify that there are at least 200 rounds remaining in ammunition drum. Refer to TM 9-2350-300-10 for ammunition loading procedures.

(19) Check that slack point in feed chute is properly located, and adjust slack point as necessary (TM 9-2350-300-10).

(20) Assure that drum drive assembly (fig. 6-38) shift pin is set to F (fire).

(21) Mark first conveyor element coming out of declutching feeder assembly.

CAUTION

Manual release of gun brakes is mandatory in the following procedure. Extended application of power to gun brake solenoid and declutching feeder solenoid will cause damage.

(22) Manually release both gun drive motor brakes (fig. 6-7).

(23) Rotate cannon in firing direction and count number of conveyor elements coming out of declutching feeder until marked conveyor element returns to its original position. The number of elements should be 123. If number of elements is not as specified, disconnect return chute from declutching feeder and add or remove elements as required. Reconnect return chute.

(24) Apply both gun drive motor brakes.

(25) Set BRAKE-CLEAR AND BRAKE switch (fig. 6-33) at BRAKE AND CLEAR, and clear cannon.

(26) Secure chute covers.

(27) Install gun shield.

6-31. Elevation Potentiometer Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Release elevation drive motor brake (fig. 6-5), manually raise cannon to its maximum elevation, and reapply brake.

(4) Disconnect cable connector W7P3 (fig. 6-52) from elevation potentiometer assembly.

(5) Remove screws (1, fig. 6-53), and remove cover (2) and gasket (3) from elevation potentiometer assembly.

(6) Remove housing securing screws and remove elevation potentiometer assembly (fig. 6-55).

b. Inspection. Inspect elevation potentiometer assembly for the presence of the following conditions:

(1) Bent, broken, or cracked housing.

(2) Bent, broken, or missing spring pin.

(3) Abraded or damaged insulation on wiring.

(4) Damage or binding of variable resistor.

(5) Bent, broken, or damaged connector pins.

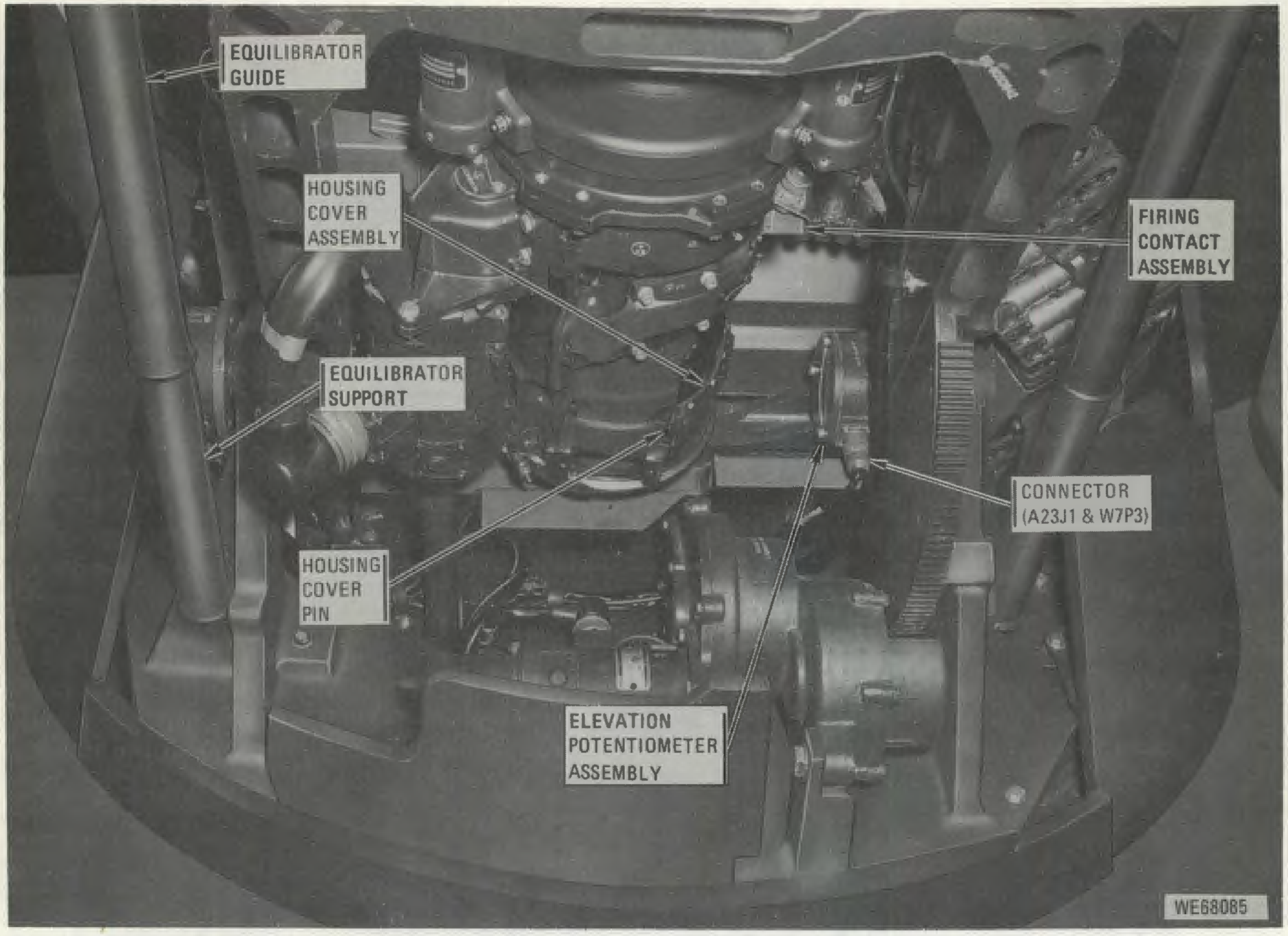


Figure 6-52. XM168 cannon and XM157 mount, view with cannon in raised position, parts location.

c. Disassembly.

(1) Remove aligning pin (10, fig. 6-53).

(2) Loosen screws (14) and hold-down clamps (13), and lift out variable resistor (4).

(3) Tag and unsolder leads from variable resistor.

(4) Remove O-ring (5) from variable resistor shaft.

(5) Remove screws (9) securing connector (8) to potentiometer housing and pull connector out of housing.

d. Assembly of Elevation Potentiometer.

(1) Orient connector (8, fig. 6-53) with wide keyway to the right, and install.

(2) Insert O-ring (5) on variable resistor (4) shaft.

(3) Solder connector leads to variable resistor (fig. 6-54).

(4) Place variable resistor in potentiometer assembly housing. Engage retaining clamps (13, fig. 6-53) and tighten screws (14) until variable resistor remains in position, but can be turned by hand. Do not install cover at this point.

(5) Install aligning pin (10) so that it does not protrude from opposite side of potentiometer shaft.

e. Installation.

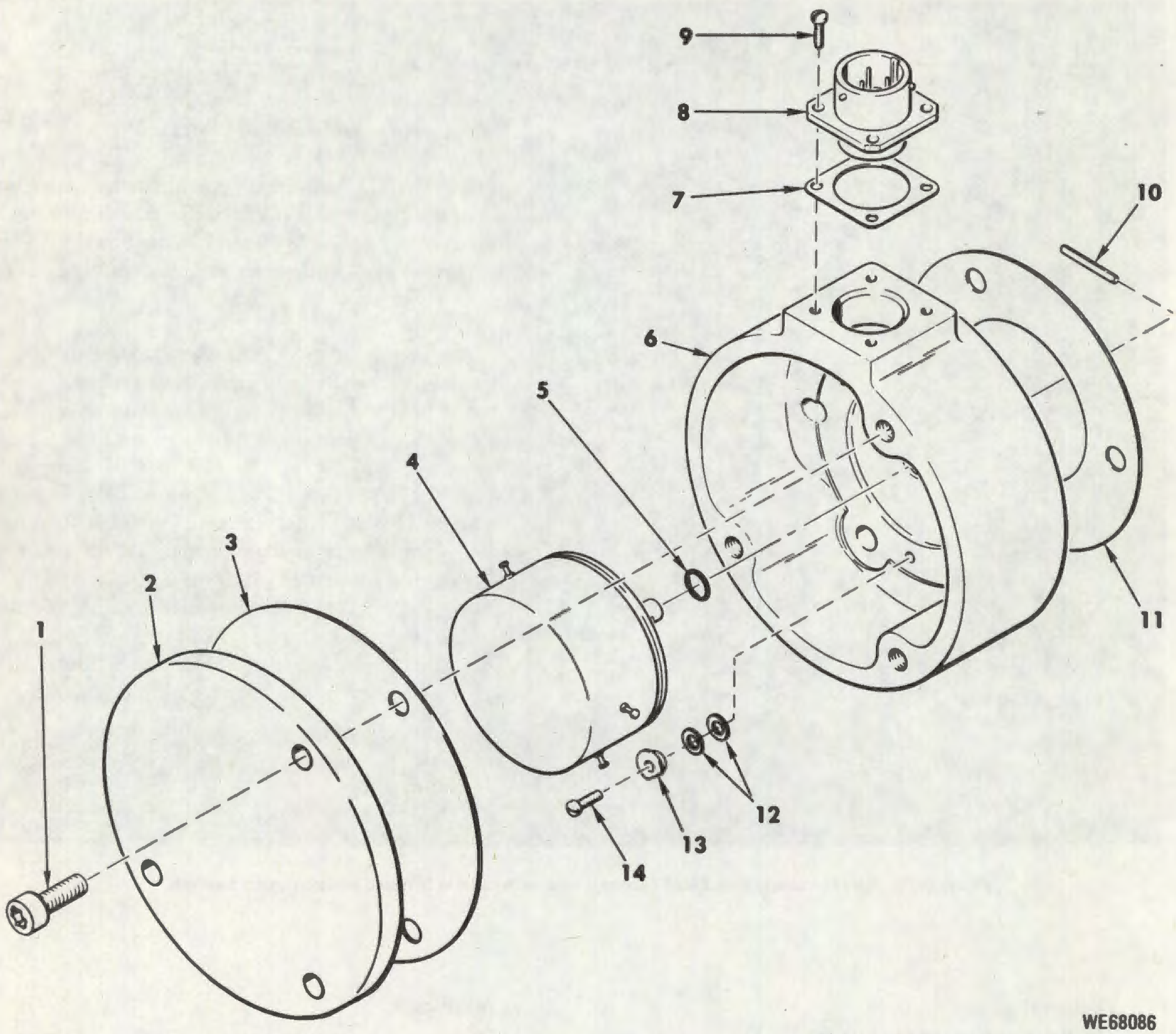
NOTE

The following procedures will be facilitated if the cannon is positioned to the rear of the chassis. Test set AN/MWM-2 is placed on the chassis deck, and the interconnecting cable is routed through the open commander's hatch.

NOTE

The elevation potentiometer assembly cover must be removed and the variable resistor loosely secured (d(4) preceding) prior to installing the assembly.

(1) Attach AN/MWM-2 cable W32 between sight current generator J7 connector and AN/MWM-2 J3 connector. Connect multimeter 300M-A (set polarity switch to RE-



1 Screw	6 Housing	11 Gasket
2 Cover	7 Gasket	12 Washer
3 Gasket	8 Connector	13 Clamp
4 Variable resistor	9 Screw	14 Screw
5 Packing (O-ring)	10 Aligning pin	

Figure 6-53. Elevation potentiometer assembly, exploded view.

VERSE) to AN/MWM-2, and set multimeter to measure 15 Vdc in search mode.

(2) Position AN/MWM-2 controls as follows:

METER SELECTOR switch SCG-1
SCG-1 switch 14
METER POLARITY switch............ up (+)

(3) Connect cable connector W7P3 to elevation potentiometer assembly.

(4) Verify that distribution box NORM-STATIC-TEST switch (fig. 6-11) is at STATIC position.

(5) Set SYSTEM POWER switch to ON (fig. 6-1) and gunner control panel MODE switch to MAN.

(6) Turn elevation potentiometer variable resistor shaft so that aligning pin is aligned with line A on bottom of elevation potentiometer assembly housing.

(7) Hold variable resistor shaft so that aligning pin remains aligned with line A, and turn variable resistor body until voltmeter indicates approximately 15 Vdc.

(8) Accurately align aligning pin with line B.

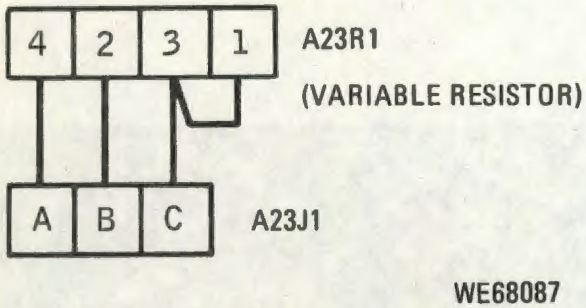


Figure 6-54. Elevation potentiometer assembly wiring diagram.

(9) Switch multimeter 300M-A to digital mode and set readout wheels to 7.50. Hold variable resistor shaft so that aligning pin remains aligned with line B, and turn variable resistor body until meter indication is nulled.

CAUTION

Do not allow screwdriver to contact potentiometer terminals while performing following step.

(10) While continuing to observe that meter indication remains nulled, tighten clamp screws (fig. 6-53).

(11) Set SYSTEM POWER switch to OFF.

CAUTION

When performing following step, make certain that wires are clear of attaching screws and washers prior to tightening.

(12) Install elevation potentiometer assembly housing on saddle assembly (fig. 6-55) so that aligning pin is in bottom slot of saddle shaft, and saddle dowel pin is in positioning hole in potentiometer assembly housing.

NOTE

Cannon is at 0 degrees or 60 degrees elevation when appropriate lines scribed on sight support and on linkage assembly are in alignment (fig. 6-56).

(13) Set SYSTEM POWER switch to ON, allow 10-second delay, and verify that with cannon at 0 degrees elevation, multimeter reads approximately 15 Vdc, and that at 60 degrees it reads between 7.40 and 7.60 Vdc.

(14) Set SYSTEM POWER switch to OFF and disconnect test equipment.

(15) Install cover (2, fig. 6-53) and new gasket (3), if required, on elevation potentiometer assembly housing.

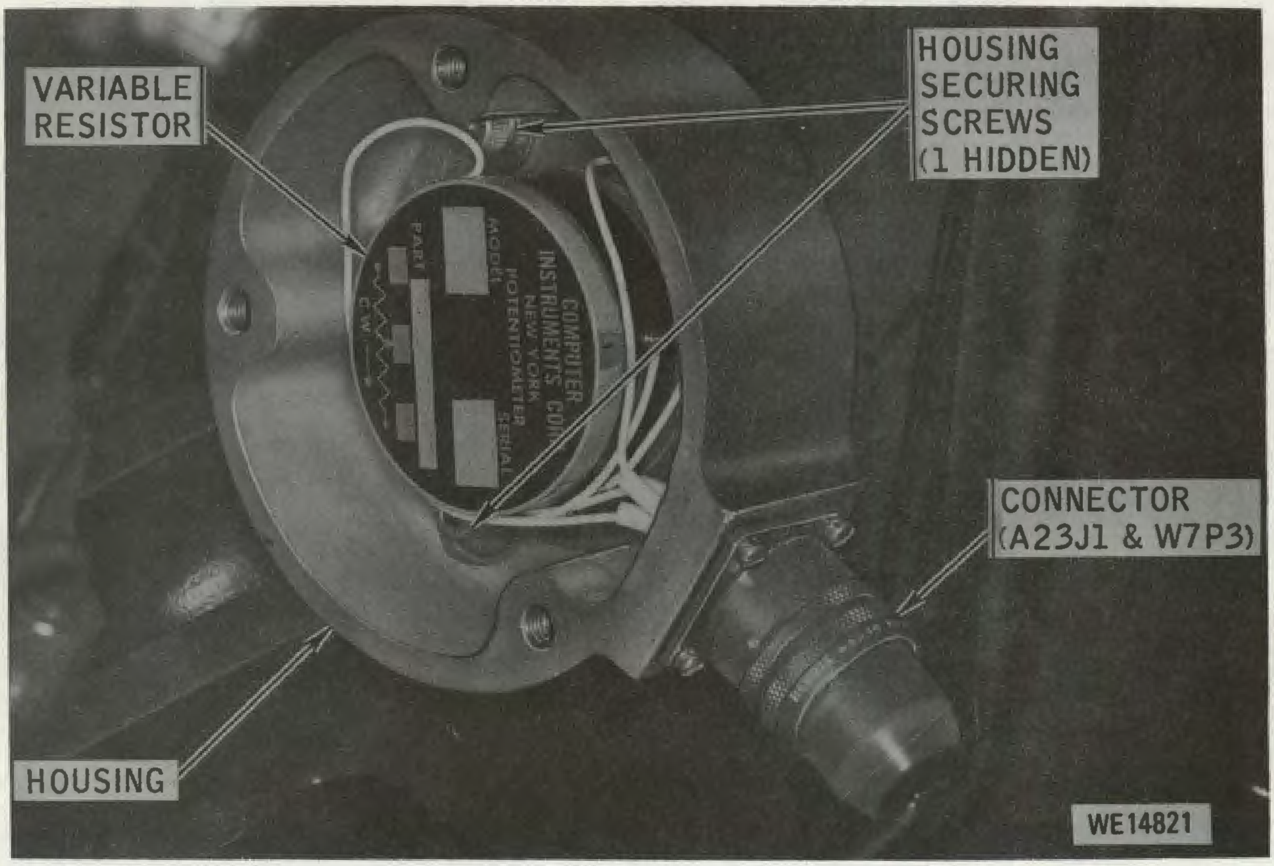


Figure 6-55. Elevation potentiometer assembly with cover removed, parts identification.

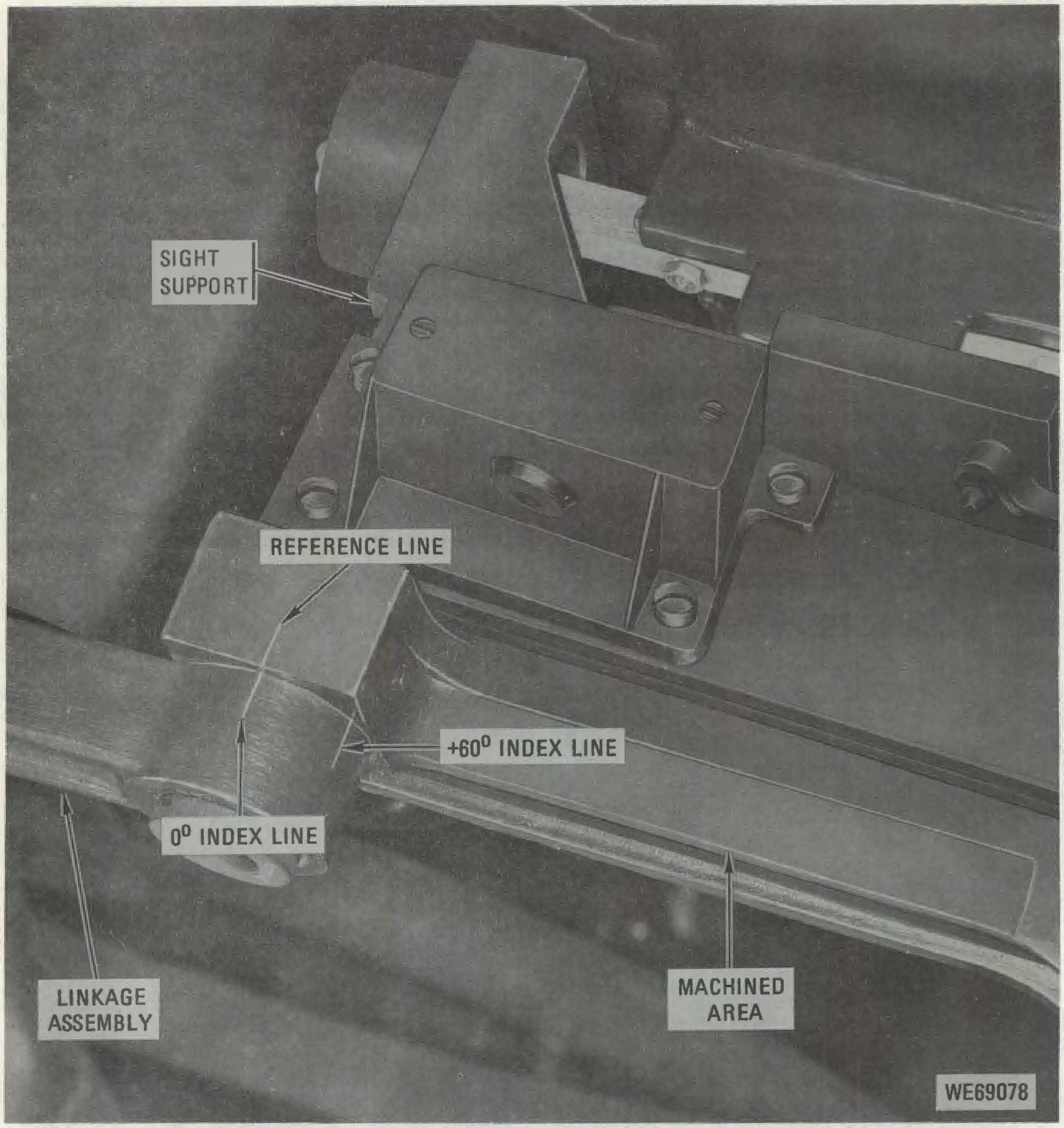


Figure 6-56. XM157 mount, location of elevation angle index lines.

6-32. Elevation Limit Switch Assembly

Repair of the elevation limit switch consists of replacing the switch assembly (11, fig. 6-57) or the switch actuator adapters (2 and 5). It is not necessary to remove the entire elevation limit switch assembly prior to accomplishing repairs.

a. *Removal of Switch Assembly and Switch Actuators.*

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect cable connector W8P11 from elevation limit switch assembly (fig. 6-12).

NOTE

Refer to figure 6-57 for identification of elevation limit switch assembly components.

(4) Remove screws (10, fig. 6-57), washers (9), and remove cover (8) from elevation limit switch assembly.

(5) Release elevation drive brake and manually elevate cannon until all switch actuator adapters (2 and 5) are free of cam on elevation switch assembly. Reset brake.

(6) Remove screws (4, 7, and 12) and washers (3, 6, and 13), securing switch assembly (11) and switch actuator adapters (2 and 5) to mounting plate (1).

(7) Remove nut (14) securing switch assembly connector to mounting plate.

(8) Electrical (elevation limit) switch assembly 8437158 has been replaced by electrical switch assembly 8439119. To replace the old switch proceed as follows:

(a) Remove limit switch cover and retain hardware (8, fig. 6-57).

(b) Remove switch cam actuator (15) and associated parts.

(c) Disconnect external cable assembly.

(d) Remove and retain screws holding switch parts to mounting plate.

(e) Remove mounting plate (1) and switch assembly (11) as a unit.

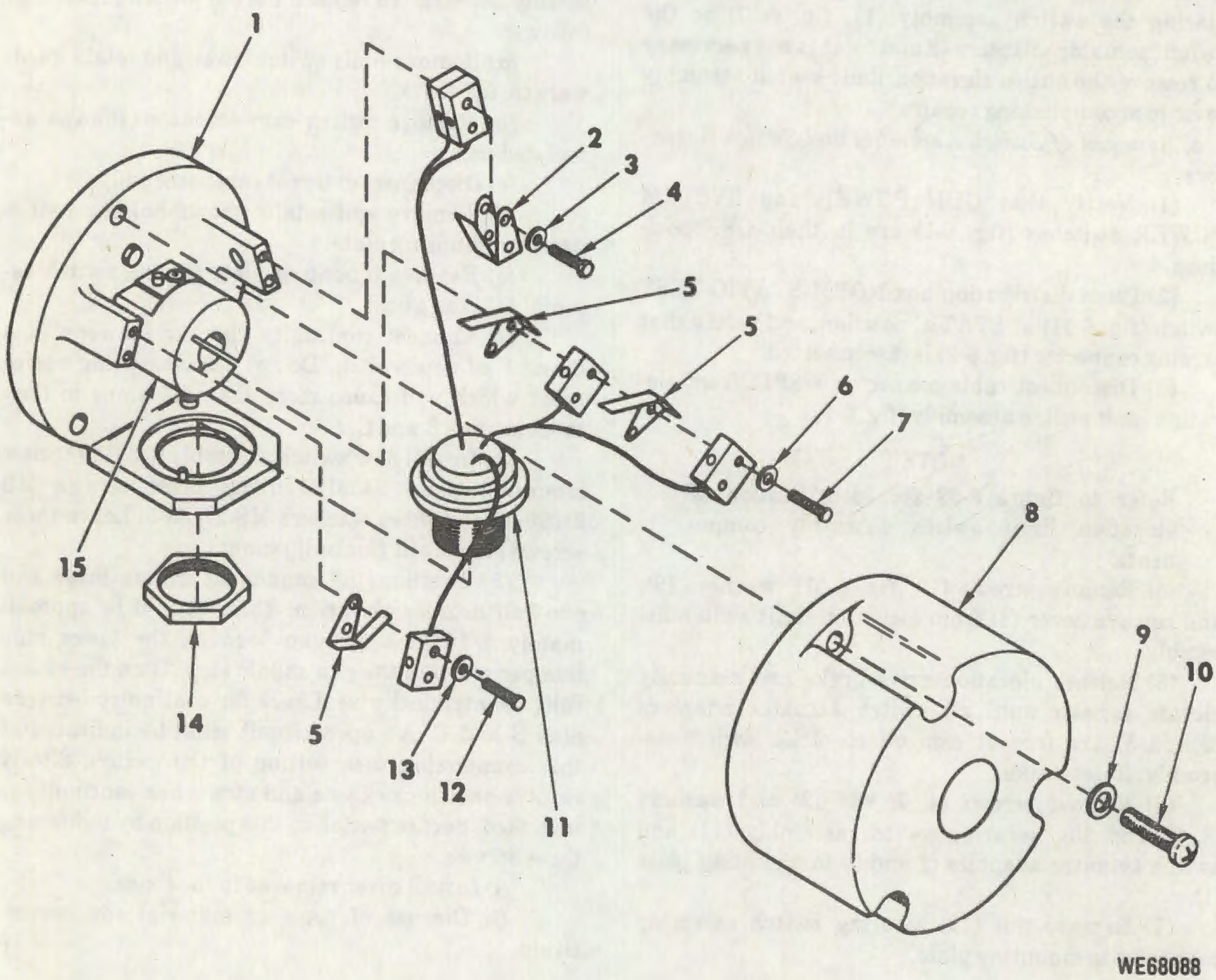
(f) Connect continuity checker between pins B and C of new switch. Do not use measuring equipment which will cause more than 0.2 amps to flow through pins B and C.

(g) Install new switch assembly 8439119 to new mounting plate 8439120 using three screws MS 21090-22 and three washers MS 27183-5. Leave these screws loose until final adjustment.

(h) Position the cannon at minus three and one-half degrees elevation. There should be approximately 3/16 inch air gap between the lower stop bumper pad and the gun saddle stop. Turn the switch fully counterclockwise. Check for continuity between pins B and C. An open circuit must be indicated at this counterclockwise setting of the switch. Slowly revolve switch clockwise and stop when continuity is indicated. Secure switch in this position by tightening three screws.

(i) Install cover removed in *(a)* above.

(j) Dispose of replaced material administratively.



1 Mounting plate
2 Switch actuator adapter
3 Washer
4 Screw
5 Switch actuator adapter
6 Washer
7 Screw
8 Cover
9 Washer
10 Screw
11 Switch assembly
12 Screw
13 Washer
14 Nut
15 Cam actuator

Figure 6-57. Elevation limit switch assembly, exploded view.

b. Inspection. Inspect the elevation limit switch assembly.

(1) Damage or improper operation of switches.

(2) Cracked, bent, or damaged connector pins, cover, cam, or mounting plate.

(3) Freedom of movement and spring return action of actuator adapters.

(4) Abrasions or cracked insulation on wiring.

(5) Check cam actuator for security.

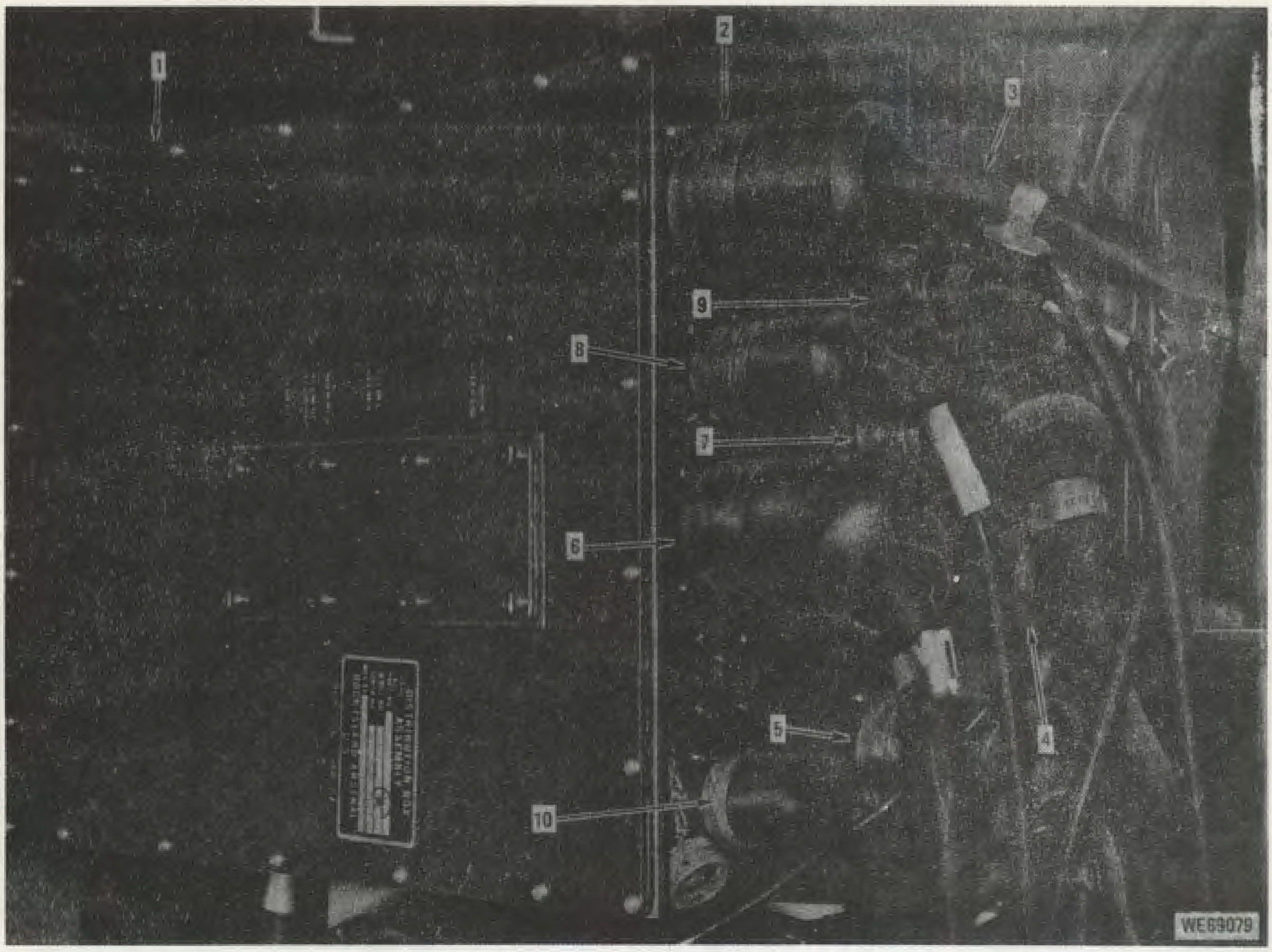
c. Installation. Installation is the reverse of removal. Immediately after installing the switch assembly (11, fig. 6-57), perform after-installation checks, paragraphs *d* through *f* following.

d. Elevation Switch A18S1 (+18 Degrees) After-Installation Check.

NOTE

Adjustment of switch A18S1 also sets the actuating point of switch A18S2 (+13 degrees). The difference between the actuating points of the two switches is controlled by a machined cam surface.

(1) Disconnect cable connector W8P1 (6, fig. 6-58) at distribution box. Pull cable W8 up through mount so connector W8P1 is accessible near elevation limit switch assembly.



1 Distribution box
2 Connectors (A1J1 & W10P1)
3 Connectors (A1J2 & W2P1) (hidden)
4 Connectors (A1J4 & W4P1)
5 Connectors (A1J10 & W1P6)
6 Connectors (A1J8 & W8P1)
7 Connectors (A1J3 & W3P1)
8 Connectors (A1J7 & W14P1)
9 Connectors (A1J9 & W5P1)
10 Connectors (A1J5 & W17P1)

Figure 6-58. Distribution box, connector identification.

(2) Turn mount so that cannon is positioned over commander's hatch, and both azimuth switches are actuated on a hatch cam.

(3) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(4) Verify that distribution box NORM-STATIC-TEST switch (fig. 6-11) is at STATIC position, and that arming connector (fig. 6-2) is disconnected.

(5) Connect an ohmmeter between pins F and L of distribution box cable connector W8P1.

(6) Position cannon at an elevation of approximately 45 degrees. Meter should indicate continuity.

(7) While observing ohmmeter, slowly lower cannon muzzle until meter indicates an open circuit. Stop lowering cannon at this point.

(8) Measure distance between stop on saddle assembly and stop on base support assembly (points A and B, fig. 6-59). Measurement should be between 2-7/8 inches and 3-1/8 inches. If measurement is out of tolerance, perform (9) through (14) following. If measurement is within range specified, proceed to (15).

(9) Remove cover from elevation limit switch assembly (fig. 6-5).

(10) Elevate cannon to maximum elevation and loosen screw on actuating cam for switches A18S1 and A18S2 (fig. 6-60) enough to permit movement of cam by tapping with drift pin.

(11) Position cannon so that measurement between points A and B (fig. 6-59) is 3 inches. Tap cam until meter indicates that switch has actuated.

(12) Elevate cannon to maximum elevation and tighten screw on actuating cam.

(13) Repeat (7) and (8) preceding.

(14) Install cover.

(15) Disconnect ohmmeter, and connect W8P1 (6, fig. 6-58) to distribution box.

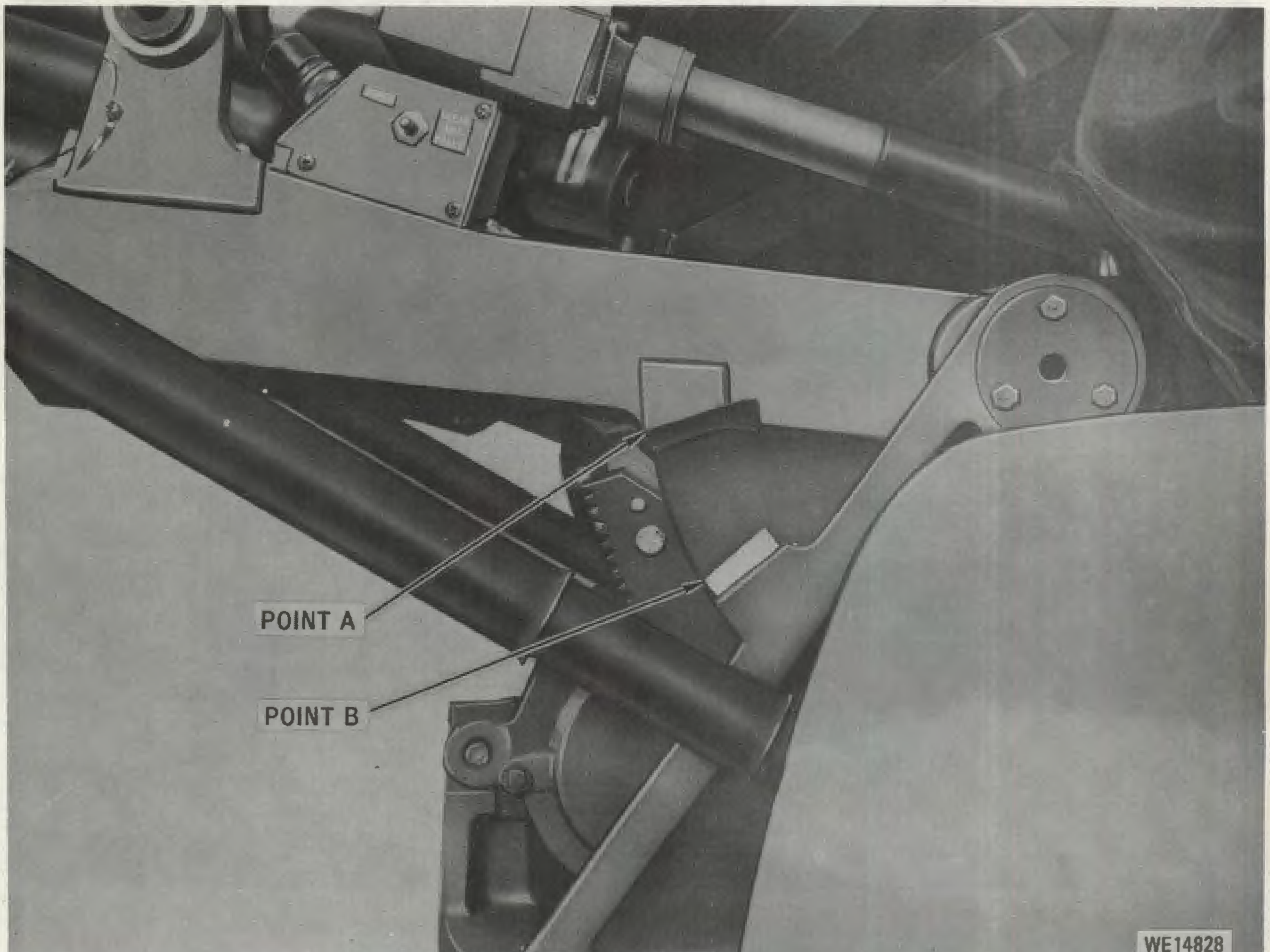


Figure 6-59. XM157 mount, points of measurement for testing elevation limit switches A18S1, A18S2, A18S3.

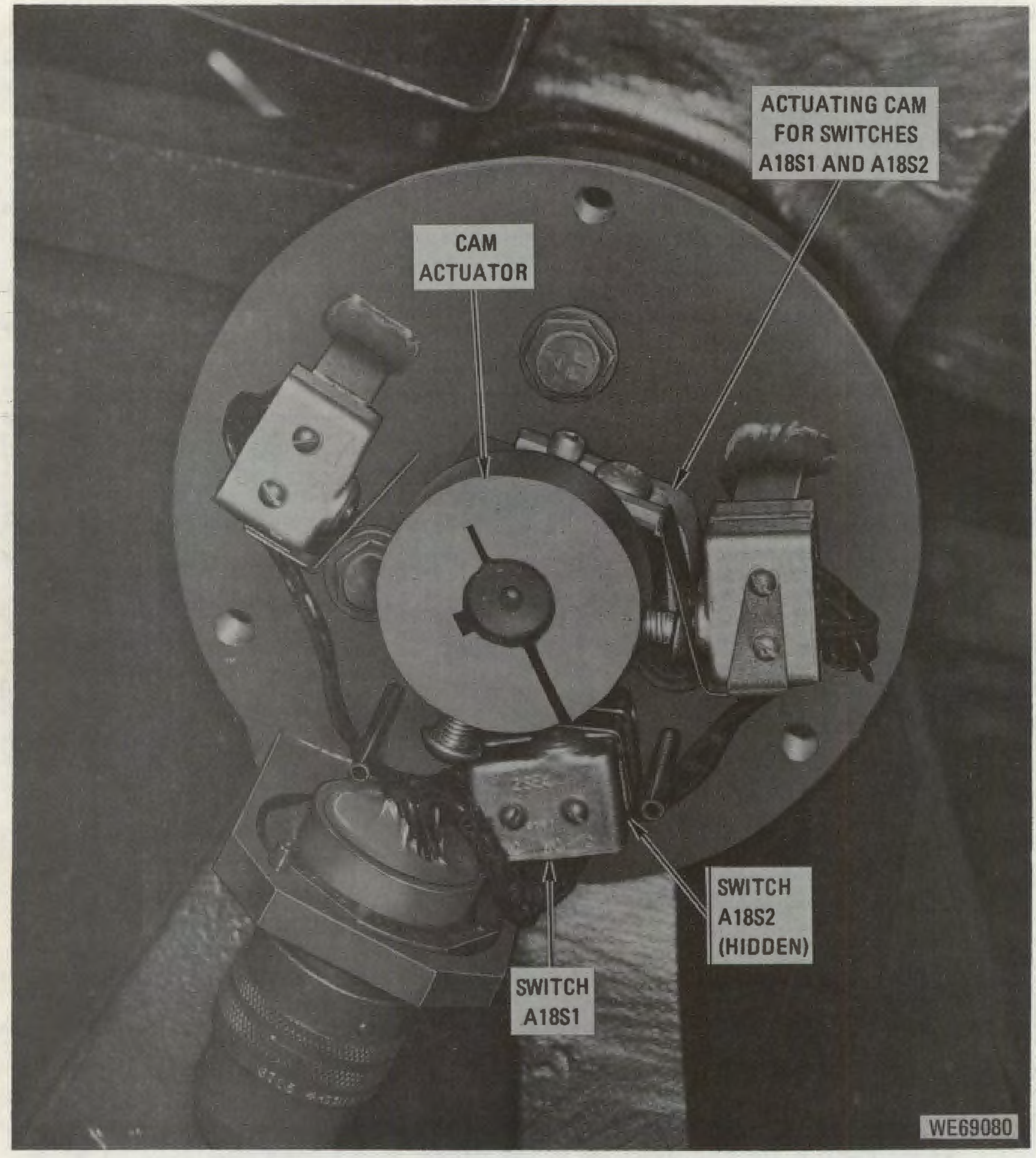


Figure 6-60. Elevation limit switch assembly, cover removed, orientation of actuating cam with cannon at maximum elevation angle.

e. Lower Limit Switch A18S3 After-Installation Check.

(1) Perform (1) through (4) in d. preceding.

(2) Connect an ohmmeter between pins J and L of connector W8P1.

(3) Manually raise cannon muzzle until cannon is at an elevation of approximately 45 degrees. Meter should indicate continuity.

(4). While observing ohmmeter, slowly lower cannon muzzle until meter indicates an open circuit. Stop lowering cannon at this point.

(5) Measure distance between stop on saddle assembly and stop on base support assembly (points A and B, fig. 6-59). Measurement should be between 1/4 inch and 3/16 inch. If measurement is out of tolerance, perform (6) through (9) following. If measurement is within range specified, proceed to (10).

(6) Remove cover from elevation limit switch assembly (fig. 6-5).

(7) Manually raise cannon to gain access to A18S3 actuating screw (fig. 6-61) and turn screw as required to bring switch actuating point within tolerance. (Turn screw clockwise to lower actuating point.)

(8) Repeat (4) and (5) preceding.

(9) Install cover.

(10) Disconnect ohmmeter, and connect cable connector W8P1 to distribution box.

f. Upper Limit Switches A18S4 and A18S5 After-Installation Check.

(1) Perform (1) through (4) in d. preceding.

NOTE

Switches A18S4 and A18S5 share a common actuator. Adjustment of the actuating point for A18S4 affects the actuating point of A18S5. To check actuation of switch A18S5, refer to figure 3-7 to determine switch condition and pin connections.

(2) Connect an ohmmeter between pins B and c of connector W8P1 (6, fig. 6-58) to check switch A18S4.

(3) Manually position cannon so that barrels are approximately horizontal. Meter should indicate continuity.

(4) While observing ohmmeter, slowly raise cannon muzzle until indication of open circuit is seen on meter. Stop raising cannon at this point.

(5) Measure distance between stop on sector gear and lower stop on base support assembly (points C and D, fig. 6-62). Measurement should be between 1/4 inch and 3/16 inch. If measurement is out of tolerance, perform (6) through (8) following. If measurement is within range specified, proceed to (9).

(6) Remove cover from elevation limit switch assembly (fig. 6-5).

(7) Manually lower cannon to gain access to actuating screw for switch A18S4 (fig. 6-61), and turn screw as required to bring switch actuating point within tolerance. (Turn screw clockwise to lower actuating point.)

(8) Repeat (4) and (5) preceding.

(9) Install cover if removed in (6) preceding.

(10) Disconnect ohmmeter, and connect cable connector W8P1 to distribution box.

6-33. Equilibrator Assemblies.

The XM157 mount contains two equilibrator assemblies.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Release elevation drive motor brake, raise cannon muzzle to maximum elevation, and reapply brake (fig. 6-5).

WARNING

There are approximately 150 pounds of spring force left in each equilibrator at +80 degrees elevation. The following operation requires at least two men to perform.

(4) Using a socket-head screw key, loosen setscrew that secures equilibrator guide to saddle assembly. Refer to figures 6-12 and 6-52.

WARNING

Make sure equilibrator assembly is held firmly when disengaging equilibrator guide from saddle assembly.

(5) Push or pull down and outward on equilibrator guide, tapping on guide with soft faced hammer if necessary to free it. Use caution not to dent guide.

NOTE

If equilibrator assembly being removed is on right side of mount, it will be necessary to pivot equilibrator support down to chassis deck in order to gain access to spring pin. Refer to figure 6-63 for identification of equilibrator assembly components.

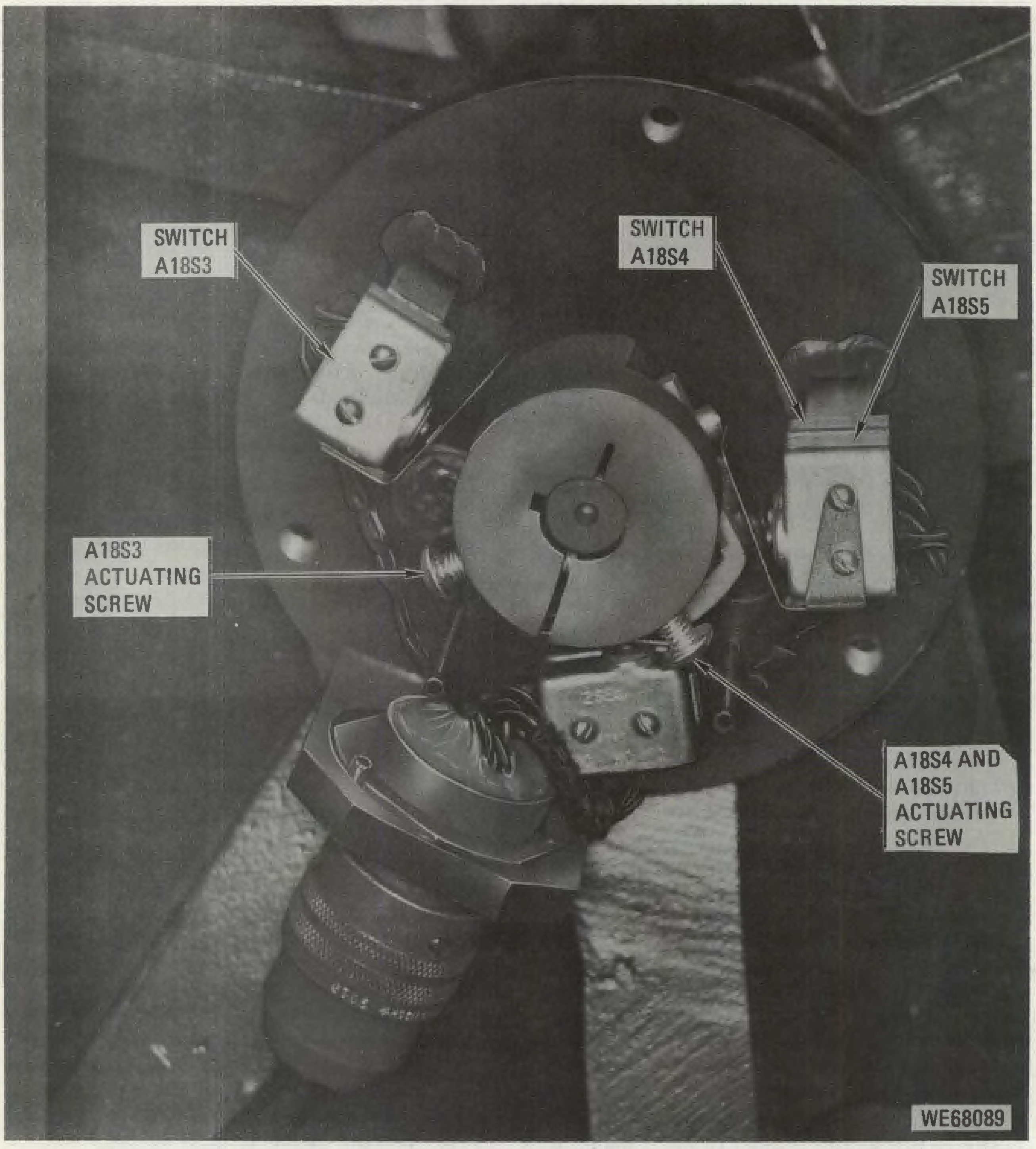


Figure 6-61. Elevation limit switch assembly, cover removed, orientation of switch actuating screw with cannon at elevation of approximately 30 degrees.

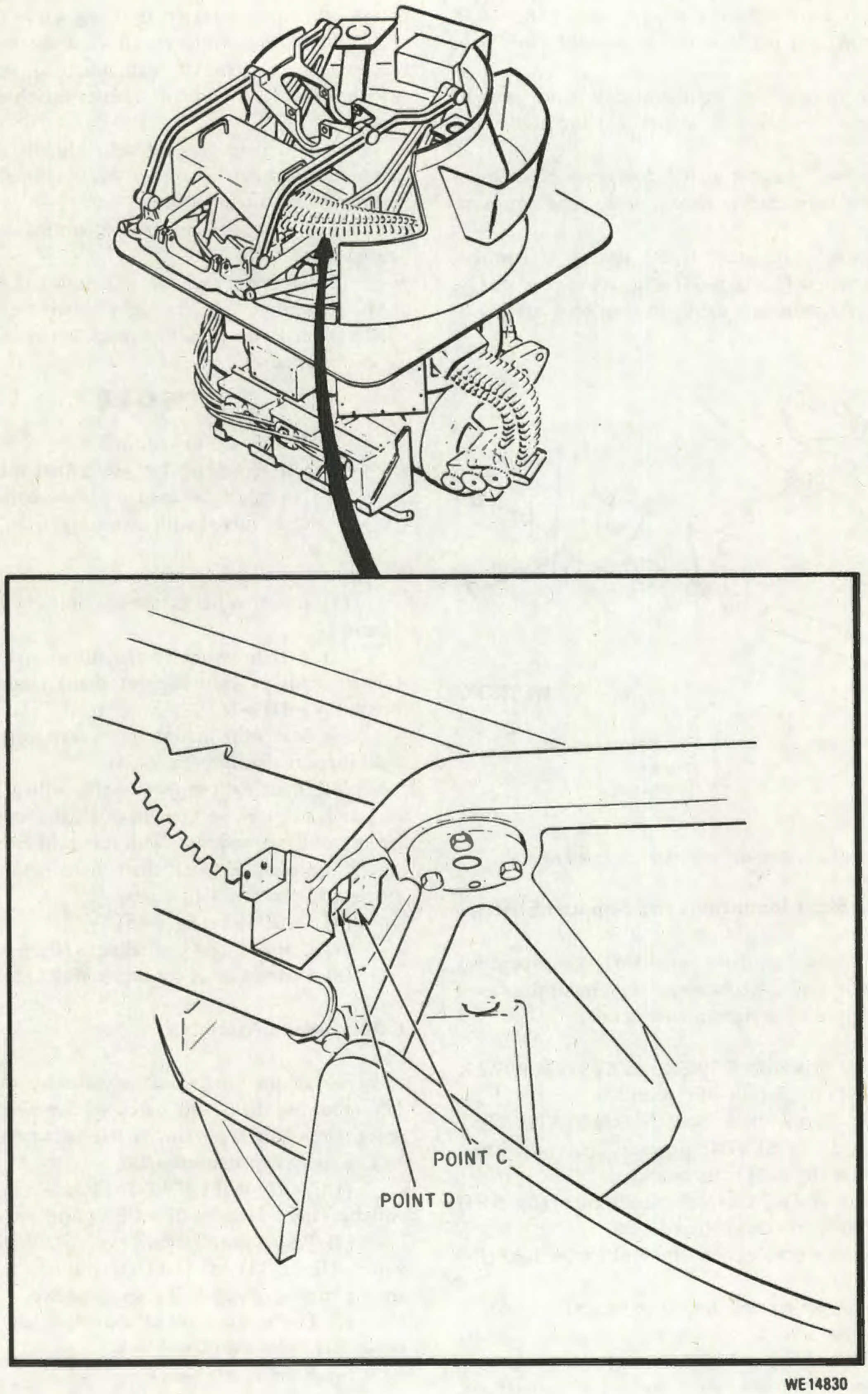


Figure 6-62. XM157 mount, points of measurement for testing upper limit switches A18S4 and A18S5.

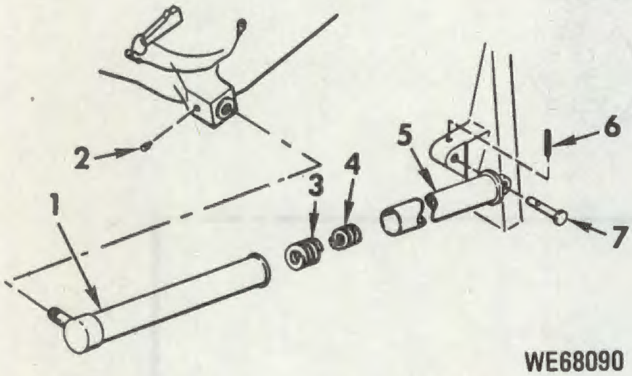
(6) Remove guide (1, fig. 6-63) and springs (3 and 4).

(7) At base of equilibrator support (5, fig. 6-63), drive out spring pin (6) that secures headed pin (7) in mount bracket.

(8) Pull outward on equilibrator support near its base, and remove equilibrator support (5) and headed pin (7).

b. Inspection. Inspect equilibrator assembly components for distortion, cracks, breaks, or dirt and corrosion and scoring.

c. Installation. Installation is the reverse of removal. Assure that setscrew (2, fig. 6-63) is in groove of guide (1). Tighten setscrew until it is tight and then back off 3/4 to 1-1/4 turn.



1 Equilibrator guide
2 Set screw
3 Spring
4 Spring
5 Equilibrator support
6 Spring pin
7 Headed pin

Figure 6-63. Equilibrator assembly, exploded view.

6-34. XM61 Sight Mountings and Support Shafts.

The XM157 mount contains four XM61 sight mountings and two support shafts. Replacement sight mountings are a matched set supplied in a sight mounting kit.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Assure that sight is mechanically caged (fig. 6-64) by aligning white marks on knob and sight.

(4) Disconnect cable connector W6P2 from sight (fig. 6-65).

(5) Disconnect ground strap from sight (fig. 6-66).

(6) Remove screws securing sight to sight support shafts (fig. 6-65) and remove sight.

(7) Remove both rear sight support shaft bolts and washers (fig. 6-64).

(8) At forward end of each sight support shaft remove sight mount adapters attaching screws (fig. 6-67).

(9) Slowly withdraw (from front end) each sight support shaft from its rear mounting, leaving forward mounting and sight mount adapter attached to sight support shaft.

(10) Remove forward sight support shaft bolts and washers, and separate support shafts, forward sight mountings, and sight mount adapters.

(11) Press each forward mounting out of its associated adapter.

(12) Remove each rear mounting (fig. 6-64).

b. Inspection. Inspect sight mountings and support shafts for distortion, cracks, breaks, or corrosion.

c. Installation.

NOTE

The four sight mountings supplied in each sight mounting kit are a matched set. They must be used together, and must not be mixed with mountings from other kits.

(1) Insert sight mountings into two sight mount adapters.

(2) Attach assembled mountings and adapters onto forward ends of sight support shafts (support shafts are marked – FWD→7).

(3) Seat sight mountings in rear sight mountings in sight support assembly (fig. 6-64).

(4) Insert sight support shafts, with attached mountings and adapters, in openings of sight support assembly (from front end) and mate with rear sight mountings.

(5) Install support shaft bolts and washers, and mount adapters attaching screws.

(6) Install sight (fig. 6-65).

(7) Connect sight ground strap (fig. 6-66).

(8) Connect cable connector W6P2 to sight.

6-35. Saddle Assembly.

Repair of the saddle assembly consists of replacing the gun mounting ball, and quick release pins. Removal of quick release pins is obvious by reference to fig. 6-68.

a. Removal of Mounting Ball.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Position cannon at approximately 0 degrees elevation (fig. 6-56) over travel lock.

(4) Remove gun shield.

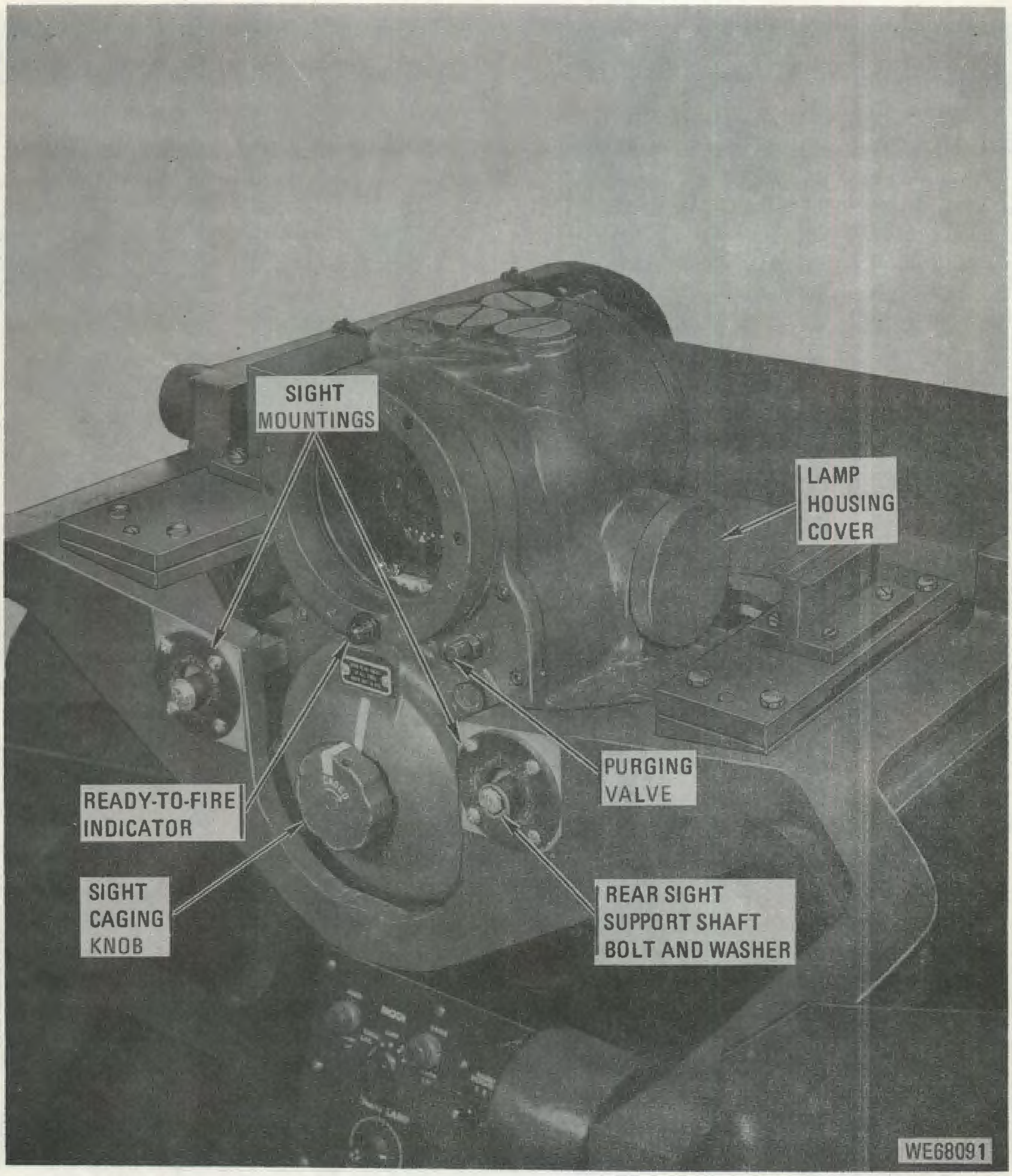


Figure 6-64. XM61 sight, right rear view, parts location.

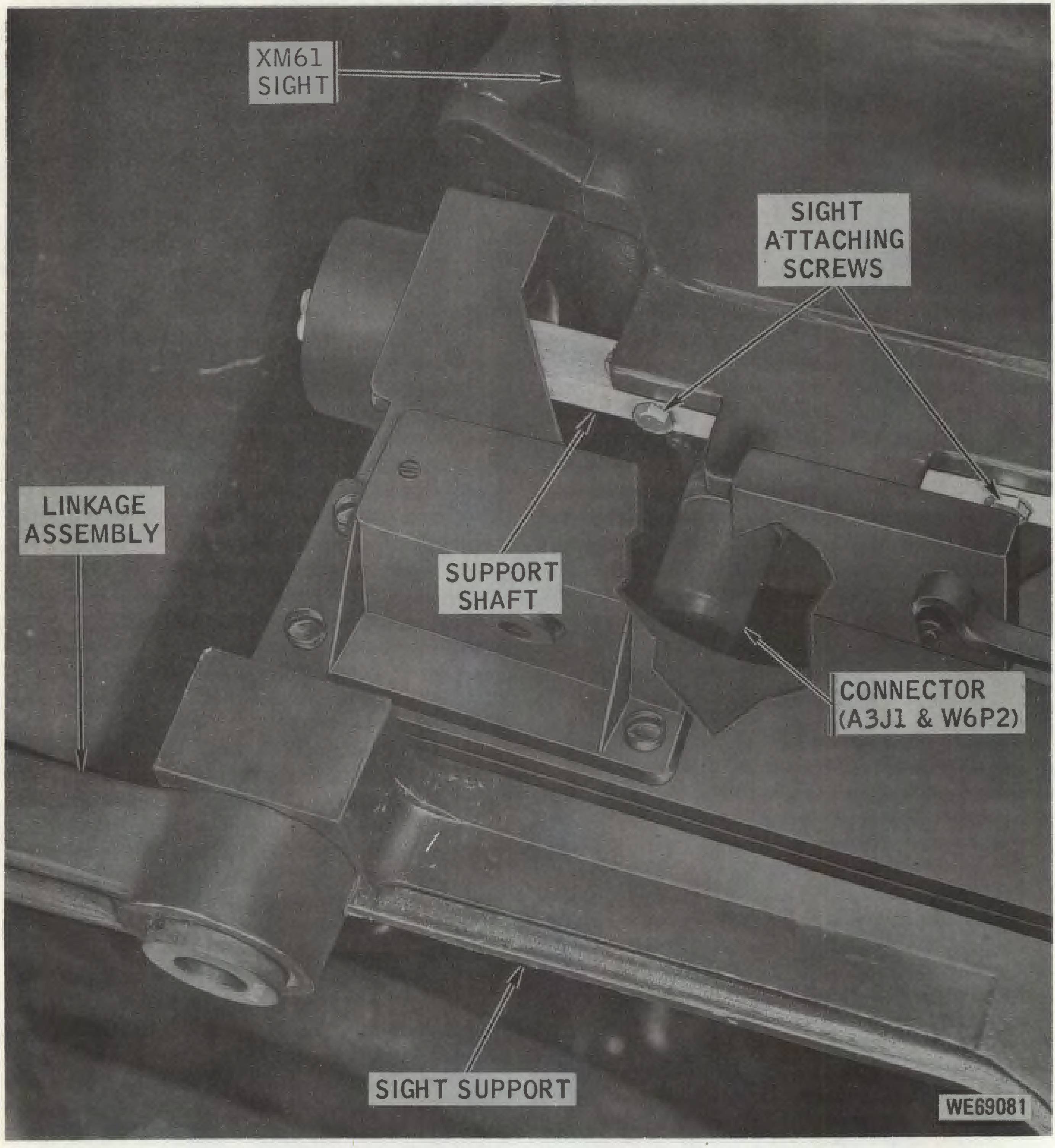


Figure 6-65. XM61 sight, means of attachment.

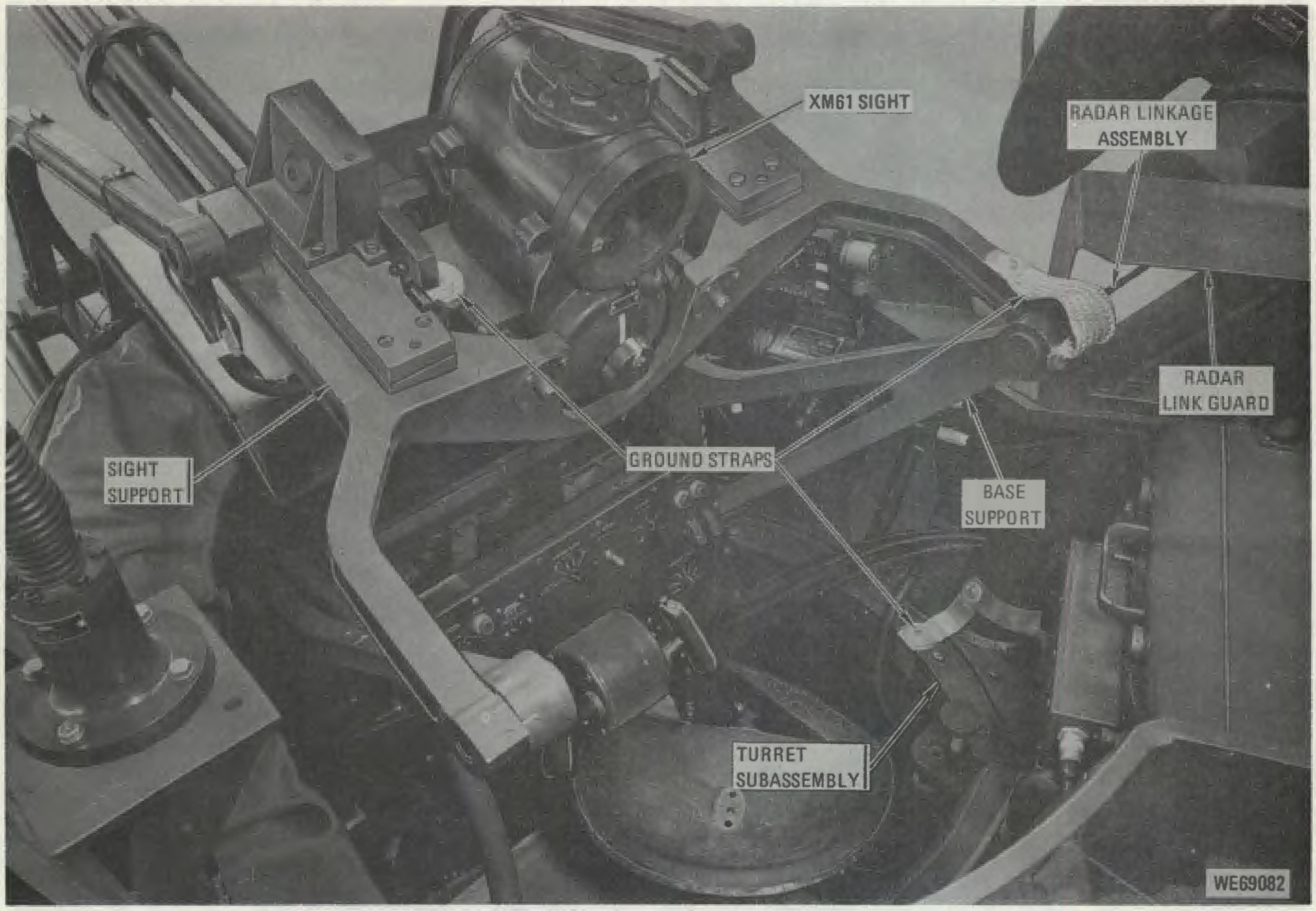


Figure 6-66. XM157 mount, interior view showing grounding straps that assure electromagnetic compatibility.

(5) With downward pressure being exerted at cannon muzzle, remove bolts and washers securing mounting ball to saddle assembly, and remove mounting ball (fig. 6-68).

(6) Place and clamp cannon in travel lock.

b. Inspection. Inspect mounting ball for damage, dirt, or corrosion.

c. Installation of Mounting Ball. Installation is the reverse of removal. Prior to installing mounting ball, coat ball with grease per MIL-G-23827 (GIA).

6-36. Slip Ring Assembly.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Release azimuth drive motor brakes (9, fig. 6-22).

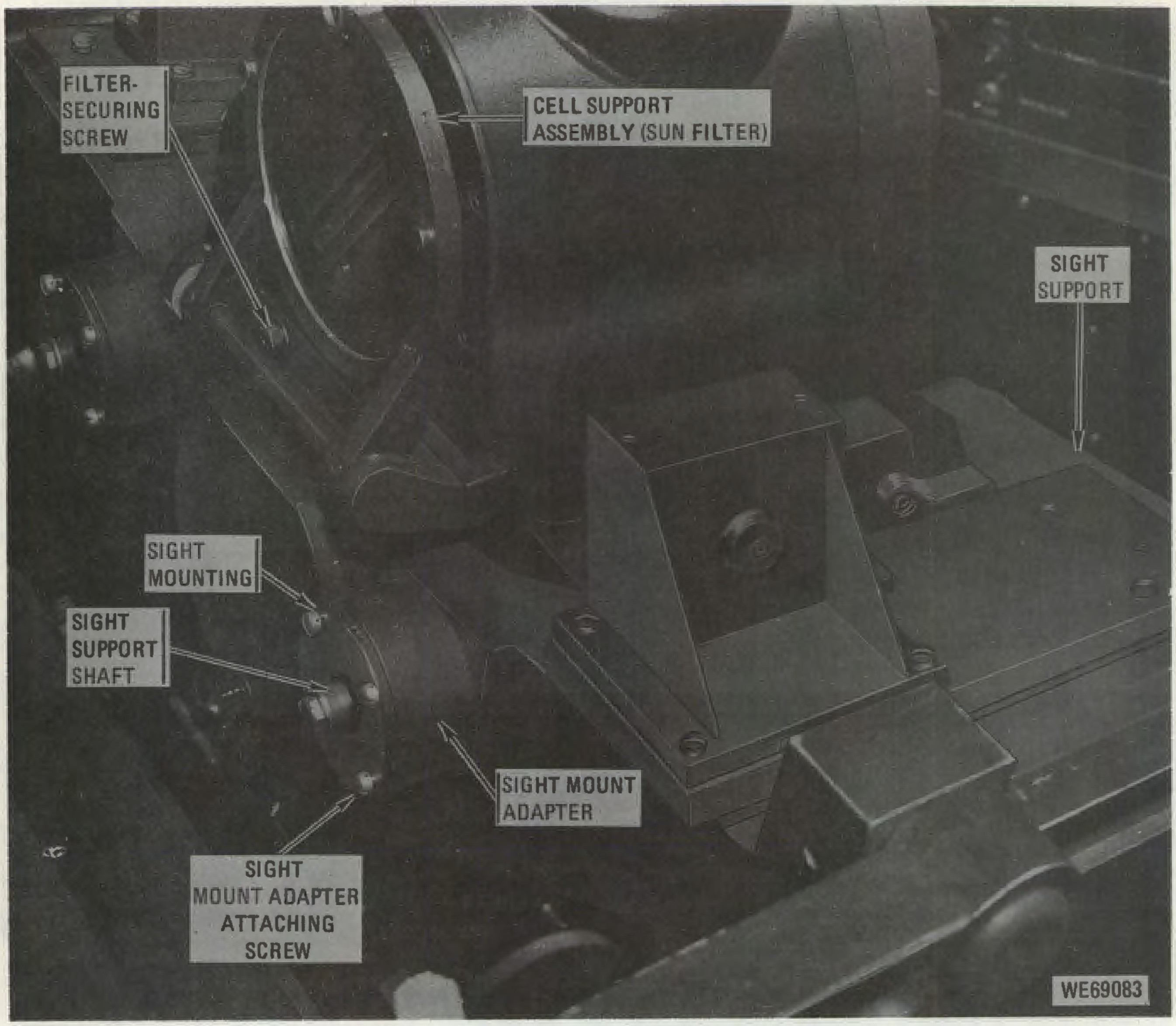


Figure 6-67. XM61 sight, right front view, parts location.

(4) Position XM157 mount to gain access to slip ring assembly connectors, and disconnect the six cable connectors connected to the slip ring assembly.

NOTE

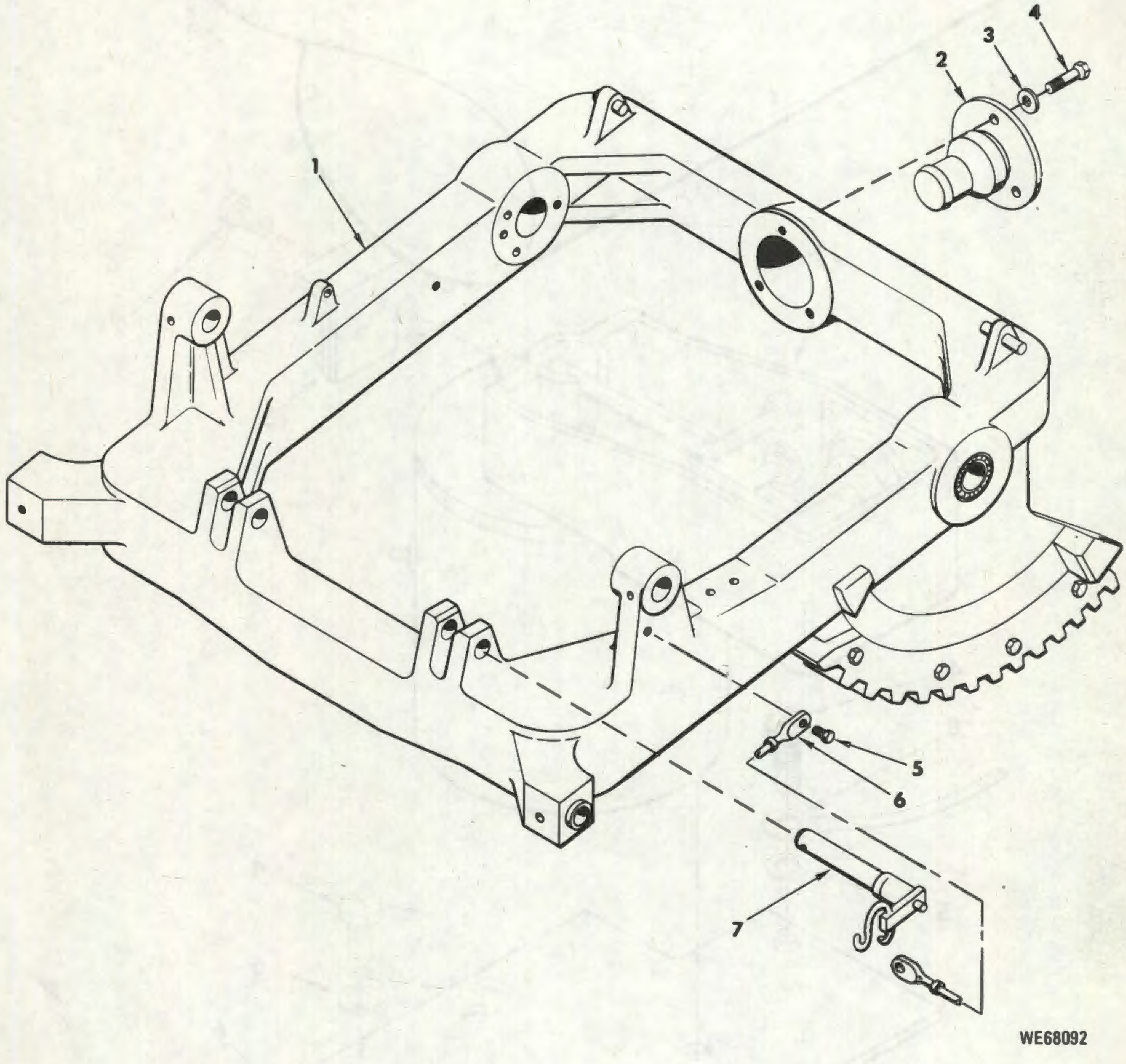
Refer to figure 6-69 for identification of slip ring assembly mounting components. Position XM157 mount as necessary to gain access to the slip ring assembly mounting components in the following procedures.

(5) Remove upper securing screw (2, fig. 6-69) connecting slip ring assembly (1) to drum assembly mounting bracket (3).

(6) Remove screws (4) and washers (5) connecting slip ring bracket (6) to chassis floor.

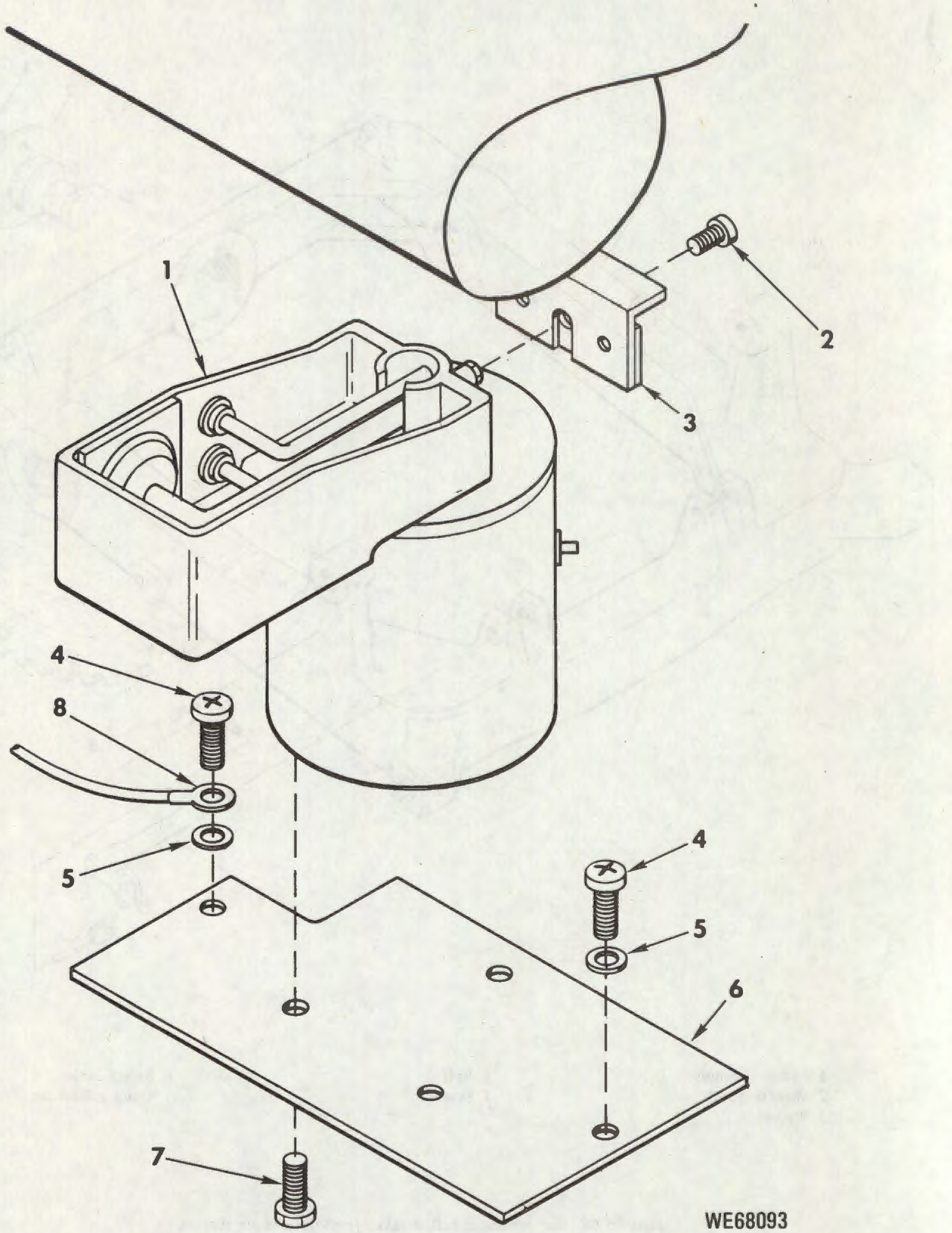
(7) Remove slip ring assembly, with slip ring bracket attached.

(8) Remove screws (7) and separate slip ring assembly from slip ring bracket.



1 Saddle assembly	4 Bolt	6 Safety cable
2 Mounting ball	5 Screw	7 Quick release pin
3 Washer		

Figure 6-68. Gun mounting ball, details of removal and installation.



1 Slip ring assembly
2 Screw
3 Drum assembly mounting bracket
4 Screw
5 Washer
6 Slip ring bracket
7 Screw
8 Ground strap connection

Figure 6-69. Slip ring assembly, details of removal and installation.

b. Inspection. Inspect the slip ring assembly for the presence of the following conditions:

(1) Broken, bent or missing connector pins.

(2) Cracked, bent or damaged housing.

(3) Freedom of rotary movement of top slip ring bracket.

(4) Internal corrosion:

(a) Remove four screws attaching J1 connector to the slip ring assembly housing.

(b) Pull J1 connector away from housing to expose interior portion of slip ring assembly.

(c) Check exposed area of inside of housing and connector for evidence of corrosion.

(d) Turn top rotary bracket of slip ring assembly one full revolution while checking observable portion of commutator for evidence of corrosion.

(e) If the commutator or the internal portion of the housing show evidence of corrosion, replace the slip ring assembly. If there is no evidence of corrosion, proceed with repair procedures in paragraph *c* following.

c. Repair.

NOTE

Repair of the slip ring assembly as outlined in the following procedures is limited to sealing the J1, J2 and J3 connectors and the six (6) base screws to prevent the accumulation of moisture within the slip ring.

(1) With J1 connector pulled away from slip ring assembly housing, clean the metal mating surfaces on the housing and J1 connector.

(2) Apply a thin layer of Permatex, FSN 8030-252-3391, to the mating surfaces and to each side of the rubber gasket.

(3) Reinstall rubber gasket, J1 connector, and the four attaching screws.

NOTE

The J2 and J3 connectors and their attaching nuts and winged lock washers in paragraph (4) following are not to be removed for sealing.

(4) Apply permatex on and around the winged lock washers installed on J2 and J3 connectors.

NOTE

In the following steps, the six screws are to be loosened, sealed and retightened one at a time.

(5) Loosen (approximately 6 or 7 turns) one of the six screws located on the base (bottom) of the slip ring assembly housing.

(6) Apply permatex to the exposed threads and to the underside of the screw head.

(7) Retighten screw.

(8) Perform steps (5), (6) and (7) for each of the remaining screws, in turn.

d. Installation.

NOTE

Refer to figure 6-69 for identification of slip ring assembly mounting components. Position XM157 mount as necessary to gain access to the slip ring assembly mounting components in the following procedures.

(1) Attach slip ring assembly (1, fig. 6-69) to slip ring bracket (6) with screws (7). Position connectors on stationary portion of slip ring to the right.

(2) Position slip ring assembly, with slip ring bracket attached, over chassis floor mounting holes. End of slip ring bracket with cutout for chassis cable faces rear of chassis.

(3) Attach slip ring assembly to slide bracket and drum assembly drive bracket using bolt (2). Turn bolt in until locking feature of slip ring is engaged. Then give bolt three more turns.

NOTE

In the following procedure, also assure that the ground strap connection (8) is made as shown in figure 6-69 at the rear of the slip ring bracket.

(4) Loosely secure slip ring bracket to chassis floor using screws (4) and washers (5).

(5) Manually rotate the XM157 mount around once to allow slip ring assembly to seat in center position. Tighten all attaching hardware.

NOTE

Refer to system interconnection diagram (fig. 3-37) as necessary to identify cable connectors in the following step.

(6) Connect slip ring assembly cable connectors as follows:

Cable connector	*Corresponding slip ring assembly (A14) connector)*
W14P4	J6
W16P1 (coaxial)	J5
W15P1 (coaxial)	J4
A9P3 (coaxial)	J3
A9P1 (coaxial)	J2
A9P7	J1

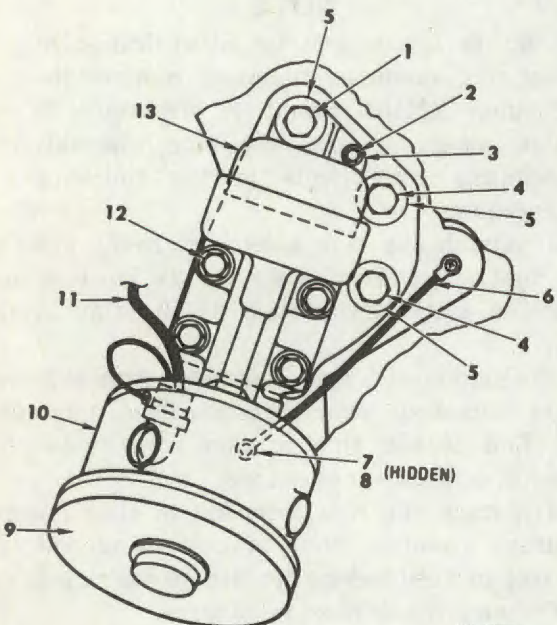
6-37. Azimuth Indicator Assembly

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect W17 cable and pigtail (11) from azimuth indicator (10, fig. 6-70).



1 Bolt	8 Washer
2 Bolt	9 Window
3 Washer	10 Azimuth indicator assembly
4 Bolt	11 Cable (W17)
5 Washer	12 Bolt
6 Jumper cable assembly	13 Cover
7 Screw	

Figure 6-70. Azimuth indicator assembly, details of removal and installation.

(4) Disconnect jumper assembly (6) from azimuth indicator by removing screw (7) and washer (8).

(5) Remove bolt (2), washer (3), bolt (1), and washer (5) and remove cover (13).

CAUTION

Do not remove four bolts (12).

(6) While supporting dial end of indicator, remove bolts (4) and washers (5), and remove azimuth indicator by lifting vertically.

(7) Reinstall cover (13) using washer (3) and bolt (2).

b. Inspection. Inspect the azimuth indicator assembly for the presence of the following conditions:

(1) Damaged connector or connector pins.

(2) Cracked, bent, or damaged housing on indicator.

(3) Cracked, broken, or missing gear teeth.

(4) Cracked or broken dial lens.

(5) Freedom of movement.

c. Repair. Repair of azimuth indicator is limited to replacement of defective lamps. It is not necessary to remove azimuth indicator, except for replacement of entire assembly.

d. Installation.

(1) Center cannon over front of vehicle.

(2) Align all three pointers of the azimuth indicator assembly to zero.

CAUTION

Perform following procedure carefully to avoid damage to azimuth indicator gears.

(3) With azimuth indicator cover (13) removed, orient assembly mounting holes approximately in line with threaded holes in base and lower assembly carefully while providing mesh with mating gear.

(4) Install washer (5) and bolts (4) loosely, and check gear backlash by manually rotating the mount 360 degrees and assuring smooth operation of the indicator.

(5) Tighten bolts (4) and install cover (13) with washer (3), bolt (2), washer (5), and bolt (1).

(6) Connect jumper assembly (6) to azimuth indicator with washer (8) and screw (7).

(7) Connect pigtail and cable W17 (11) to azimuth indicator (10).

6-38. Control Assembly.

CAUTION

Assure that connector W1P4 (14, fig. 6-87) is disconnected from mount system battery prior to removal/installation of control assembly.

a. Removal.

NOTE

Repair of the control assembly can be accomplished without removal of same (refer to paras. 6-39 and 6-40 following); therefore the following instructions apply only when necessary to replace an entire control assembly.

(1) Disconnect connectors W10P2, W9P2, and W6P1 from control assembly.

(2) Remove the two bolts securing the control assembly to the right upright base support.

(3) Remove gun shield, release elevation drive motor brake, and elevate cannon to a position permitting access to the rear of the control assembly. Reapply brake.

(4) With one man supporting the control assembly, remove the four bolts from the rear of the control assembly securing it to the base plate.

(5) Remove control assembly.

b. Installation. Installation is the reverse of removal.

6-39. Elevation Control Assembly

Repair of the elevation control assembly consists of replacing the damper, tachometer assembly, variable resistor and gear assembly, and spring. It is unnecessary to remove the elevation control assembly prior to replacing any of the components. The damper, tachometer assembly, and variable resistor and gear assembly are located on the left grip assembly side of the elevation control assembly. The spring is located on the right grip assembly side of the elevation control assembly. The appropriate grip assembly must be removed prior to replacing any component. The procedures for removing either grip are the same.

a. Removal of Grip Assembly.

NOTE

Procedures refer to either right or left grip assembly.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

CAUTION

Exercise care in removing grip assembly to avoid damaging shaft seal on O-ring groove, and internal wiring.

NOTE

Do not remove cover from handle.

(3) Remove grip assembly from elevation control assembly by removing setscrew and pulling grip gently off shaft (fig. 6-71).

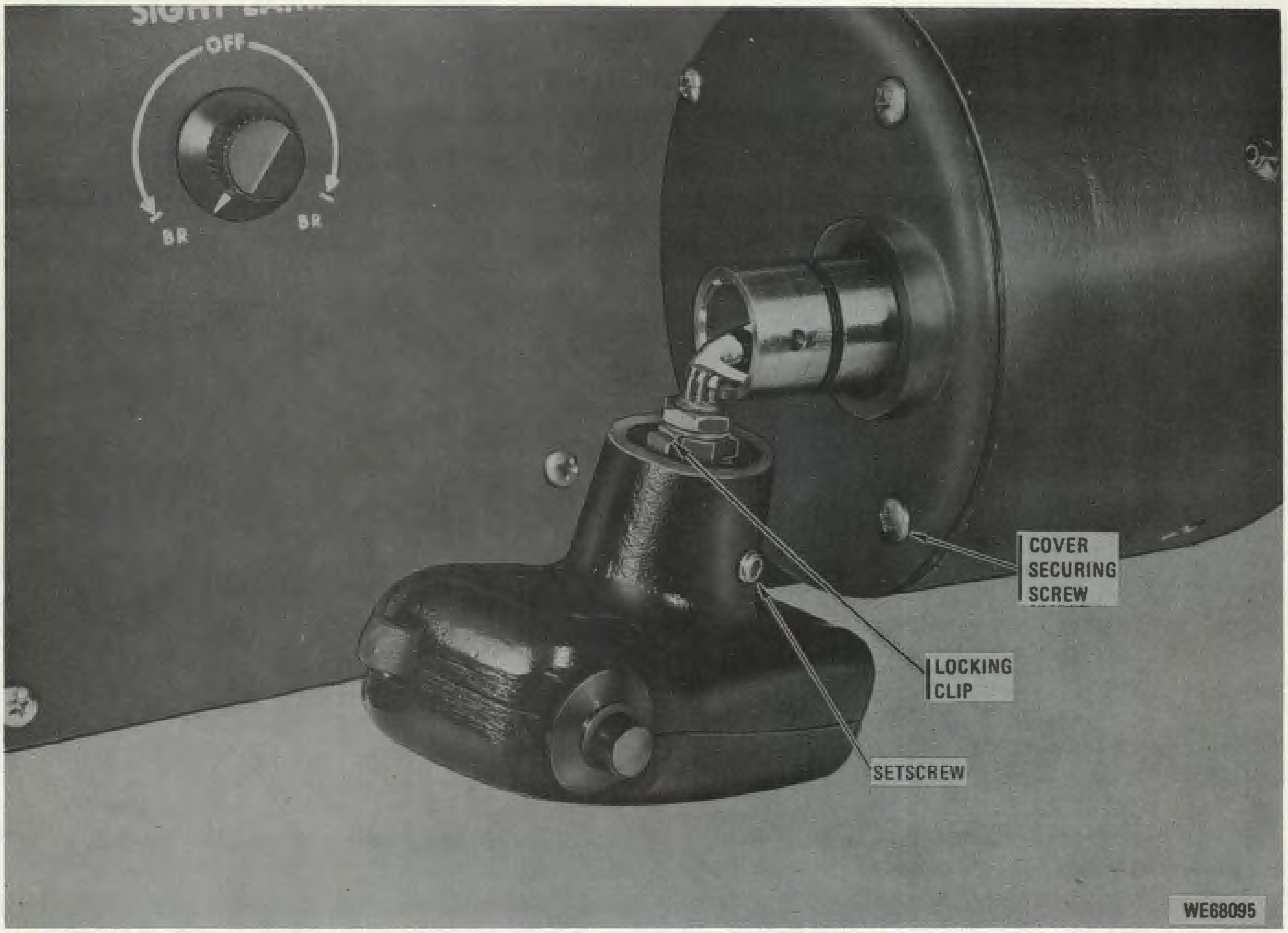


Figure 6-71. Elevation control assembly, left grip assembly removed, location of locking clip.

(4) Unlock connector by rotating locking clip (fig. 6-71), and separate connector halves.

b. Removal of Damper.

(1) Remove both right- and left-hand grip assemblies from elevation control assembly as instructed in paragraph a. preceding.

(2) Remove screws (1, fig. 6-72) and remove elevation control assembly right and left covers (2 and 8), and gaskets (3).

(3) Remove screw securing damper to gear (fig. 6-73, right cover removed).

(4) Remove three screws (11) and damper (10).

c. Inspection of Damper. Inspect damper for cracks, breaks, corrosion, freedom of movement, and evidence of leakage.

d. Installation of Damper. Installation of the damper is the reverse of removal (b. preceding).

e. Removal of Tachometer Assembly.

(1) Remove left-hand grip assembly from elevation control assembly as instructed in a. preceding.

(2) Remove elevation control assembly left cover (8, fig. 6-72) and gasket (3).

(3) Tag and remove tachometer assembly leads (fig. 6-73).

(4) Loosen three screws (11) and rotate tachometer retaining clamps (15, fig. 6-72), and remove tachometer assembly (12).

f. Inspection of Tachometer Assembly. Inspect tachometer assembly for distortion, cracks, breaks, corrosion, and freedom of movement.

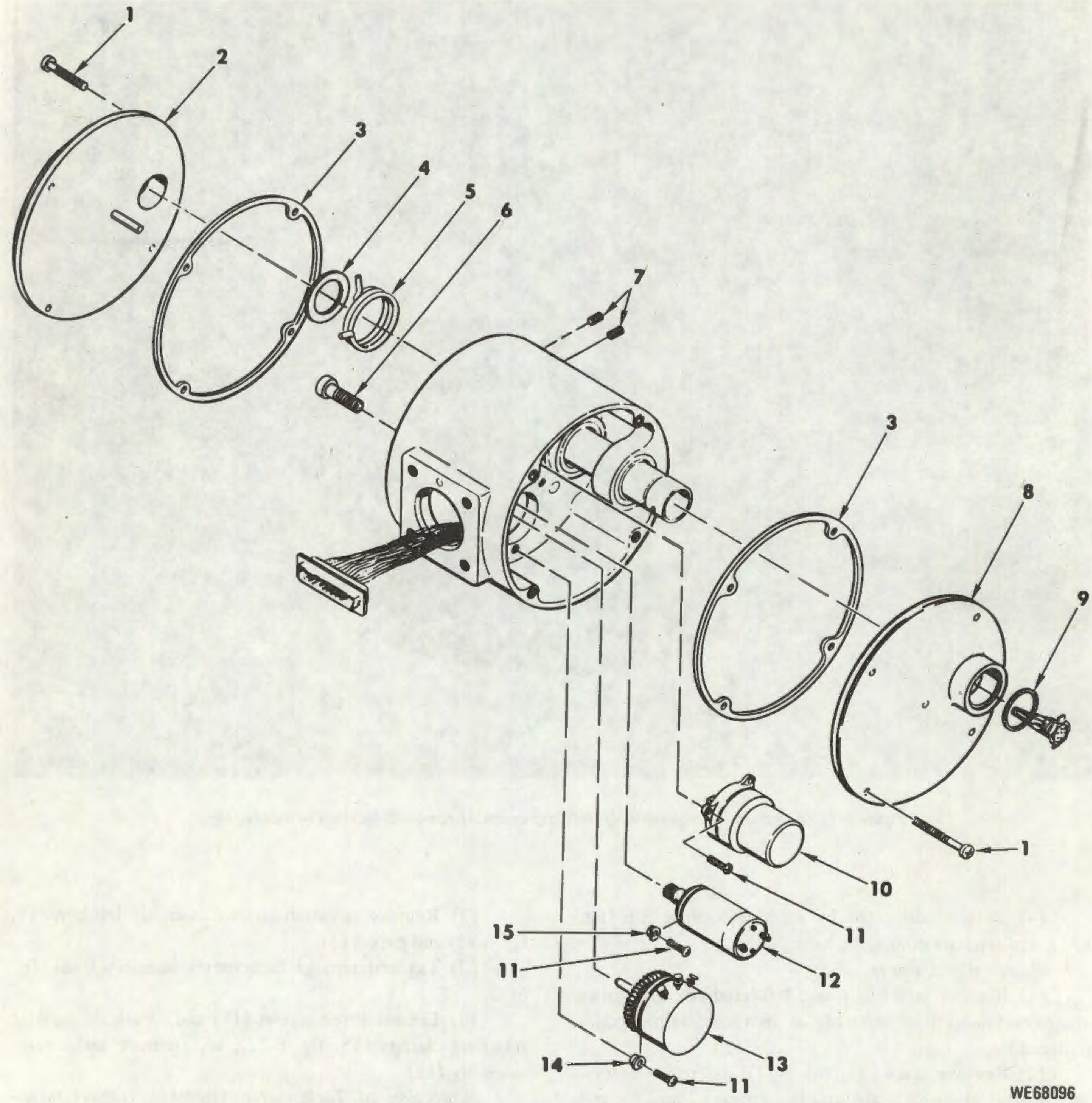
g. Installation of Tachometer Assembly. Installation of the tachometer assembly is the reverse of removal (e. preceding).

h. Removal of Variable Resistor and Gear Assembly.

(1) Remove left-hand grip assembly from elevation control assembly as instructed in a. preceding.

(2) Remove elevation control assembly left cover (8, fig. 6-72) and gasket (3).

(3) Tag and unsolder variable resistor leads (fig. 6-73).



1 Screw	6 Damper securing screw	11 Screw
2 Right cover	7 Setscrew	12 Tachometer
3 Gasket	8 Left cover	13 Resistor and gear assembly
4 Spacer	9 Seal (O-ring)	14 Clamp
5 Spring	10 Damper	15 Clamp

Figure 6-72. Elevation control assembly, exploded view.

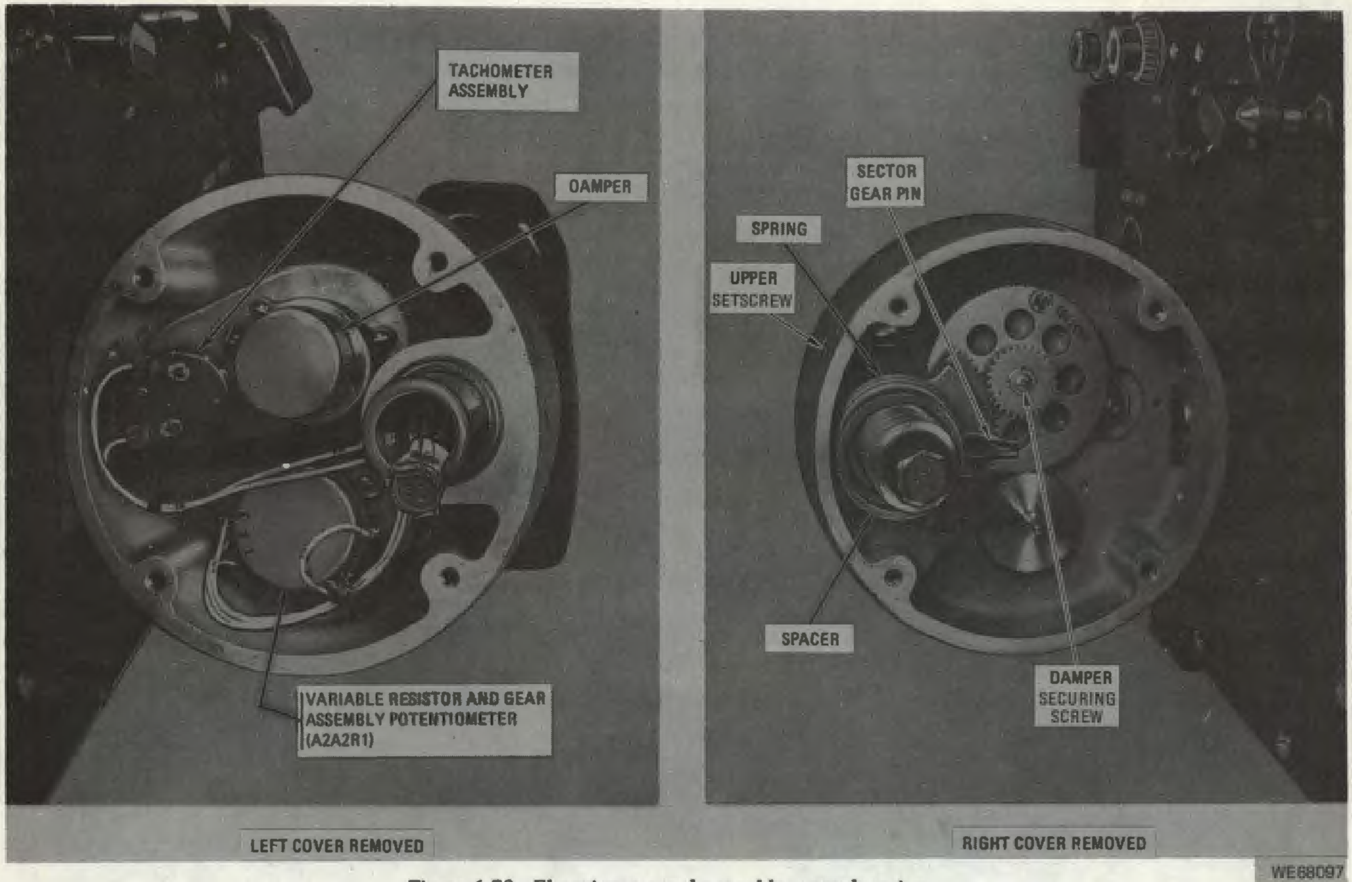


Figure 6-73. Elevation control assembly, parts location.

(4) Loosen three screws (11) and rotate variable resistor retaining clamps (14, fig. 6-72) and remove variable resistor and gear assembly (13).

i. Inspection of Variable Resistor and Gear Assembly. Inspect variable resistor and gear assembly for cracks, breaks, corrosion, and freedom of movement.

j. Installation of Variable Resistor and Gear Assembly.

(1) Position variable resistor and gear assembly in mounting hole (fig. 6-73), making sure that gear teeth are engaged. Engage retaining clamps (14, fig. 6-72), and tighten screws until variable resistor remains in position, but can be turned by hand.

(2) Rotate elevation control assembly right grip assembly fully clockwise in elevation and release it. Repeat for right grip assembly rotated fully counterclockwise in elevation. In each case note that grip assembly returns to its center or null position. If return action is not positive, replace spring (k. through m. following) before proceeding further.

(3) With right-hand grip assembly in center position, connect ohmmeter between terminals 3 and 4 on variable resistor (fig. 6-73). Rotate variable resistor body, observing indication on ohmmeter, until indicated resistance is as close to 0 ohms as possible, but not more than 10 ohms. If indication cannot be obtained, replace variable resistor and gear assembly, and repeat installation procedures.

NOTE

Observe ohmmeter while performing (4) following to assure that resistor does not turn.

(4) Tighten variable resistor clamp-securing screws.

(5) Rotate elevation control assembly right-hand grip assembly fully clockwise until stop is reached, and release. Grip assembly should return to center position and ohmmeter indication (between terminals 3 and 4 on variable resistor) should be less than 10 ohms. If indication is out of tolerance repeat (3) through (5) preceding.

(6) Repeat (5) with right-hand grip assembly rotated fully counterclockwise. Disconnect ohmmeter.

(7) Connect ohmmeter between terminals 1 and 3 on variable resistor (fig. 6-73). Rotate elevation control assembly right-hand grip assembly fully counterclockwise until stop is reached. Resistance should be between 10 and 100 ohms. If indication is out of tolerance, adjust top

setscrew (fig. 6-74). Turn setscrew counterclockwise to decrease resistance. Apply sealing compound (MIL-S-22473, grade AA) to setscrew after final adjustment.

(8) Connect ohmmeter between terminals 2 and 3 on variable resistor (fig. 6-73). Rotate elevation control assembly right-hand grip assembly fully clockwise until stop is reached. Resistance should be between 10 and 100 ohms. If indication is out of tolerance, adjust bottom setscrew (fig. 6-74). Turn setscrew counterclockwise to decrease resistance. Apply sealing compound (MIL-S-22473) grade AA, to setscrew after final adjustment.

(9) Solder wires to resistor terminals.

(10) Set distribution box NORM-STATIC-TEST switch (fig. 6-11) to NORM, and set SYSTEM POWER switch (fig. 6-1) to ON.

(11) Using right-hand grip assembly, elevate and depress cannon under power to verify servo operation. Position cannon at approximately 0 degrees elevation.

(12) With grip assembly centered, carefully squeeze action switch; cannon should remain stationary. If cannon moves in elevation in either direction, release action switch and determine part number of distribution box installed. If distribution box part number is 8437152 (1000000 series serial numbers), proceed with (13) following. If distribution box part number is 8438325 (2000000 series serial numbers), proceed with (14) following.

(13) Carefully loosen variable resistor retaining screws and carefully reposition variable resistor until cannon does not move in elevation with the action switch squeezed, tighten retaining screws, repeat (12) preceding and continue with (15) following.

(14) Remove access plate (7, fig. 6-84) on distribution box, and adjust variable resistor R34 (fig. 6-86) on slew circuit card assembly (A1A2) until cannon does not move with action switch squeezed. Install access plate on distribution box and proceed with (15) following.

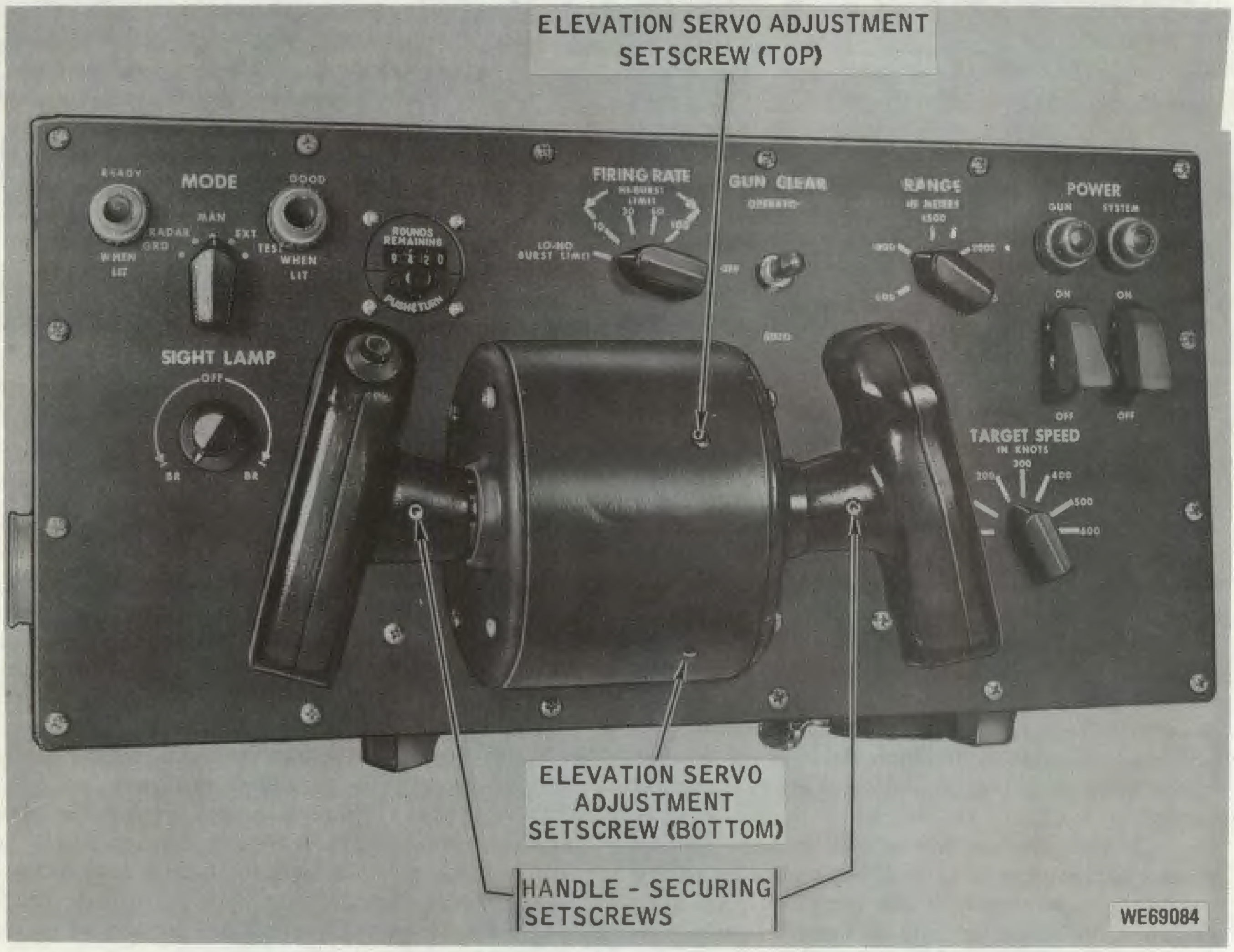


Figure 6-74. Elevation control assembly, location of screws.

(15) Set SYSTEM POWER switch to OFF (fig. 6-1), and set distribution box NORM-STATIC-TEST switch (fig. 6-11) to STATIC.

(16) Install gasket (3, fig. 6-72), and left cover (8) on elevation control assembly housing.

(17) Mate and lock left-hand grip assembly connector to elevation control assembly connector.

(18) Install left-hand grip assembly on elevation control assembly shaft and tighten setscrew (fig. 6-74).

k. Removal of Spring,

(1) Remove right-hand grip assembly from elevation control assembly as instructed in paragraph a. preceding.

(2) Remove elevation control assembly right cover (2, fig. 6-72) and gasket (3).

(3) Remove spacer (fig. 6-73).

(4) Detach spring from pin on sector gear (fig. 6-73) and slide spring off shaft.

l. Inspection of Spring. Inspect spring for distortion, breaks, and corrosion.

m. Installation of Spring.

(1) Install spring (5, fig. 6-72) on the shaft so that sector gear pin (fig. 6-73) engages between ears of spring.

(2) Install spacer (4, fig. 6-72) on shaft.

(3) Install elevation control assembly right cover (2, fig. 6-72), with gasket (3) so that pin (16) engages between ears of spring (15) and secure with screws (1).

(4) Install right-hand grip assembly in the reverse order of removal described in paragraph a. preceding.

6-40. Control Panel Assembly.

Repair of the control panel assembly at the organizational level consists of replacing the RANGE and TARGET SPEED potentiometers, the variable resistor and gear assembly, sensing switches and switch actuators, indicator lamp assemblies, rounds counter, SYSTEM POWER and GUN POWER switches, switch guards, knobs, ball plungers, tachometer, and damper. Figure 6-75 illustrates the control panel assembly components that may be replaced by organizational maintenance. Replacement of the indicator lamp assemblies, rounds counter, SYSTEM POWER and GUN POWER switches, switch guards, knobs, ball plungers, tachometer, and damper are obvious by reference to figure 6-75. Tag all leads when removing these components. Procedures for replacement of the RANGE and TARGET SPEED potentiometers, the variable resistor and gear assembly, sensing switches, and switch actuators are contained in the following subparagraphs. If necessary, the entire control assembly can be replaced. However, it is not necessary to remove the entire control assembly from the mount prior to replacing any components replaceable by organizational maintenance. Prior to replacing any of the control panel assembly components perform the preliminary procedures given in paragraph a. following.

a. Preliminary Control Panel Assembly Repair Procedures.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove front panel securing screws (fig. 6-76) and pivot panel down to provide access to components mounted on rear (fig. 6-77).

CAUTION

Sliding panel to left, detaches it from case.

(4) If necessary to detach panel to gain access to components, slide front panel to left, taking care not to damage front panel when it detaches from case.

b. Removal of RANGE Potentiometer.

NOTE

Refer to figure 6-75, sheets 1 and 2, for identification of RANGE potentiometer mounting components.

(1) Perform preliminary procedures given in paragraph a. preceding.

(2) Remove knob (18, fig. 6-75) on RANGE potentiometer (11).

(3) Tag and unsolder potentiometer leads.

(4) Loosen ball plunger (25) for RANGE potentiometer approximately one turn.

(5) Loosen screws (28) and clamps (36) securing potentiometer to housing, and remove potentiometer and detent ring.

(6) Remove O-ring (9) from potentiometer shaft.

(7) Remove pin (12) securing detent ring to potentiometer shaft, and remove detent ring.

c. Inspection of RANGE Potentiometer. Inspect potentiometer for cracks, breaks, corrosion, and freedom of movement.

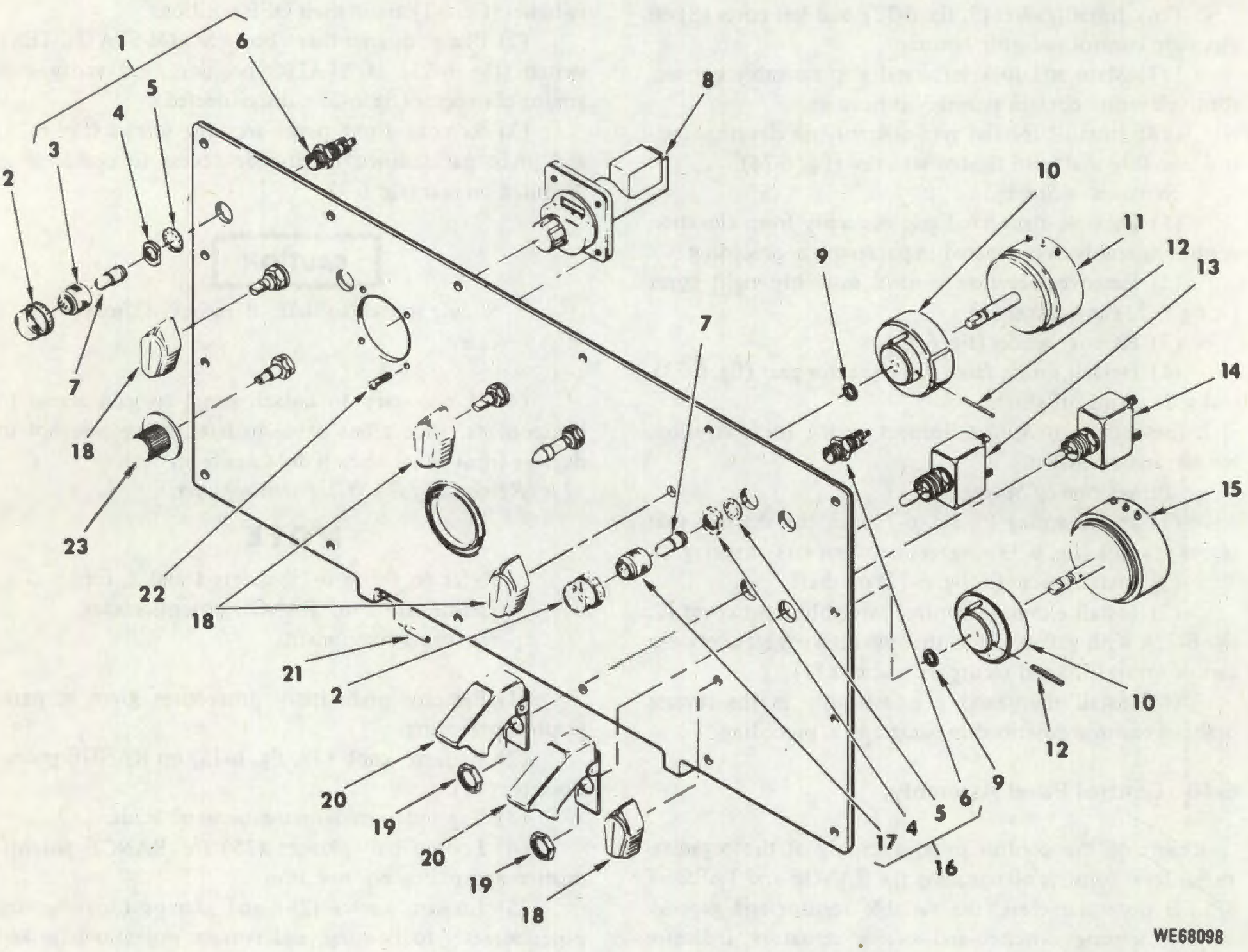
d. Installation of RANGE Potentiometer.

NOTE

Refer to figure 6-75, sheets 1 and 2, for identification of RANGE potentiometer mounting components.

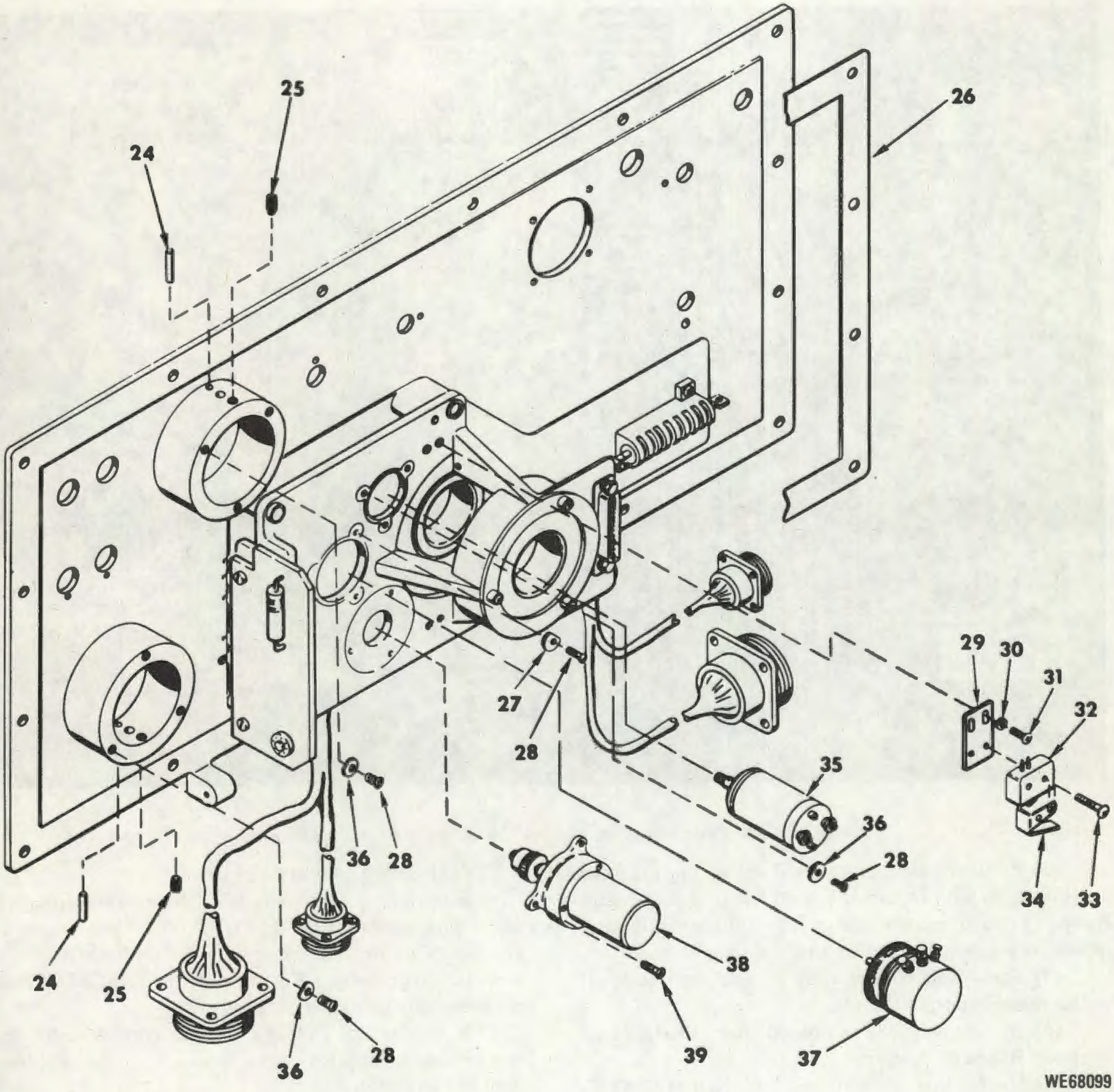
(1) Position detent ring (with stop pin inserted) on potentiometer shaft so that detent stop pin is on same side of shaft as flatted section. Secure detent ring to shaft with pin (12, fig. 6-75).

(2) Install O-ring (9) on potentiometer shaft.



1 Indicator light assembly	9 Packing (O-ring)	17 Cap
2 Boot	10 Detent ring	18 Knob
3 Cap	11 "Range" potentiometer	19 Nut
4 Nut	12 Pin	20 Guard
5 Washer	13 "Gun power" switch	21 Pin
6 Lamp socket	14 "System power" switch	22 Screw
7 Lamp	15 "Target speed" potentiometer	23 Knob
8 Rounds counter	16 Indicator light assembly	

Figure 6-75. Gunner's control panel assembly - sheet 1 of 2.



24 Pin
25 Ball plunger
26 Gasket
27 Clamp
28 Screw
29 Adjustable mounting plate
30 Washer
31 Screw
32 Sensing switch
33 Screw
34 Actuator
35 Tachometer
36 Clamp
37 Variable resistor and gear assembly
38 Damper
39 Screw

Figure 6-75. Gunner's control panel assembly - sheet 2 of 2.

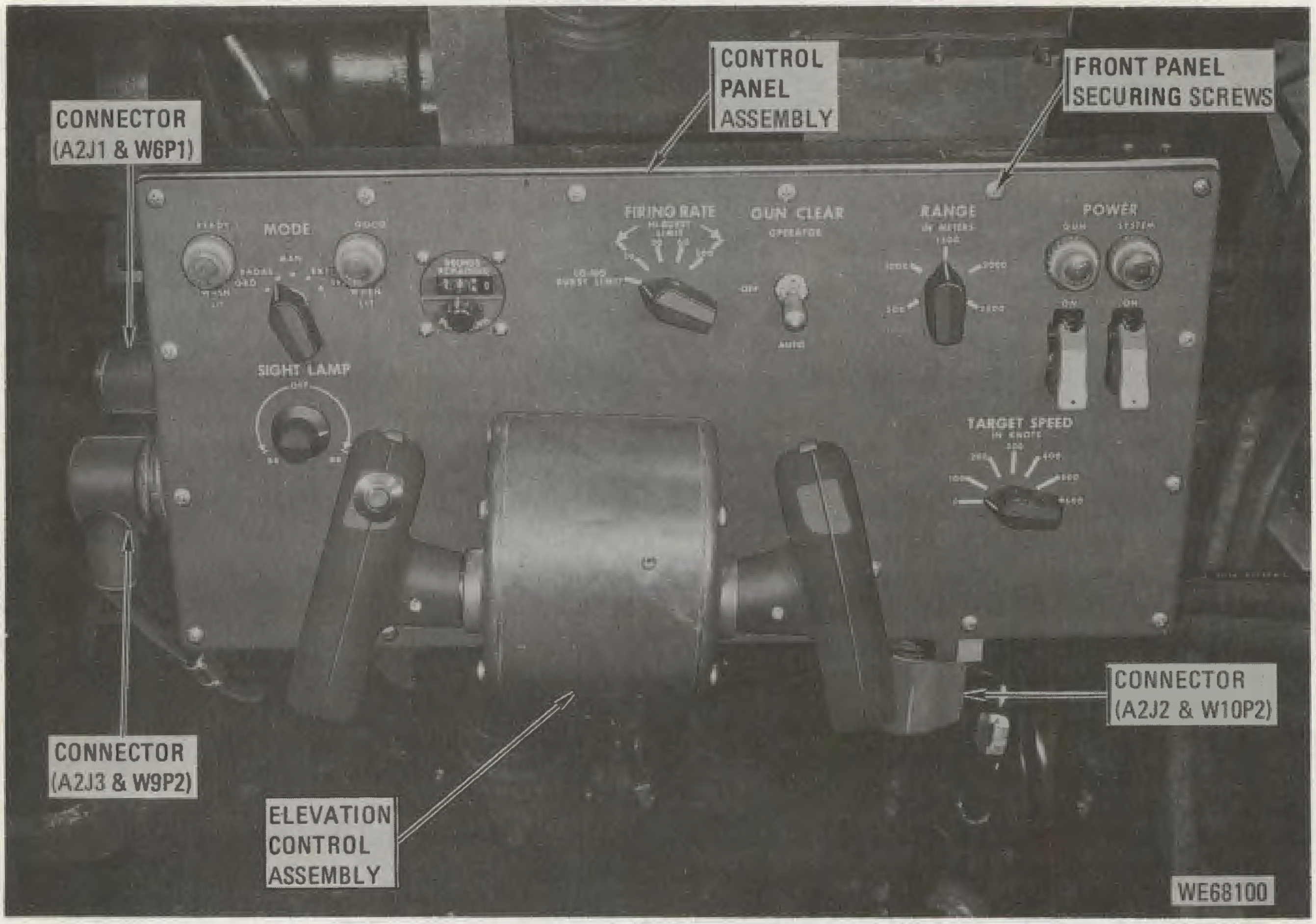


Figure 6-76. Control assembly, front view with identification of external connectors.

(3) Position potentiometer and detent ring in proper panel opening, with terminals toward left of panel. Engage clamps (36) and tighten screws (28) until potentiometer remains in position, but can be turned by hand.

(4) Screw ball plunger (25) in tight, and back off approximately one-quarter turn.

(5) Install knob (18) on potentiometer shaft, and set knob to 1500-meter position.

(6) Verify that distribution box NORM-STATIC-TEST switch is at STATIC, and set control panel MODE switch at MAN.

(7) Attach potentiometer leads.

(8) Connect a voltmeter between terminals 1 and 2 on potentiometer, with positive lead on terminal 1 (fig. 6-77).

(9) Set SYSTEM POWER switch to ON.

(10) After approximately 10 seconds, turn potentiometer housing so that an indication of 7.3 to 7.7 volts is obtained.

(11) Secure potentiometer, and recheck voltmeter indication.

(12) Set SYSTEM POWER switch to OFF, and disconnect voltmeter.

(13) Secure control panel assembly.

e. Removal of TARGET SPEED Potentiometer. Removal procedures for the TARGET SPEED potentiometer (15, fig. 6-75) are identical to those for the RANGE potentiometer (b. preceding). Remove only the TARGET SPEED potentiometer mounting components.

f. Inspection of TARGET SPEED Potentiometer. Inspect potentiometer for cracks, breaks, corrosion, and freedom of movement.

g. Installation of TARGET SPEED Potentiometer. Installation procedures for the TARGET SPEED potentiometer are identical to those for the RANGE potentiometer (d. preceding) except that the knob is set to zero knots, and the positive lead of the voltmeter is connected to terminal 2. The potentiometer is adjusted for a 7.3 to 7.7 volts reading.

h. Removal of Variable Resistor and Gear Assembly.

NOTE

Refer to figure 6-75, sheets 1 and 2, for identification of variable resistor and gear assembly mounting components.

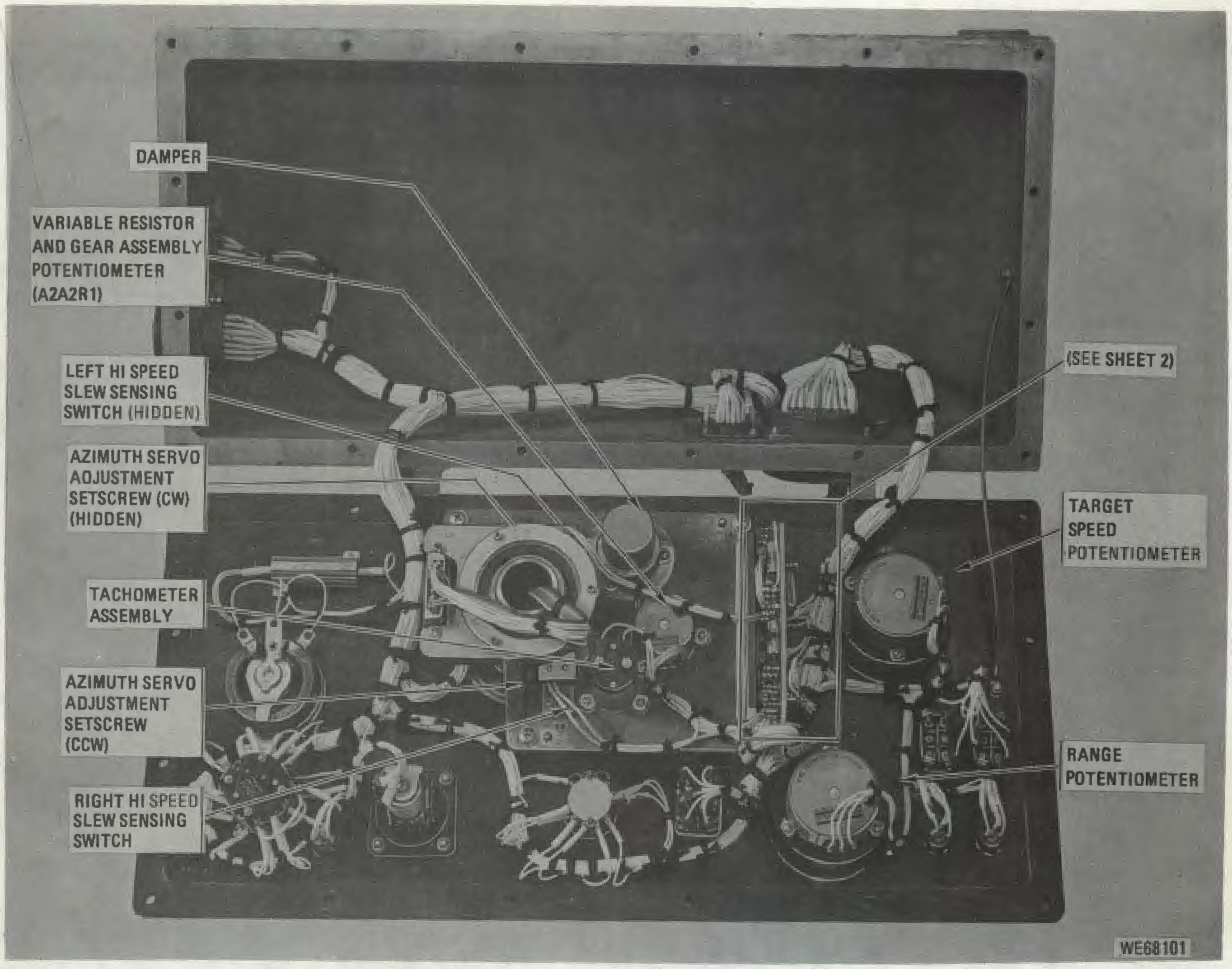


Figure 6-77. Control panel assembly, parts location - sheet 1 of 2.

(1) Perform preliminary procedures given in paragraph a. preceding.

(2) Tag and unsolder variable resistor leads.

(3) Loosen screws (28) and rotate variable resistor clamps (27), and remove variable resistor and gear assembly (37).

i. Inspection of Variable Resistor and Gear Assembly. Inspect variable resistor and gear assembly for distortion, cracks, breaks, corrosion, and freedom of movement.

j. Installation of Variable Resistor and Gear Assembly.

(1) Position variable resistor and gear assembly in mounting hole (fig. 6-77) making sure that gear teeth are engaged. Engage retaining clamps (27, fig. 6-75) and tighten screws (28) until variable resistor remains in position, but can be turned by hand.

(2) Rotate elevation control assembly clockwise until it hits mechanical stop, release it, and check that it returns to center position. Repeat for counterclockwise direction of elevation control assembly. If return action is not positive, with one definite center position established for return from either direction, send entire control assembly to direct support maintenance for repair. If return action is satisfactory, proceed to (3) following.

(3) With elevation control assembly in center position, connect ohmmeter between terminals 3 and 4 on variable resistor body (fig. 6-77). Rotate variable resistor body, observing indication on ohmmeter, until indicated resistance is as close to 0 ohms as possible, but not more than 10 ohms. If indication cannot be obtained, replace variable resistor and gear assembly and repeat installation procedures.

NOTE

Observe ohmmeter when performing following procedure to assure that variable resistor does not turn.

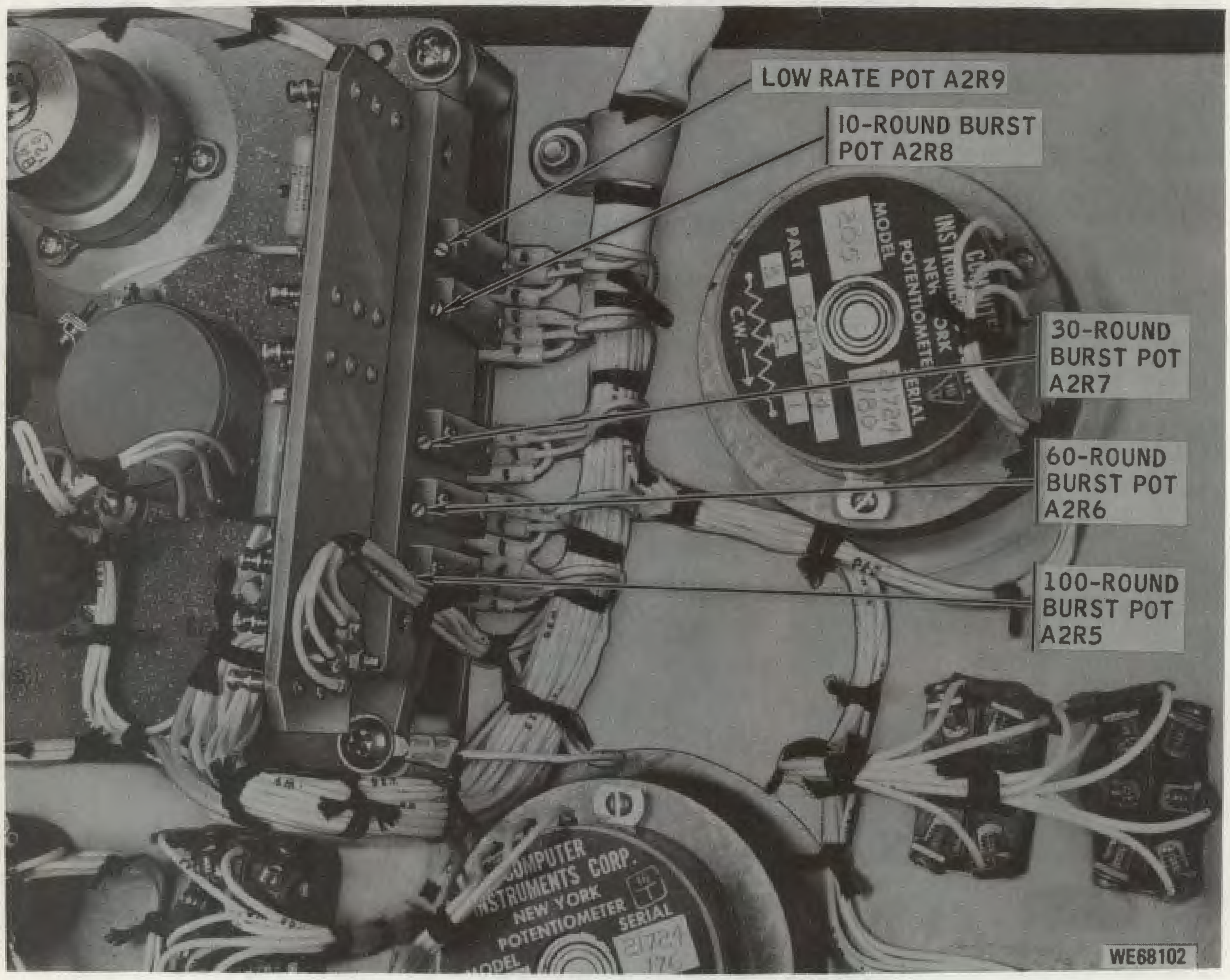


Figure 6-77. Control panel assembly, parts location - sheet 2 of 2.

(4) Tighten variable resistor clamp-securing screws.

(5) Rotate elevation control assembly in clockwise direction to the stop. Release handle. Control should return to center position and ohmmeter indication should be less than 10 ohms. If indications are out of tolerance repeat (3) through (5) preceding.

(6) Repeat (5) in counterclockwise direction. Disconnect ohmmeter.

(7) Connect ohmmeter between terminals 2 and 3 on variable resistor body, and rotate elevation control assembly to fully-counterclockwise position. Resistance indication should be between 10 and 100 ohms. If indication is outside of range specified, adjust counterclockwise azimuth servo adjustment setscrew (fig. 6-77) to bring it within limits. (Turning setscrew counterclockwise decreases resistance.) Apply sealing compound (MIL-S-22473, grade C) to setscrew after final adjustment.

(8) Connect ohmmeter between terminals 1 and 3 on variable resistor body, and turn elevation control assembly to fully clockwise position. Resistance indication should be between 10 and 100 ohms. If indication is outside of range specified, adjust clockwise azimuth servo adjustment setscrew (fig. 6-77) to bring it within limits. (Turning setscrew counterclockwise decreases resistance.) Apply sealing compound (MIL-S-22473, grade C) to setscrew after final adjustment.

(9) Release elevation control assembly and disconnect ohmmeter.

(10) Attach and solder variable resistor leads and secure control panel assembly.

(11) Set distribution box NORM-STATIC-TEST switch (fig. 6-11) to NORM, and set SYSTEM POWER switch (fig. 6-1) to ON.

(12) Using grip assemblies, rotate the turret to the right and to the left in azimuth under power to verify servo

operation. Release both grip assemblies and allow the assembly to center.

(13) With the elevation control assembly centered, carefully squeeze one of the action switches; XM157 mount should remain stationary. If turret moves in azimuth in either direction, release action switch and determine part number of distribution box installed. If distribution box part number is 8437152 (1000000 series serial numbers), proceed with (14) following. If distribution box part number is 8438325 (2000000 series serial numbers), proceed with (15) following.

(14) Carefully loosen variable resistor rim clenching clamp retaining screws (28, fig. 6-75, sheets 1 and 2) and carefully reposition variable resistor (37) until cannon does not move with action switch squeezed. Tighten retaining screws and repeat (12) and (13) preceding.

(15) Remove access cover on distribution box (7, fig. 6-84) and adjust variable resistor R33 on slew circuit card assembly A1A2 (fig. 6-86, sheet 2) until cannon does not move with action switch squeezed. Install access cover on distribution box.

k. Removal of Sensing Switches and Switch Actuators. The control panel assembly contains two sensing switches and switch actuation assemblies. The switch and actuator are separate parts. Removal procedures for each switch and actuator assembly are the same.

(1) Perform preliminary procedures given in paragraph a. preceding.

(2) If switch is to be replaced, tag leads and cut them off approximately 4 inches from switch (fig. 6-77).

(3) Remove screws (33, fig. 6-75), and remove sensing switch (32) and switch actuator (34) from adjustable mounting plate.

l. Inspection of Sensing Switches and Switch Actuators. Inspect the sensing switch and switch actuator for the presence of the following conditions:

(1) Damage or improper operation of switch.

(2) Bent or corroded actuator.

(3) Freedom of movement and spring return action of actuator.

m. Installation of Sensing Switches and Switch Actuators.

(1) Attach switch (32, fig. 6-75) and actuator (34) to adjustable mounting plate.

(2) If switch is not being replaced, set control assembly MODE switch to GRD, disconnect cable connector W10P1 (fig. 6-58) from distribution box and connect ohmmeter between pins AL and AM on connector W10P1. If new switch is being installed, connect ohmmeter to switch leads. In either case, ohmmeter should indicate open circuit.

(3) Adjust adjustable mounting plate as necessary to set sensing switch to actuate between 1/8- and 3/16-inch before elevation control assembly strikes appropriate mechanical stop.

(4) Disconnect ohmmeter.

(5) If new switch is being installed, cut leads to desired length and splice. Otherwise, connect cable connector W10P1 to distribution box.

(6) Secure control panel assembly.

6-41. Sight Current Generator.

Repair of the sight current generator at the organizational level consists of replacing any of the 12 circuit card assemblies, the servo assembly, the magnet current supply module, torque current supply module, any of the seven relays, the MUZZLE VELOCITY or AIR DENSITY dial assemblies. Figure 6-78 illustrates the sight current generator components that may be replaced by organizational maintenance. Replacement of the magnet current supply module, the torque current supply module, the relays, and the MUZZLE VELOCITY and AIR DENSITY dial assemblies are obvious from reference to figure 6-78. Procedures for replacing the circuit card assemblies and servo assembly are contained in the following subparagraphs. If necessary, the entire sight current generator can be replaced (fig. 6-79). However, it is not necessary to remove the entire sight current generator from the mount prior to replacing any components replaceable by organizational maintenance. Prior to replacing any of the sight current generator components, perform the preliminary procedures given in paragraph a. following.

a. Preliminary Sight Current Generator Repair Procedures.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove sight current generator cover to gain access to components (figs. 6-78 and 6-80).

b. Removal of Circuit Card Assemblies.

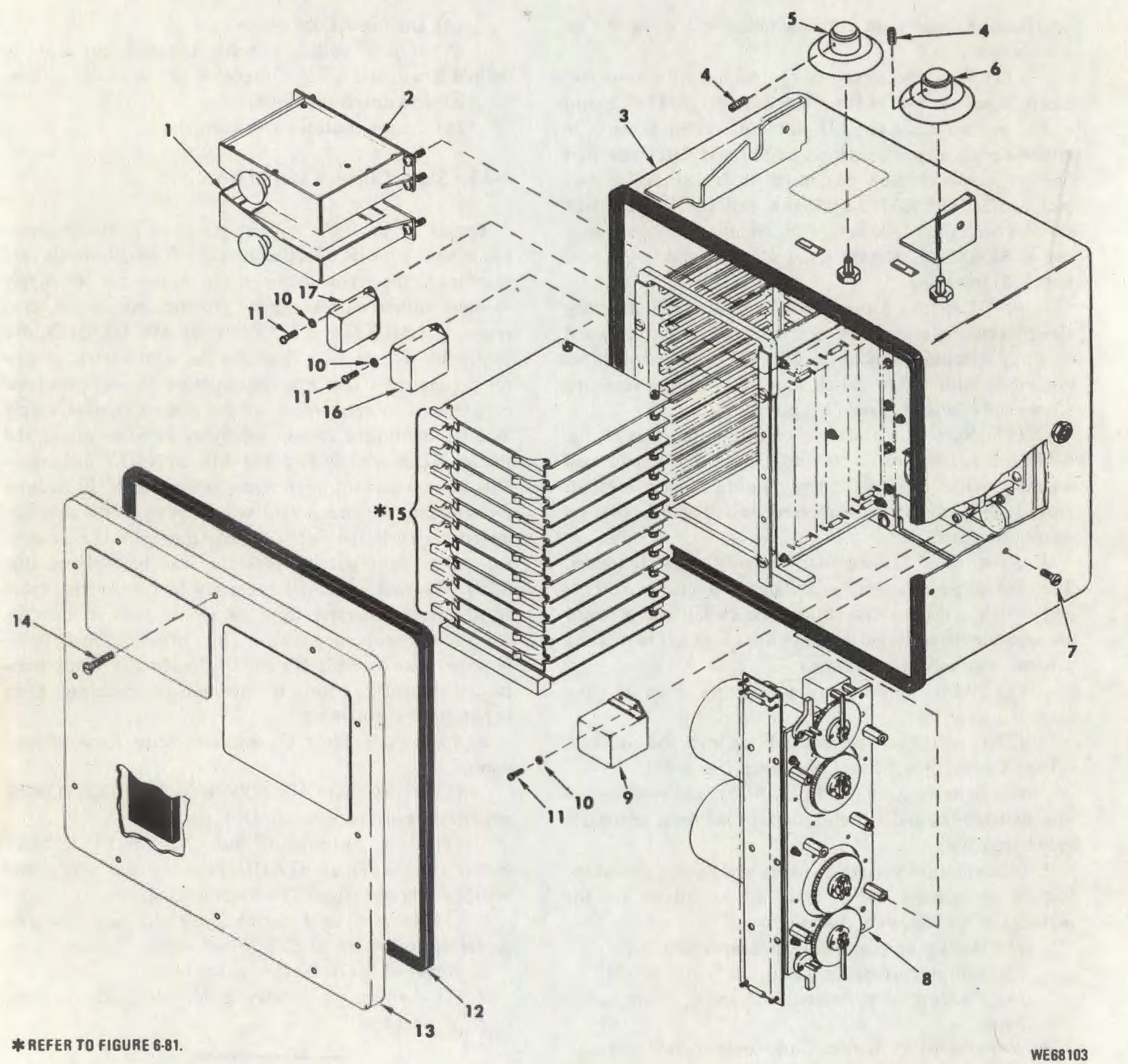
(1) Perform preliminary procedures given in paragraph a. preceding.

CAUTION

Exercise care in removing circuit card assemblies to prevent damaging of parts by contact with adjacent circuit card assemblies.

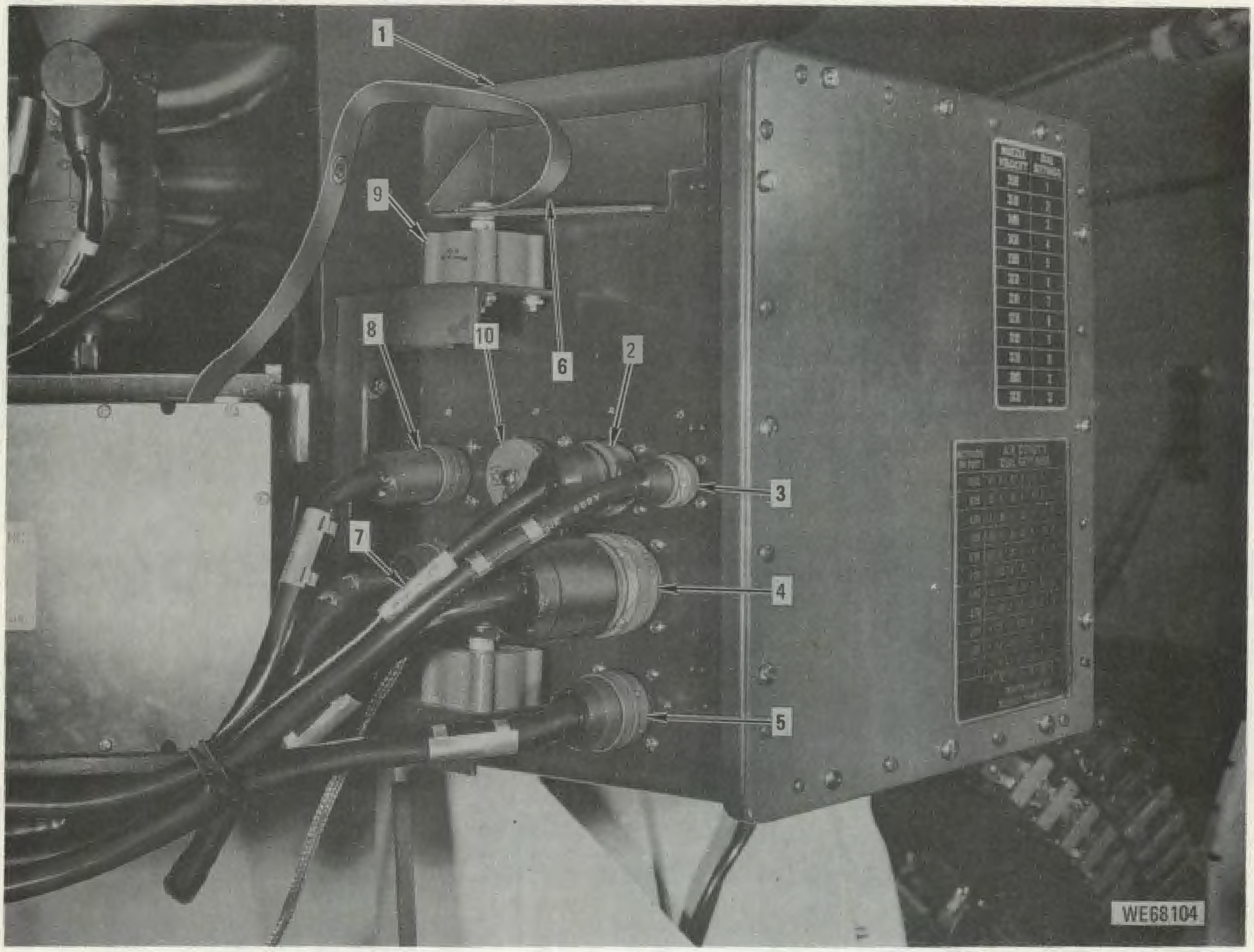
NOTE

Refer to figure 6-81 for identification of sight current generator circuit card assemblies. Ballistics correction circuit card assembly A21A2 does not have extractor levers. Remove this circuit card assembly by pulling it straight out of the sight current generator.



1 Magnet current supply module (A21A13)
2 Torque current supply module (A21A14)
3 Case
4 Setscrew
5 Knob, air density
6 Knob, muzzle velocity
7 Screw
8 Servo assembly (A21A15)
9 Relay
10 Washer
11 Screw
12 Gasket
13 Cover
14 Screw
15 Circuit card assemblies
16 Relay
17 Relay

Figure 6-78. Sight current generator, exploded view.



1 Sight current generator
2 Connectors (A21J2 & W6P3)
3 Connectors (A21J5 & A24JP1)
4 Connectors (A21J1 & W9P1)
5 Connectors (A21J6 & W12P1)
6 Ground strap
7 Connectors (A21J4 & W13P1)
8 Connectors (A21J3 & W7P1)
9 Resilient mount
10 Test connector (A21J7)

Figure 6-79. Sight current generator, removal/installation details.

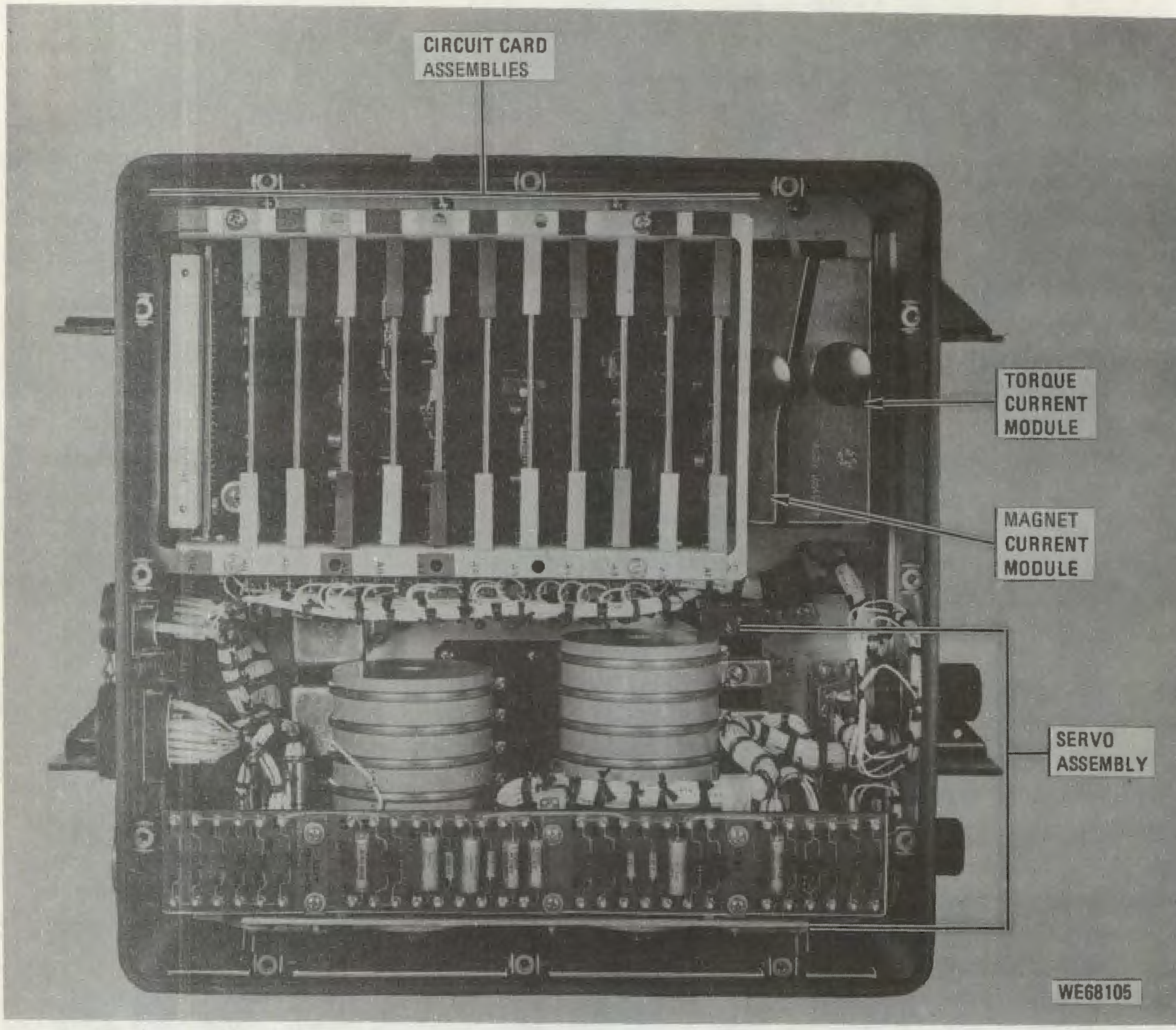


Figure 6-80. Sight current generator with cover removed, parts location.

(2) Grasp inner ends of two extractor levers at top and bottom of circuit card assembly to be removed (fig. 6-82) and, using thumbs, force levers outward, away from circuit card assembly. Remove circuit card assembly.

c. Inspection of Circuit Card Assemblies. Inspect the circuit card assemblies for the presence of the following:

(1) Bent, broken, or damaged connector pins.

(2) Cracks, breaks, or other signs of physical damage to circuit card or extractor levers.

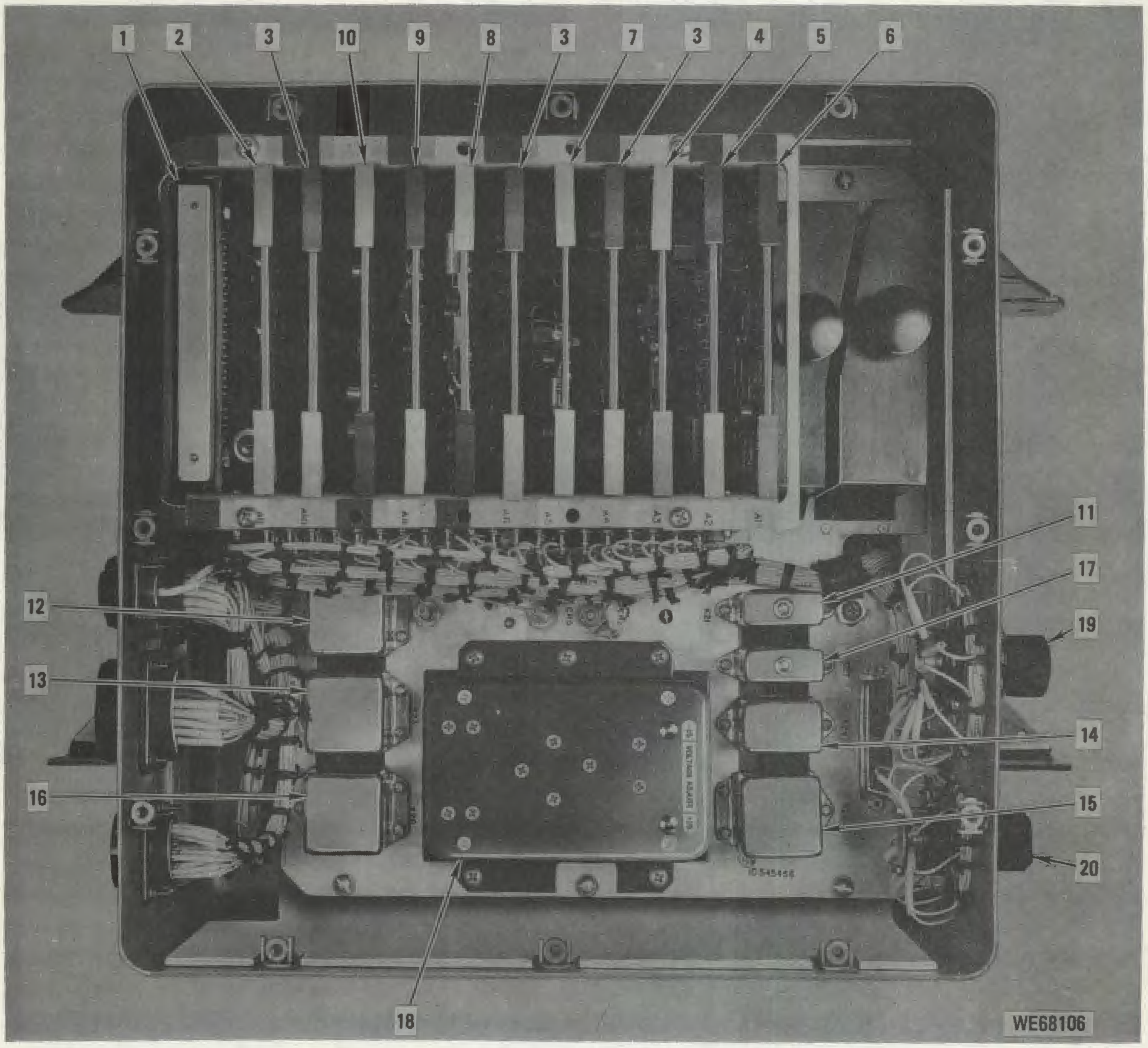
(3) Physical damage to circuit card assembly components.

d. Installation of Circuit Card Assemblies.

NOTE

The ballistics correction circuit card assembly (fig. 6-83) includes two sections, each section having its own connector. One section is designed to furnish the proper ballistics correction in the sight current generator when ammunition having XM220 ballistics is being used. The other section is designed to serve the same purpose when ammunition having M246E3 ballistics is being used. When changeover from one type of ammunition to the other is required, it is necessary to change the effective section of the ballistics correction circuit card assembly by turning it end for end.

(1) If ballistics correction circuit card assembly A21A12 is being replaced or turned end for end (for ammunition changeover), proceed as follows:



1 Circuit card assembly, ballistics correction (A21A12)
2 Circuit card assembly, time delay (A21A11)
3 Circuit card assembly, voltage comparator (A21A4, A21A6 and A21A10)
4 Circuit card assembly, buffer amplifier (A21A3)
5 Circuit card assembly, outbound configuration (A21A2)
6 Circuit card assembly, ballistics data (A21A1)
7 Circuit card assembly, firing indicator (A21A5)
8 Circuit card assembly, acquisition time delay (A21A7)
9 Circuit card assembly, sight correction (A21A8)
10 Circuit card assembly, pulse width multiplier (A21A9)
11 Relay K21
12 Relay K22
13 Relay K23
14 Relay K24
15 Relay K25
16 Relay K26
17 Relay K27
18 Power supply PS1
19 Air density switch S2
20 Muzzle velocity switch S1

Figure 6-81. Sight current generator, location of components, servo assembly removed.

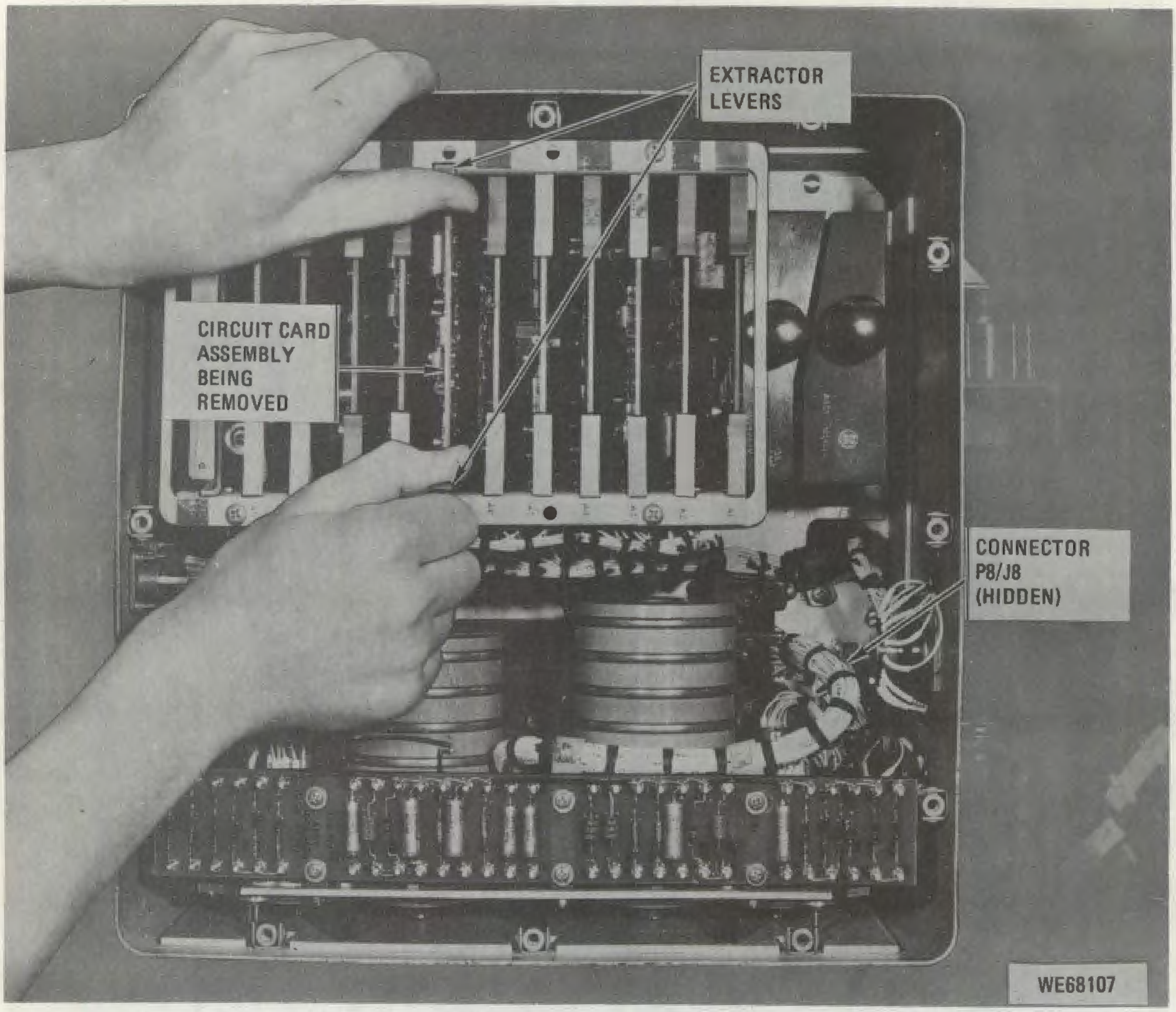


Figure 6-82. Sight current generator, removal of typical circuit card assembly.

(a) Install connector protective cover (fig. 6-83) on connector at opposite end of circuit card assembly to be used.

(b) Install circuit card assembly in the sight current generator. The arrow corresponding to the ballistics to be used must point toward the sight current generator connector.

(2) Orient circuit card assembly so side of board on which components are mounted faces to left, slide circuit card assembly into proper rack (fig. 6-81), and press in firmly.

(3) Check that circuit card assembly has been inserted into correct location by observing color codes above and below each rack position. Upper extractor lever on each circuit card assembly should be same color as coding square located above that rack position. Lower extractor lever on each circuit card assembly should be same color as coding square located below that rack position.

(4) Install sight current generator gasket (12, fig. 6-78) and cover (13).

e. Removal of Servo Assembly.

(1) Perform preliminary procedures given in paragraph a. preceding.

(2) Remove screws (7, fig. 6-78) securing servo assembly (8) to sight current generator housing, and remove servo assembly.

(3) Loosen connector screws, and separate P8 from J8 (fig. 6-82).

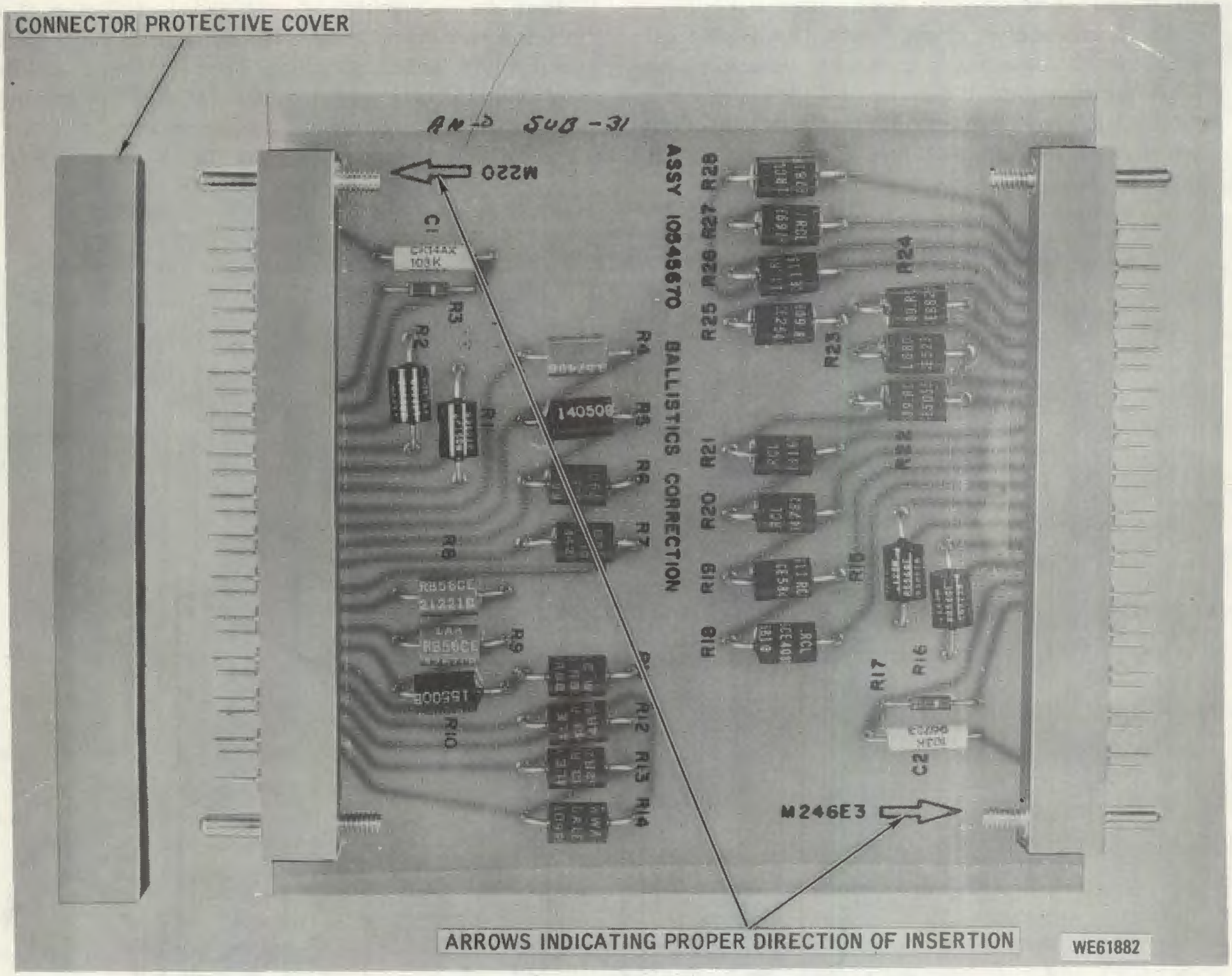


Figure 6-83. Dual section ballistics correction circuit card assembly A21A12.

CAUTION

When withdrawing servo assembly from sight current generator housing, be careful not to strike teeth of servo gears against cover lugs on inside of housing.

f. Inspection of Servo Assembly. Inspect the servo assembly for the presence of the following:

(1) Bent, broken, or damaged connector pins.
(2) Abraded or cracked wiring insulation.
(3) Cracked, broken, corroded, or missing gear teeth.
(4) Cracked, broken, or punctured housings.

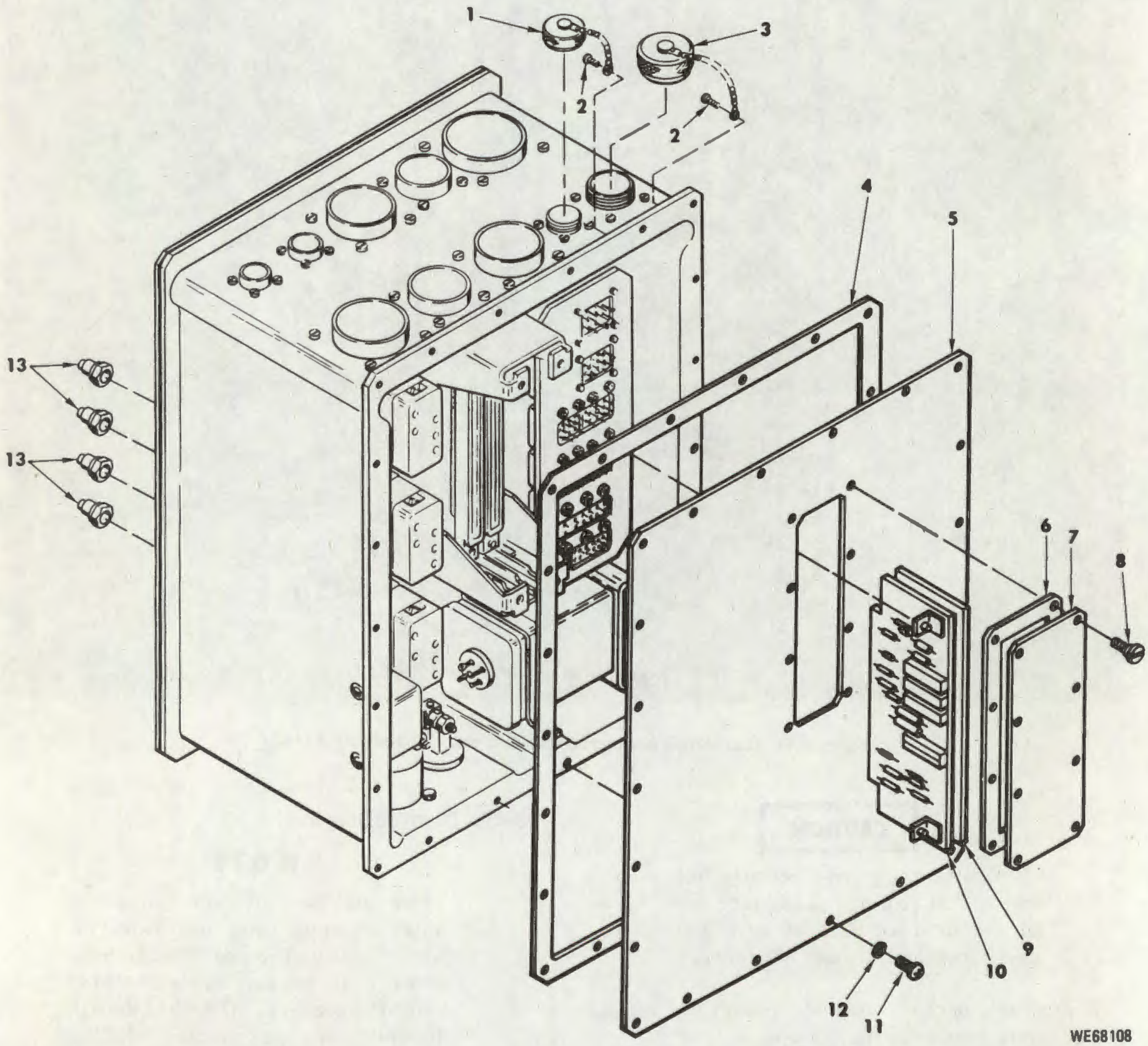
g. Installation of Servo Assembly. Installation of servo assembly is the reverse of removal (para. e. preceding). Once servo assembly is installed, install sight current generator gasket (12, fig. 6-78) and cover (13).

6-42. Distribution Box.

NOTE

There are two different distribution boxes presently being used with the XM157 mount. The two different distribution boxes are part number 8437152 (serial numbers 1000001 through 1000148), and part number 8438325 (serial numbers 2000001 and forward). Where repair procedures differ for the different distribution boxes, the difference is noted.

Repair of the distribution box at the organizational level consists of replacing the two circuit card assemblies (and the circuit card assembly mounting studs), the cover gaskets, the circuit breaker dust and moisture seal boots, or the electrical connector covers. Figure 6-84 illustrates the distribution box components that may be replaced by organizational maintenance. Replacement of the dust and moisture seal boots and electrical connector covers are obvious from reference to figure 6-84. Procedures for replacing the circuit card assemblies and cover gaskets are contained in the following subparagraphs. If necessary, the entire distribution box can be replaced (fig. 6-85). However, except for replacing the cover gasket on the side of distribution box that attaches to the mount, it is not necessary to remove the entire distribution box from the mount prior to re-



1 Electrical connector cover
2 Screw
3 Electrical connector cover
4 Gasket
5 Cover
6 Gasket
7 Access plate
8 Screw
9 "Time delay" circuit card assembly (A1A1)
10 "Slew" circuit card assembly (A1A2)
11 Screw
12 Washer
13 Dust and moisture seal boots

Figure 6-84. Distribution box, exploded view.

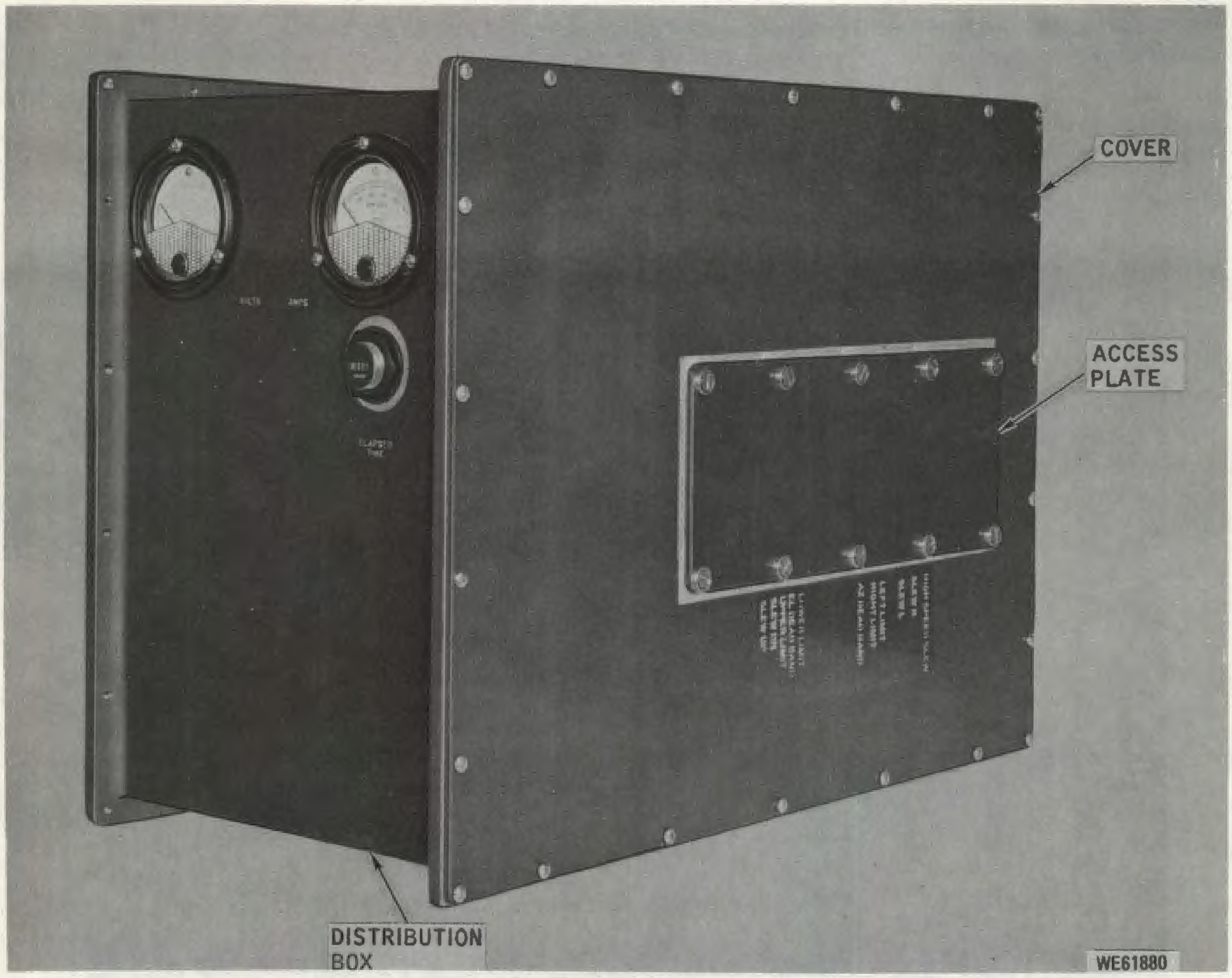


Figure 6-85. Distribution box, identification of cover and access plate.

placing any components replaceable by organizational maintenance. Prior to replacing any of the distribution box components perform the preliminary procedures given in paragraph a. following.

a. Preliminary Distribution Box Repair Procedures.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

b. Removal of Circuit Card Assemblies.

(1) Perform preliminary procedures given in paragraph a. preceding.

NOTE

Beside the identification plates, the two distribution boxes used with the XM157 mount can be identified by the nomenclature of the mount servo systems adjustment potentiometers on each distribution box. Refer to figure 6-86, sheets 1 and 2, to identify the differences.

(2) Identify the distribution box being repaired and proceed as follows:

(a) If repairing 8437152 distribution box, remove cover (5, fig. 6-84).

(b) If repairing 8438325 distribution box, remove access plate (7, fig. 6-84).

(3) Loosen the mounting studs securing the circuit card assembly to be removed. Remove circuit card assembly.

c. Inspection of Circuit Card Assemblies. Inspect the circuit card assemblies for the presence of the following:

(1) Bent or damaged connector pins.

(2) Cracks, breaks, or other signs of physical damage to circuit card.

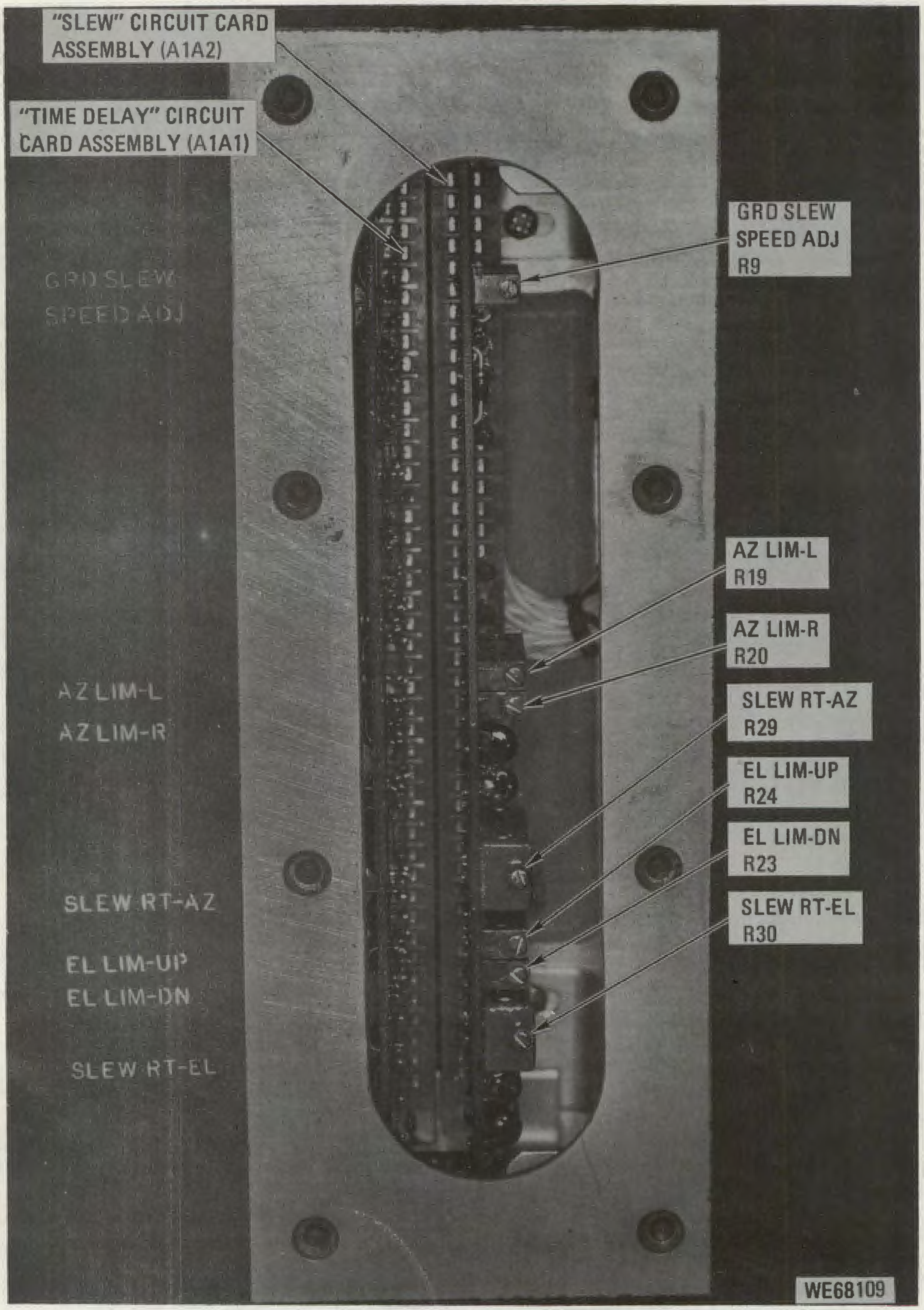


Figure 6-86. Distribution box, identification of circuit card assemblies and mount servo systems adjustment potentiometers, access plate removed (8437152) - sheet 1 of 2.

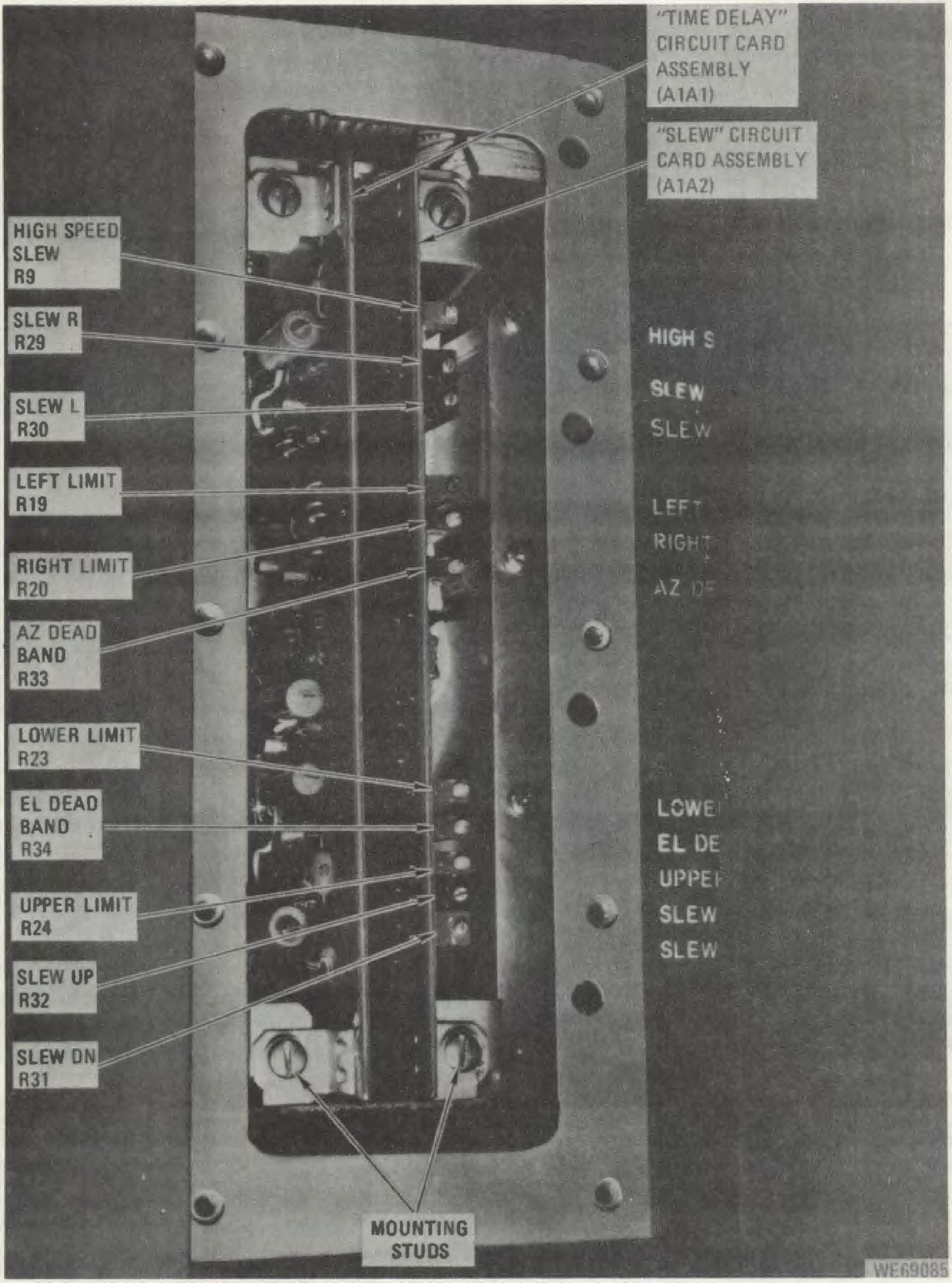


Figure 6-86. Distribution box, identification of circuit card assemblies and mount servo systems adjustment potentiometers, access plate removed (8438325)—sheet 2 of 2.

(3) Physical damage to circuit card assembly components.

(4) Bent, broken, or damaged mounting studs.

d. Replacement of Circuit Card Assembly Mounting Studs.

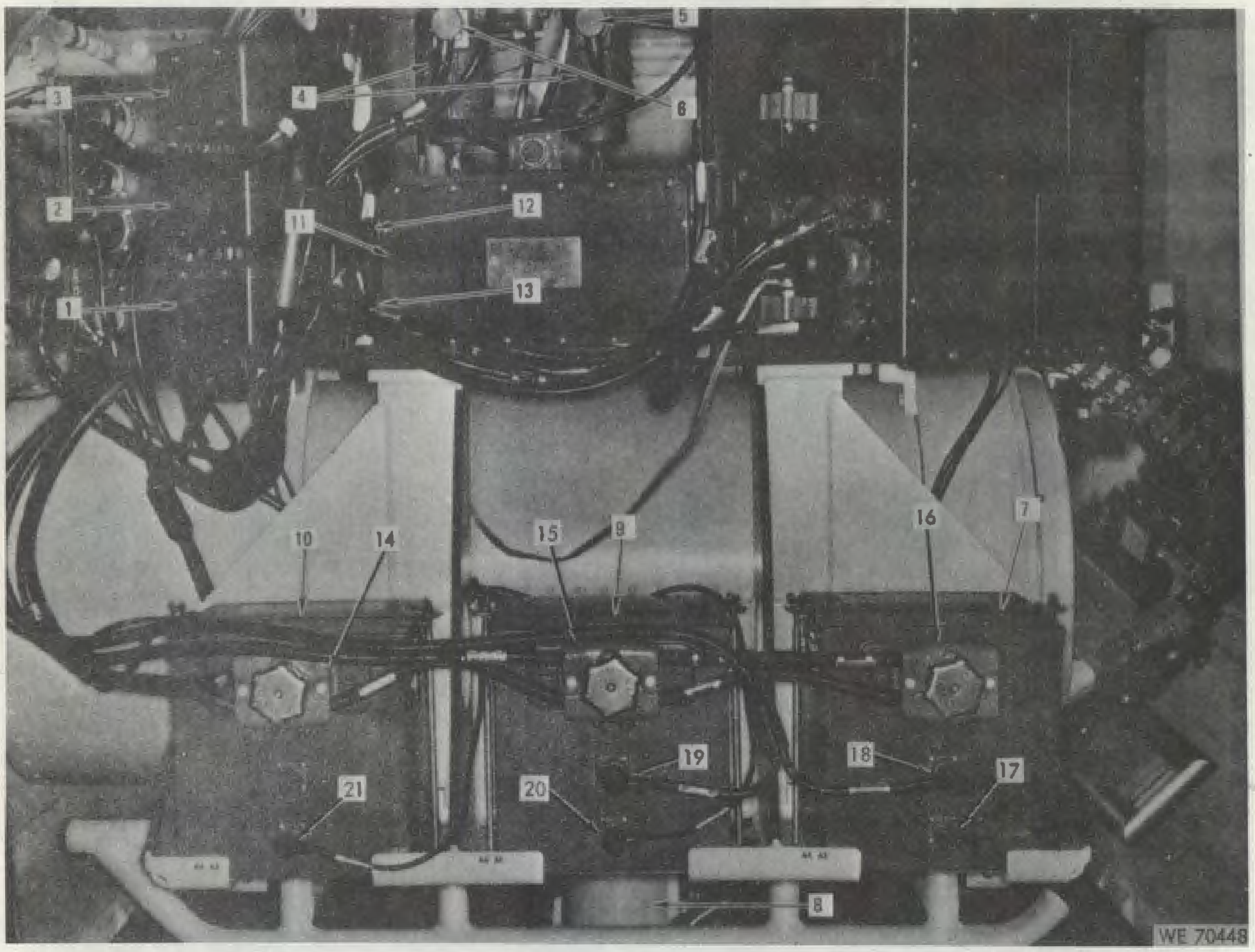
(1) *Removal.* Using pliers, twist off retainer ring from stud and remove stud from bracket.

(2) *Installation.* Insert stud into bracket and install retainer ring. When installing retainer ring, do not distort ring any more than necessary. Use pliers to straighten ring out after installation.

e. Installation of Circuit Card Assemblies. Installation of the circuit card assemblies is the reverse of removal (para. *b.* preceding). Assure circuit card assembly mounting studs are secured to mounting brackets.

f. Removal of Cover Gaskets.

(1) Perform preliminary procedures given in a. preceding.



1 Elevation servo amplifier (A15A3)
2 Azimuth servo amplifier #2 (slave)
3 Azimuth servo amplifier #1 (master)
4 Azimuth drive motors
5 Connector (A17A1J1 & W8P8)
6 Connector (A17A2J1 & W8P9)
7 Gun battery No. 2
8 Slip ring assembly
9 Gun battery No. 1
10 System battery
11 Inverter
12 Connector (A5J1 & W2P2)
13 Connector (A5J2 & W13P2)
14 Connector (A4A3J2 & W1P4)
15 Connector (A4A1J2 & W1P1)
16 Connector (A4A2J2 & W1P5)
17 Connector (A4A2J3 & W4P10)
18 Connector (A4A2J1 & W1P3)
19 Connector (A4A1J1 & W1P2)
20 Connector (A4A1J3 & W4P9)
21 Conneetor (A4A3J3 & W4P8)

Figure 6-87. XM157 mount, identification of servo amplifiers, inverter, and batteries.

NOTE

If replacing the cover gasket on the side of the distribution box that attaches to the mount, the entire distribution box must be removed from the mount.

(2) Remove distribution box cover (fig. 6-84).

(3) Pull old gasket off cover. Scrape off any remaining pieces of gasket or hardened cement.

(4) Clean surface under gasket with rubber cement thinner and allow to dry.

g. Installation of Cover Gaskets.

(1) Assure surface under gasket is clean. Scrape off any remaining pieces of gasket or hardened cement. Clean surface with rubber cement thinner and allow to dry.

(2) Bond new gasket to cover with adhesive RTV-102.

(3) Install distribution box cover and torque screws uniformly to 20 to 23 inch-pounds.

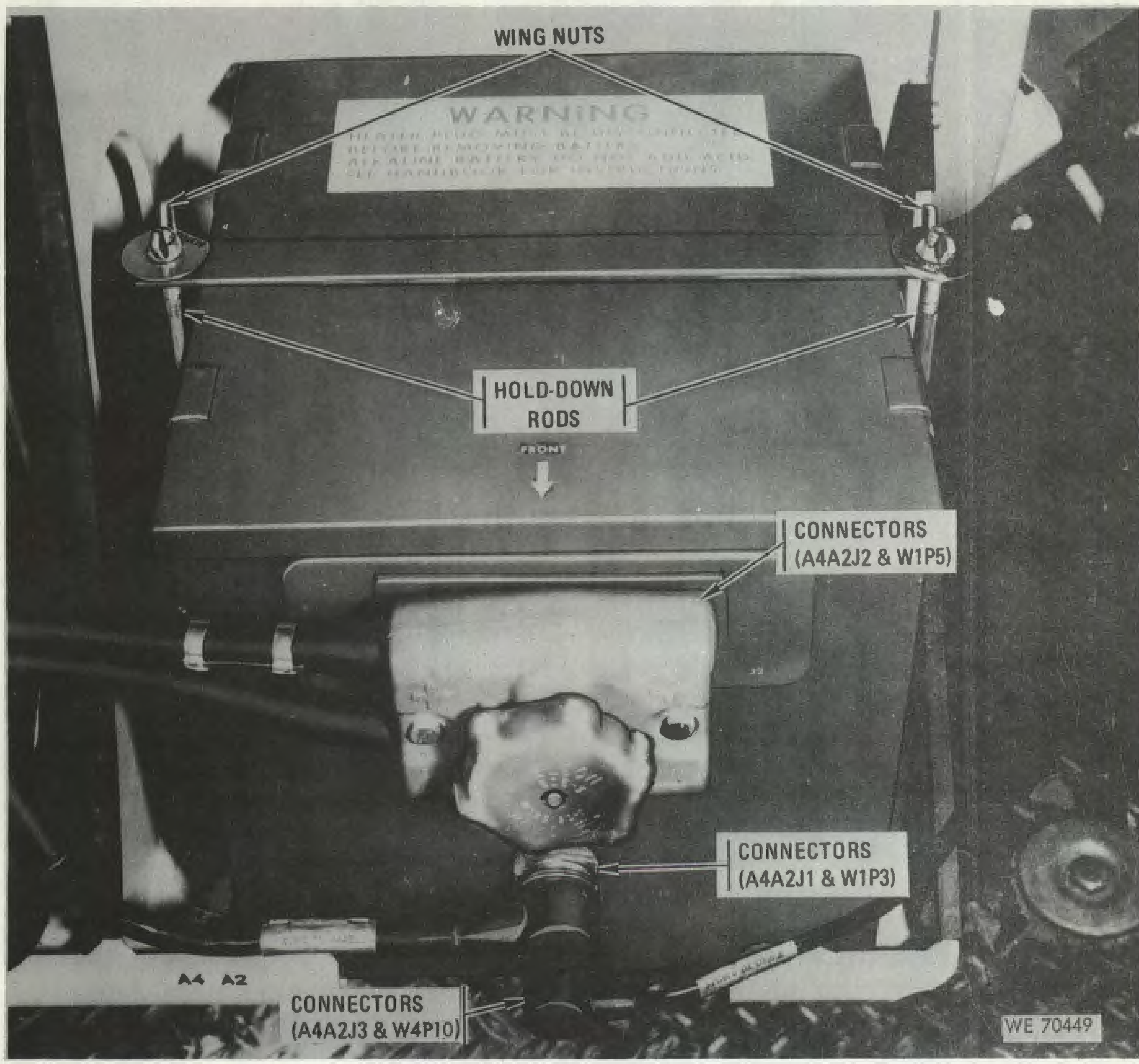


Figure 6-88. Mount battery A4A2, typical removal/installation details.

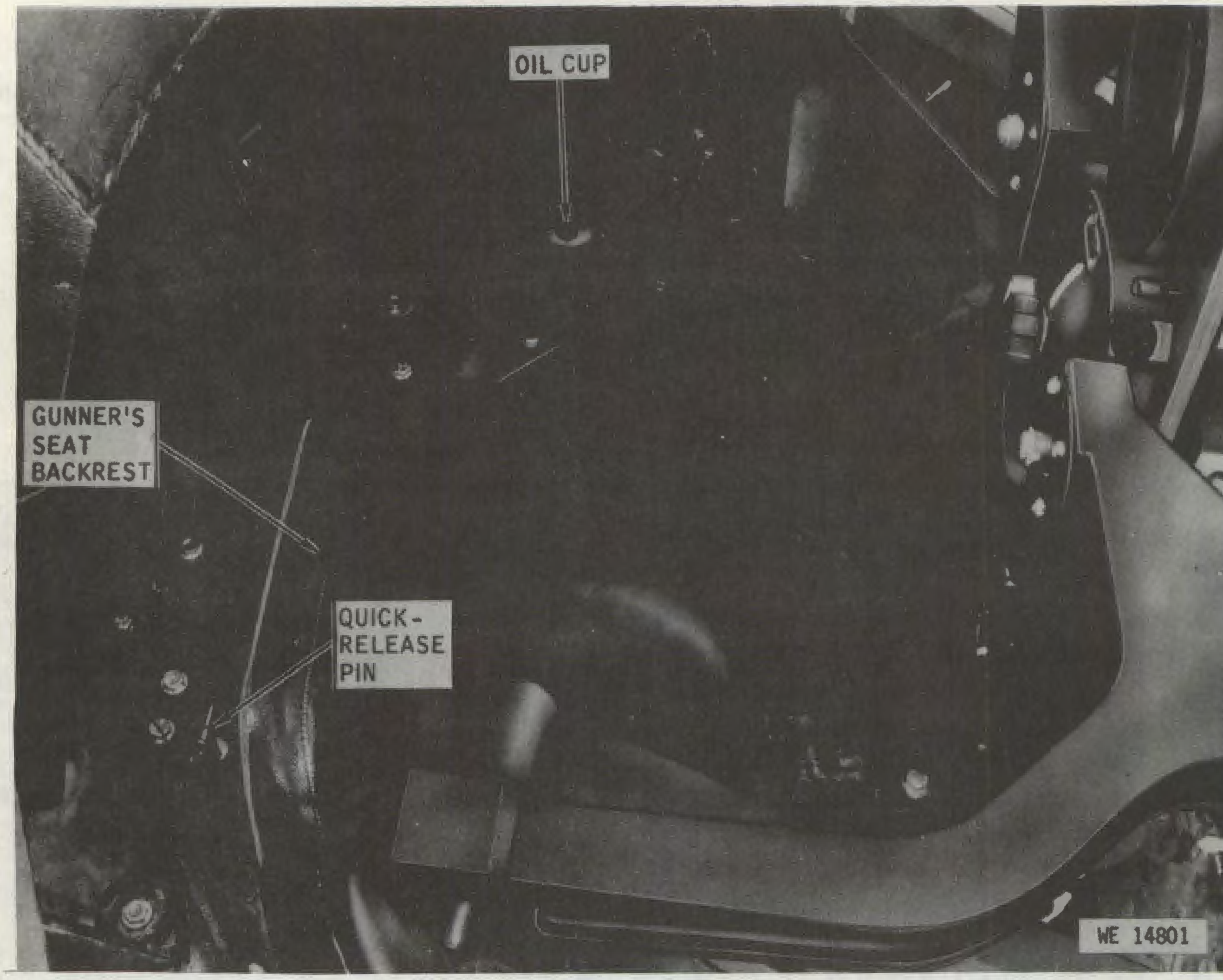


Figure 6-89. Gunner's seat backrest and mount oil cup, removal installation details

6-42.1 Inverter (A5)

NOTE

The inverter (A5) is removed at organizational level for replacement only.

a. Removal.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF position.

(2) Place distribution box (A1) NORM-STATIC-TEST switch (fig. 6-11) in STATIC position and verify that arming connector (fig. 6-2) is disconnected.

(3) Disconnect connector W13P2 from A5J2, and connector W2P2 from A5J1 on inverter (A5) (fig. 6-87).

(4) Remove six mounting bolts and remove inverter (A5).

b. Installation. Installation of the inverter (A5) is the reverse of removal.

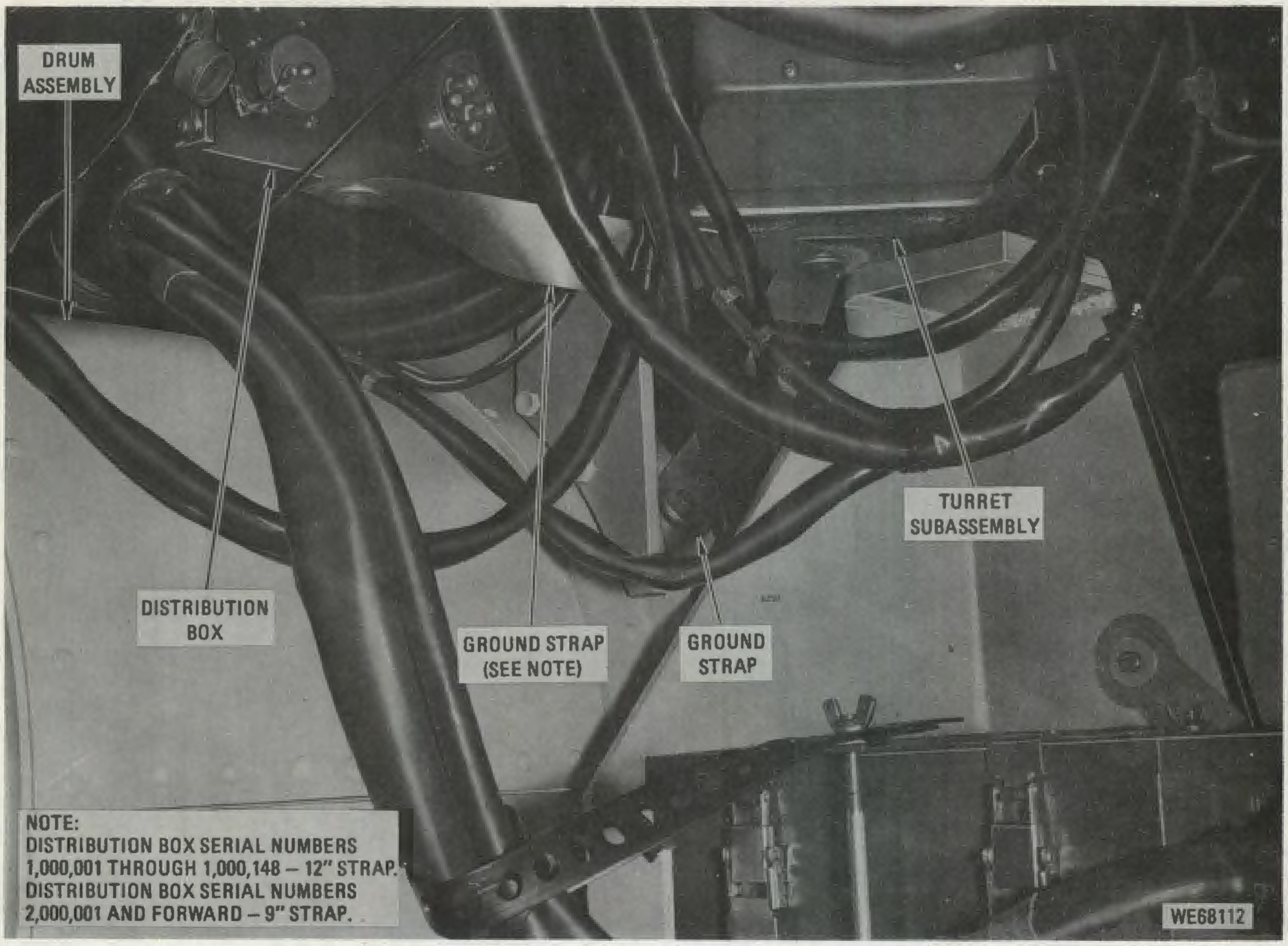


Figure 6-90. Ground straps between distribution box and turret subassembly, and between drum assembly and turret subassembly.

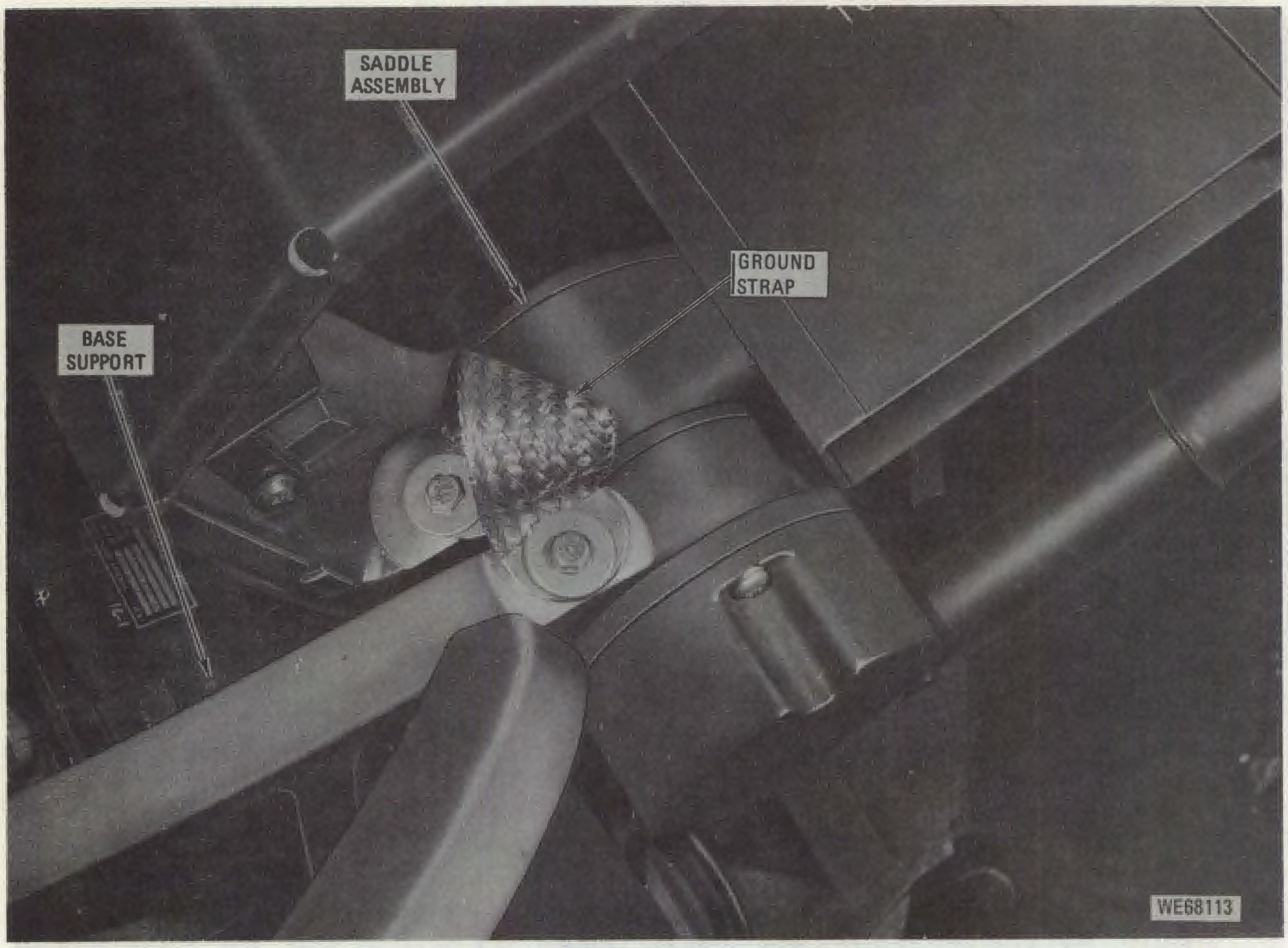


Figure 6-91. Ground strap between saddle assembly and base support.

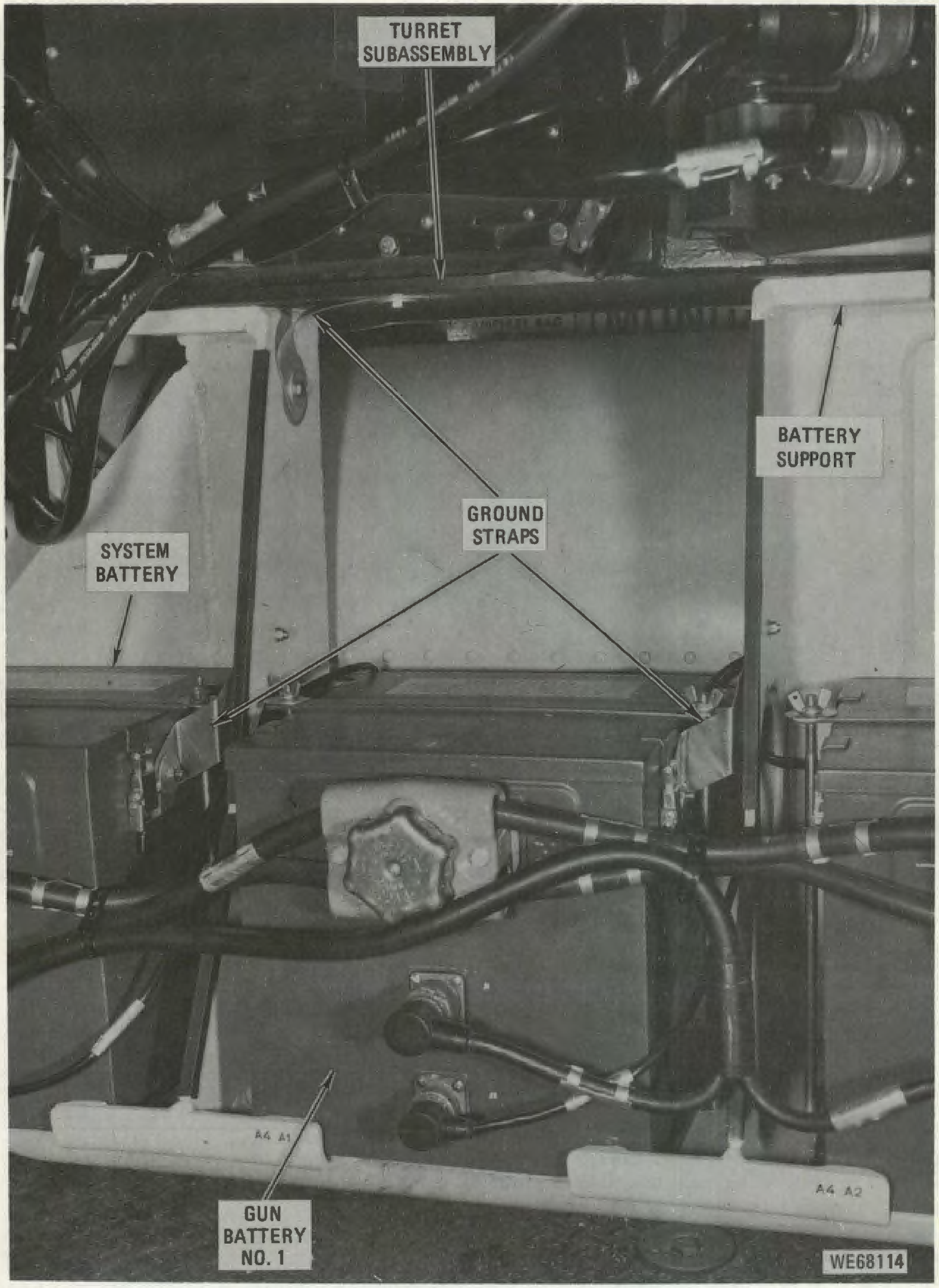


Figure 6-92. Ground straps between case of system battery and battery support, gun battery no. 1 and battery support, and turret subassembly and battery support.

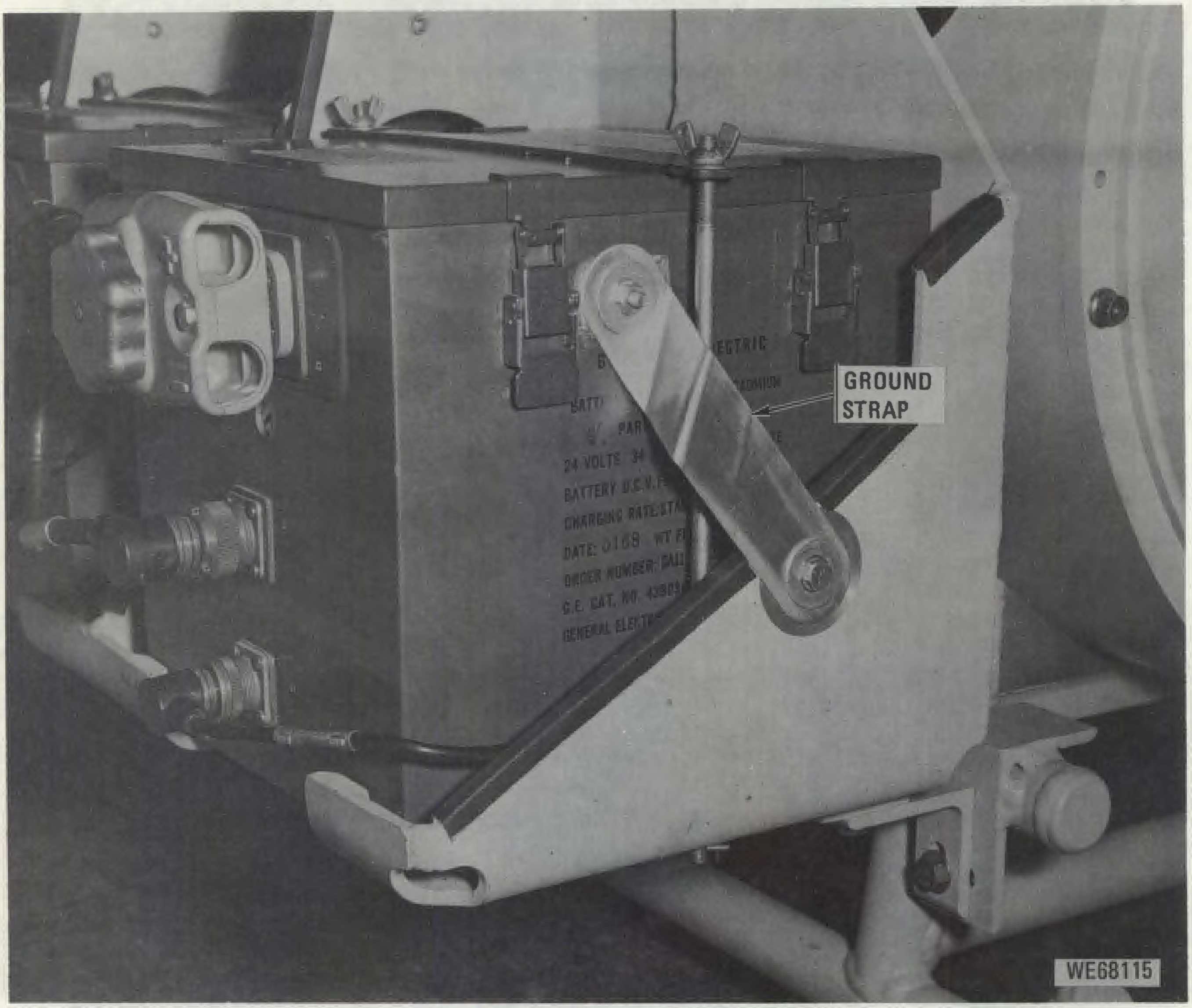


Figure 6-93. Ground straps between case of gun battery no. 2 and battery support.

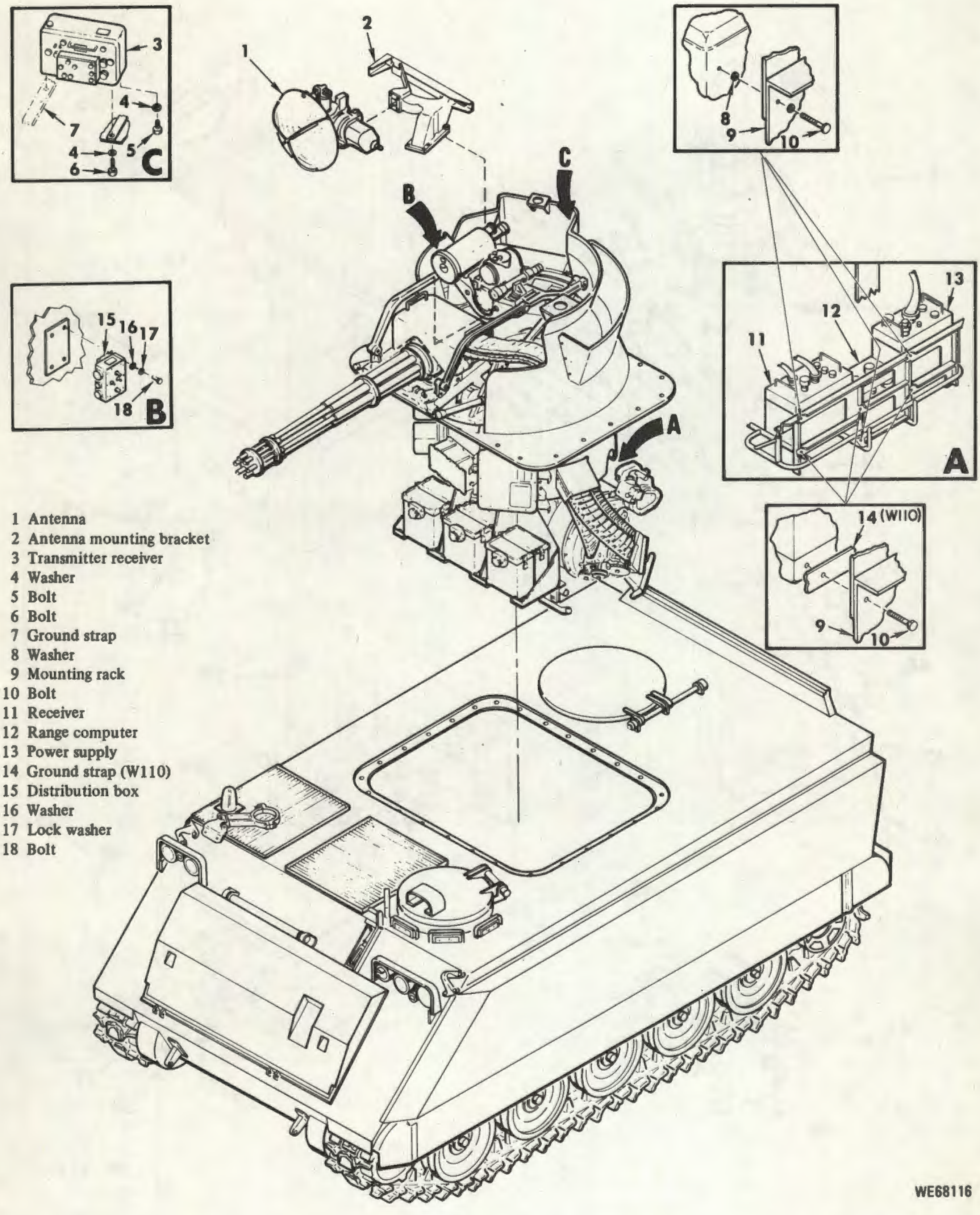
Section IV. REPAIR OF RADAR SET AN/VPS-2

6-43. General.

Repair of the radar consists of replacing damaged or malfunctioning parts or components found during inspection, and checkout/fault isolation procedures. Instructions for repairing the AN/VPS-2 radar set at the organizational level are given in the following paragraphs. Table 6-5 lists the components of the radar set that are repairable at the organizational level, and provides a guide to the location of instructions for each repair function. Figure 6-94 illustrates the major AN/VPS-2 radar set components. Where repair instructions are not given, the repair procedures are obvious. Whenever an electrical or electronic component is

Table 6-5. Guide to Repair of Radar Set.

Component	Repair instructions
Antenna assembly (unit 1)	Par. 6-44
Transmitter-receiver (unit 2)	Par. 6-45
Receiver (unit 3)	Par. 6-46
Range computer (unit 4)	Par. 6-47
Power supply (unit 5)	Par. 6-48
Distribution box (stow control) (unit 6)	Par. 6-49



1 Antenna
2 Antenna mounting bracket
3 Transmitter receiver
4 Washer
5 Bolt
6 Bolt
7 Ground strap
8 Washer
9 Mounting rack
10 Bolt
11 Receiver
12 Range computer
13 Power supply
14 Ground strap (W110)
15 Distribution box
16 Washer
17 Lock washer
18 Bolt

Figure 6-94. Radar set AN/VPS-2, removal/installation details.

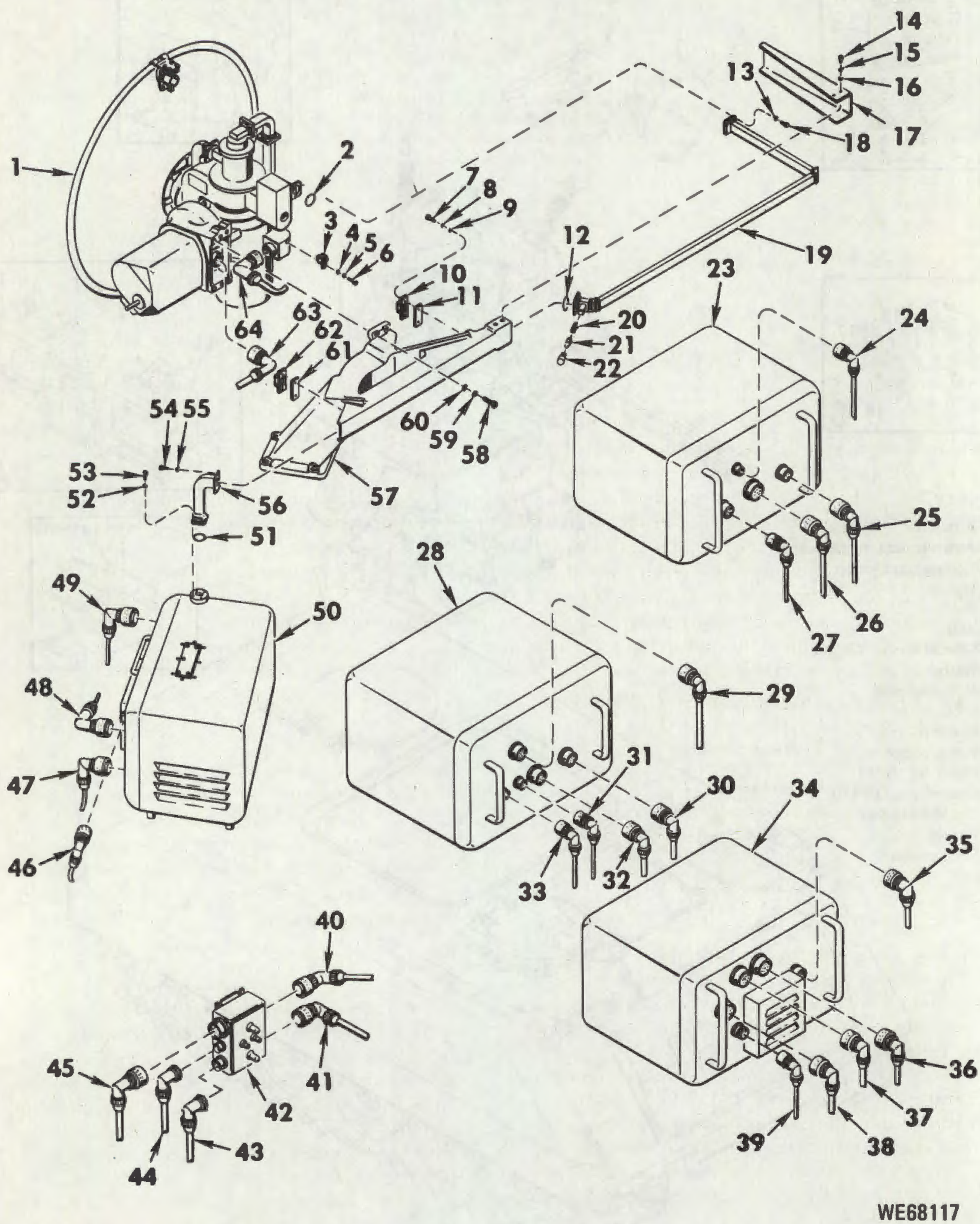


Figure 6-95. Radar set AN/VPS-2, exploded view.

Figure 6-95. Continued.

1 Antenna (unit 1)
2 Waveguide seal
3 Loop clamp
4 Washer
5 Lock washer
6 Cap screw
7 Cap screw
8 Lock washer
9 Washer
10 Loop clamp
11 Shim
12 Waveguide seal
13 Lock washer
14 Cap screw
15 Lock washer
16 Washer
17 Waveguide guard
18 Cap screw
19 Waveguide assembly
20 Glow lamp
21 Lamp holder
22 Lens
23 Range computer (unit 4)
24 Cable conn. (W104P1)
25 Cable conn. (W103P3)
26 Cable conn. (W105P1)
27 Cable conn. (W12P3)
28 Receiver (unit 3)
29 Cable conn. (W105P3)
30 Cable conn. (W105P2)
31 Cable conn. (W103P2)
32 Cable conn. (W106P1)
33 Cable conn. (W104P2)
34 Power supply (unit 5)
35 Cable conn. (W102P1)
36 Cable conn. (W101P1)
37 Cable conn. (W103P1)
38 Cable conn. (W12P2)
39 Cable conn. (W5P2)
40 Cable conn. (W107P1)
41 Cable conn. (W108P1)
42 Distribution box stow control (unit 6)
43 Cable conn. (W7P2)
44 Cable conn. (W6P4)
45 Cable conn. (W101P2)
46 Cable conn. (W105P5)
47 Cable conn. (W106P2)
48 Cable conn. (W102P2)
49 Cable conn. (W105P4)
50 Transmitter-receiver (unit 2)
51 Waveguide seal
52 Lock washer
53 Cap screw
54 Cap screw
55 Lock washer
56 Waveguide
57 Support bracket
58 Screw
59 Lock washer
60 Washer
61 Shim
62 Loop clamp
63 Cable conn. (W108P2)
64 Cable conn. (W107P2)

replaced, the appropriate system checks will be preformed to ensure proper adjustment and operation. The system interconnection diagram (fig. 3-36) provides reference for proper connection of electrical plugs and jacks. Radar set components will be subjected to inspection each time they are removed for corrective maintenance or are suspected of improper operation. Inspection consists of examining to detect mechanical or electrical failure or missing parts.

6-44. Antenna AS-2049/VPS-2 (Unit 1).

a. Removal.

CAUTION

Damage to the radar set will occur if it is operated with the antenna disconnected.

CAUTION

Do not operate antenna by hand. Forcing the antenna gearing without electrically releasing the brakes can cause heating and welding of brake friction disks.

(1) Rotate gun mount, in accordance with operating procedures in TM 9-2350-300-10, to a postition that permits easy access to the antenna while standing on the upper deck of the vehicle.

(2) Turn off power to the antenna by setting SYSTEM POWER switch on control assembly to the OFF position.

(3) Remove radar link guard over radar linkage (fig. 6-66).

(4) Disconnect radar linkage universal joint from shaft of elevation servo drive assembly on antenna.

(5) Disconnect cable connectors (63 and 64, fig. 6-95) from elevation and traverse servo drive assemblies on antenna.

(6) Remove four cap screws (14), lock washers (15), washer (16), and waveguide guard (17) from bracket (57).

(7) Remove eight cap screws (18 and 54) and lock washers (13 and 55) that attach waveguide assembly (19) to rotary joint on antenna and flexible waveguide to transmitter-receiver.

(8) Remove four cap screws (7), lock washers (8), washers (9), two waveguide loop clamps (10 and 62), two shims (11 and 61) (if used), indicators (20 and 21), and remove waveguide assembly (19) from bracket (57).

CAUTION

Do not use reflector or feed assembly to lift the antenna. Use traverse and elevation housing for lifting. Use two men to lift the antenna. Support antenna while removing screws in (9) following.

(9) Remove four screws (58), lock washers (59), and washers (60) that attach antenna (1) to bracket (57).

(10) Pull antenna (1) from locating pins on bracket (57) and rest antenna on vehicle deck with reflector and feed assembly pointing upward.

(11) Remove two waveguide seals (2 and 12) for inspection.

b. Inspection.

(1) Inspect waveguide seals (2 and 12) for deformations and deterioration.

(2) Inspect waveguide assembly (19), and antenna (1) for dents, holes, breaks, and cracks.

(3) Inspect all attaching parts for breaks, cracks, bad threads, and other deformations.

(4) Inspect cable connectors (63 and 64) for breaks in insulation, broken connector, and bent, missing, or dirty pins or sockets.

c. Installation.

(1) Install antenna (1) on bracket (57) using screws (58), lock washers (59), and washers (60).

(2) Install two waveguide seals (2 and 12).

(3) Slide waveguide assembly (19) through bracket (57) and loosely attach loop clamps (10 and 62) using cap screws (7), lock washers (8), and washers (9). Do not tighten loop clamps (10 and 62).

(4) Attach both ends of waveguide assembly (19) using cap screws (18 and 54) and lock washers (13 and 55).

(5) Assure that back side of waveguide assembly (19) fits tightly against clamping points inside of bracket (57). Use shims (11 and 61) as required to fill space and adjust thickness as necessary by adding shim stock or peeling laminations. Secure loop clamps (10 and 62) by tightening cap screws(7).

CAUTION

Do not connect radar linkage to elevation servo drive assembly on antenna before aligning the shaft of the elevation servo drive assembly. Improper alignment may shear pins in the elevation servo drive assembly.

(6) Prior to connecting radar linkage to shaft on elevation servo drive assembly, position the gun to 0 degrees elevation; rotate the shaft extending from the elevation servo drive assembly fully clockwise, then counter-clockwise 180 degrees; hold the shaft in position and connect the radar linkage.

(7) Perform boresighting adjustment in accordance with procedures in TM 9-2350-300-10.

(8) Install radar linkage guard over radar linkage.

d. Antenna Components. Position the gun mount for easy access to the antenna and remove power as instructed in paragraphs *a*(1) and (2) preceding, before proceeding with disassembly.

(1) *Flexible waveguide (53, fig. 6-96).* The following procedures hold true for any flexible waveguide removal with the exception of part number change.

(a) Removal.

1. Remove eight cap screws (1 and 52), lock washers (2 and 51), washers (3 and 50), and flexible waveguide (53).

2. Remove waveguide seals (4 and 42).

(b) Inspection.

1. Inspect waveguide seals for deformation and deterioration.

2. Inspect the exterior of flexible waveguide for holes, deformations, and cuts.

3. Inspect interior of flexible waveguide for evidence of leakage, e.g., water or dust.

(c) Installation. Install flexible waveguide (53) in reverse order of removal.

(2) *Waveguide (49, fig. 6-96) and rotary joint (5).*

(a) Removal.

1. Remove flexible waveguide per instructions in (1)(a), preceding.

2. Remove four cap screws (13), lock washers (12), and washers (11).

3. Remove five cap screws (6), lock washers (7), and washers (8).

4. Lift waveguide (49) and rotary joint (5) from access cover (25).

5. Separate waveguide from rotary joint by removing four cap screws (46), lock washers (47), and washers (48).

6. Remove two waveguide seals (9 and 45) from rotary joint (5) and one waveguide seal (4) from waveguide (49).

(b) Inspection.

1. Inspect waveguide seals for deformation and deterioration.

2. Inspect waveguide and rotary joint for cracks, breaks, holes, and deformation.

3. Inspect interior of waveguide and rotary joint for evidence of leakage, e.g., water or dust.

(c) Installation. Assemble rotary joint (5) and waveguide (49), and install in reverse order of removal.

(3) *Flexible waveguide (14, fig. 6-96).*

(a) Removal.

1. Remove eight cap screws (13 and 19), lock washer (12 and 20), washers (11 and 21), and flexible waveguide (14).

2. Remove waveguide seals (9 and 10).

(b) Inspection.

1. Inspect seals for deformation and deterioration.

2. Inspect flexible waveguide for cracks, breaks, holes, and deformation.

3. Inspect interior of flexible waveguide for evidence of leakage, e.g., water or dust.

(c) Installation. Install flexible waveguide (14) in reverse order of removal.

(4) *Waveguide (15, fig. 6-96).*

(a) Removal.

1. Remove eight cap screws (19 and 16), lock washers (20 and 17), washers (21 and 18), and waveguide (15).

2. Remove waveguide seals (10 and 30).

(b) Inspection.

1. Inspect seals for deformation and deterioration.

2. Inspect waveguide for cracks, breaks, holes, and deformation.

3. Inspect interior of waveguide for evidence of leakage, e.g., water or dust.

(c) Installation. Install waveguide (15) in reverse order of removal.

(5) *Rotary joint (34, fig. 6-96).*

(a) Removal.

1. Perform procedures in paragraph 6-44a(6) and (7) to detach waveguide assembly from the rotary joint.

2. Remove nine cap screws (16 and 31), lock washers (17 and 32), washers (18 and 33), and rotary joint (34).

3. Remove two waveguide seals (30, fig. 6-96, and 2, fig. 6-95) from rotary joint.

(b) Inspection.

1. Inspect seals for deformation and deterioration.

2. Inspect rotary joint for cracks, breaks, holes, and deformation.

3. Inspect interior of rotary joint for evidence of leakage, e.g., water or dust.

(c) Installation. Install rotary joint (34, fig. 6-96) in reverse order of removal.

(6) *Rotary retainer (35, fig. 6-96).*

(a) Removal.

1. Remove screws (13), lock washers (12), washers (11), screws (16), lock washers (17), washers (18), and remove waveguides (14 and 15) as one assembly. Do not loosen waveguide seals (9).

2. Remove cap screws (18, fig. 6-95), lock washers (13), five screws (31, fig. 6-96), lock washers (32), washers (33), and rotary joint (34). Do not loosen waveguide seals.

3. Remove five screws (29), lock washers (28), washers (27) and rotary retainer (35).

(b) Inspection. Inspect rotary retainer for cracks, breaks, and deformation.

(c) Installation. Install rotary retainer in reverse order of removal.

(7) *Access cover (25, fig. 6-96).*

(a) Removal.

1. Remove flexible waveguide (53) in accordance with paragraph d(1) preceding.

2. Remove four screws (19), then remove five screws (6), lock washers (7), and washers (8). Raise up rotary joint (5) and waveguide (49) (as an assembly) approximately one half inch and slide forward to remove from access cover (25).

3. Remove eight cap screws (22), lock washers (23), washers (24), and access cover (25).

4. Remove preformed packing (26).

(b) Inspection.

1. Inspect access cover for cracks, breaks, and deformation.

2. Inspect preformed packing for deformation and deterioration.

3. Inspect for evidence of leakage to parts protected by access cover, e.g., water or dust.

4. Inspect as instructed in paragraph d(2)(b) preceding.

(c) Installation. Install access cover (25) in reverse order of removal.

(8) *Reflector and feed assembly* (4, fig. 6-97).

(a) Removal.

1. Remove nut (36, fig. 6-96), lock washer (37), washer (38), and weight (39).

2. Remove eight screws (41) and plate (40).

3. Remove four cap screws, lock washers, and washers (50, 51, and 52); four cap screws, lock washers, and washers (1, 2, and 3); and flexible waveguide (53).

4. Remove four cap screws, lock washers, and washers (16, 17, and 18); and eight cap screws, lock washers, and washers (22, 23, and 24).

5. Remove access cover (25), with waveguides (49, 14, and 15) and rotary joint (5) attached, from reflector and feed assembly.

6. Remove waveguide seals (30 and 42), and preformed packing (26).

7. Unscrew access cap (6, fig. 6-98).

NOTE

Calibration shaft (8, fig. 6-98) may have to be turned to loosen setscrew in procedure 8 following.

8. Loosen the outboard setscrew only (7, fig. 6-97) that secures calibration shaft (8, fig. 6-98) to coupling (8, fig. 6-97).

9. Withdraw calibration shaft (8) from coupling (8, fig. 6-97).

CAUTION

To avoid damage to the alignment pin and the gear assembly on the traverse servo drive assembly (27), perform procedure 10. following, very carefully.

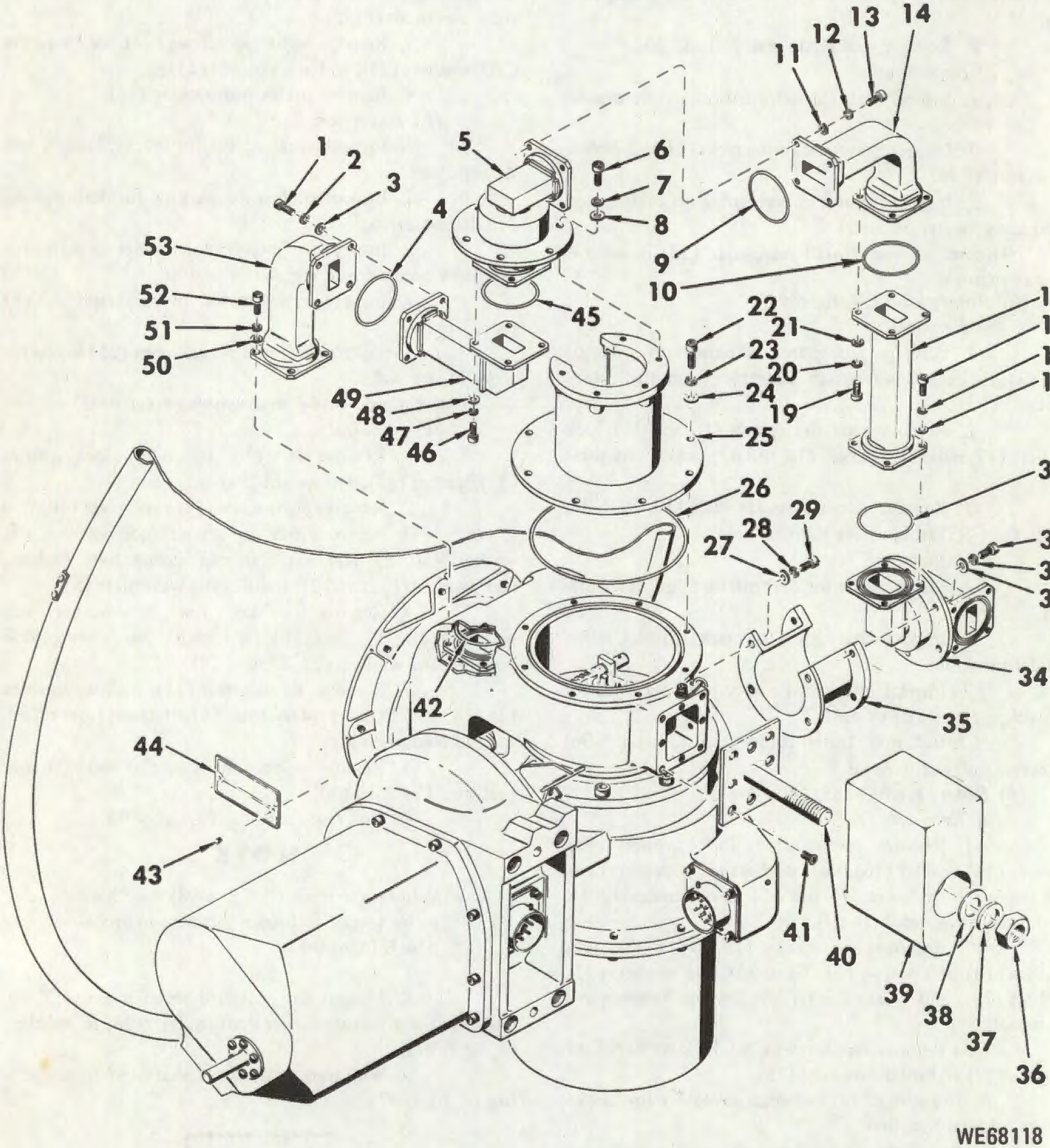


Figure 6-96. Antenna, partially exploded top view.

1 Screw
2 Lock washer
3 Washer
4 Waveguide seal
5 Rotary joint
6 Screw
7 Lock washer
8 Washer
9 Waveguide seal
10 Waveguide seal
11 Washer
12 Lock washer
13 Screw
14 Flexible waveguide
15 Waveguide
16 Screw
17 Lock washer
18 Washer
19 Screw
20 Lock washer
21 Washer
22 Screw
23 Lock washer
24 Washer
25 Access cover
26 Packing (O-ring)
27 Washer
28 Lock washer
29 Screw
30 Waveguide seal
31 Screw
32 Lock washer
33 Washer
34 Rotary joint
35 Rotary retainer
36 Nut
37 Lock washer
38 Washer
39 Counterweight
40 Plate
41 Screw
42 Waveguide seal
43 Drive screw
44 Identification plate
45 Waveguide seal
46 Screw
47 Lock washer
48 Washer
49 Waveguide
50 Washer
51 Lock washer
52 Screw
53 Flexible waveguide

Figure 6-96. Continued.

ITEM	NO.	TORQUE	
		INCH - LBS.	FOOT - LBS.
SCREW	1	50	4.17

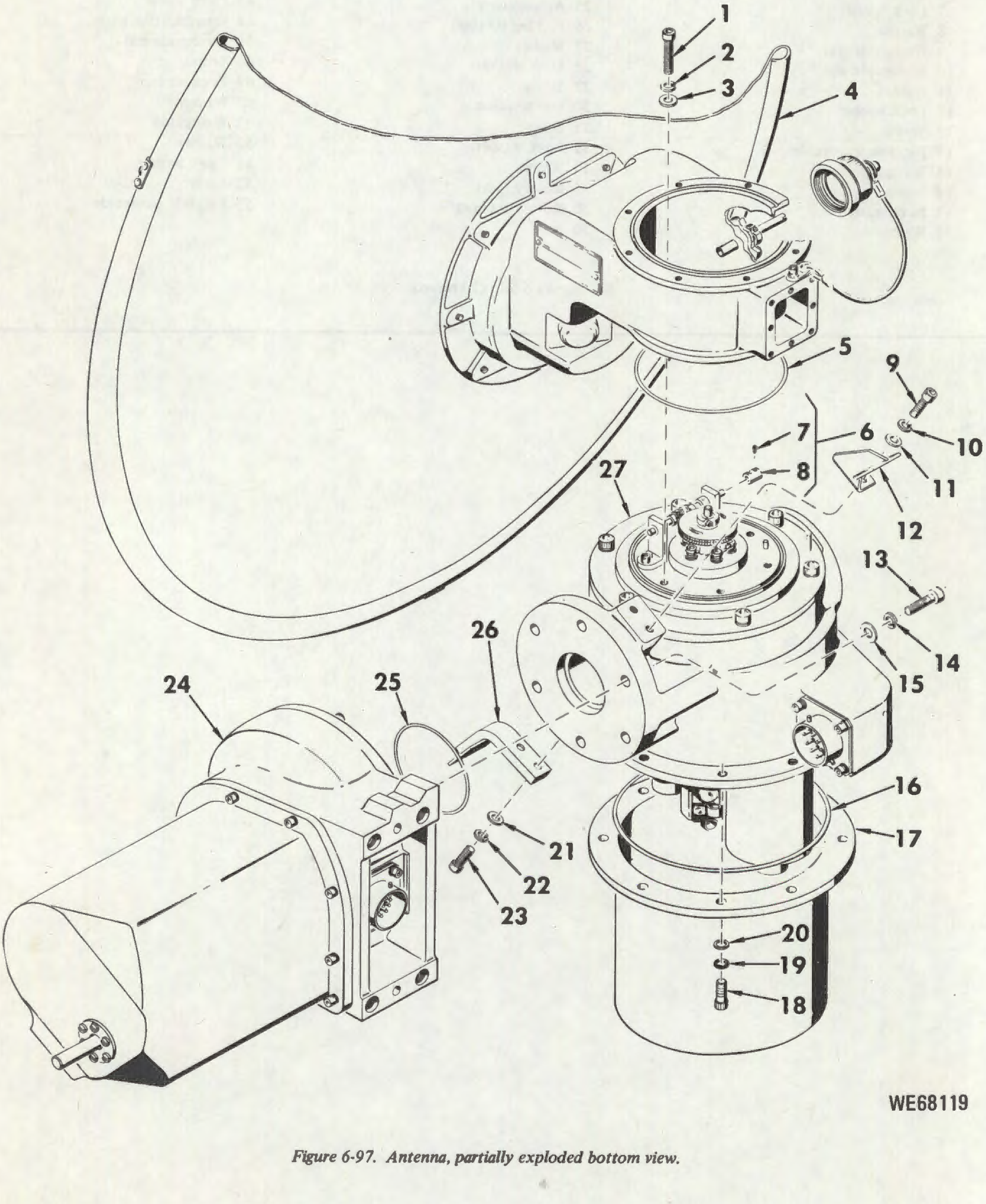
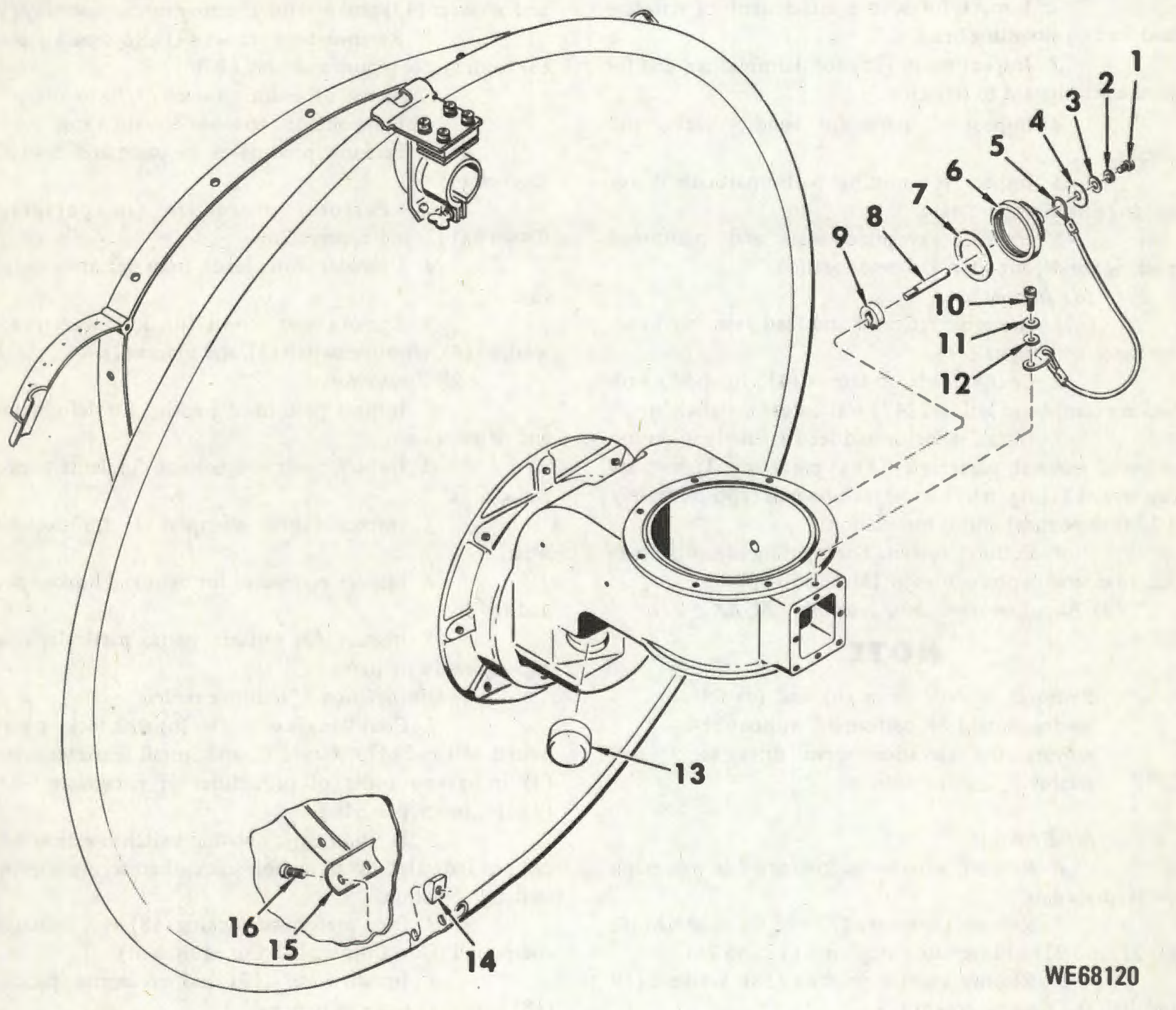


Figure 6-97. Antenna, partially exploded bottom view.

1 Screw
2 Lock washer
3 Washer
4 Reflector and feed assembly
5 Packing (O-ring)
6 Collar assembly
7 Setscrew
8 Coupling
9 Screw
10 Lock washer
11 Washer
12 Elevation stop arm
13 Screw
14 Lock washer
15 Washer
16 Packing (O-ring)
17 Traverse cover
18 Screw
19 Lock washer
20 Washer
21 Washer
22 Lock washer
23 Screw
24 Elevation servo drive assembly
25 Packing (O-ring)
26 Elevation stop arm
27 Traverse servo drive assembly

Figure 6-97. Continued.



1 Screw
2 Lock washer
3 Washer
4 Retainer
5 Wire rope assembly
6 Access cap
7 Gasket
8 Calibration shaft
9 Hub clamp
10 Screw
11 Lock washer
12 Washer
13 Rubber bumper
14 Nut
15 Guard
16 Screw

Figure 6-98. Reflector and feed assembly, partially exploded view.

10. Remove six cap screws (1), lock washers (2), and washers (3), and carefully lift reflector and feed assembly (4) along a straight line away from traverse servo drive assembly (27).

11. Remove preformed packing (5).

(b) Removal of reflector and feed assembly parts. Remove parts as illustrated in figure 6-98. To remove calibration shaft (8), perform procedures outlined in d(8)(a)3. through d(8)(a)9. preceding.

(c) Inspection.

1. Inspect parabolic reflector for dents, holes, and distorted shape.

2. Inspect for secure attachment of reflector and feed to mounting bracket.

3. Inspect guard (15) for deformation, and for secure attachment to reflector.

4. Inspect all parts for bends, cracks, and breaks.

5. Inspect for missing parts; particularly for missing attaching hardware.

6. Inspect waveguide seals and preformed packing for deformation and deterioration.

(d) Installation.

1. Assemble reflector and feed assembly in accordance with figure 6-98.

2. Coat threads of screws (41, fig. 6-96) with locking compound MIL-S-22473 just before installation.

3. Install reflector and feed assembly in reverse order of removal, paragraph d(8)(a) preceding. Tighten six cap screws (1, fig. 6-97) to 50 inch-pounds (approximately 4.17 foot-pounds) during installation.

4. Perform antenna boresighting adjustments in accordance with procedures in TM 9-2350-300-10.

(9) *Elevation servo drive assembly (24, fig. 6-97).*

NOTE

Removal procedures in (b) and (c) following should be performed without removing the elevation servo drive assembly.

(a) Removal.

1. Remove antenna as instructed in paragraph 6-44a. preceding.

2. Remove capscrews (23 and 9), washers (10, 11, 21, and 22) and elevation stop arms (12 and 26).

3. Remove eight capscrews (18), washers (19 and 20), and traverse cover (17).

4. Have a second man support elevation servo drive assembly (24) and remove six capscrews (13, fig. 6-97), lock washers (14), and washers (15). Lift the elevation servo drive assembly away from traverse servo drive assembly (27).

5. Remove preformed packing (25).

(b) Removal of motor pinion assembly (6, fig. 6-99).

1. Perform procedures outlined in paragraph 6-44a(1) through (5).

2. Remove nine capscrews (14), lock washers (15), washers (16), and elevation drive cover (17).

3. Remove preformed packing (18).

4. Tag and unsolder leads from terminals E4, E5, E8, and E9.

5. Cut cable straps to remove motor pinion assembly (10) wires from cable.

6. Remove four screws (11), lock washers (12), and washers (13) and carefully remove motor assembly (9).

7. Remove four screws (7) and separate plate (8) from motor pinion assembly (10).

(c) Removal of sensitive switch (3, fig. 6-99).

1. Drive antenna to lower elevation stop.

2. Perform procedures in paragraph 6-44a(1) through (4).

3. Perform procedures in paragraph 6-44d(9)(b)2. and 3. preceding.

4. Unsolder wire leads from sensitive switch (3).

5. Remove two screws (6), lock washers (5), washers (4), sensitive switch (3), and spacer (2).

(d) Inspection.

1. Inspect preformed packing for deformation and deterioration.

2. Inspect cover and housing for dents, breaks, and cracks.

3. Inspect rubber bumper (1) for excessive wear.

4. Inspect connector for bent and broken pins, and for dirt.

5. Inspect for missing parts, particularly attaching hardware items.

(e) Installation of sensitive switch.

1. Coat threads of screws (6) with locking compound MIL-S-22473, Grade C, and install sensitive switch (3) in reverse order of procedures in paragraph 6-44d (9)(c)4. and 5. preceding.

2. Position switch so that switch is actuated by cam, as indicated by an audible click, then secure sensitive switch in position.

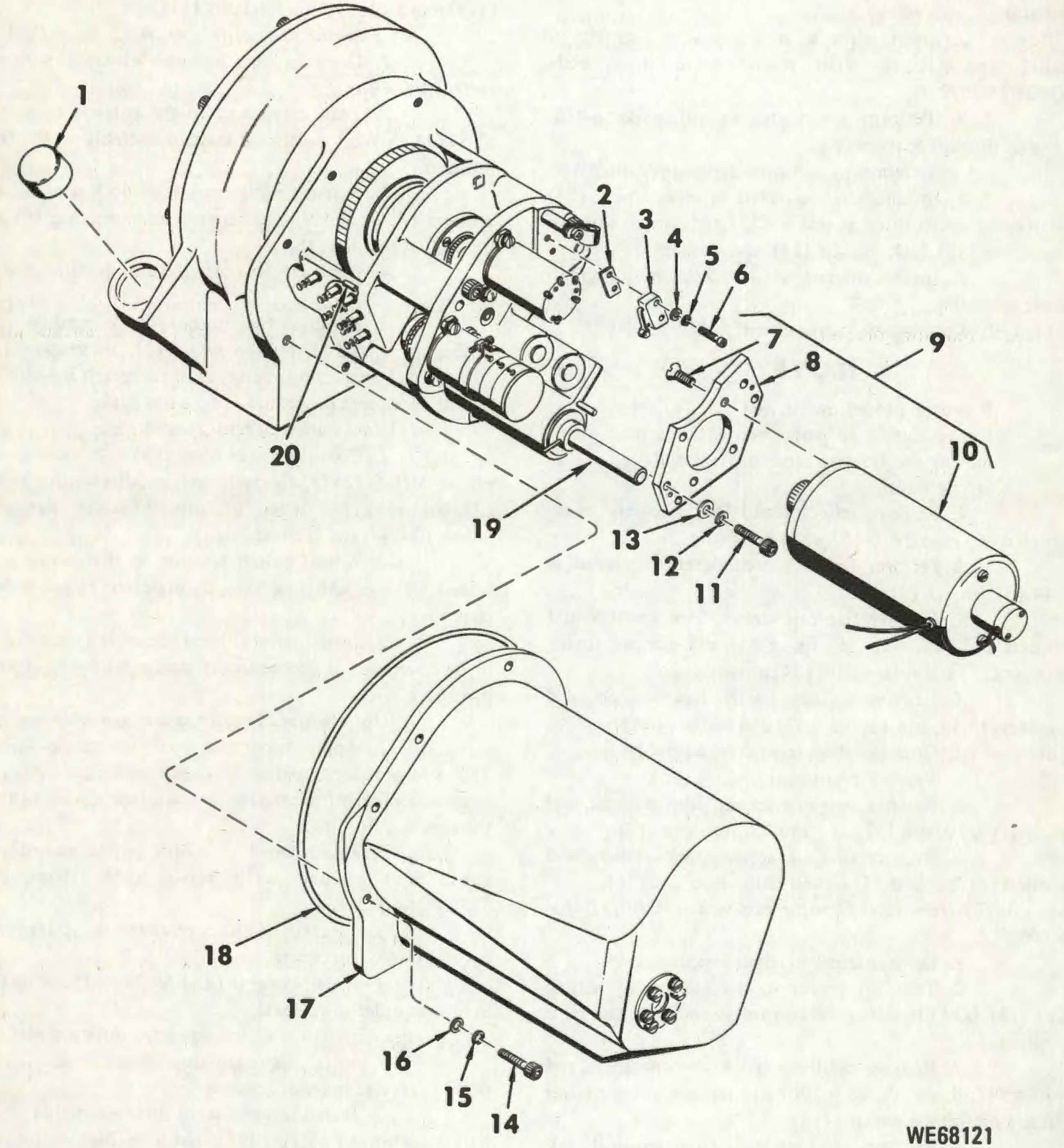
3. Coat preformed packing (18) with insulating compound (Dow Corning DC-4 or equivalent).

4. Install cover (17) and preformed packing (18) in reverse order of removal.

5. Connect radar linkage to elevation servo drive assembly and install radar link guard as instructed in paragraph 6-44c(4) and (5) preceding.

(f) Installation of motor pinion assembly.

1. Apply moderate coat of grease MIL-G-21164 to gear teeth and install motor pinion assembly (10)



1 Rubber bumper	6 Screw	11 Screw	16 Washer
2 Spacer	7 Screw	12 Lock washer	17 Elevation drive cover
3 Switch	8 Plate	13 Washer	18 Packing (O-ring)
4 Washer	9 Motor assembly	14 Screw	19 Shaft
5 Lock washer	10 Motor pinion assembly	15 Lock washer	20 Diode

Figure 6-99. Elevation servo drive assembly, partially exploded view.

in reverse order of procedures in paragraph 6-44d(9)(b)4. through 7. preceding.

2. Insert wires of motor pinion assembly in cable and secure with plastic cable straps FSN 5340-074-2072.

3. Perform procedures in paragraph 6-44d-(9)(e)3. through 5. preceding.

(g) Installation of elevation servo drive assembly.

1. Install elevation servo drive assembly (24) on traverse servo drive assembly (27) and secure with six cap screws (13), lock washers (14), and washers (15).

2. Install antenna as instructed in paragraph 6-44c preceding.

(10) *Traverse servo drive assembly (27, fig. 6-97).*

NOTE

Removal procedures in (b) and (c) following should be performed without removing the traverse servo drive assembly.

(a) Removal.

1. Remove reflector and feed assembly as instructed in paragraph 6-44d(8)(a) preceding.

2. Perform removal procedures in paragraph 6-44a(5) through (8).

3. Remove five cap screws, lock washers, and washers (27, 28, and 29, fig. 6-96) and remove rotary retainer (35) and rotary joint (34) as an assembly.

4. Remove six cap screws, lock washers, and washers (13,14, and 15, fig. 6-97) and remove traverse servo drive assembly from elevation servo drive assembly.

5. Remove preformed packing (25).

6. Remove two cap screws, lock washers, and washers (9, 10, and 11) and elevation stop arm (12).

7. Remove two cap screws, lock washers, and washers (21, 22, and 23) and elevation stop arm (26).

(b) Removal of motor pinion assembly (11, fig. 6-100).

1. Drive antenna to upper elevation stop.

2. Turn off power to the antenna by setting SYSTEM POWER switch on control assembly to the OFF position.

3. Remove eight cap screws, lock washers, and washers (7, 8, and 9, fig. 6-100) and remove traverse cover (6) and preformed packing (18).

4. Tag and unsolder leads from terminals E3, E4, E9, and E10.

5. Cut cable straps to remove motor pinion assembly (11) wires from cable.

6. Remove four cap screws, lock washers, and washers (13, 14, and 15) and carefully remove motor assembly (10).

7. Remove four screws (16) and separate plate (12) from motor pinion assembly (11).

(c) Removal of sensitive switch (2, fig. 6-100).

1. Drive antenna to upper elevation stop and right traverse stop.

2. Turn off power to the antenna by setting SYSTEM POWER switch on control assembly to the OFF position.

3. Remove eight cap screws, lock washers, and washers (7, 8, and 9) and remove traverse cover (6) and preformed packing (18).

4. Unsolder wire leads from sensitive switch (2).

5. Remove two screws, lock washers, and washers (3, 4, and 5), sensitive switch (2), and spacer (1).

(d) Inspection. Same as in paragraph 6-44d(9)(d) preceding, except procedure 3. does not apply.

(e) Installation of sensitive switch.

1. Coat threads of screws (5) with locking compound MIL-S-22473, Grade C and install sensitive switch (2) in reverse order of procedures in paragraph 6-44d(10)(c)4. and 5. preceding.

2. Adjust switch position so that switch is actuated by the actuating cam, as indicated by an audible click.

3. Install cover (6) and preformed packing (18) in reverse order of procedures in paragraph 6-44d(10)(c)3. preceding.

(f) Installation of motor pinion assembly.

1. Apply moderate coat of grease MIL-G-21164 to gear teeth and install motor pinion assembly (11) in reverse order of procedures in paragraph 6-44d(10)(b)4. through 7. preceding.

2. Insert wires of motor pinion assembly in cable and secure with plastic cable straps FSN 5340-074-2072.

3. Perform procedures in paragraph 6-44d(10)(e)3. preceding.

4. Install cover (6) and preformed packing (18) in reverse order of removal.

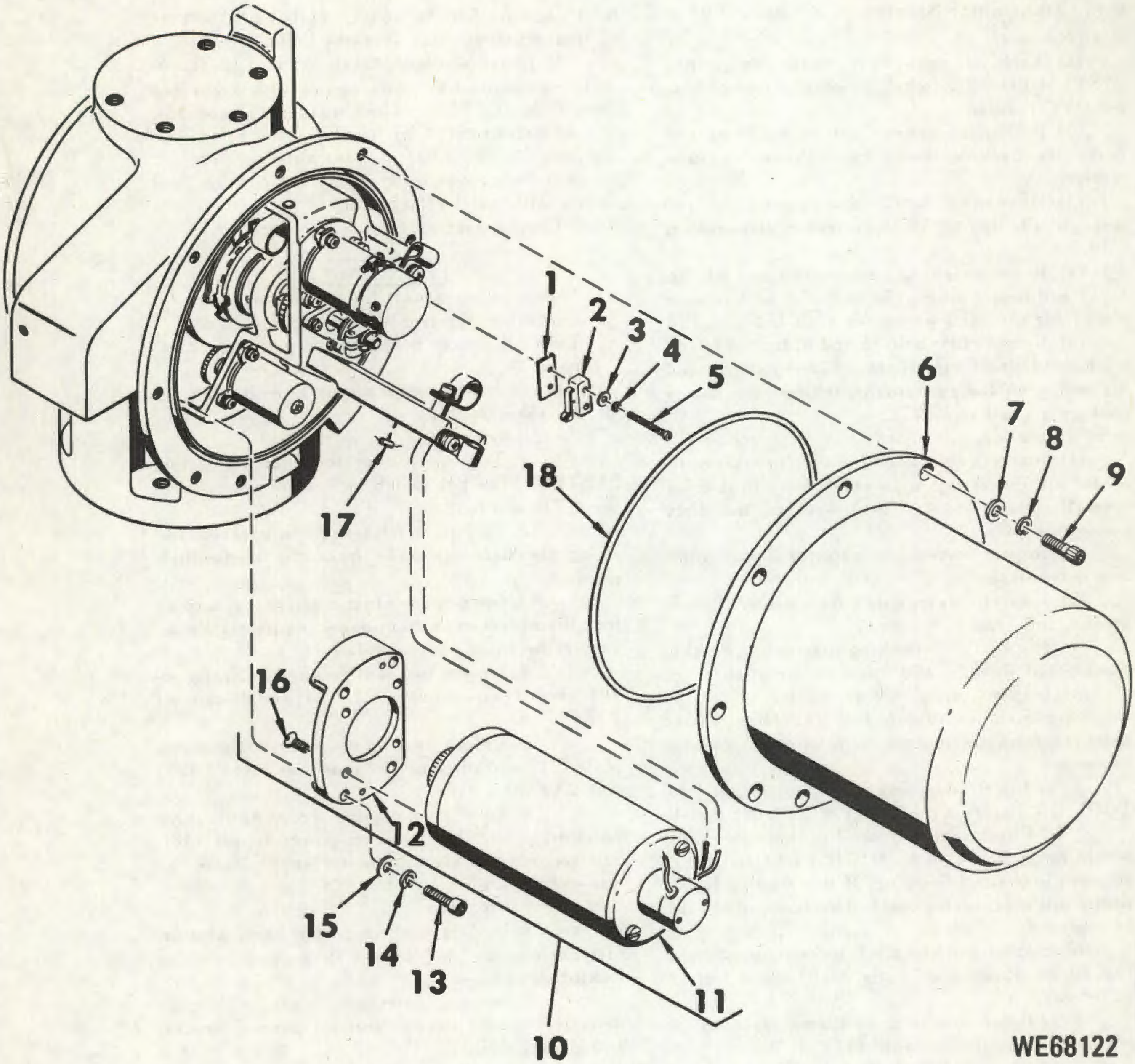
(g) Installation of traverse servo drive assembly.

1. Install elevation stop arms (12 and 26, fig. 6-97) in reverse order of removal.

2. Install traverse servo drive assembly (17, fig. 6-97), preformed packing (25), and assembled rotary joint and rotary retainer (34 and 35, fig. 6-96) in reverse order of removal, paragraph 6-44d(10)(a)3. through 5. preceding.

3. In reverse order, perform removal procedures, paragraph 6-44a(5) through (8).

4. Install reflector and feed assembly as instructed in paragraph 6-44d(8)(d) preceding.



1 Spacer	7 Washer	13 Screw
2 Switch	8 Lock washer	14 Lock washer
3 Washer	9 Screw	15 Washer
4 Lock washer	10 Motor assembly	16 Screw
5 Screw	11 Motor pinion assembly	17 Diode
6 Traverse cover	12 Plate	18 Packing (O-ring)

Figure 6-100. Traverse servo drive assembly, partially exploded view.

6-45. Transmitter-Receiver RT-860/VPS-2.

a. Removal.

(1) Turn off power to radar by setting SYSTEM POWER switch on control assembly to the OFF position.

(2) Pull quick release pin on backrest and swing the backrest away from the transmitter-receiver.

(3) Disconnect four cable assemblies (46 through 49, fig. 6-95) from transmitter-receiver (50).

(4) Remove eight cap screws (53 and 54, fig. 6-95) and lock washers (52 and 55), and remove waveguide (56) and waveguide seals (51 and 12).

(5) Remove four bolts (5 and 6, fig. 6-94) and washers (4) from base of transmitter- receiver and lift unit from the gun mount, taking care not to damage ground strap (7).

b. Inspection.

(1) Inspect cable assemblies for breaks, worn spots, and deterioration in insulation; broken or cracked connectors; and bent, broken, and dirty connecting pins.

(2) Inspect waveguide seals for deformation and deterioration.

(3) Inspect waveguide for dents, holes, breaks, and cracks.

(4) Inspect all attaching parts for breaks, cracks, bad threads, and other deformations.

(5) Inspect tuning tool as follows:.

(a) Remove tuning tool (27, fig. 6-101, sheet 1) from its mount on microwave chassis assembly.

(b) Insert and press down tuning tool into TOOL GA fixture on AN/TPM-23 front panel.

(c) Check that pointer of tuning tool reads within range indicated by HIGH FREQ lettering adjacent to channel 6 setting. If this reading is not within this area, tuning tool is defective and should be replaced.

(6) Inspect and clean RF (crystal) oscillators (28, 30, 31, 32, 33 and 35, fig. 6-101, sheet 1 of 4) as follows:

(a) Remove crystal oscillator installed in microwave chassis assembly (11).

(b) Clean sides of crystal oscillator from bottom (plug end) up approximately ½ inch using fine abrasive (flint) paper, Spec P-P-105 *b*. Remove all superficial scratches and abrasive dust.

(c) Apply a thin coat of Silicone compound, MIL-S-86608 (Dow Corning 4 compound), to the cleaned surface, and install crystal oscillator into microwave chassis assembly (11).

(d) Apply the same procedures to clean the remaining five crystal oscillators stored in the transmitter-receiver front panel assembly.

c. Installation.

(1) Set transmitter-receiver in gun mount, and assure that ground strap (7, fig. 6-94) is aligned with mounting hole.

NOTE

There are two different size bolts used to mount the transmitter-receiver.

(2) Install four mounting bolts (5 and 6, fig. 6-94), and washers (4), with long bolts (6) in rear of transmitter-receiver. Tighten bolts.

(3) Install waveguide seals (51 and 12, fig. 6-95), waveguide (56), and secure with eight cap screws (53 and 54), and lock washers (52 and 55).

(4) Connect four cable assemblies (46 through 49, fig. 6-95) to transmitter-receiver.

(5) Swing seat backrest into up position, and secure with quick-release pin.

d. Components of Transmitter-Receiver.

WARNING

Voltages dangerous to life are present in the transmitter-receiver when power is applied. Turn off power before opening the front panel.

(1) *Klystron power supply assembly (38, fig. 6-101, sheet 1 of 4).*

(a) Removal.

1. Turn off power to radar by setting SYSTEM POWER switch on control assembly to the OFF position.

2. Pull quick release pin on backrest and swing the backrest away from the transmitter-receiver.

3. Open transmitter-receiver by turning four thumbscrews on front panel counterclockwise. Lower the front panel carefully.

4. Loosen two captive screws (25, fig. 6-101, sheet 1) on connector P18 (24) and disconnect P18.

5. Unlock two screws (22) on interlock plate (21) and disconnect connectors 2A6P1 (23) and 2A1A3P4 (18).

6. Loosen six captive screws (36), three on either side of the klystron power supply (38), and remove the klystron power supply from the transmitter-receiver.

(b) Inspection.

1. Inspect connectors for bent, broken, dirty, or missing pins, broken shells, and defective locking devices.

2. Inspect interlock plate (21) for defective locking device, and for breaks, cracks, and deformation.

(c) Installation. Install the klystron power supply in the reverse order of removal. Exercise care to avoid crushing or breaking wires during the installation.

(2) *Mixer diodes (12 and 16, fig. 6-101, sheet 1 of 4).*

(a) Removal and installation.

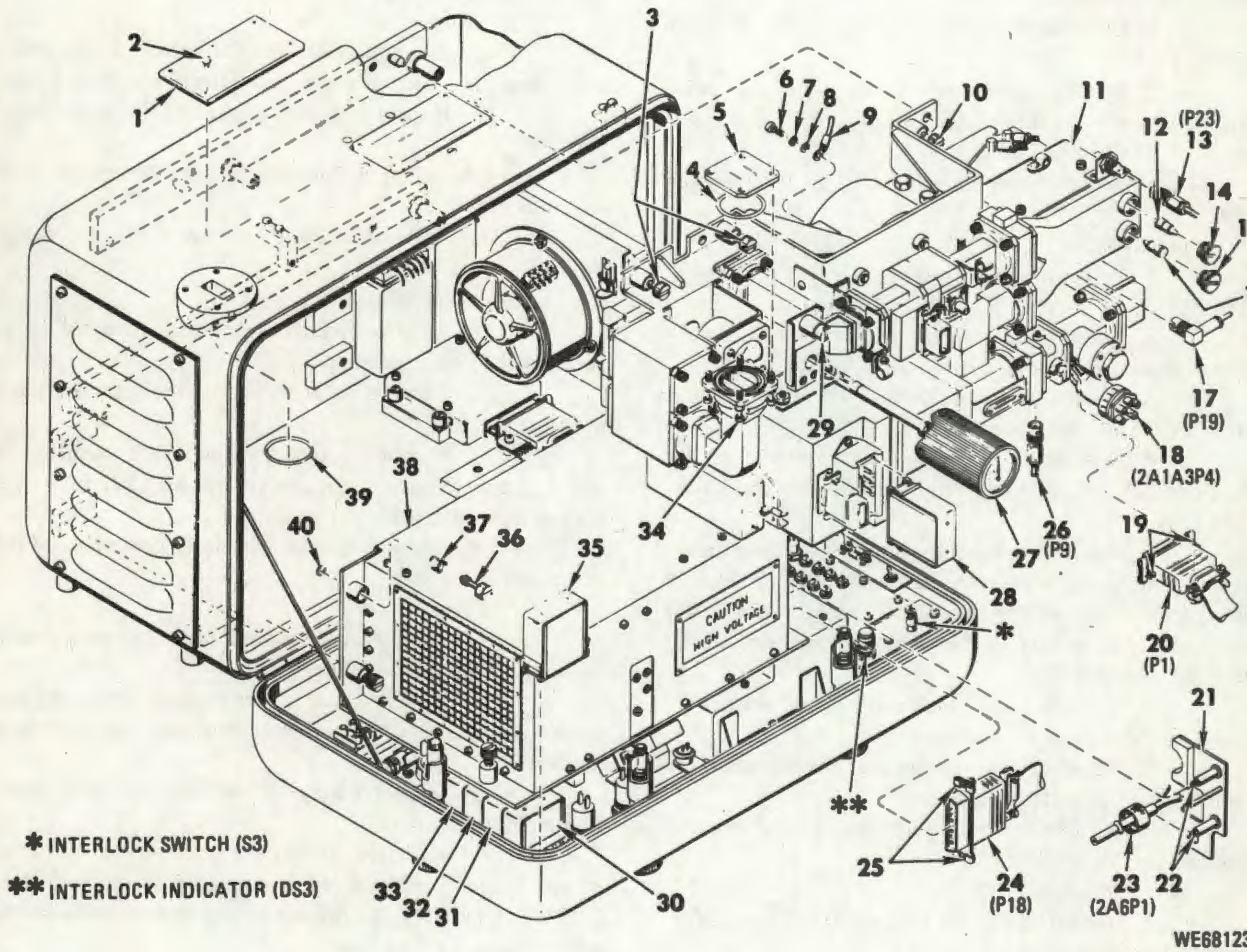
1. Perform procedures in (1)(a) 1. through 3. preceding.

CAUTION

To avoid damage to mixer diodes, do not allow the diodes to contact any metal surface during removal or installation.

NOTE

Mixer diodes (12 and 16) must be replaced in matched pairs for proper operation of the transmitter-receiver.



1 Screw	11 Microwave chassis assembly	21 Interlock plate	31 Rf oscillator
2 Plate	12 Diode (A1A5CR1)	22 Lock screws	32 Rf oscillator
3 Captive screws	13 Connector P23	23 Connector 2A6P1	33 Rf oscillator
4 Waveguide seal	14 Cap	24 Connector P18	34 Captive screw
5 Waveguide seal	15 Cap	25 Lock screws	35 Rf oscillator
6 Screw	16 Diode (A1A5CR2)	26 Connector P9	36 Captive screw
7 Lock washer	17 Connector P19	27 Alignment tool	37 Helical spring
8 Flat washer	18 Connector 2A1A3P4	28 Rf oscillator	38 Klystron power supply assembly
9 Terminal lug	19 Lock screws	29 Screw	39 Waveguide seal
10 Captive screw	20 Connector P1	30 Rf oscillator	40 Retaining ring

Figure 6-101. Transmitter-receiver, partially exploded view - sheet 1 of 4.

2. Unscrew diode retaining cap (14) and note polarity of mixer diode(12).

3. Install replacement diode with the same polarity and screw cap into place.

4. Unscrew cap (15) and note polarity of mixer diode (16).

5. Install replacement diode with the same polarity and screw cap into place.

6. Close and lock front panel.

(3) *Microwave chassis assembly (11, fig. 6-101, sheet 1 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 5. preceding.

2. Loosen four captive screws (34) to disconnect waveguide from waveguide flange.

3. Loosen two captive screws (19) on connector P1 (20) and disconnect P1.

4. Disconnect three coaxial connectors P9 (26), P19 (17), and P23 (13) from microwave chassis assembly (11).

5. Using two men to support the microwave chassis assembly, loosen seven captive screws (3 and 10 typical) and withdraw the microwave chassis assembly far enough to permit access to the wire lead attached to the rear of the assembly.

6. Remove screw, lock washer, and washer (6, 7, and 8) and disconnect wire lead (9).

7. Remove the microwave chassis assembly fully from the transmitter-receiver.

8. Remove two waveguide seals (4 and 39), and waveguide seal, or window (5).

(b) Inspection.

1. Inspect waveguide seals (4 and 39) for deformation and deterioration.

2. Inspect waveguide seal (5) for deformation and deterioration, and for a broken or cracked window in the seal.

3. Inspect connectors for bent, broken, dirty, or missing pins, broken shells, and defective locking devices.

4. Inspect interlock plate (21) for defective locking device, and for breaks, cracks, and deformation.

5. Inspect wire lead (9) for loose terminal and crushed or split insulation.

(c) Installation. Install microwave chassis assembly in reverse order of removal, applying locking compound MIL-S-22473, Grade HV, to threads of screw (6) immediately before installing the screws.

(4) *Pulse shaper assembly (4, fig. 6-101, sheet 2 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 5. preceding.

2. Loosen two screws (5, fig. 6-101, sheet 2) on connector P17 (6) and disconnect P17.

3. Loosen three captive screws (3) and remove pulse shaper assembly (4).

(b) Inspection.

1. Inspect connectors for bent, broken, dirty, or missing pins, broken shells, and defective locking device.

2. Inspect fasteners (1, 2, and 3) for defective parts.

(c) Installation. Installation is in the reverse order of removal.

(5) *Static power inverter (10, fig. 6-101, sheet 2 of 4).*

(a) Removal.

1. Remove microwave chassis assembly as instructed in (3)(a) preceding.

2. Remove pulse shaper assembly as instructed in (4)(a) preceding.

3. Remove two screws and lock washers (11 and 12) and remove static power inverter (10) from rear wall of transmitter-receiver case.

4. Tag and remove wire leads connected to the static power inverter.

(b) Inspection.

1. Inspect as prescribed for microwave chassis assembly in (3)(b) preceding.

2. Inspect static power inverter for cracks and breaks in the case, the terminal strip, and the mounting brackets.

3. Inspect wiring for crushed and split insulation and loose terminals.

(c) Installation. Install the static power inverter in reverse order of removal, applying locking compound MIL-S-22473, Grade HV, to threads of screws (13) immediately before installing the screws.

(6) *Air conditioning filter (9, fig. 6-101, sheet 2 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 3. preceding.

2. Disengage two scissor clips (8) and open the cover over filter (9).

3. Push cable assembly aside and remove filter (9).

(b) Inspection. Inspect for accumulated dirt in area of filter and fan (17).

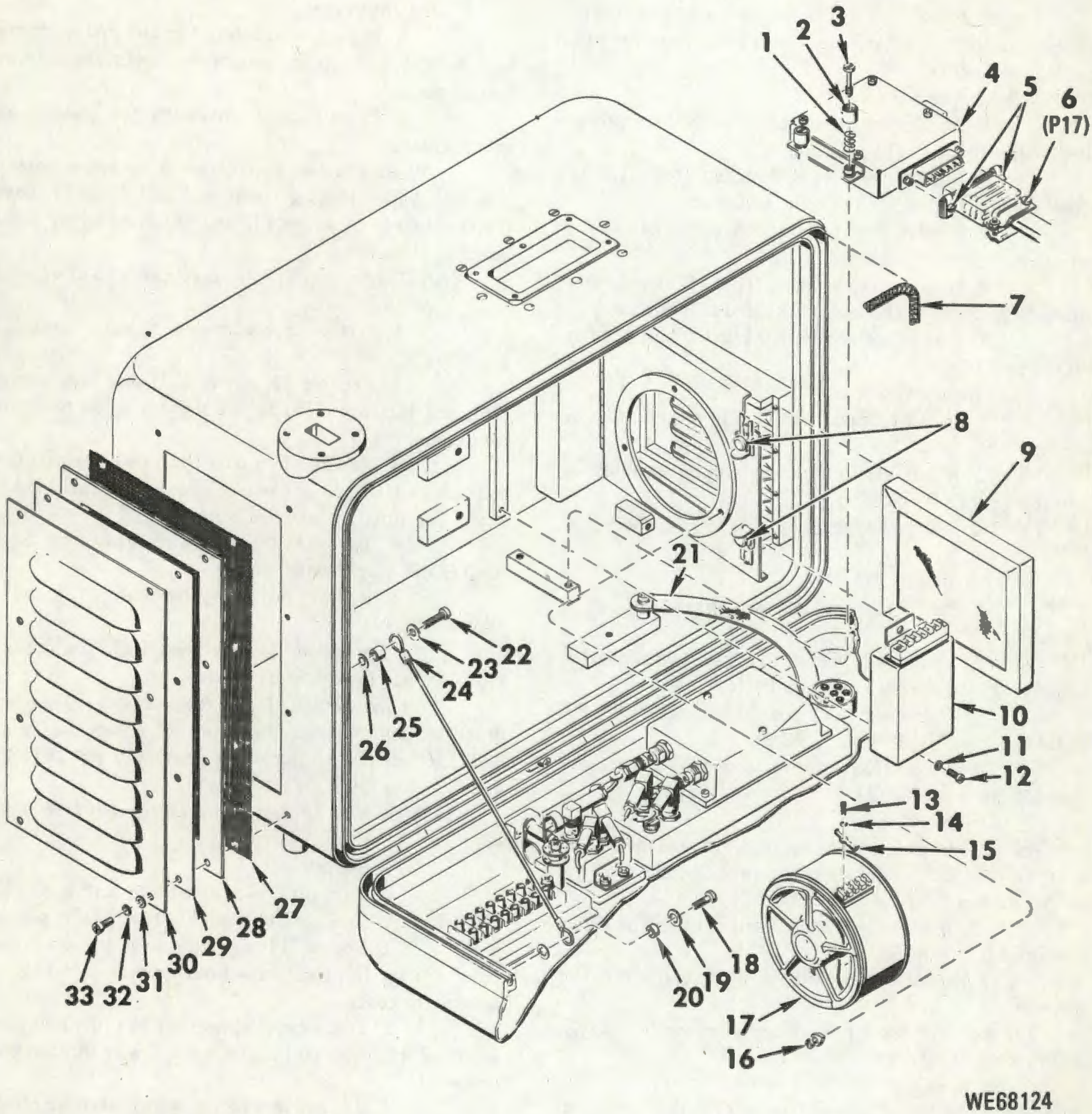
(c) Installation. Installation is in reverse order of removal.

(7) *Tubeaxial fan (17, fig. 6-101, sheet 2 of 4).*

(a) Removal.

1. Remove klystron power supply assembly as instructed in (1)(a) preceding.

2. Tag and remove wire leads from tubeaxial fan (17).



1 Spring	10 Static power inverter	18 Screw	26 Lock washer
2 Spacer	11 Lock washer	19 Washer	27 Wire fabric
3 Captive screw	12 Screw	20 Sleeve spacer	28 Gasket
4 Pulse shaper assembly	13 Screw	21 Ground strap	29 Louvre filter
5 Locking device	14 Washer	22 Screw	30 Metal louvre
6 Connector P17	15 Terminal	23 Washer	31 Washer
7 Electrical shielding gasket	16 Rim clenching clamp	24 Wire rope assembly	32 Lock washer
8 Scissor clips	17 Tubeaxial fan	25 Sleeve spacer	33 Screw
9 Air conditioning filter			

Figure 6-101. Transmitter-receiver, partially exploded view - sheet 2 of 4.

3. Loosen three screws in rim clenching clamps around base of fan, rotate the clamps away from the fan, and remove the fan.

(b) Inspection.

1. Inspect as prescribed for klystron power supply assembly in (1)(b) preceding.

2. Inspect wire leads detached from fan for loose terminals and crushed or split insulation.

3. Inspect terminal strip on tubeaxial fan for defective connecting hardware.

4. Inspect rim clenching clamps (16) and other attaching hardware for breaks, cracks, and deformation.

5. Inspect for accumulated dirt in area of filter (9) and fan (17).

(c) Installation.

1. Install tubeaxial fan (17) in reverse order of removal.

2. Install klystron power supply assembly as instructed in (1)(c) preceding.

(8) *Transmit gate assembly (3, fig. 6-101, sheet 3 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 3. preceding.

2. Loosen two screws to release two connector retainers (1) and remove connector P10 (2).

3. Disconnect four coaxial connectors P3, P7, P8 (not shown), and P24 (4, 5, and 8).

4. Loosen four captive screws (6) and remove transmit gate assembly (3).

(b) Inspection.

1. Inspect connectors for dirt and corrosion, bent, broken, and missing pins, broken shells, and defective locking device.

2. Inspect for broken, bent, or otherwise defective attaching hardware.

(c) Installation. Installation is in reverse order of removal.

(9) *Klystron beam power supply assembly (34, fig. 6-101, sheet 3 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 4. preceding.

2. Unlock two screws (22, fig. 6-101, sheet 1) on interlock plate (21) and disconnect connector 2A6P1 (23).

3. Remove screw (74, fig. 6-101, sheet 3) lock washer (73), washer (72), loop clamps (71 and 69), and spacer (70) to detach cable of klystron beam power supply (34) from front panel of transmitter-receiver.

4. Disconnect connector P4 (37) from klystron beam power supply (34).

5. Remove six screws and lock washers (35 and 36) and remove klystron beam power supply (34).

(b) Inspection.

1. Inspect connectors for dirt and corrosion, bent, broken, and missing pins, broken shells, and defective locking device.

2. Inspect cable assemblies for crushed and split insulation.

(c) Installation. Installation is in reverse order of removal. Apply locking compound MIL-S-22473, Grade HV, to threads of screws (35 and 74) immediately before installing the screws.

(10) *Toggle switch (9, fig. 6-101, sheet 3 of 4).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 3. preceding.

2. Remove 12 screws (27) and lock washers (26), and lift cover (13) to one side for access to component assembly (11).

3. Remove two nuts (83), lock washers (84), and screws (10) and lift out component assembly (11) to extent permitted by attached wiring.

4. Tag and unsolder wire leads from SERV RAD CONT toggle switch S6 (9).

5. Remove attaching hardware (12) and remove switch (9).

(b) Inspection. Inspect wire leads for defective insulation and broken wire strands.

(c) Installation. Install toggle switch (9) in reverse order of removal, applying locking compound MIL-S-22473, Grade HV, to threads of screws (11 and 26) immediately before installing the screws.

(11) *60-MHz local oscillator (5, fig. 6-101, sheet 4 of 4).*

(a) Removal.

1. Turn off power to radar by setting SYSTEM POWER switch on control assembly to the OFF position.

2. Loosen 11 captive screws (6) on housing cover (7) on front of transmitter-receiver case (11) and remove the cover.

3. Disconnect connector P21 (10) from power splitter Z1(12) and pull connector and wire through grommet.

4. Tag and unsolder all wire leads from 60-MHz local oscillator (5).

5. Remove four nuts (4), lock washers (3) and 60-MHz local oscillator (5).

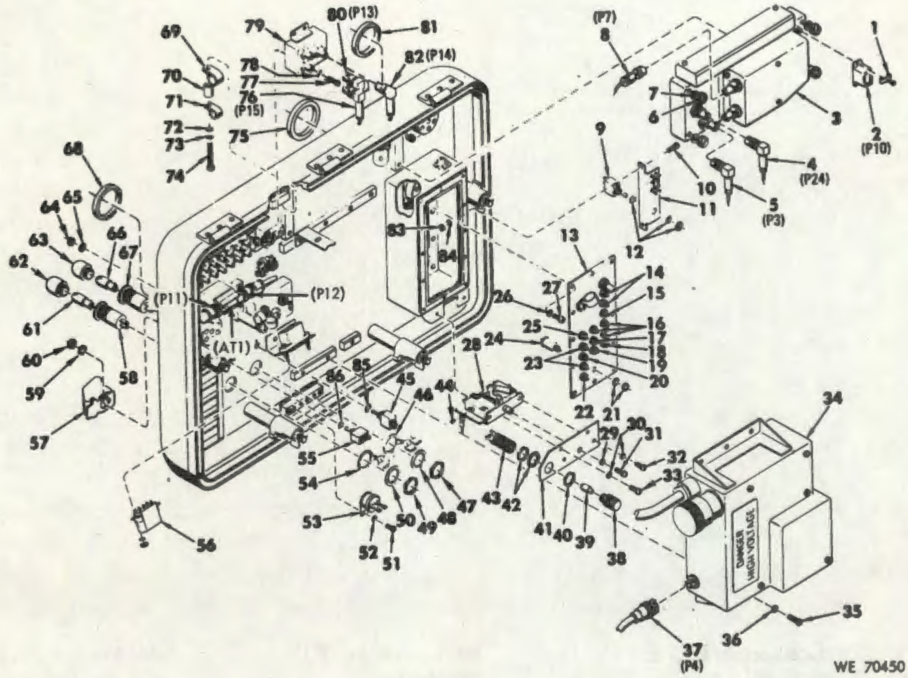
(b) Inspection.

1. Inspect all wire for defective insulation and broken wire strands.

2. Inspect connector for dirt and corrosion, broken and bent parts, and defective locking device.

(c) Installation. Installation is in the reverse order of removal.

(12) *Spark gap in klystron beam power supply assembly (3, fig. 6-102).*

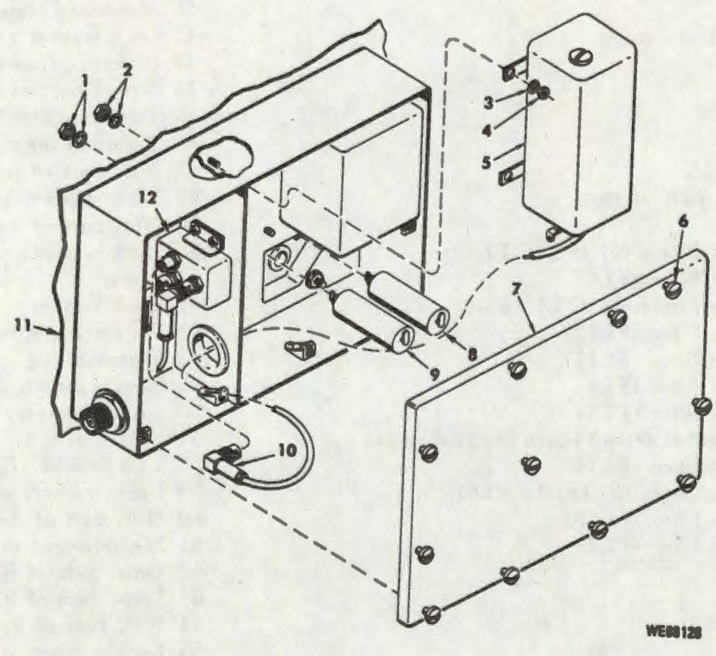


1 Connector retainer
2 Connector P10
3 Transmit gate assembly
4 Connector P24
5 Connector P3
6 External relieved body screw
7 Washer
8 Connector P7
9 Toggle switch
10 Screw
11 Component assembly
12 Nut and washers, part of item 9
13 Cover
14 Radio interference filters (2) (FL8 / FL10)
15 Radio interference filter (FL6)
16 Radio interference filters (3) (FL1 / FL13 / FL7)
17 Radio interference filter (FL12)
18 Radio interference filter (FL11)
19 Radio interference filter (FL4)
20 Radio interference filter (FL5)
21 Nut and washer, part of items 14 thru 20, 22 thru 25
22 Radio interference filter (FL14)
23 Radio interference filters (2) (FL3 / FL9)
24 Radio interference filter (FL15)
25 Radio interference filter (FL2)
26 Lock washer
27 Screw
28 Interlock switch (S3)
29 Nut
30 Lock washers (2)
31 Screw
32 Screw
33 Screw
34 Klystron beam power supply assembly
35 Screw
36 Lock washer
37 Connector P4
38 Lens, part of item 43
39 Incandescent lamp
40 Nut, part of item 43
41 Mounting plate
42 Lock washer and nut, part of item 43
43 Interlock (power) indicator
44 Screw, part of item 28
45 Toggle switch (S1)
46 Terminal lug
47 Nut, part of item 67
48 Lock washer, part of item 67
49 Nut, part of item 58
50 Lock washer, part of item 58
51 Screw
52 Lock washer
53 Thermostatic switch (S5)
54 Terminal lug
55 Toggle switch (S2)
56 Armature relay (K1)
57 Switch guard
58 Lampholder (DS2)
59 Lock washer, part of item 55
60 Nut, part of item 55
61 Incandescent lamp
62 Lens, part of item 58
63 Lens, part of item 67
64 Nut, part of item 45
65 Lock washer, part of item 45
66 Incandescent lamp
67 Lampholder (DS1)
68 Gasket
69 Loop clamp
70 Sleeve spacer
71 Loop clamp

Figure 6-101. Transmitter-receiver, partially exploded view—sheet 3 of 4.

72 Washer
73 Lock washer
74 Screw
75 Gasket
76 Connector P15
77 Screw
78 Lock washer
79 Directional coupler
80 Connector P13
81 Gasket
82 Connector P14
83 Nut
84 Lock washer
85 Washer, part of item 45
86 Washer, part of item 55

Figure 6-101. Sheet 3 of 4 continued.



1 Nut and washer, part of item 8
2 Nut and washer, part of item 8
3 Lock washer
4 Nut
5 60-MHz local oscillator (2A3)
6 Captive screw, part of item 7
7 Housing cover
8 Radio interference filter (FL16)
9 Radio interference filter (FL17)
10 Connector P21
11 Transmitter-receiver case, front panel
12 Power splitter Z1

Figure 6-101. Transmitter-receiver, partially exploded view—sheet 4 of 4.

(a) Removal.

1. Perform procedures in (1)(a)1. through 3. preceding.

CAUTION

When removing, inspecting, and / or replacing spark gap, do not handle glass area of the spark gap; handle only the metal ends of the spark gap.

2. Remove cap (1), preformed packing (2), and spark gap (3).

(b) Inspection. Inspect preformed packing for deformation and deterioration.

NOTE

Prior to installation of the spark gap ((c) following) check for presence of DC-4 moisture sealing compound. If compound is present, clean spark gap and electrical cap and spark gap receiving cavities by wiping with a lint-free cloth.

(c) Installation. Install spark gap in reverse order of removal.

CAUTION

Do not attempt to operate radar set without the spark gap tube; extensive damage to the transmitter-receiver can result.

(13) *Diode in klystron beam power supply assembly (8, fig. 6-102).*

(a) Removal.

1. Perform procedures in (1)(a)1. through 3. preceding.

2. Remove six screws (35, fig. 6-101, sheet 3) and lock washers (36) and lift klystron beam power supply assembly (34) far enough to permit removal of access plate (6, fig. 6-102).

3. Remove two screws (4), lock washers (5), access plate (6), and insulator plate (7).

4. Note polarity of diode (8) and unsolder diode leads from standoff terminals.

(b) Inspection. Inspect insulator plate (7) for breaks and cracks, and inspect for cracked, loose, or bent standoff terminals.

(c) Installation. Install the diode in the reverse order or removal, being careful to avoid heat damage to the diode during soldering.

6-46. Receiver.

a. Removal.

(1) Assure distribution box arming connector (fig. 6-2) is removed.

(2) Rotate gun mount assembly for access to rack assembly that mounts receiver, range computer, and power supply units of the radar (fig. 6-10).

(3) De-energize radar by setting SYSTEM POWER switch, and GUN POWER switch on control assembly (fig. 6-1) to OFF.

(4) At distribution box (fig. 6-11), set NORM-STATIC-TEST switch to STATIC.

(5) Loosen, but do not remove, four cap screws (10, fig. 6-94) that secure the receiver (11) to the rack assembly.

(6) Remove step quick-release pins (6, fig. 6-10), raise step and secure in the up position with the step retainer.

(7) Remove rack-retaining quick release pins (8), and fold rack down to ~~its~~ service position.

NOTE

Refer to figure 6-95 for identification of receiver mating cable connectors.

(8) Remove five cable connectors (29 through 33, fig. 6-95) from receiver (28).

(9) Remove four cap screws (10, fig. 6-94) loosened in (4) preceding and two washers (8), and remove receiver (11).

b. Inspection. Inspect for the presence of any of the following conditions:

(1) Bent, broken, or missing connector pins.

(2) Cracks, breaks or punctures in the assembly.

(3) Damaged gaskets or seals.

c. Repair. Repair consists of replacement of receiver or worn gaskets (1 and 2, fig. 6-103).

d. Installation. Installation is in the reverse order of removal. Assure W110 ground strap (14, fig. 6-94) is installed as shown. Two washers (8, fig. 6-94) are installed between receiver and radar rack where W110 ground strap is not located.

6-47. Range Computer.

a. Removal.

(1) Assure distribution box arming connector (fig. 6-2) is removed.

(2) Rotate gun mount assembly for access to rack assembly that mounts receiver, range computer, and power supply units of the radar (fig. 6-10).

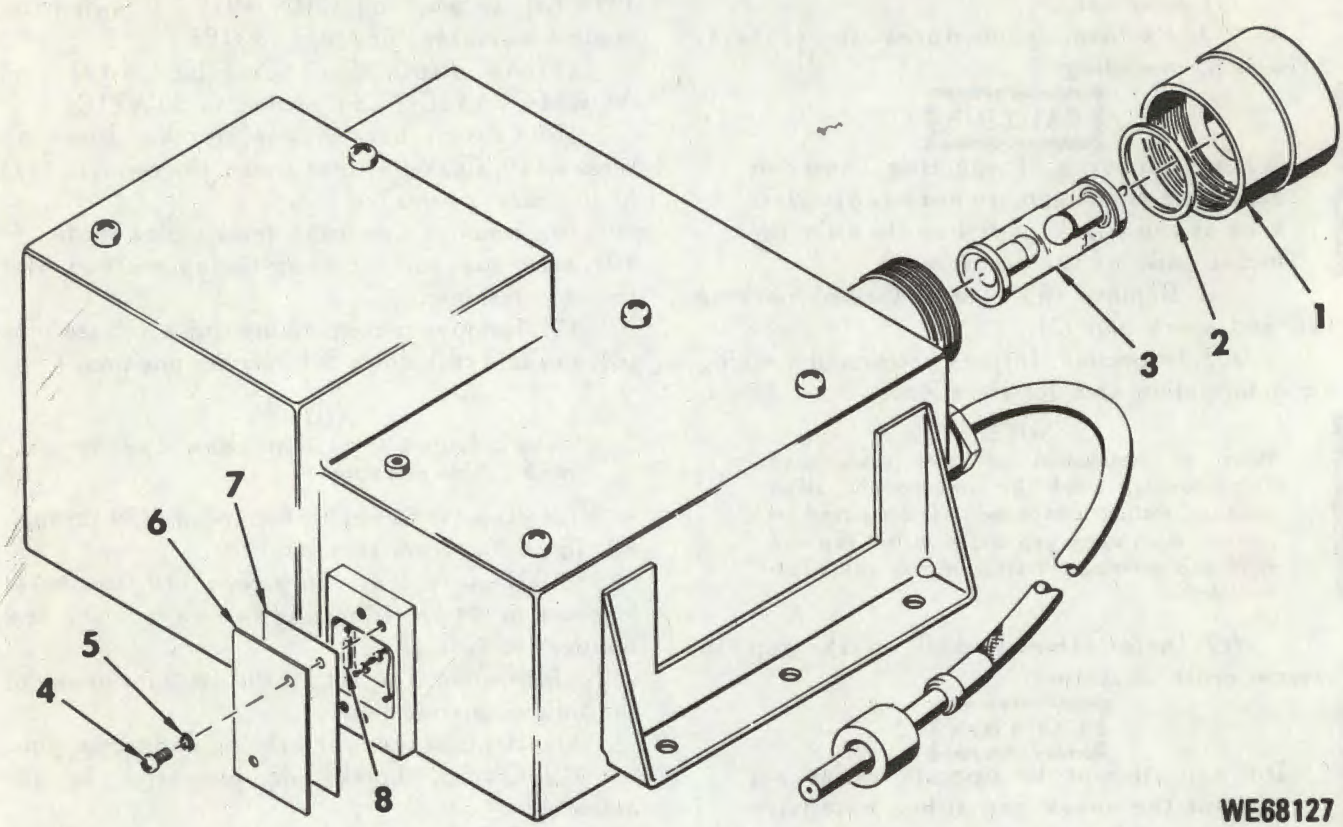
(3) De-energize radar by setting SYSTEM POWER switch and GUN POWER switch on control assembly (fig. 6-1) to OFF.

(4) At distribution box (fig. 6-11), set NORM-STATIC-TEST switch to STATIC.

(5) Loosen, but do not remove, front screws (10, fig. 6-94) that secure the range computer (12) to the rack assembly.

(6) Remove step quick-release pins (6, fig. 6-10), raise step and secure in the up position with the step retainer.

(7) Remove rack-retaining quick release pins (8, fig. 6-10) and fold rack down to its service position.



1 Electrical cap
2 Preformed packing
3 Spark gap
4 Screw
5 Lock washer
6 Access plate
7 Plate insulator
8 Diode semiconductor device

Figure 6-102. Klystron beam power supply assembly, exploded view.

NOTE

Refer to figure 6-95 for identification of range computer mating cable connectors.

(8) Remove four cable connectors (24 through 27, fig. 6-95) from range computer (23).

(9) Remove four screws (10, fig. 6-95) loosened in (5) preceding, and two washers (8), and remove range computer (12), taking care not to damage W110 ground strap (14).

b. Inspection. Loosen four front panel attaching thumbscrews (fig. 6-104), remove range computer cover, and inspect for the presence of any of the following conditions:

(1) Bent, broken, or missing connector pins.

(2) Cracks, breaks, or punctures in the assembly or any internal components.

(3) Burned, charred, or corroded internal wiring or components.

(4) Damaged gaskets or seals.

c. Disassembly.

NOTE

Disassembly shall be performed only to the extent required to accomplish the inspection, repair, or replacement of faulty items.

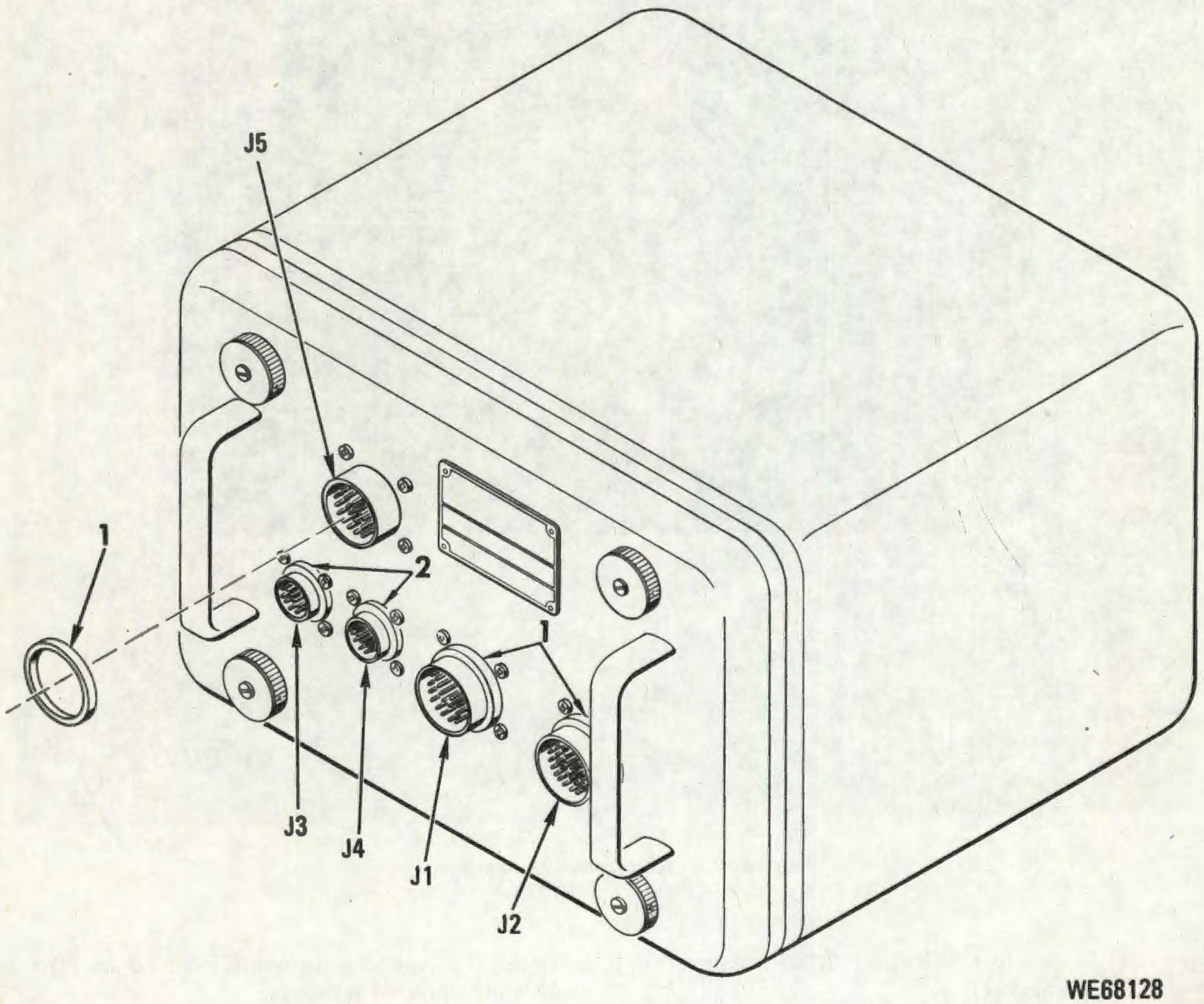
(1) Remove circuit card assemblies (1 through 7, 13, and 21 through 31, fig. 6-105, sheet 1) as follows:

(a) Loosen eight fasteners (17) and remove two rim clenching clamps (18).

(b) Remove card extractor (32) from storage location on side of chassis.

(c) Insert hooks on card extractor (32) into two holes located at top of the circuit card assembly to be removed. Pull card extractor gently to remove circuit card assembly.

(2) Remove circuit card assemblies (8, 9, and 12, fig. 6-105, sheet 1) as follows:



1 Gasket

2 Gasket

Figure 6-103. Receiver, unit 3, partially exploded view.

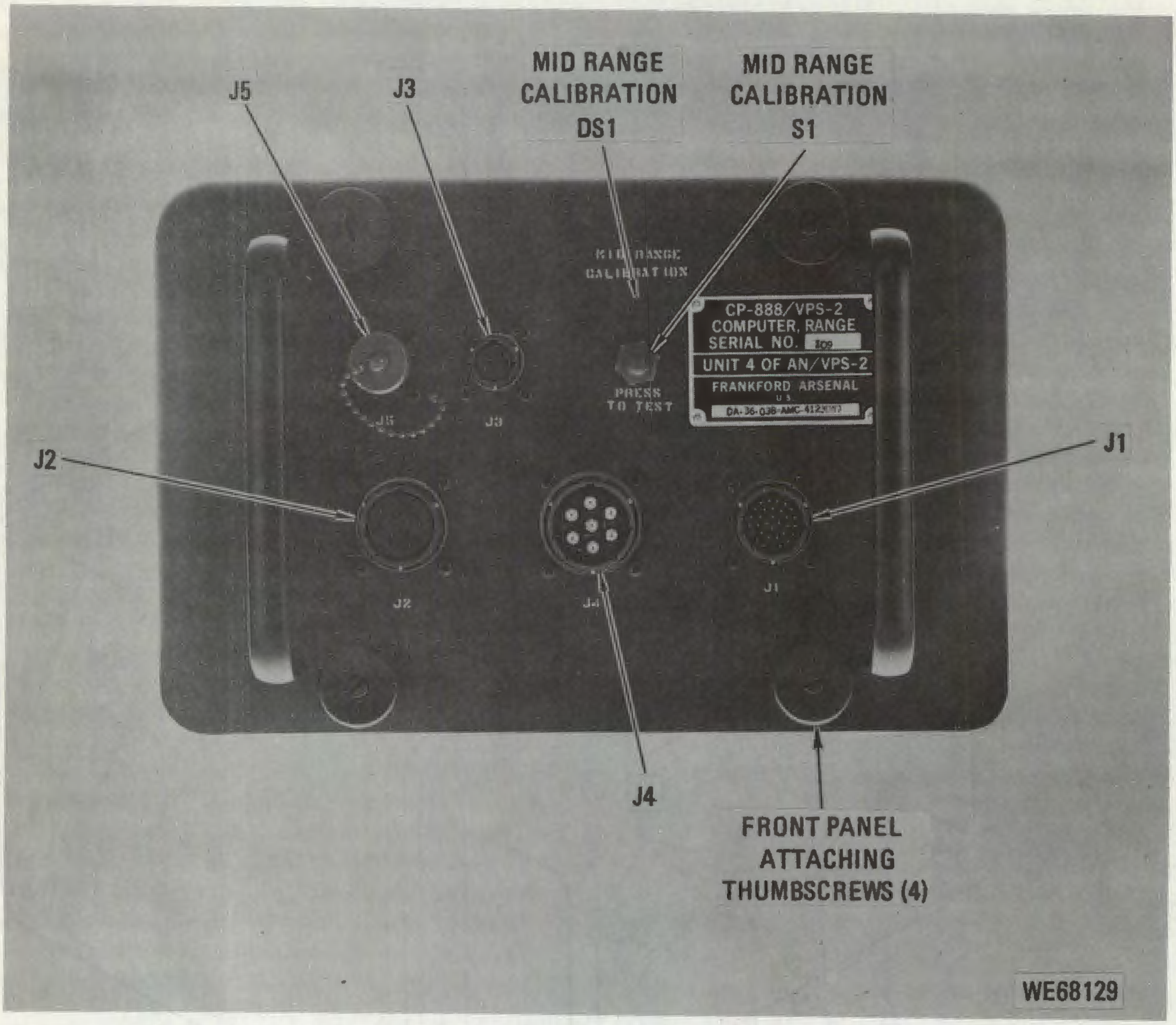


Figure 6-104. Range computer, front panel.

(a) Loosen four fasteners (10) and remove two rim clenching clamps (11).

(b) Using card extractor (32), insert hooks in circuit card assembly to be removed and pull gently.

(3) Remove master clock assembly (26, fig. 6-105, sheet 2) as follows:

(a) Remove connector P1 (25) from master clock assembly (26).

(b) Remove two nuts (15) and lock washers (14).

(c) Move master clock assembly (26) back so soldered components are more accessible.

(d) Tag wire leads and unsolder from master clock assembly (26).

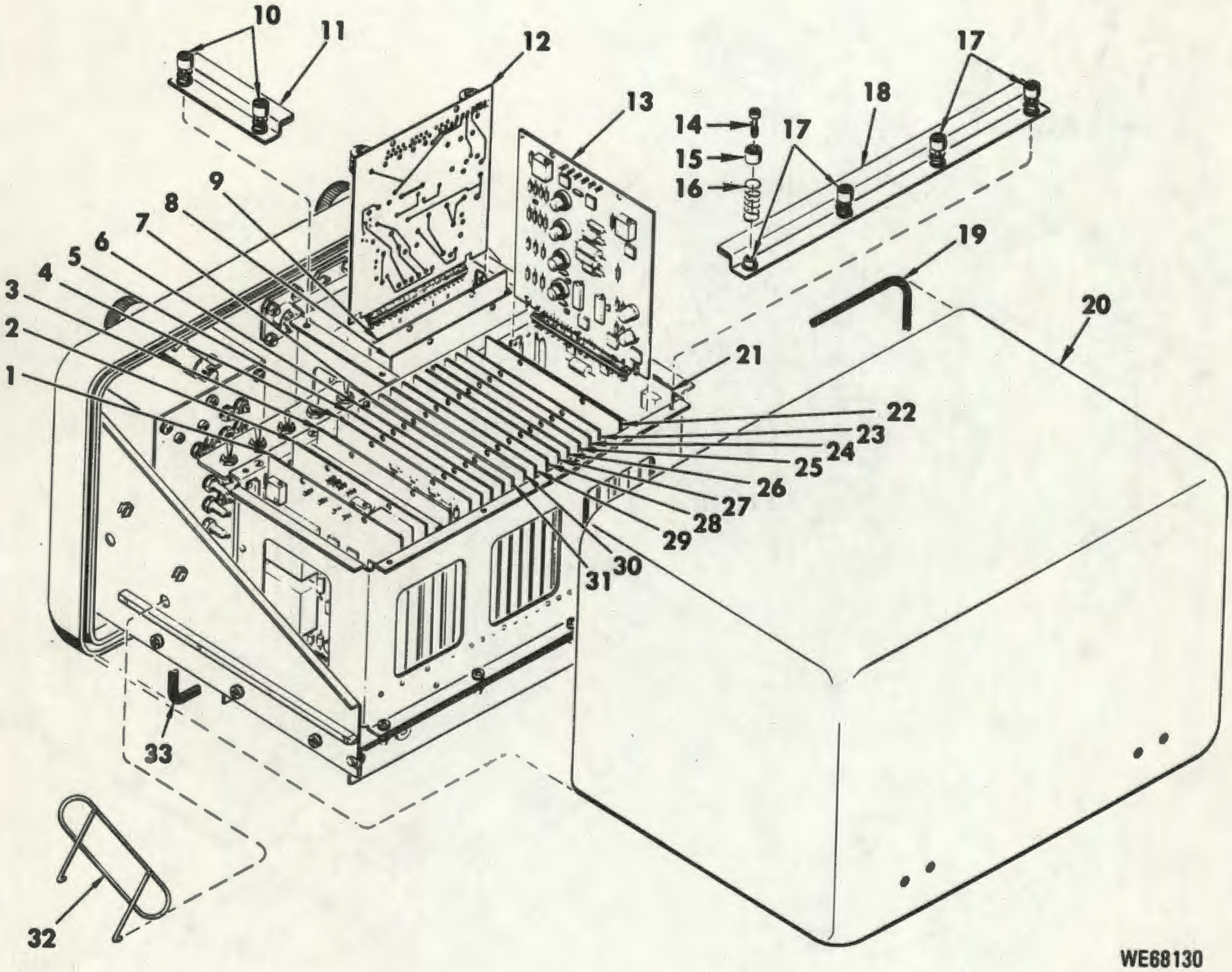
(4) To replace components mounted on plate assembly (13), proceed as follows:

CAUTION

Extreme care must be observed not to bend the pins underneath the circuit card slots.

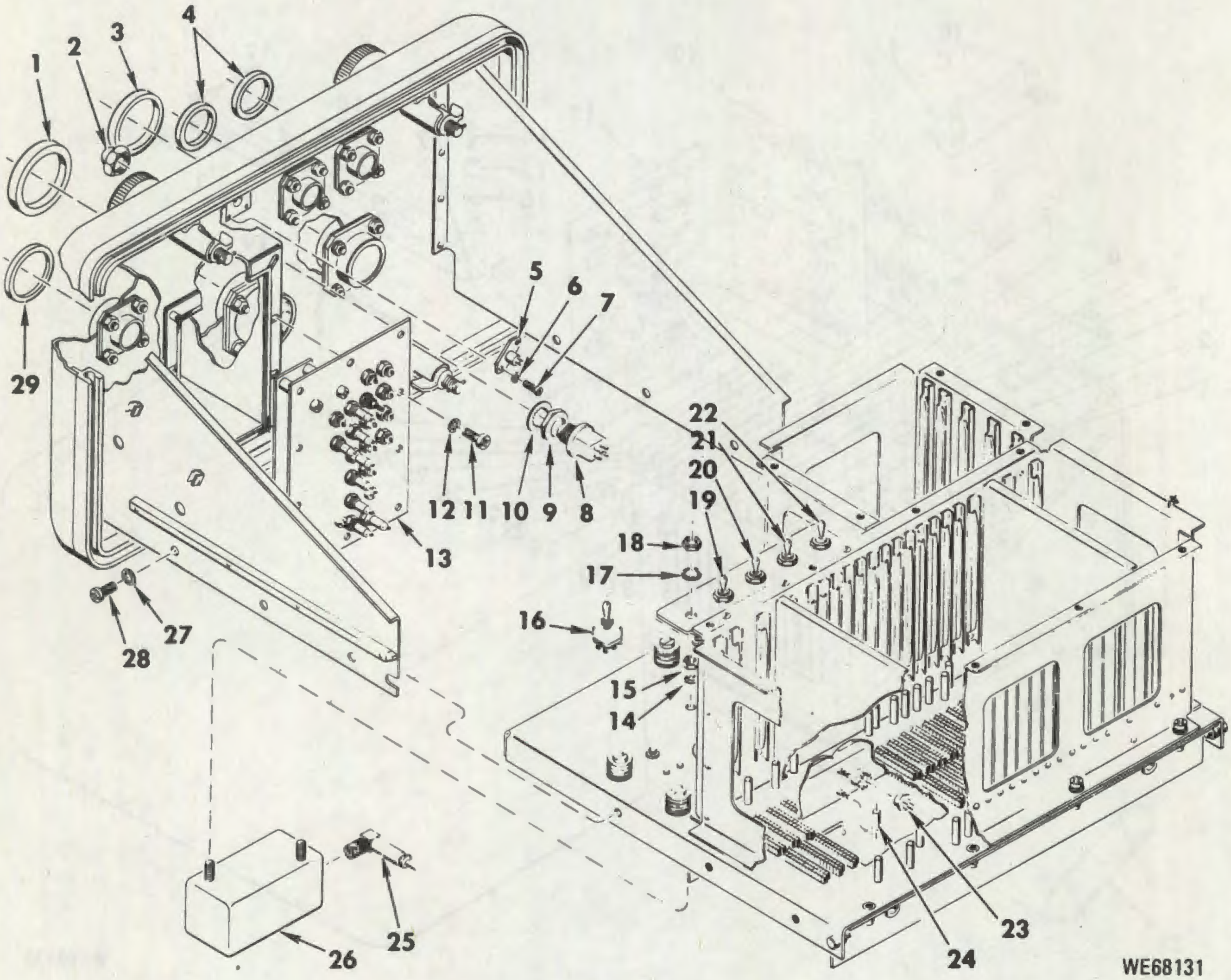
(a) Remove six screws (28), washer (27), and separate assemblies to limit of cabling using caution not to pull wires loose.

(b) Remove eight screws (11), washers (12), and plate assembly (13).



1 Range D/A converter assembly (A16)
2 Range rate D/A converter assembly (A17)
3 Modulator trigger generator assembly (A3)
4 RCFD generator assembly (A7)
5 RCFD decoder assembly (A5)
6 Range register B assembly (A9)
7 Range register A assembly (A8)
8 5 volt filter assembly (A18)
9 15 volt regulator assembly (A19)
10 Positive locking fastener
11 Rim clenching clamp
12 25 volt regulator assembly (A20)
13 Phase detector assembly (A15)
14 Screw (component of fastener)
15 Retainer (component of fastener)
16 Spring (component of fastener)
17 Positive locking fastener
18 Rim clenching clamp
19 Electrical shielding gasket
20 Range computer cover
21 Control amplifier assembly (A21)
22 Fine/fine delay assembly (A22)
23 Universal board assembly (A23)
24 Computer timing generator assembly (A4)
25 Rate integrator assembly (A14)
26 Search/track and gain control assembly (A10)
27 Rate scaler assembly (A13)
28 Range rate counter A assembly (A11)
29 Range rate counter B assembly (A12)
30 Pulse-repetition frequency counter assembly (A2)
31 Range counter assembly (A6)
32 Card extracter
33 Rubber seal

Figure 6-105. Range computer, partially exploded view - sheet 1 of 2.



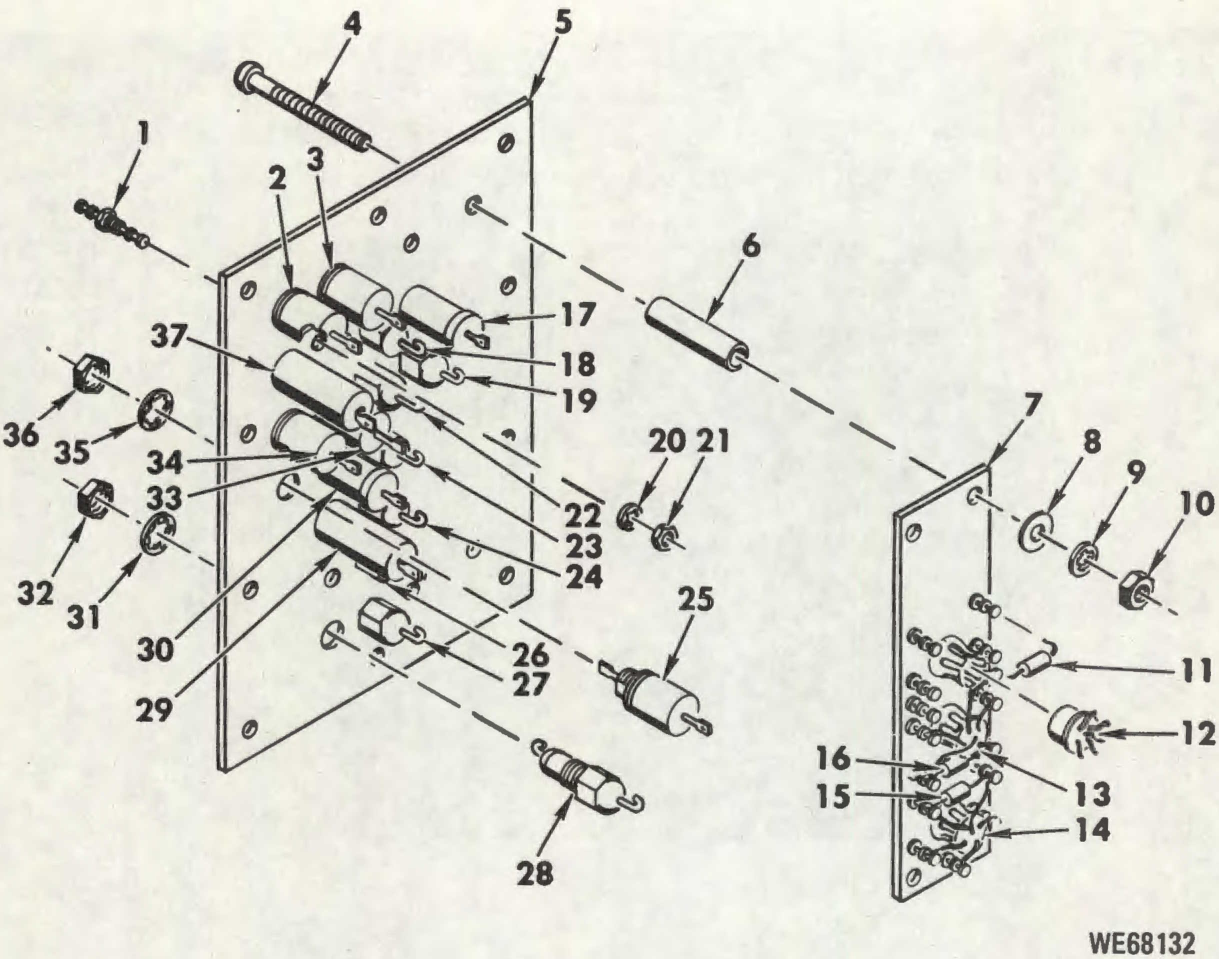
1 Gasket	9 Nut	16 Toggle switch (S6)	23 Relay K1
2 Dust seal boot	10 Lock washer	17 Lock washer	24 Diode (CR1)
3 Gasket	11 Screw	18 Nut	25 Connector P1
4 Gasket	12 Lock washer	19 Toggle switch (S5)	26 Master clock assembly (A1)
5 Light assembly (DS1)	13 Plate assembly	20 Toggle switch (S4)	27 Lock washer
6 Lock washer	14 Lock washer	21 Toggle switch (S3)	28 Screw
7 Screw	15 Nut	22 Toggle switch (S2)	29 Gasket
8 Push switch (S1)			

Figure 6-105. Range computer, partially exploded view - sheet 2 of 2.

(c) Remove nuts (10, fig. 6-106), lock washers (9), washers (8), sleeve spacers (6), screws (4), and component board (7).

d. Assembly. Assembly is in the reverse order of disassembly.

e. Installation. Installation is in the reverse order of removal. Assure W110 ground strap (14, fig. 6-94) is installed as shown. Two washers (8, fig. 6-94) are installed between range computer and radar rack where W110 ground strap is not located.



1 Terminal	13 Relay (K3)	23 Fixed capacitor (C1)	31 Lock washer
2 Radio interference filter (FL4)	14 Relay (K2)	24 Fixed capacitor (C7)	32 Nut
3 Radio interference filter (FL9)	15 Diode (CR2)	25 Radio interference filter (FL1)	33 Radio interference filter (FL7)
4 Screw	16 Diode (CR4)	26 Fixed capacitor (C4)	34 Radio interference filter (FL2)
5 Mounting plate	17 Radio interference filter (FL10)	27 Fixed capacitor (C5)	35 Lock washer
6 Sleeve spacer	18 Fixed capacitor (C3)	28 Fixed capacitor (C6)	36 Nut
7 Component board	19 Fixed capacitor (C17)	29 Radio interference filter (FL5)	37 Radio interference filter (FL3)
8 Washer	20 Lock washer	30 Radio interference filter (FL6)	
9 Lock washer	21 Nut		
10 Nut	22 Fixed capacitor (C2)		
11 Diode (CR3)			
12 Relay (K4)			

Figure 6-106. Plate assembly, exploded view.

6-48. Power Supply.

Repair of the radar power supply (15, fig. 6-10) consists of replacing the air filters, the gaskets, the servo electronics assemblies, the converter assembly, the inverter, the four relays, the six circuit breakers, the fan, and the radio frequency interference (RFI) box assembly filters, capacitors, and thermostatic switch.

a. Removal.

(1) Verify that distribution box arming connector (fig. 6-2) is disconnected.

(2) Rotate gun mount assembly for access to rack assembly that mounts receiver, range computer, and power supply (fig. 6-107) units of the radar.

(3) De-energize radar by placing SYSTEM POWER switch on control panel (fig. 6-1) to OFF.

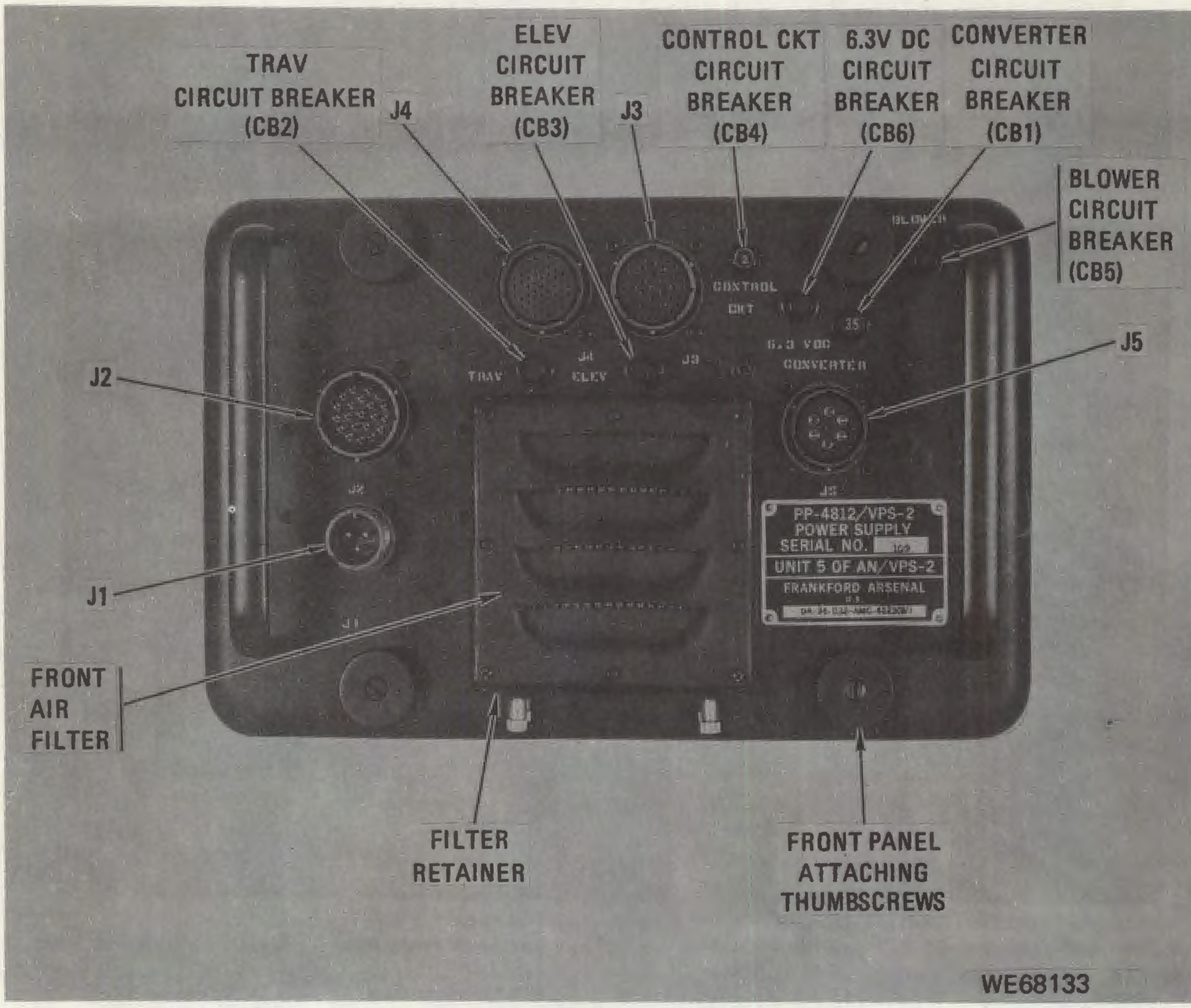


Figure 6-107. Power supply, front panel.

(4) Set GUN POWER switch on control panel to OFF. Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position.

(5) Before folding down rack assembly that mounts power supply, loosen, but do not remove the four bolts (10, fig. 6-94) that mount the power supply (13).

(6) Remove step quick-release pins (6, fig. 6-10); raise and lock step. Remove rack-retaining quick-release pins (8), and fold rack down to its service position.

NOTE

Refer to figure 6-95 for identification of power supply mating cable connectors.

(7) Disconnect five cable connectors (35 through 39, fig. 6-95) from power supply (34).

(8) Remove and retain four bolts (10, fig. 6-94) and two washers (8), that attach power supply (13) to rack assembly, and remove power supply from rack assembly, taking care not to damage W110 ground strap (14).

b. Inspection. Loosen four front panel attaching thumbscrews (fig. 6-107), remove power supply cover, and inspect for the presence of any of the following conditions:

(1) Bent, broken, or missing connector pins.

(2) Cracks, breaks, punctures, or corrosion.

(3) Freedom of operation of circuit breakers.

(4) Damaged filters and gaskets.

(5) Damaged, loose, or corroded internal components.

c. Disassembly.

NOTE

Refer to figures 6-108 (sheets 1, 2, and 3) and 6-109 for identification of power supply components.

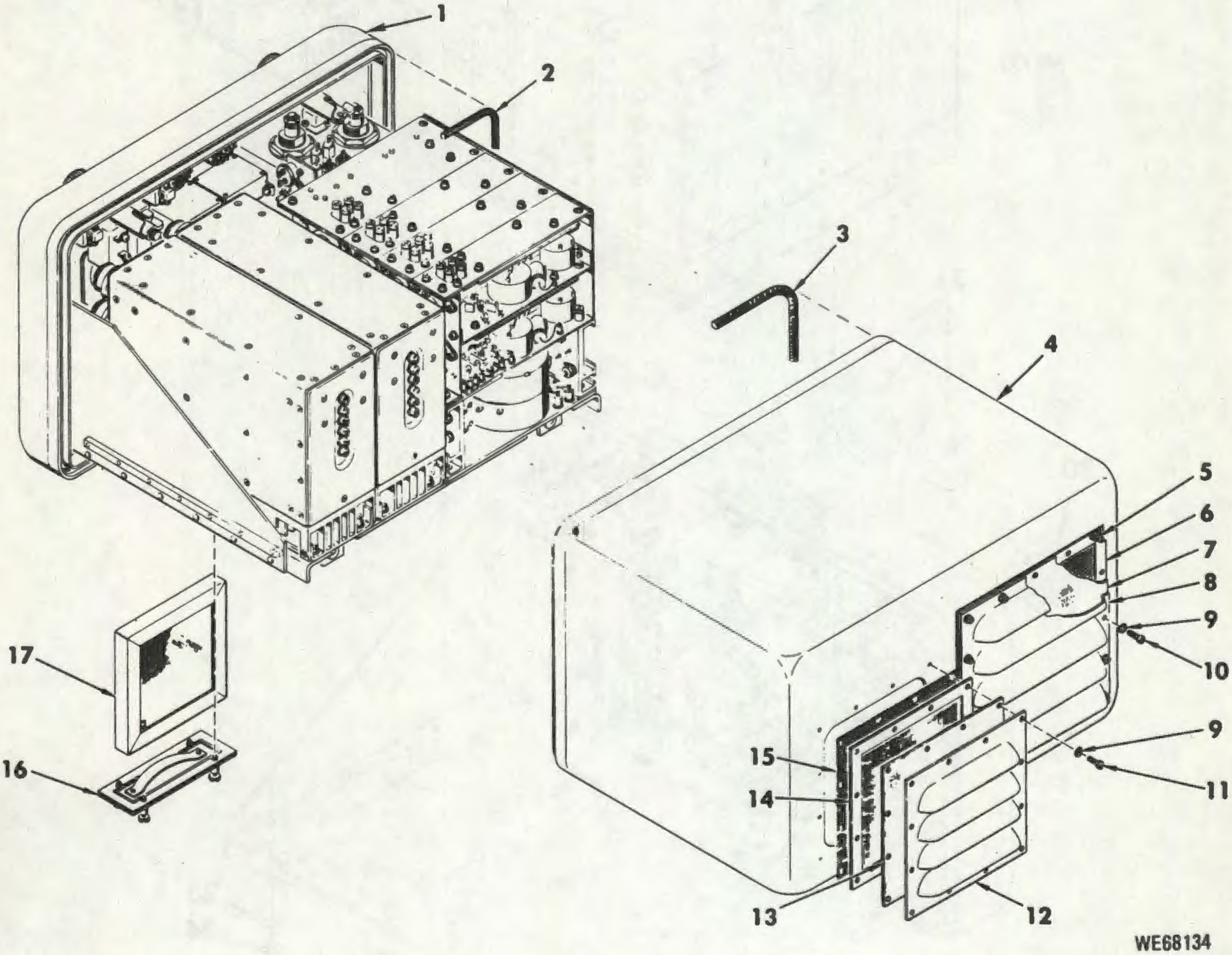
Replacement of power supply components is obvious by reference to figures 6-108 (sheets 1, 2, and 3) and 6-109. The following subparagraphs provide replacement procedures for items where the procedures may not be obvious.

(1) *Front air filter.*

NOTE

It is not necessary to remove the entire power supply to remove the front air filter. If the power supply has not already been removed, perform (1) through (3) of paragraph a. preceding, and proceed as follows.

(a) Turn four captive screws, components of filter retainer (16, fig. 6-108, sheet 1) that attach retainer to bottom of air filter box. Remove and retain retainer.



1 Front panel assembly	6 Gasket	10 Screw	14 Gasket
2 Gasket	7 Wire screen	11 Screw	15 Wire screen
3 Gasket	8 Louver plate	12 Louver plate	16 Filter retainer
4 Chassis cover	9 Lock washer	13 Filter	17 Front air filter
5 Wire screen			

Figure 6-108. Power supply, partially exploded view - sheet 1 of 3.

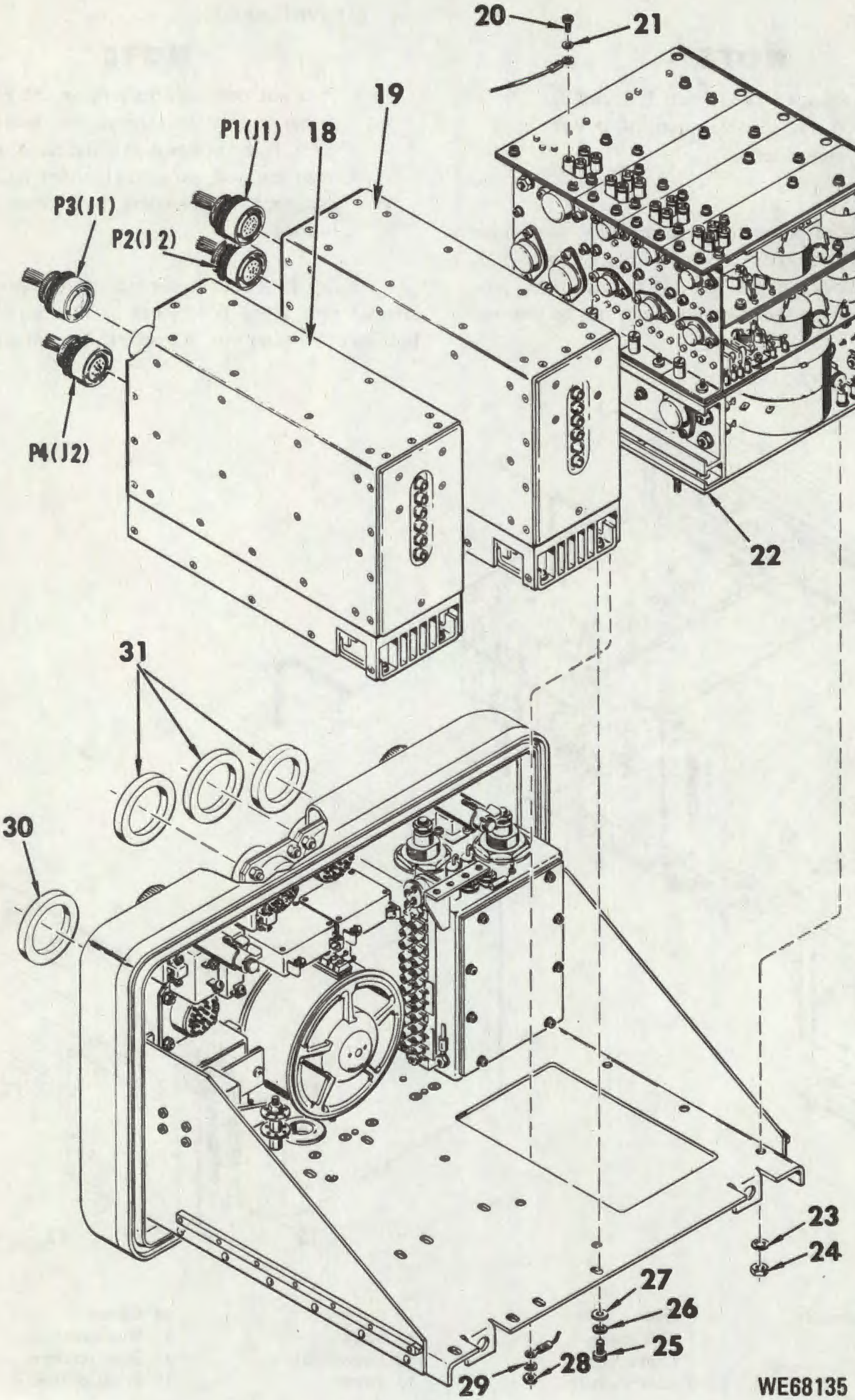
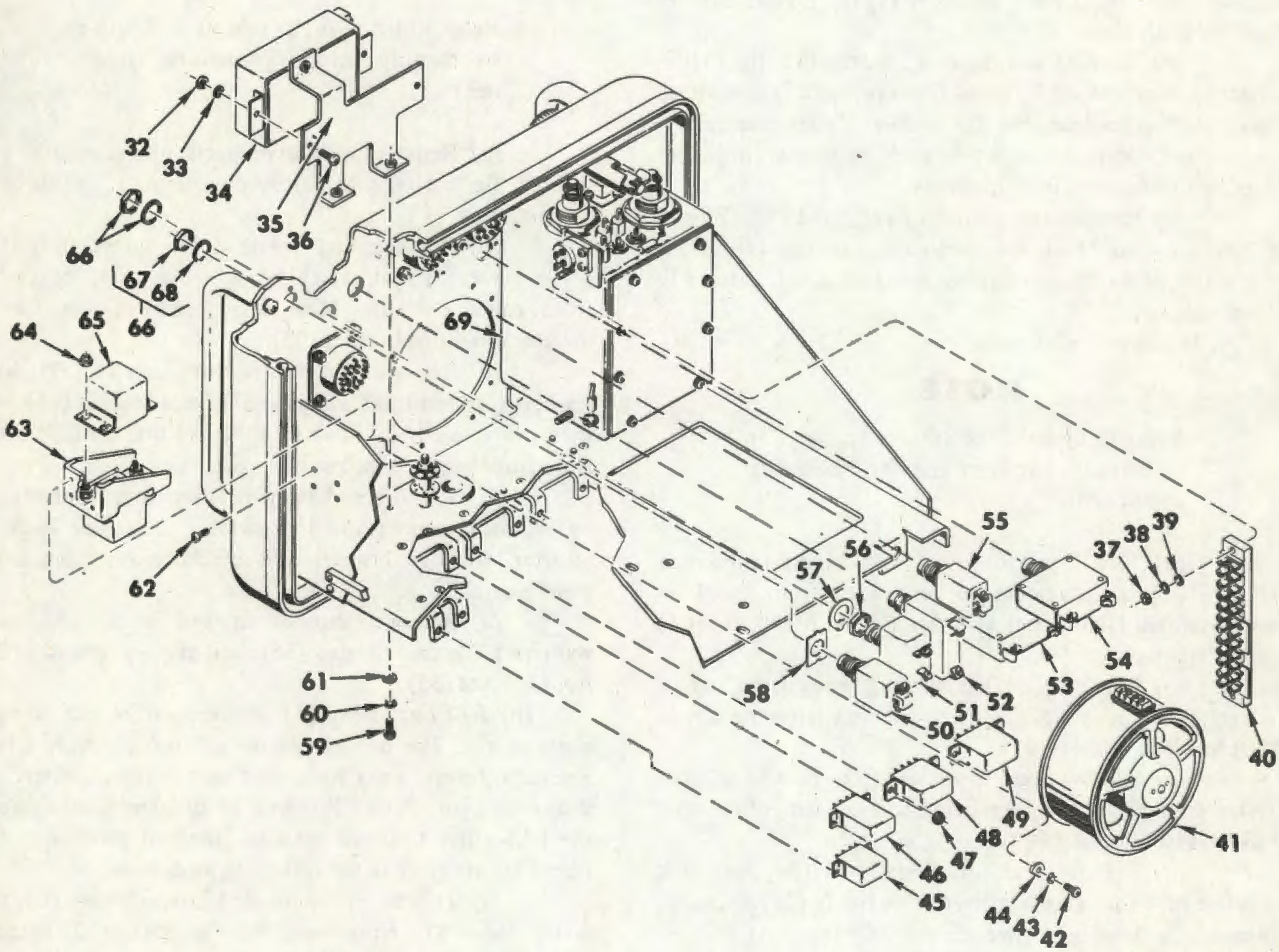


Figure 6-108. Power supply, partially exploded view - sheet 2 of 3.

18 Servo electronics assembly (A2)	23 Lock washer	28 Nut
19 Servo electronics assembly (A1)	24 Nut	29 Lock washer
20 Screw	25 Screw	30 Gasket
21 Washer	26 Lock washer	31 Gasket
22 Converter assembly	27 Washer	

Figure 6-108. Sheet 2 of 3 continued.



32 Nut	42 Screw	52 Circuit breaker (CB6)	62 Screw
33 Lock washer	43 Lock washer	53 Circuit breaker (CB3)	63 Bracket
34 Inverter	44 Clamp	54 Circuit breaker (CB2)	64 Nut
35 Bracket	45 Relay (K4)	55 Circuit breaker (CB4)	65 Relay (K3)
36 Screw	46 Relay (K5)	56 Nut	66 Circuit breaker attaching components
37 Nut	47 Nut	57 Keyed washer	67 Nut
38 Lock washer	48 Relay (K2)	58 Keyed washer	68 Lock washer
39 Washer	49 Relay (X1)	59 Screw	69 RFI box assembly
40 Terminal board	50 Circuit breaker (CB5)	60 Lock washer	
41 Fan (tubeaxial)	51 Circuit breaker (CB1)	61 Washer	

Figure 6-108. Power supply, partially exploded view - sheet 3 of 3.

(b) Using long-nose pliers, gently grip front air filter (17, fig. 6-108, sheet 1) and remove from housing.

(2) *Servo electronics assemblies.* The servo electronics assemblies A1 and A2 (19 and 18, fig. 6-108, sheet 2) are identical and interchangeable. The procedures given below apply to the removal of either servo electronics assembly.

(a) Turn four front panel attaching thumbscrews (fig. 6-107) counterclockwise to release front panel assembly. Slide front panel assembly (1, fig. 6-108, sheet 1) out of chassis cover (4).

(b) Remove and retain six screws (25, fig. 6-108, sheet 2), lock washers (26) and flat washers (27) that attach servo electronics assembly (18 or 19) to chassis assembly. Slide servo electronics assembly back on chassis to disconnect two connectors from assembly.

(c) Remove two connectors (P3 and P4 or P1 and P2) that connect to servo electronics assembly (18 or 19, fig. 6-108, sheet 2), and remove servo electronics assembly from chassis.

(3) *Converter assembly.*

NOTE

Refer to figure 6-108 (sheets 1, 2, and 3) to identify converter assembly mounting components.

(a) Turn four front panel attaching thumbscrews (fig. 6-107) counterclockwise to release front panel assembly. Slide front panel assembly (1, fig. 6-108, sheet 1) out of chassis cover (4).

(b) Remove and tag all wire leads from top of converter assembly (22) by removing and replacing screws (20) and lock washers (21).

(c) Remove four wire leads from bottom of converter assembly (22) by removing and replacing three nuts (28) and lock washers (29).

(d) Remove and retain six nuts (24) and lock washers (23) that attach converter assembly (22) to chassis assembly, and remove converter assembly from chassis.

(4) *Fan.*

NOTE

Refer to figure 6-108 (sheets 1, 2, and 3) to identify fan mounting components.

(a) Remove both servo electronics assemblies (18 and 19, fig. 6-108, sheet 2) by performing (2)(a) through (c) preceding.

(b) Remove converter assembly (22, fig. 6-108, sheet 2) by performing (3)(a) through (d) preceding.

(c) Remove and retain two nuts (37, fig. 6-108, sheet 3), lock washers (38), and flat washers (39) that attach terminal board (40) to side of the RFI box (69). Remove terminal board with wire leads attached for access to fan (41) mounting hardware.

(d) Loosen four screws (42) that attach clamps (44) and fan (41) to front panel assembly. Turn clamps and remove fan from front panel assembly.

(e) Remove and tag wire leads from fan (41) by removing screws and lock washers attaching leads to fan.

(5) *Inverter.*

NOTE

Refer to figure 6-108 (sheets 1, 2, and 3) to identify inverter mounting components.

(a) Remove both servo electronics assemblies (18 and 19, fig. 6-108, sheet 2) by performing (2)(a) through (c) preceding.

(b) Remove and retain four screws (62) (fig. 6-108, sheet 3) that attach relay bracket (63) to side of front panel assembly. Move relay bracket for access to inverter mounting bracket (35).

(c) Remove and retain three screws (59), lock washers (60), and flat washers (61) from bracket (35), and then move assembled inverter (34) and bracket (35) away from front panel for access to wiring.

(d) Remove and tag wire leads from inverter (34) by removing screws and lock washers attaching leads to inverter. Remove inverter and bracket (34) from front panel assembly.

(e) Remove and retain two nuts (32), lock washers (33), and screws (36), and remove inverter (34) from bracket (35).

(6) *RFI box assembly filters, capacitors, and thermostatic switch.* The procedures for removal of the RFI box assembly filters, capacitors, and thermostatic switch are shown in figure 6-109. Removal of all components except the FL6 filter (28) are obvious. Removal procedures for filter (31) are given in the following procedures.

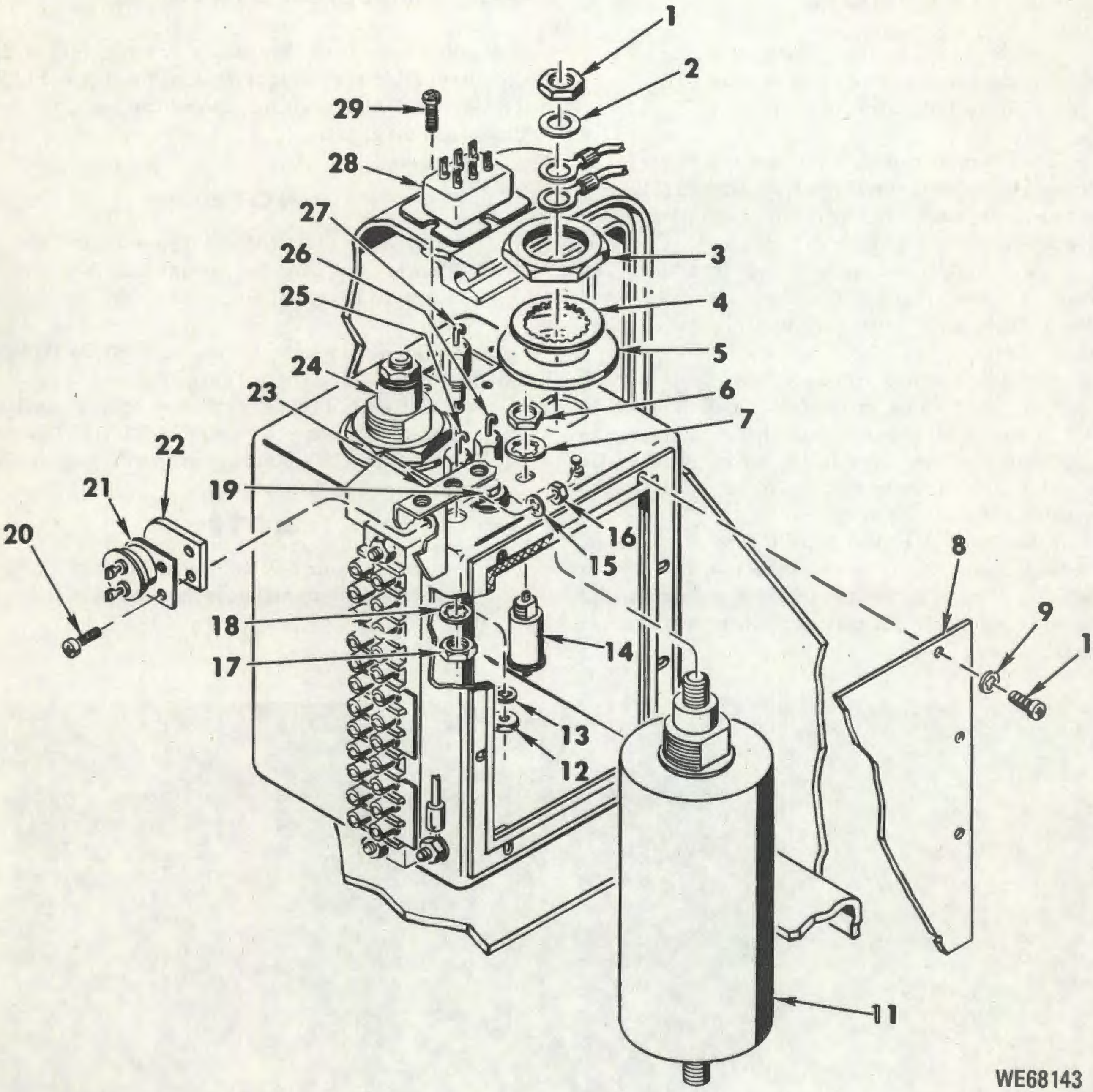
(a) To gain access to RFI box assembly (69, fig. 6-108, sheet 3), remove converter assembly (22) by performing (3)(a) through (d) preceding.

NOTE

Refer to figure 6-109 to identify the RFI box assembly components.

(b) Remove and retain eight screws (10, fig. 6-109), lock washers (9), and remove cover (8) from RFI box assembly.

(c) Remove and tag wire leads from front filter (11) by removing and replacing nuts (1) and lock washers (2). Then, remove and retain filter by removing and retaining nut (3), lock washer (4), and washer (5).



1 Nut	11 Filter (FL2)	21 Thermostatic switch (S1)
2 Washer	12 Nut	22 Insulator
3 Nut	13 Lock washer	23 Filter (FL5)
4 Lock washer	14 Filter (FL3)	24 Filter (FL1)
5 Washer	15 Lock washer	25 Capacitor (C1)
6 Nut	16 Nut	26 Capacitor (C2)
7 Lock washer	17 Nut	27 Capacitor (C3)
8 Cover	18 Lock washer	28 Filter (FL6)
9 Lock washer	19 Filter (FL4)	29 Screw
10 Screw	20 Screw	

Figure 6-109. Power supply RFI box assembly, exploded view.

NOTE

Filter FL1 (24, fig. 6-109) mounting components are the same as filter FL3 (14) mounting components.

(d) Remove and tag leads from rear filter (24) by removing and replacing nuts (1) and lock washers (2). Then, remove and retain rear filter by removing and retaining nut (3), lock washer (4), and washer (5).

(e) Unsolder and tag wire leads from filter (28). Remove and retain four nuts (12), lock washers (13), and screws (29), securing filter (28) to RFI box assembly. Remove filter (28).

d. Assembly. Assembly is the reverse of disassembly (c. preceding). Use locking compound (Grade HV, MIL-S-22473 or equivalent) to coat threads of all mounting screws (except captive screws) immediately before assembly. Do not coat threads of screws (62, fig. 6-108, sheet 3) when reassembling bracket (63) to chassis.

e. Installation. Installation is the reverse of removal (a. preceding). Assure W110 ground strap (14, fig. 6-94) is installed as shown. Two washers (8, fig. 6-94) are installed between power supply and radar rack where W110 ground strap is not located.

6-49. Distribution Box (Stow Control).

Repair of the radar distribution box (fig. 6-1) at the organizational level consists of replacing the MODE, ELEV, TRAV, and MAINT switches, the switch boots, the two diodes, and the gaskets.

a. Removal.

NOTE

Distribution box (fig. 6-110) can be removed with the gun mount assembly oriented in any position.

(1) De-energize radar by placing SYSTEM POWER switch on control panel (fig. 6-1) to OFF.

(2) Set GUN POWER switch on control panel to OFF. Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

NOTE

Refer to figure 6-95 for identification of distribution box mating cable connectors.

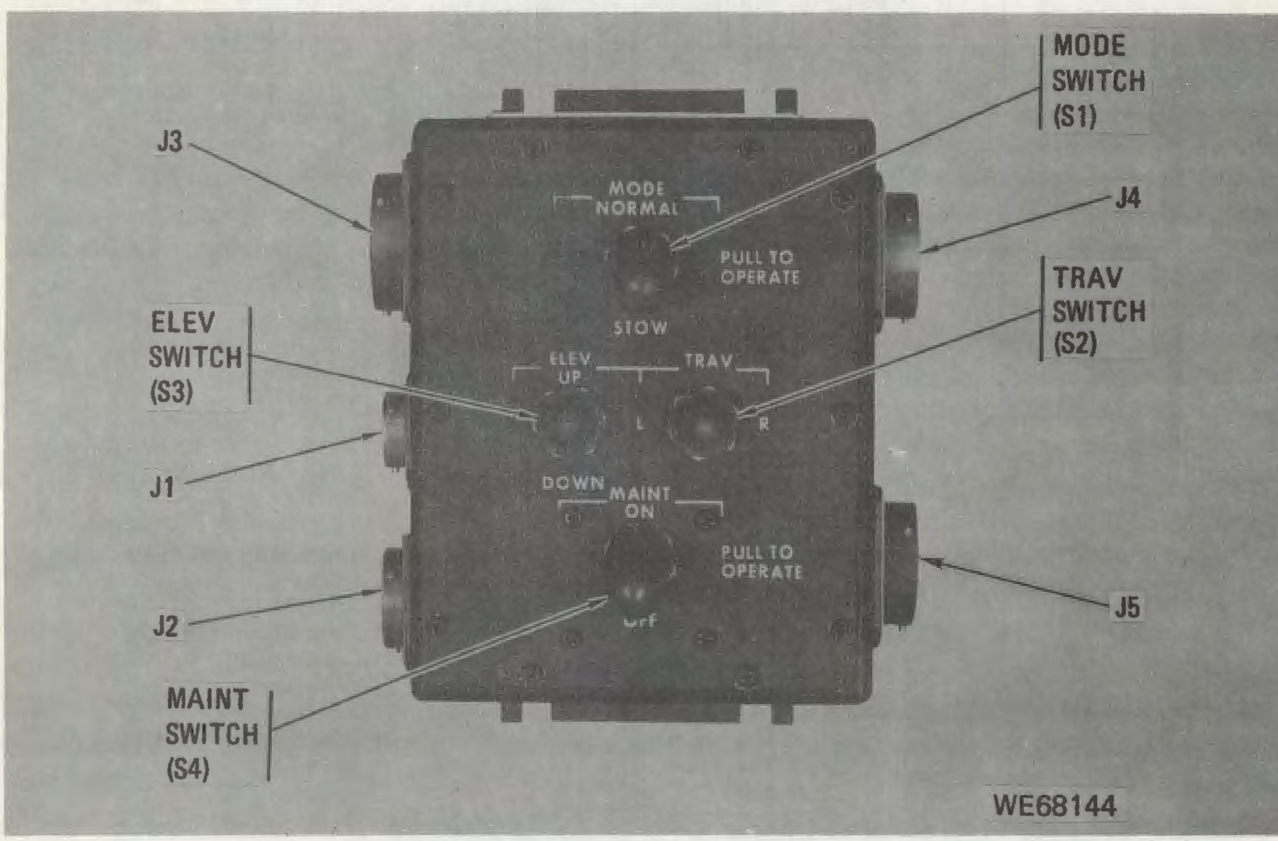


Figure 6-110. Distribution box, front panel.

(3) Disconnect five cable connectors (40, 41, 43, 44 and 45, fig. 6-95) from distribution box (42).

NOTE

Refer to figure 6-94 for identification of distribution box mounting components.

(4) Remove and retain four bolts (18, fig. 6-94), lock washers (17), and flat washers (16) that attach distribution box (15) to mount assembly, and remove distribution box from mount assembly.

b. Inspection. Inspect the distribution box for the presence of any of the following conditions:

(1) Bent, broken, or missing connector pins.

(2) Cracks, breaks, punctures, or corrosion.

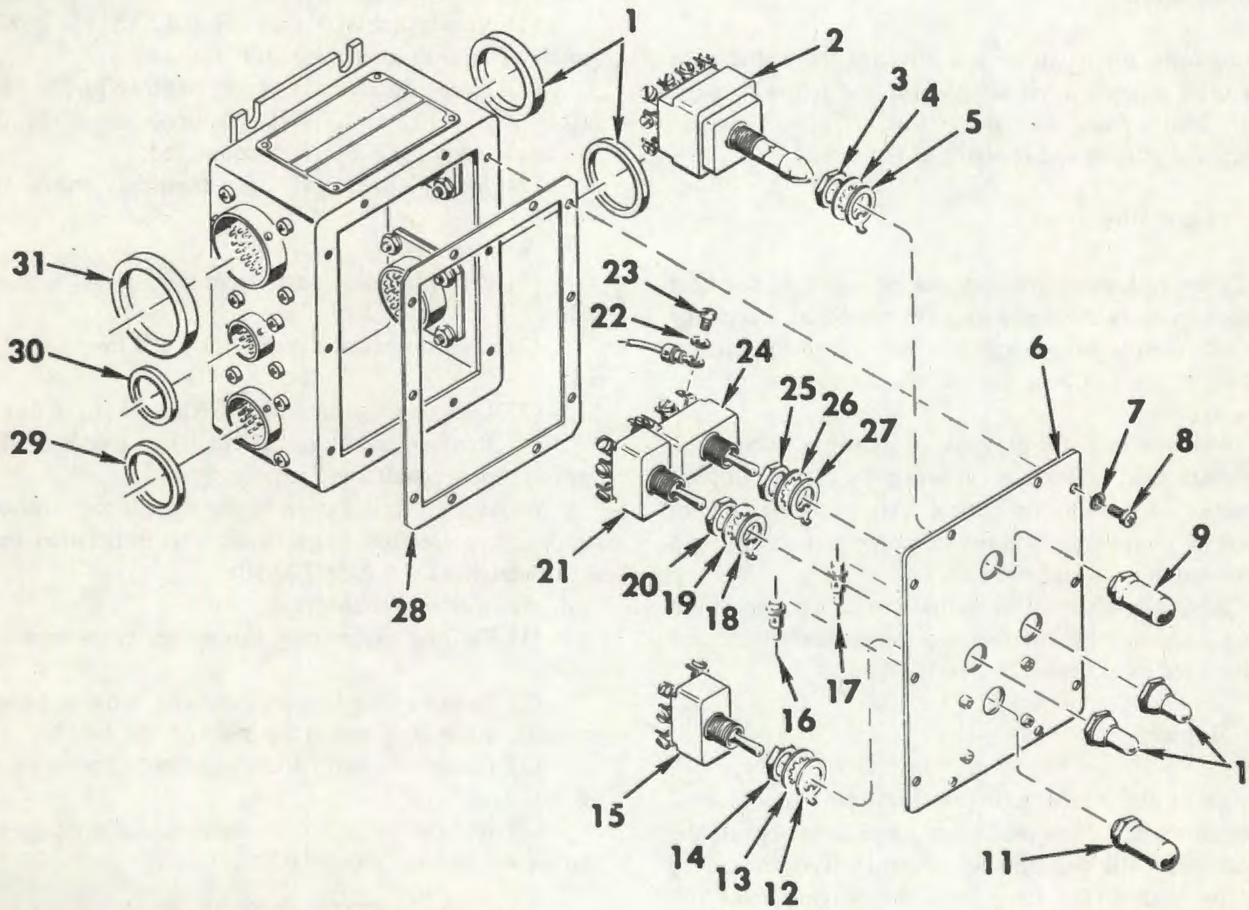
(3) Damaged or worn gaskets and switch boots.

(4) Freedom of operation of switches.

c. Disassembly.

NOTE

Refer to figure 6-111 for identification of distribution box components.



WE68145

1 Gasket	9 Boot	17 Diode (CR1)	25 Nut
2 "MODE" switch (S1)	10 Boot	18 Keyed washer	26 Lock washer
3 Nut	11 Boot	19 Lock washer	27 Keyed washer
4 Lock washer	12 Keyed washer	20 Nut	28 Gasket
5 Keyed washer	13 Lock washer	21 "ELEV" switch (S3)	29 Gasket
6 Cover	14 Nut	22 Washer	30 Gasket
7 Washer	15 "MAINT" switch (S4)	23 Screw	31 Gasket
8 Screw	16 Diode (CR2)	24 "TRAV" switch (S2)	

Figure 6-111. Distribution box, exploded view.

Replacement of distribution box components is obvious by reference to figure 6-111. The following subparagraphs provide replacement procedures for items where the procedures may not be obvious.

(1) Remove and retain 10 screws (8, fig. 6-111) and washers (7) from cover (6), and fold cover to side to permit access to wiring.

(2) Remove switch boot (9, 10, or 11) on switch to be replaced.

(3) Disconnect and tag wires from switch by removing and retaining screws (23) and washers (22). Remove switch.

d. Assembly. Assembly is the reverse of disassembly (c. preceding). When replacing gasket, bond replacement gasket with adhesive RTV-102.

e. Installation. Installation is the reverse of removal (a. preceding).

Section V. REPAIR AND SERVICE OF SIGHT XM61

6-50. General.

Instructions for repairing and servicing the XM61 sight at the organizational level are given in the following paragraphs. Instructions are given for inspection, repair, cleaning, and purging and charging of the sight.

6-51. Inspection.

a. Exterior. Inspect the exterior of the sight for heat damage, broken or missing parts, and corrosion. Check the front and rear windows and the sun filter for smears, scratches, or cracks. Check the electrical connector for bent or broken pins.

b. Interior. Check for presence of moisture or contaminants inside sight housing as evidenced by fogging of glass or presence of particles on optical surfaces. If evidence of moisture or contaminants is found, purge and charge sight as instructed in paragraph 6-54.

c. Caging Mechanism. Check that the caging mechanism operates smoothly by rotating the caging knob back and forth between its extremes of travel.

6-52. Repair.

Repair of the XM61 sight at the organizational level consists of replacing the reticle lamp and lamp socket, the filter assembly, the boresight adjustment covers, the caging knob, the ready-to-fire lamp, and the purging valve and screw. Figure 6-112 illustrates the sight components that may be replaced by organizational maintenance. Replacement of all replaceable sight components is obvious by reference to figure 6-112. If necessary, the XM61 sight can be replaced (fig. 6-65). However, it is not necessary to remove the sight from the mount prior to replacing any of the components replaceable by organizational maintenance. Procedures for replacing the sight and the sight reticle lamp are given in the following subparagraphs. Prior to removing the sight, or replacing any of the sight components, perform the preliminary procedures given in paragraph a. following.

a. Preliminary Procedures.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Assure that sight is mechanically caged (fig. 6-64).

b. Removal.

(1) Perform preliminary procedures given in a. preceding.

(2) Disconnect cable connector W6P2 from sight (fig. 6-65).

(3) Disconnect ground strap from sight (fig. 6-66).

(4) Remove attaching screws (fig. 6-65) securing sight to support shafts, and remove sight.

c. Installation. Installation of the sight is the reverse of removal (b. preceding). Immediately after installation, boresight the sight (TM 9-2350-300-10).

d. Removal of Reticle Lamp.

(1) Perform preliminary procedures given in a. preceding.

(2) Remove lamp housing cover (fig. 6-64) to provide access to reticle lamp socket assembly (A, fig. 6-113).

(3) Disconnect lamp socket assembly connector (B, fig. 6-113).

(4) Remove lamp socket assembly by grasping ball plunger and pulling outward (C, fig. 6-113).

CAUTION

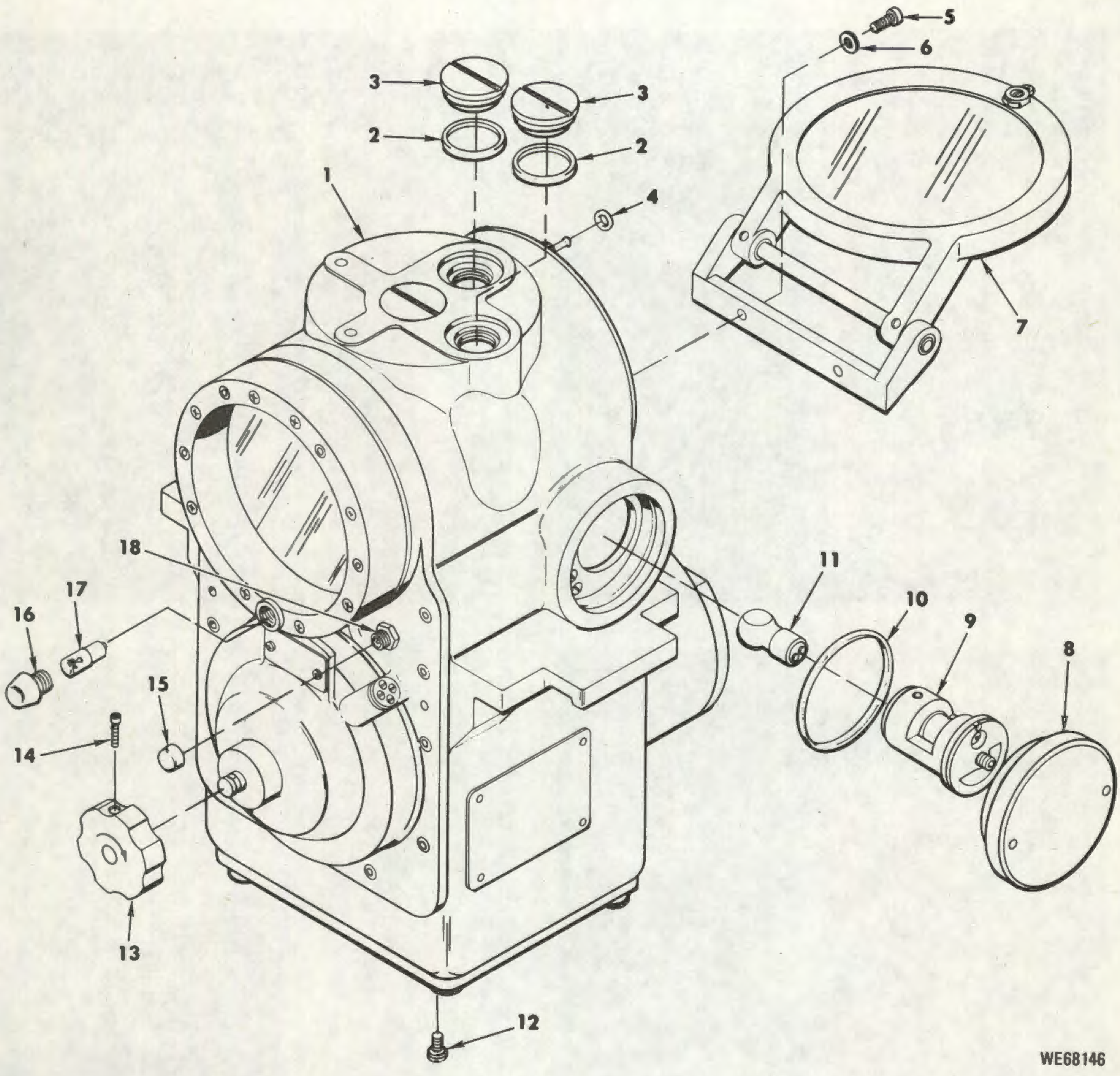
Do not touch reticle lamp with bare fingers.

(5) Remove reticle lamp (D, fig. 6-113).

e. Installation of Reticle Lamp.

(1) Insert reticle lamp in lamp socket assembly. Assure the nonreflective area of the lamp is aligned relative to the socket assembly keyway as shown in D, figure 6-113.

(2) Insert reticle lamp socket assembly in sight well. Assure well-locating pin is in socket assembly keyway (B, fig. 6-113).



1 Sight
2 Packing
3 Boresight adjustment cover
4 Bumper
5 Screw
6 Washer
7 Filter assembly
8 Lamp housing cover
9 Lamp socket assembly
10 Packing
11 Reticle lamp
12 Purging screw
13 Caging knob
14 Screw
15 Valve cap
16 Indicator lamp cap
17 Ready-to-fire indicator lamp
18 Purging valve

Figure 6-112. XM61 sight, exploded view.

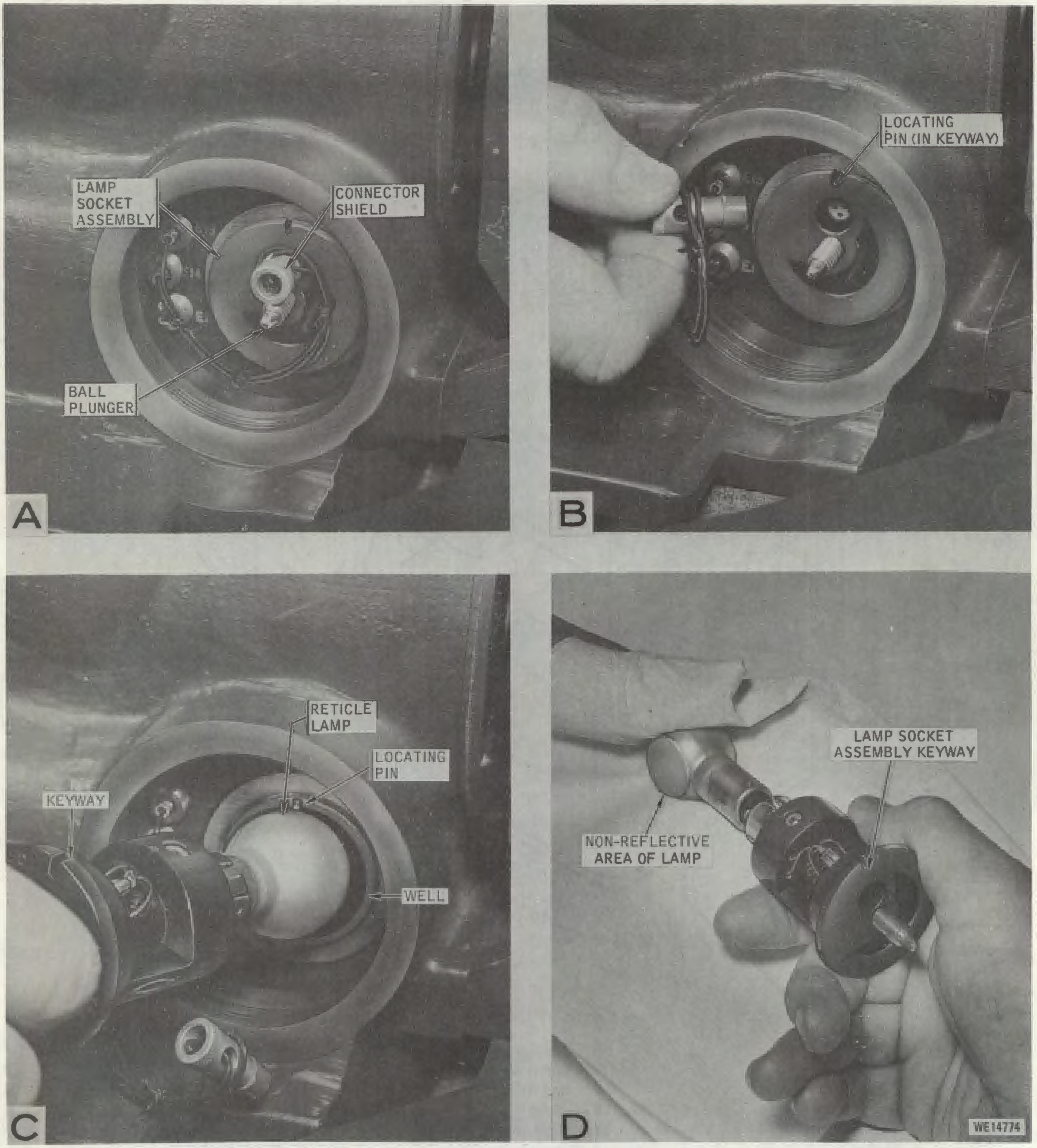


Figure 6-113. Sight reticle lamp socket assembly, removal/installation details.

(3) Connect lamp socket assembly connector.

(4) Install lamp housing cover (8, fig. 6-112) and gasket (10).

6-53. Cleaning.

Clean all glass surfaces with cotton and water. Clean grease and oil from metal parts with dry-cleaning solvent or mineral spirits paint thinner. After parts are cleaned, rinse and dry them thoroughly.

6-54. Purging and Charging.

a. General. The interior of the sight housing must be purged periodically with dry nitrogen to eliminate moisture and air contaminants. It must then be charged to a pressure of 5 psig (with nitrogen) to retard future buildup of moisture and contaminants. In addition to time-interval purging, the sight must be purged when inspection (para. 6-51) reveals unsatisfactory conditions. For purging kit components and operation, refer to TM 750-116.

b. Procedure.

WARNING

Use only dry nitrogen gas for purging and charging sight.

(1) Remove cap from purging valve on rear of sight (fig. 6-64).

(2) Remove purging screw (fig. 6-114).

(3) Connect dry nitrogen gas purging kit (fig. 2-4) to sight purging valve, and regulate pressure of gas at 5 psig.

(4) Allow nitrogen gas to flow through interior of sight housing for five minutes, or longer if necessary to remove all traces of moisture.

(5) Install purging screw, and tighten securely.

(6) Close pressure regulator valve.

NOTE

Low pressure gage should show constant indication for at least 10 minutes. If it does, proceed to (8) following. If it does not, perform (7).

(7) If gage pressure indication drops off, tighten purging screw, check connections, and recharge. If leak indication persists, return sight to depot maintenance.

(8) If gage pressure indication remains constant, disconnect purging kit and install valve cap.

Section VI. ADJUSTMENTS

6-55. Boresighting.

Refer to TM 9-2350-300-10 for system boresighting instructions.

6-56. Control Assembly Adjustments.

a. Elevation Control Assembly, Variable Resistor and Gear Assembly.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

CAUTION

Pulling grip assembly off too forcefully may damage internal wiring.

NOTE

Do not remove cover from grip assembly.

(3) Release left-hand grip assembly from elevation control assembly by loosening setscrew and pulling grip gently off shaft (fig. 6-71).

CAUTION

Exercise care in removing cover to avoid damaging cover shaft seal on O-ring groove.

(4) Unlock connector by rotating locking clip (fig. 6-71), and separate connector halves. Remove grip and O-ring from shaft.

(5) Remove elevation control assembly left cover (8, fig. 6-72).

(6) Loosen variable resistor retaining clamps (14, fig. 6-72).

(7) Perform (1) through (16) of paragraph 6-39j. Ignore soldering instructions.

b. Control Panel Assembly RANGE Potentiometer.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

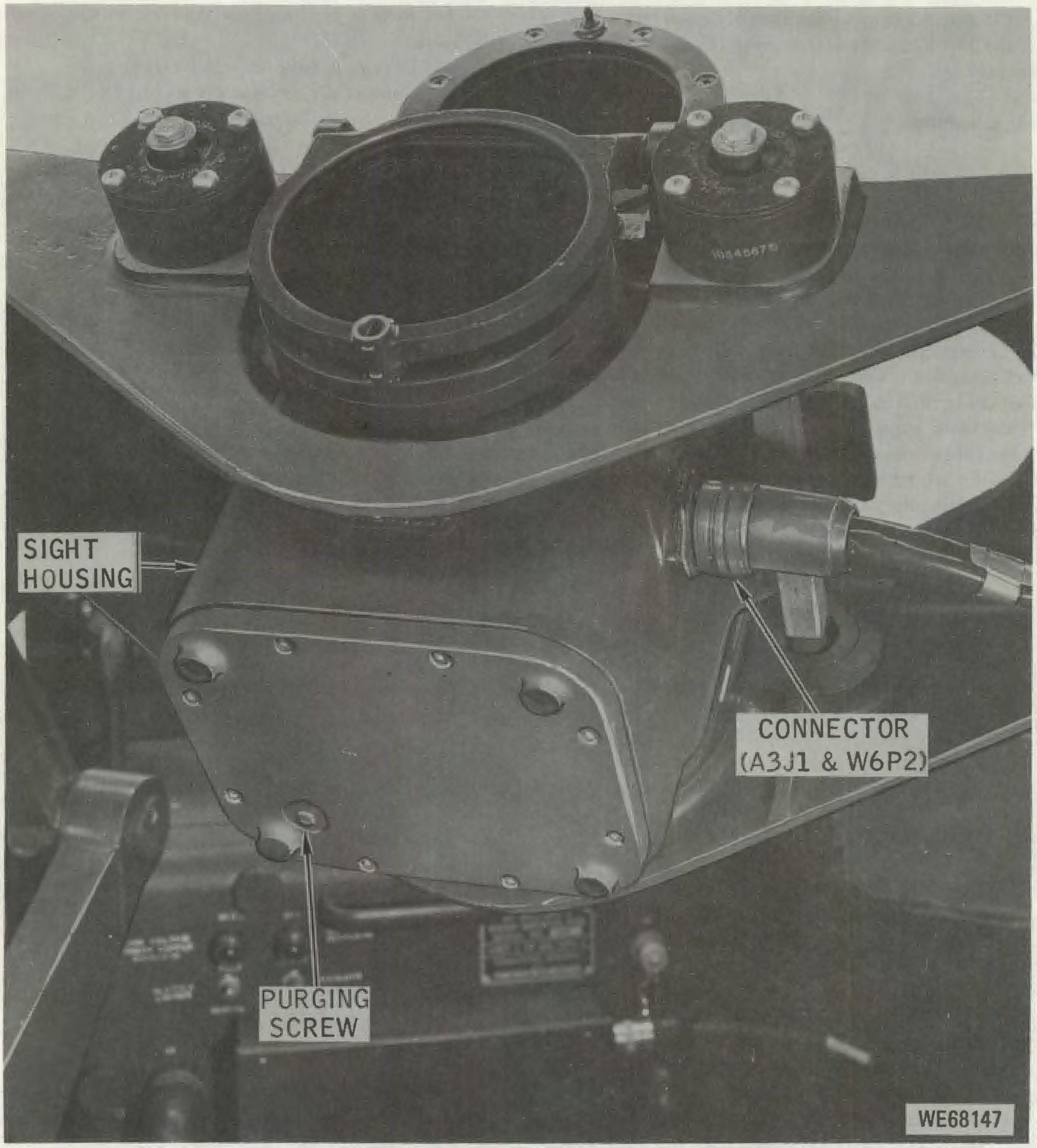


Figure 6-114. XM61 sight, bottom view showing location of purging screw.

(2) Place distribution NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove front panel securing screws (fig. 6-76) and pivot panel down to provide access to components mounted on rear (fig. 6-77).

CAUTION

Sliding panel to left detaches it from case.

(4) If necessary to detach panel to gain access to components, slide front panel to left, taking care not to damage front panel when it detaches from case.

(5) Loosen RANGE potentiometer retaining clamps (fig. 6-77).

NOTE

Refer to figure 6-75 for identification of RANGE potentiometer mounting components.

(6) Perform (3) through (13) of paragraph 6-40d. Ignore instructions to install knob and attach potentiometer leads.

c. TARGET SPEED Potentiometer. Adjustment procedures for the TARGET SPEED potentiometer are identical to those for the RANGE potentiometer (b. preceding) except that the knob is set to 0 knots, and the positive lead of the voltmeter is connected to terminal 2. The potentiometer meter is adjusted for a 7.5 ±0.2 volt reading.

d. Variable Resistor and Gear Assembly.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove front panel securing screws (fig. 6-76) and pivot panel down to provide access to components mounted on rear (fig. 6-77).

CAUTION

Sliding panel to left detaches it from case.

(4) If necessary to detach panel to gain access to components, slide front panel to left, taking care not to damage front panel when it detaches from case.

(5) Loosen variable resistor retaining clamps (fig. 6-77, sheet 1).

(6) Perform (1) through (10) in paragraph 6-40j. Ignore instructions to attach variable resistor leads.

e. Sensing Switches and Switch Actuators.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove front panel securing screws (fig. 6-76) and pivot panel down to provide access to components mounted on rear (fig. 6-77).

CAUTION

Sliding panel to left detaches it from case.

(4) If necessary to detach panel to gain access to components, slide front panel to left, taking care not to damage front panel when it detaches from case.

NOTE

The control panel contains two sensing switch and switch actuator assemblies (right HI speed slew, A2A156, and left HI speed slew, A2A157). Refer to figure 6-77 to identify the assemblies.

(5) Loosen the appropriate sensing switch and switch actuator adjustable mounting plate securing screws (31, fig. 6-75) so that plate can be moved.

(6) Perform (2) through (6) in paragraph 6-40m.

f. Burst Limit Potentiometers. Control panel assembly burst limit potentiometers are adjusted only as required during system checkout/fault isolation procedures.

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Remove front panel securing screws (fig. 6-76) and pivot panel down to provide access to components mounted on rear (fig. 6-77).

CAUTION

Sliding panel to left detaches it from case.

(4) If necessary to detach panel to gain access to components, slide front panel to left, taking care not to damage front panel when it detaches from case.

CAUTION

Assure that the rear of the control panel assembly does not make contact with any metal objects while SYSTEM POWER switch is set to ON. Arcing may result.

(5) Set SYSTEM POWER switch to ON.

NOTE

The control panel assembly contains five burst limit potentiometers (LO NO burst A2A1R9, 10-round A2A1R8, 30-round A2A1R7, 60-round A2A1R6, and 100-round A2A1R5). Refer to figure 6-77, sheet 2, to identify the potentiometers.

(6) Adjust appropriate burst limit potentiometer (fig. 6-77) as instructed in checkout/fault isolation procedures.

(7) Set SYSTEM POWER switch to OFF.

(8) Secure control panel assembly.

6-57. Distribution Box Adjustments.

Distribution box adjustments consist of adjusting the distribution box mount servo systems adjustment potentiometers. The potentiometers are located on the distribution box "slew" circuit card assembly A1A2, and are adjusted only as required during system checkout/fault isolation procedures. To adjust the potentiometers proceed as follows:

NOTE

There are two different distribution boxes presently being used with the XM157 mount. The two distribution boxes are part number 8437152 (serial numbers 1000001 through 1000148), and part number 8438325 (serial numbers 2000001 and forward). Where adjustment procedures differ for the distribution boxes, the difference is noted. Besides the identification plates, the two distribution boxes used with the XM157 mount can be identified by the nomenclature and number of mount servo systems adjustment potentiometers in each distribution box. Refer to figure 6-86, sheets 1 and 2, to identify the differences.

a. Remove distribution box access plate (fig. 6-85).

b. Adjust appropriate servo systems adjustment potentiometer as instructed in checkout/fault isolation procedures, table 4-2.

c. Install distribution box access plate.

6-58. Elevation Potentiometer Assembly Adjustment.

a. Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

b. Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

c. Release elevation drive motor brake (14, fig. 6-24), manually raise cannon to its maximum elevation, and reapply brake.

d. Remove elevation potentiometer assembly cover (fig. 6-52).

e. Loosen elevation potentiometer retaining clamps (fig. 6-53).

NOTE

The following procedures will be facilitated if the cannon is positioned to the rear of the chassis. Test set AN/MWM-2 is placed on the chassis deck, and the interconnecting cable is routed through the open commander's hatch.

f. Attach AN/MWM-2 cable W32 between sight current generator J7 connector and AN/MWM-2 J3 connector. Connect multimeter 300M-A to AN/MWM-2, and set 300M-A to measure 15 Vdc in search mode.

g. Position AN/MWM-2 controls as follows:

METER SELECTOR switch SCG-1
SCG-1 switch 14
METER POLARITY switch F (negative)

h. Perform (5) through (15) in paragraph 6-31e.

6-59. Elevation Limit Switch Assembly Adjustments.

The elevation limit switch assembly contains five different switches and the associated switch actuators; −5 degrees lower limit (A18S3), 13 degrees lower limit (A18S2), 18 degrees lower limit (A18S1), and 80 degrees upper limit (A18S4 and A18S5). Refer to figures 6-60 and 6-61 to identify the switches and actuators.

a. If either A18S1 or A18S2 lower limit switches are being adjusted, perform (1) through (15) in paragraph 6-32d.

b. If A18S3 lower limit switch is being adjusted, perform (1) through (10) in paragraph 6-32e.

c. If either A18S4 or A18S5 upper limit switches are being adjusted, perform (1) through (10) in paragraph 6-32f.

6-60. Azimuth Switch Assembly Adjustments.

The azimuth switch assembly contains two switches and associated actuators (right limit, A19S1, and left limit, A19S2). Both switches are adjusted in the same manner.

a. Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

b. Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

c. Identify switch to be adjusted (fig. 6-28), and remove switch mounting bracket from turret subassembly wall, being sure to note and record the location and size of shims (fig. 6-27).

d. Force spring clips (7, fig. 6-28) off switch roller guide (6). Loosen the two hex nuts securing the switch to the bracket.

e. Check that mount is positioned so that switch actuating bar (3, fig. 6-28) is opposite switch mounting holes in turret subassembly wall.

f. Position shims in proper locations, and install switch and bracket.

g. With switch roller horizontal, rotate mount until switch roller is aligned with the maximum cam surface of the actuating bar (fig. 6-30).

h. Adjust switch hex nuts on each side of mounting bracket until switch roller just touches the maximum cam surface. Then adjust switch further downward by making three complete revolutions of the hex nuts. Disconnect azimuth switch assembly A19J1 connector (fig. 6-27). Refer to figure 6-29 and use an ohmmeter to verify switch actuation. Ensure that switch has sufficient overtravel. Insert the flat of a screwdriver blade between the switch roller and cam surface. If screwdriver blade raises the roller, there is sufficient overtravel.

i. Tighten hex nuts and install spring clip (7, fig. 6-28). Switch is properly installed when roller is horizontal and pin on spring clip enters keyway in switch body. (Keyways on the two switches are toward each other.)

j. Refer to figure 6-30, use ohmmeter, and verify that each switch remains actuated over the full range on the actuating bars.

k. Remove test equipment, and connect azimuth switch assembly A19J1 connector.

6-61. Gun Position Switch Adjustment

a. Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

b. Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

c. Force spring clips (7, fig. 6-28) off switch (1) roller guide.

d. Unscrew switch roller guide and remove from switch.

e. Loosen hex nuts (9, fig. 6-28) securing switch to bracket.

f. With switch roller horizontal, rotate the mount until switch roller is approximately centered on the cam.

CAUTION

Do not set roller on the inclined edge of the cam to adjust switch. Refer to azimuth switch alignment illustration (fig. 6-30) as an example.

g. Adjust switch hex nuts on each side of mounting bracket until switch roller just touches the cam surface. Then adjust switch further downward by making three complete revolutions of the hex nuts. Ensure that switch has sufficient overtravel. Insert the flat of,a screwdriver blade between the switch roller and cam surface. If screwdriver blade raises roller, there is sufficient overtravel.

h. Tighten hex nuts and install roller guide and spring clip. Switch is properly installed when roller is horizontal and pin on spring clip enters keyway in bottom of switch body.

NOTE

TB1 is located on the interior top of the chassis, to the rear of the mount. Terminals are numbered from the right side of the chassis to the left.

i. Verify correct installation of switch by connecting ohmmeter between TM1-1 and TB1-2. Commander's hatch must be open. Rotate mount to actuate switch. Ohmmeter should indicate continuity with switch actuated.

6-62. Radar Reflector and Feed Alignment

The following procedures provide a test of the electrical/mechanical alignment of the antenna reflector and feedhorn assemblies.

a. Perform distant aiming point boresight procedure in accordance with TM 9-2350-300-10.

b. Set SYSTEM POWER switch (fig. 6-1) to ON position.

c. Remove front cover from connector J4 (fig. 4-10) on transmitter-receiver front panel and connect headset microphone H-144/U to J4.

d. Place CLUTTER LOCKON switch (S2) (fig. 4-10) to the TEST position.

e. Position the XM61 sight reticle on a prominent target that can be encompassed by the inner reticle at a distance of 750 to 1200 meters.

NOTE

Take care there are no moving objects around the selected target.

f. Elevate the cannon above the target while maintaining the mount steady in azimuth.

g. Depress radiate foot switch. Note the absence of doppler audio. Slowly lower the cannon until audio is detected in the headset, then stop.

NOTE

Upon receipt of doppler audio, target should be just below center of sight reticle.

h. Maintaining this position in elevation, rotate the mount to the right until no audio is detected. Slowly rotate the mount to the left until audio is detected, then stop. Note displacement from the center of the reticle to the target.

i. Repeat *h* preceding, rotating the mount in the opposite direction.

j. Release radiate foot switch.

k. Detection of the doppler audio discussed previously, should have occurred at equal distances in azimuth from the center of the sight reticle to the target. This indicates proper alignment of the electrical and mechanical axes of the radar. If distances are not equal, replacement of the antenna is indicated.

l. Place CLUTTER LOCKON switch (S2) in the NORMAL position.

m. Set the SYSTEM POWER switch to the OFF position.

6-63. Mount Batteries Service and Adjustment

Service and adjustment of mount batteries consists of inspection (with applicable action), charging, cleaning, performance of charging circuit and electrical leakage tests, and adjustment for cold weather operation. The electrical leakage test is performed if a battery malfunction is suspected.

a. Inspection. Inspection is mainly a visual check for conditions that impair the operation of a battery. The level of electrolyte in each cell is vital to operation and should be checked at least weekly during periods of system use. The electrolyte level indication is valid only after batteries have been fully charged to 27 to 28 volts at less than 10 amps and have been allowed to stand idle for two to four hours under no-load condition. Inspect the mount batteries in accordance with the following:

(1) Position cannon over rear of chassis.

(2) Verify that GUN POWER and SYSTEM POWER switches on control assembly (fig. 6-1) are in OFF position.

(3) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) to STATIC position and verify that the arming connector (fig. 6-2) is disconnected.

CAUTION

Fumes from lead-acid batteries can cause serious damage to nickel-cadmium batteries. Do not open any cell on mount batteries until the vehicle battery box cover is secure.

(4) Verify that cover is secured to vehicle battery box.

WARNING

Be extremely careful when working in the vicinity of a battery box when battery case is open. Uninsulated tools dropped onto battery links will cause severe electrical arcing with possible injury to personnel and damage to the battery. Do not wear rings, metal watch bands, or identification bracelets. Metal articles will, if allowed to contact intercell links of opposite polarity, fuse themselves to the links and a severe burn will result.

(5) Loosen wing nuts, remove bar from hold-down rods (fig. 6-88) and remove covers from mount batteries.

(6) Use nylon wrench stored inside battery case and loosen vent caps. See figure 6-115.

WARNING

The electrolyte used in the mount (nickel-cadmium) batteries is a caustic solution of potassium hydroxide. Serious burns will result if it comes in contact with any part of your body. Use rubber gloves, rubber apron, and a protective face shield when handling this electrolyte. If potassium hydroxide gets on your skin, wash the affected area with large quantities of water, then neutralize with a three percent solution of acetic acid, vinegar, or lemon juice. If it gets into your eyes, flood with water and wash with a three percent solution of boric acid or a weak solution of vinegar. Seek *immediate* medical attention.

WARNING

Vapor from potassium hydroxide can be explosive. Extinguish any cigarette or open flame in the vicinity of battery before removing vent caps from cells.

CAUTION

Tools, syringes, or containers used to service lead-acid batteries may contain a trace of sulphuric acid. Just a small amount of sulphuric acid entering a nickel-cadmium battery will cause irreparable damage. Do not use distilled water from containers which have been used to ship sulphuric acid.

CAUTION

Overfilling cells with, or spilling, water or electrolyte into the battery case can cause electrolytic corrosion and battery failure, unless battery is cleaned immediately.

(7) Check level of electrolyte in each cell using

special syringe stored in battery case (fig. 6-115). This syringe will automatically establish correct electrolyte level by admitting air when level drops below hole in tube.

(a) Attempt to remove electrolyte from each cell with syringe.

(b) If no electrolyte can be removed, add a small amount of distilled water, and try again to remove electrolyte.

(c) Continue process in *(a)* and *(b)* until all cells have the correct amount of electrolyte.

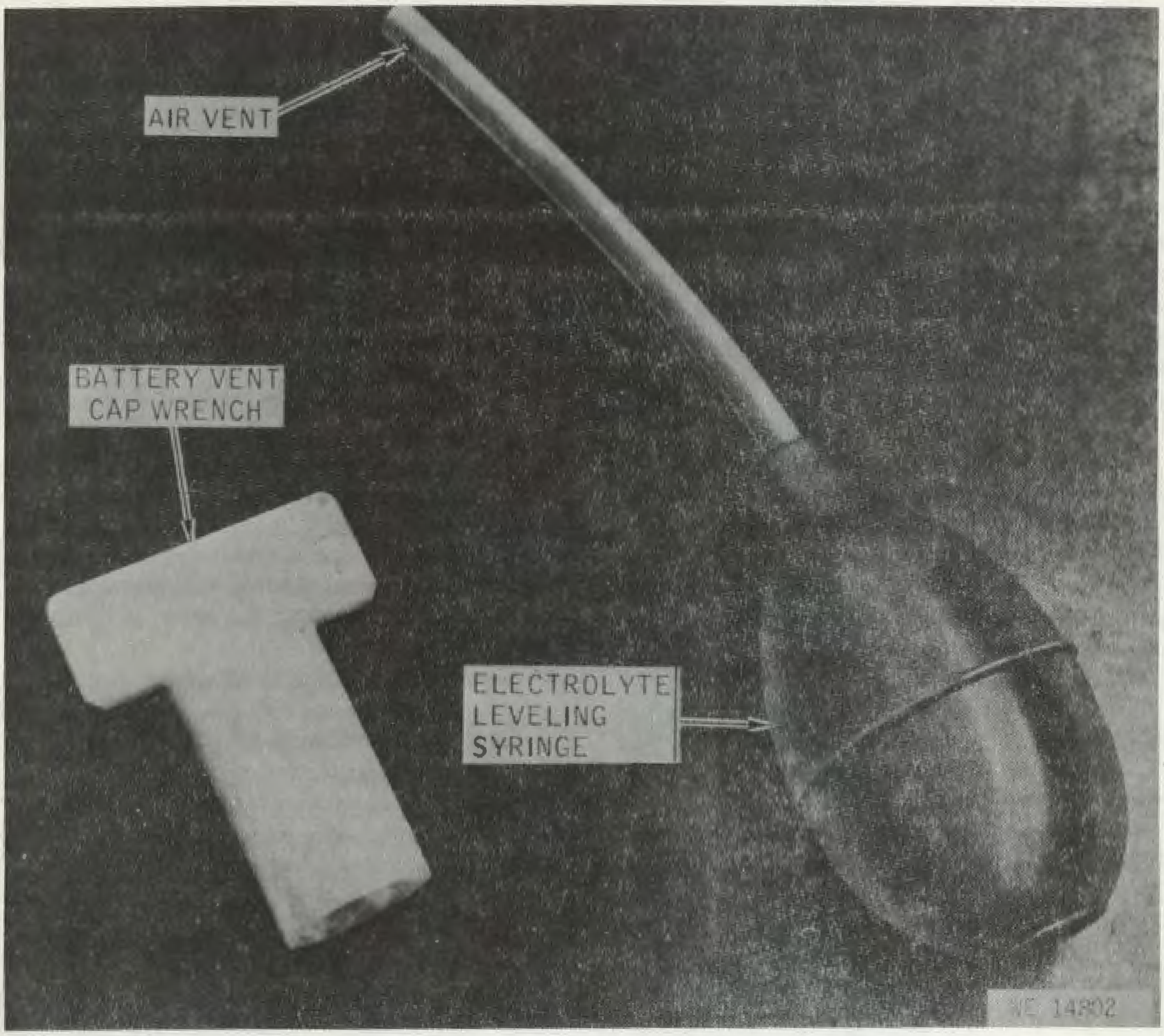


Figure 6-115. Battery vent cap wrench and electrolyte leveling syringe.

(8) Each time the electrolyte level is checked or the battery case cover is removed for cleaning, visually check and perform the following:

(a) Cell terminal screws bent or broken—replace.

(b) Loose terminal screws or terminal links—tighten as required.

(c) Cell terminals cracked—return battery to direct support.

(d) Cell case cracked—return battery to direct support.

(e) Cell vent caps warped or cracked—replace.

(f) Vent caps seated improperly—loosen and reseat.

(g) Battery connector bent or broken—return battery to direct support.

(h) Battery case pressure relief valve plugged or broken—return battery to direct support.

(i) Intercell connectors discolored—check for loose terminal screws or battery overheating.

1. If terminal screws are loose they should be tightened to the correct torque valve.

2. The sides of the battery case should remain cool during normal charging. If the battery case becomes warm within the first 20 minutes of charging, return the battery to direct support for servicing. This does not apply if battery heaters are in operation.

(j) Excessive electrolyte spewage—In normal operation, a nickel-cadmium battery will look as if it had been spattered with white paint on inside of case, cover, and cell tops. Electrolyte carried out of the cell by gassing and bubbling is converted to harmless potassium carbonate in the air. Excessive spewage is indicated by liquid collected in vent caps, on cell tops or in the battery case. It is primarily caused by excessive charging voltage or overfilling the cells in a discharged condition. Be sure to adjust electrolyte level after charging ((7) above). Check for improperly installed vent cap or cracked cell.

CAUTION

To avoid corrosion from electrolyte residue assure that battery syringe is thoroughly rinsed in clean water and dried before stowing inside battery case.

(9) After checking electrolyte level, assure that vent caps are properly installed. Stow syringe and nylon wrench inside battery case. Install battery case covers.

b. Battery Charging. The batteries may be charged using either the vehicle motor (para 6-64) or the auxiliary power unit generator (para 6-65).

c. Charging Circuit Test.

(1) Verify that GUN POWER and SYSTEM POWER switches on control assembly (fig. 6-1) are in OFF position.

(2) Place control assembly MODE switch to GRD.

(3) Start vehicle engine and set speed to idle at 1200 RPM.

(4) Observe that the distribution box voltmeter (M-2) does not exceed +28.75 vdc and that the ammeter (M-1) indicates less than 10 amps within 40 minutes. If either indication is abnormal proceed as follows:

(a) Indication of over 10 amps after 40 minutes charging at 1200 rpm—disconnect gun batteries No. 1 and No. 2 (fig. 6-88) and check ammeter.

(b) If ammeter indicates under 10 amps in *(a)* above, connect gun battery No. 1 and disconnect system battery and check ammeter.

(c) If ammeter indicates over 10 amps in *(b)* above, connect gun battery No. 2 and disconnect No. 1.

(d) If ammeter indicates 10 amps or under in *(c)* above, gun battery No. 1 is defective and should be returned to direct support.

(e) Connect system battery (gun battery No. 2 still connected). Ammeter should indicate under 10 amps.

(f) If all batteries indicate equal readings above 10 amps, the voltmeter is probably reading over +28.75 vdc. Refer to paragraph 6-64 and adjust voltage regulator.

d. Electrical Leakage Test.

(1) Position cannon over rear of chassis.

(2) Verify that GUN POWER and SYSTEM POWER switches on control assembly (fig. 6-1) are in OFF position.

(3) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) to STATIC position and verify that arming connector (fig. 6-2) is disconnected.

(4) Unscrew knob of any (A4A1, A4A2 or A4A3) cable connector J2 and remove from battery (figs. 6-87, 6-88).

(5) If battery to be checked is either gun battery No. 1 or No. 2, disconnect connector J1 also.

(6) Set function selector to DC AMPS 10 and mode selector to SEARCH MODE on 300M-A multimeter.

(7) Connect positive (red) lead of multimeter to positive (+) terminal of battery connector J2.

(8) Connect negative (black) lead to unpainted area of battery case.

(9) If no indication is apparent on multimeter, set function selector to DC AMPS 1. If there is still no indication (less than 0.1 ampere) go to next step. If there is an indication of more than 0.1 ampere or if there was an indication at the DC AMPS 10 position, there is excessive electrical leakage. If there is evidence of excessive leakage battery must be thoroughly cleaned (para *e*). Repeat test after cleaning.

(10) If indication was under 0.1 ampere in preceding step, switch multimeter to DIGITAL MODE and manipulate digital wheels until indication is nulled. If readout is over 40 ma (0.04 ampere), leakage is excessive and battery must be thoroughly cleaned and test repeated.

(11) If leakage is less than 40 ma, disconnect multimeter and set mode switch back to SEARCH MODE and function selector to DC AMPS 10.

(12) Connect multimeter leads back to battery to check leakage from negative terminal of battery.

(a) Negative (black) lead to negative (—) terminal of battery connector J2.

(b) Positive (red) lead to unpainted area of battery case.

(13) Repeat procedures in steps (9) and (10).

(14) If leakage is less than 40 ma from either

terminal, disconnect multimeter and reconnect cable connectors to battery.

e. Cleaning. Normally the mount batteries will require only external cleaning of the cases and cell tops. However, following spillage of electrolyte or in case of excessive spewage or electrical leakage a more thorough cleaning is required. The cannon and switches must be positioned and battery case cover removed as for inspection (*a* above).

(1) *Normal cleaning.*

WARNING

Rubber gloves, rubber apron and protective face shield should be worn for all battery cleaning procedures.

(a) Check that all vent caps are tight.

CAUTION

Use of a wire brush to clean batteries will cause short-circuiting and may damage cell cases, vent caps, and terminal links.

(b) Remove powdery potassium carbonate accumulation on the outside of cells and on case (para *a*(8)(*j*)). This may be brushed off with a dry cloth or nylon brush 7920-061-0037 or 7920-061-0038.

(c) Install battery case cover.

(d) Clean outside of case with soap and water. Rinse and dry.

(2) *Thorough cleaning.* To thoroughly clean mount batteries, position cannon and switches and remove battery case cover as for inspection.

CAUTION

Mount batteries should not be cleaned in lead-acid battery maintenance area. Do not use wire brush.

WARNING

The electrolyte used in mount batteries is a caustic solution of potassium hydroxide. Use rubber gloves, rubber apron and face protective shield when this electrolyte is handled. Serious burns will result if it comes in contact with any part of your body. If it gets on your skin, wash the affected area with quantities of water, then neutralize with a three percent solution of acetic acid, vinegar, or lemon juice. If it gets into your eyes, flood with water and wash with a three percent solution of boric acid or a weak solution of vinegar. Seek immediate medical attention. Assure that all cigarettes or open flames are extinguished prior to any maintenance procedures.

(a) Perform electrical leakage test and remove battery from mount.

(b) Check that vent cap of each cell is properly installed. If a vent cap does not make a seal, the preformed packing or nylon bayonet locking device may be worn or broken. Replace cell.

(c) When a vent cap has been removed, check that elastic sleeve is not stuck fast to cap before installing it back in cell. To loosen vent sleeve, insert paper clip, toothpick, or similar object inside sleeve and run it around inside cap to free sleeve. If sleeve is broken, vent cap (or cell) must be replaced. Restriction of any kind in the vent or sleeve of vent cap can cause the cell to crack or explode.

(d) Place battery on a wooden platform, positioned so as to support battery approximately three foot above a drain. Using a hose, force fresh water in between battery cells and flush out interior of battery case.

(e) Using nylon brush 7920-061-0037 or 7920-061-0038 thoroughly scrub cell tops, vent caps, terminal links, and inside of battery case.

(f) Lay battery on its side after scrubbing cells. Raise bottom of case two inches and flush with water from hose. Allow water to drain from between cells. While battery remains in this position, remove excess water and allow to air dry for several hours. Compressed air may be used to speed up the drying process. Check for damaged cells and for leaks around vent caps.

(g) Return battery to upright position, check that interior is dry, and perform electrical leakage test.

(h) If interior is not dry, electrolyte leakage is indicated. If not the result of an improperly installed vent cap or spillage, a cell case is probably cracked. In any case of electrolyte leakage direct support maintenance is required.

(i) Clean battery case on mount with soap and water. Rinse and dry.

(j) Return battery to battery case.

(k) Install battery case cover.

(l) Perform applicable procedures (para 6-64 or 6-65) to assure that batteries are fully charged.

f. Adjustment of Low Rate Battery Tap. Prior to operation in cold weather (32°F. or below), the low rate tap on each battery must be relocated to provide a slightly higher operating voltage. To accomplish this adjustment, proceed as follows:

(1) Position mount so that cannon is aimed directly to rear of chassis.

(2) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(3) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

WARNING

Be extremely careful when working in the vicinity of a battery when the battery case cover is open. Do not drop uninsulated tools onto the battery links. Severe arcing will result, with possible injury to personnel and damage to the battery. Do not wear rings, metal watch bands, or identification bracelets. Metal articles will, if allowed to contact intercell links of opposite polarity, fuse themselves to the links and severe burning will result.

(4) Remove covers from battery cases (fig. 6-87).

(5) Reposition low rate tap on each battery as shown in figure 6-116. Reinstalled screws must be torqued to 72 inch-pounds.

(6) Install battery case covers.

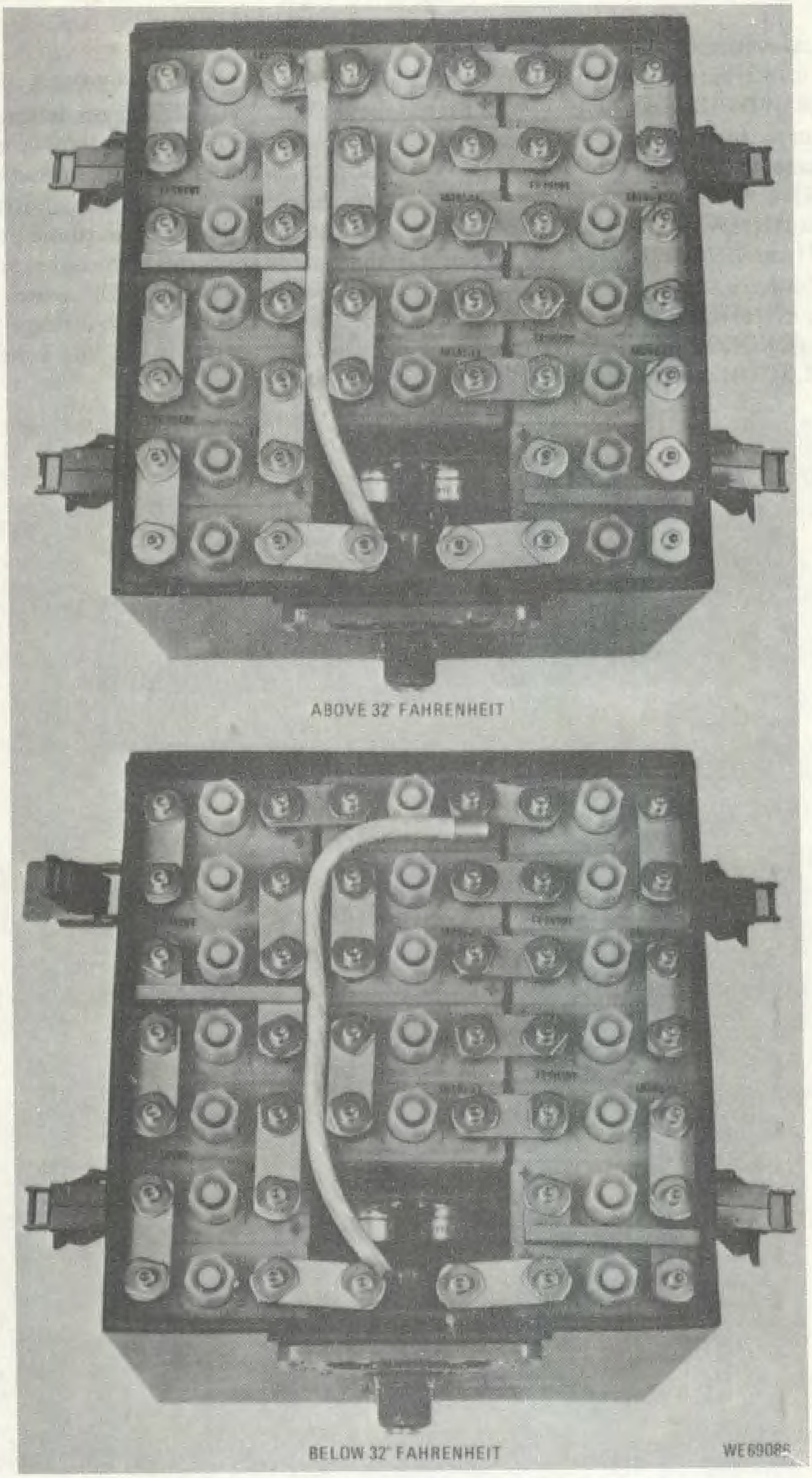


Figure 6-116. Typical mount gun battery, relocation of low rate tap for cold-weather operation.

6-64. Chassis Voltage Regulator Adjustment

a. Position cannon over right rear corner of vehicle to facilitate access to distribution box (fig. 6-58).

b. Set SYSTEM POWER and GUN POWER switches (fig. 6-1) on control panel to OFF. Set MODE switch on control panel to GRD.

c. Place AN/MWM-2 on vehicle floor near loader's bench, and connect AN/MWM-2 test cable W33 between connector J1 on AN/MWM-2 and connector J5 on system distribution box.

d. Set controls on AN/MWM-2 as follows:

(1) DISTRIBUTION BOX switch to SYS BTRY.

(2) METER SELECTOR switch to DB.

(3) TEST SET ON/OFF switch to ON.

e. Start vehicle engine, and set engine to idle at 1000 rpm.

f. Connect multimeter 300M-A to monitor voltage at OUTPUT TO METER connectors on AN/MWM-2.

g. Voltage indication on 300M-A multimeter should be 27 to 28 Vdc, and current indication on distribution box ammeter should be less than 10 amperes. If either indication is abnormal, continue procedures. If both indications are normal, proceed to m. following.

h. Set SYSTEM POWER switch on control panel to ON, and adjust chassis voltage regulator (TM 9-2300-257-20) for 27 to 28 Vdc indication on 300M-A multimeter.

NOTE

Vehicle headlights are to be turned off when making voltage regulator adjustments in the following procedure.

i. Set vehicle headlights on and allow vehicle engine to continue to idle at 1000 rpm for 20 minutes. Monitor 300M-A multimeter voltage indication during this period and adjust chassis voltage regulator as necessary to keep 300M-A voltage indication at 27 to 28 Vdc. Set vehicle headlights off when making voltage regulator adjustments, and then set headlights back on to continue procedure.

j. At the end of 20 minute period, set vehicle headlights off and adjust chassis voltage regulator for 27 to 28 Vdc indication on 300M-A multimeter.

k. Verify that ammeter (M1) on distribution box indicates less than 10 amperes. If indication is not less than 10 amperes, repeat i. through k. of paragraph 6-64. If indication is still not less than 10 amperes after repeating i. through k., inspect chassis voltage regulator, mount slip ring, and mount batteries for damage (fig. 6-20).

CAUTION

If mount batteries are to be inspected for damage, allow two hours for batteries to outgas (stabilize) under no load conditions before removing covers to make inspection.

l. Set SYSTEM POWER switch on control panel to OFF.

m. Turn off vehicle engine and disconnect test equipment.

6-65. Auxiliary Power Unit (APU) Adjustment.

a. Perform procedures in paragraph 6-64a. through e.

b. Connect and start APU in accordance with instructions in TM 9-2350-300-10.

NOTE

If current indication is high, batteries are discharged. In this case, continue charging procedures until proper current indication is obtained.

c. Voltage indication on 300M-A multimeter should be 27 to 28 Vdc, and current indication on mount distribution box ammeter should be less than 10 amperes. If voltage indication is not within specified limits, adjust APU to obtain proper indication. If current indication is too high, continue operating APU (while monitoring and adjusting voltage indication as stated previously) until current indication decreases to less than 10 amperes. If proper indications cannot be obtained after one hour, inspect mount batteries, slip ring, and APU for damage (fig. 3-20).

CAUTION

If mount batteries are to be inspected for damage, allow two hours for batteries to outgas (stabilize) under no load conditions before removing covers to make inspection.

d. Turn off APU and disconnect test equipment.

6-66. Lock Threshold Adjustment for Radar AN/VPS-2.

The following adjustment is performed after servicing or replacing a transmitter-receiver (unit 2), receiver (unit 3), or range computer (unit 4). This adjustment will assure that the lock threshold setting is 7 to 8 dB over radar ambient noise.

a. To adjust the lock threshold setting, proceed as follows:

(1) Verify that GUN POWER and SYSTEM POWER switches (fig. 6-1) are in their OFF positions.

(2) Place distribution box NORM-STATIC-TEST switch (fig. 6-11) at STATIC position, and verify that arming connector (fig. 6-2) is disconnected.

(3) Place the SYSTEM POWER switch to the ON position and place the MODE switch in RADAR position. Assure that the MID RANGE CALIBRATION circuit is working by depressing the MID RANGE CALIBRATION switch on unit 4 and observing that the MID RANGE CALIBRATION lamp illuminates (ref. TM 9-2350-300-10).

(4) Place SYSTEM POWER switch to OFF.

(5) Remove the front panel assembly of range computer (unit 4).

(6) Remove the front panel assembly of receiver (unit 3) from enclosure.

(7) Remove attenuator (3AT5) located on unit 3 (fig. 6-117) by disconnecting 3P61 from J1 and 3P70 from J2. With the attenuator (3AT5) out of the circuit, connect 3P61 and 3P70 together.

(8) Place the SYSTEM POWER switch to ON.

(9) Depress the MID RANGE CALIBRATION switch and observe that the radar locks on noise as evidenced by the MID RANGE CALIBRATION light (DS1) being lit, but not blinking (fig. 6-104).

(10) On phase detector assembly card (4A15) in the range computer (fig. 4-5), adjust R22 clockwise until the MID RANGE CALIBRATION light blinks at a rate of once per second.

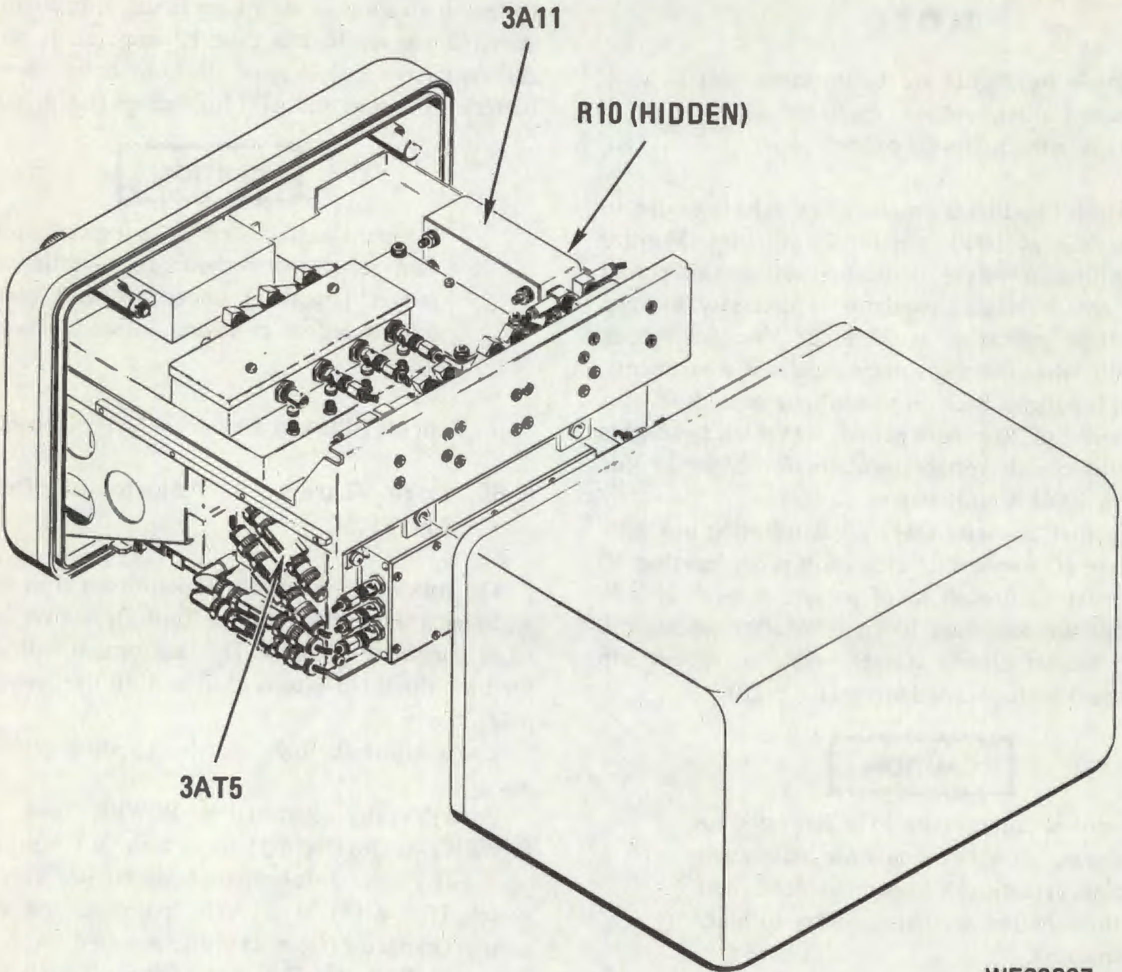


Figure 6-117. Radar receiver unit 3.

(11) Check the setting by turning R22 one-half turn counterclockwise. The radar should now lock on as evidenced by the MID RANGE CALIBRATION light not blinking. Turn R22 clockwise one-half turn and the MID RANGE CALIBRATION light should blink once per second. The threshold is now adjusted to 7 to 8 dB over ambient noise.

(12) Disconnect 3P61 from 3P70 and reconnect 3P61 to J1 on attenuator (3AT5) and 3P70 to J2 (fig. 6-117).

(13) Depress MID RANGE CALIBRATION switch and observe that MID RANGE CALIBRATION lamp illuminates. If MID RANGE CALIBRATION works properly, proceed to (15) following. If MID RANGE CALIBRATION does not work properly continue with (14) following.

(14) In unit 3, adjust R10 (located on top of oscillator (3A11) housing) (fig. 6-117) counterclockwise to increase MID RANGE CALIBRATION signal amplitude. Adjust R10 one-half turn at a time, then check MID RANGE CALIBRATION on unit 4 three times to assure that the MID RANGE CALIBRATION function is satisfactory after each half turn.

NOTE

Excessive MID RANGE CALIBRATION signal will cause an ECM indication, and a slight decrease clockwise in R10 is required. To check for an ECM indication, squeeze an ACTION switch and observe ready-to-fire light on XM61 sight. A blinking light denotes an ECM indication.

(15) Place SYSTEM POWER switch to the OFF position and reinstall units 3 and 4 back into their cases, and tighten thumbscrews.

6-67. Cable Assemblies

Repair of cable assemblies is limited to repair of torn or frayed outer covering. Repair procedure consists of potting the damaged area with adhesive 8040-828-7385 and, after adhesive has cured, wrapping the affected area with electrical insulation tape.

CHAPTER 7
PREPARATION FOR SHIPMENT AND STORAGE

For shipment and/or storage (30 days or less) the weapon shall be processed as described in the following paragraphs. Cleaning, preserving, and wrapping materials required are listed in table 7-1.

Table 7-1. Cleaning, Preserving, and Wrapping Materials for Preparation for Shipment or Storage.

Material	Federal stock number
Cleaning solvent	6850-281-1985
Oil, general purpose	9150-231-6689, or 9150-231-2007
Paper, volatile corrosion inhibitor treated (VCI)	8135-664-4003
Barrier material, greaseproof and waterproof	8135-292-9719
Tape, pressure sensitive	8135-890-9873
Grease, automotive and artillery	9150-190-0904, or 9150-190-0905

a. *Disassembly.* When destined for overseas shipment, the items listed in the following paragraphs shall be disassembled from the weapon to reduce the cubic displacement.

(1) *Tow hooks.* Remove tow hooks and related hardware, and stow in driver's compartment.

(2) *Flotation kit.* Remove flotation kit from sides of vehicle only. Replace attaching hardware (bolts) securely in tapped holes from which it was removed. Stow the removed flotation kit sections in the 3/4-ton truck assigned to the battalion. (Two and one-half kits per truck.) Secure kits in the 3/4-ton truck with crating fabricated from 1 x 6 lumber and band in place with steel strapping.

b. *Processing.* The weapon shall be processed for shipment or interim storage prior to shipment as specified in the following paragraphs.

(1) *XM741 chassis.* The XM741 chassis, including the engine, shall be processed in accordance with TB9-299/1. For fabrication of the engine access plate screen, see figure 7-1.

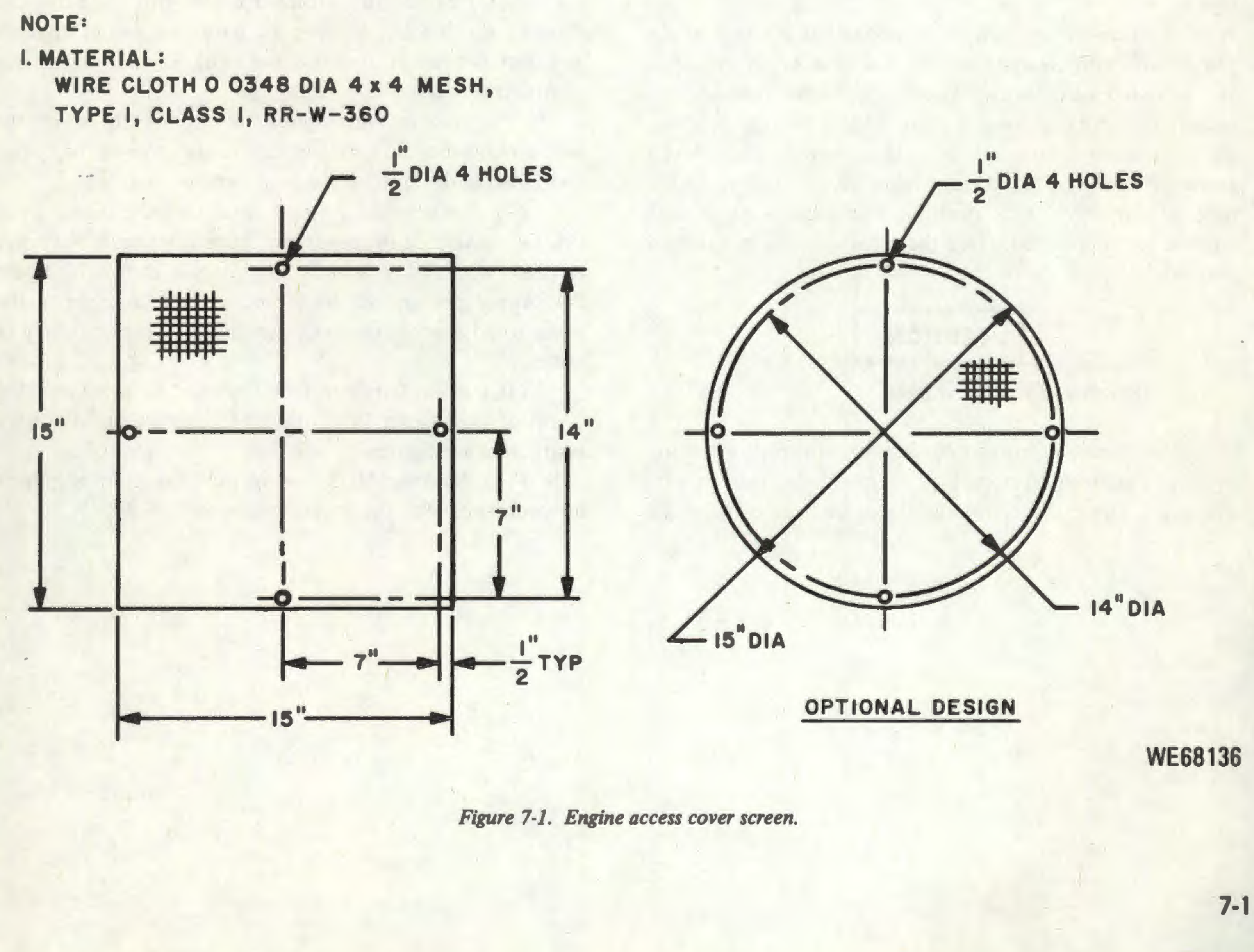


Figure 7-1. Engine access cover screen.

NOTE

For materials necessary for fabrication of engine access cover screen, wood panel, engine grille cover, and wood hutment, refer to figures 7-1 through 7-6.

CAUTION

Be careful not to contaminate needle and thrust bearings with cleaning solvent.

(2) *Gun, less barrels.* Clean all exposed surfaces of the gun with a clean cloth saturated with cleaning solvent and dry thoroughly. Apply preservative lubricating oil. Wrap the entire gun with volatile corrosion inhibitor treated (VCI) paper. Overwrap the VCI paper with barrier material and seal all seams with pressure-sensitive tape.

(3) *Barrels.* Remove the six barrels and clamps from the gun. Clean all surfaces of the clamps and barrels including the bore and chamber with cleaning solvent and clean, lint-free cloths. Apply lubricating oil to the interior and exterior surfaces of the barrels and clamps. Overwrap the entire barrel and the clamps with VCI paper. Pack the six wrapped barrels and clamps in a fiberboard box conforming to style RSC, grade V3C of PPP-B-636. Close the box and seal all seams and joints with pressure-sensitive tape.

(4) *Gun mount.* Clean all unpainted surfaces of the gun mount with cleaning solvent and dry. Apply grease to all unpainted surfaces and specifically to the azimuth, elevation, and ammo drum gear drive, and turret ring. Activate the gears through a complete cycle to evenly distribute the grease. Rotate the turret approximately 18 inches to the right of the travel lock position and lock in place with internal locks provided. Place the radar antenna in a stowed position.

CAUTION

Do not apply preservatives.

(5) *Communication equipment.* Apply pressure-sensitive tape over all open type, exposed electrical sockets and plugs. Open the communications control box on the inside of the vehicle. Insert plastic screw-type plugs in the applicable openings and apply pressure-sensitive tape over the plugs. Remove antennas from exterior of vehicle, secure together with pressure-sensitive tape, and stow inside chassis.

(6) *Turret and radar cover.* Install turret and radar cover in place and secure with tiedowns provided.

(7) *Basic issue items (BII).* Package BII in accordance with TB 9-299/1. Stow packed BII in the rear compartment of the vehicle.

(8) *Wood panel.* Install a wood panel behind the driver's seat to prevent entry to the rear compartment. For fabrication and bill of material see figure 7-2. Install the panel from the rear compartment as follows:

(a) Place ramp control handle in a locked position.

(b) Wedge the left-hand side behind the flashlight bracket on the bottom and position notch on top over the intercom box connection at the top.

(c) Secure the right-hand side with the two brackets and "T" bolts provided to secure the rear engine access panel.

(d) Place the plywood under the brackets and tighten the "T" bolts.

(e) Insert wire through the hole provided at the top of the panel.

(f) Secure the left-hand top by threading the wire through the bracket holding the personnel heater controls and over the top of the panel and twist the ends on the rear compartment side.

(g) Secure the right-hand top by threading the wire around the ramp control handle and over the top panel and twisting the ends on the rear compartment side.

(9) *Engine grille.* Apply a cover over the engine grille. For fabrication of the cover see figure 7-3. Secure the cover in place with 3/4-inch steel strapping as shown on figure 7-4. Apply pressure-sensitive tape around all edges of the cover to adjacent surfaces of the chassis to prevent entry of water.

(10) *Wood hutment.* Install a wood hutment over the turret of the system. For hutment fabrication and assembly instruction see figures 7-5 and 7-6.

(11) *Marking.* Mark the weapon system for shipment in accordance with the requirements of TB 9-299/1.

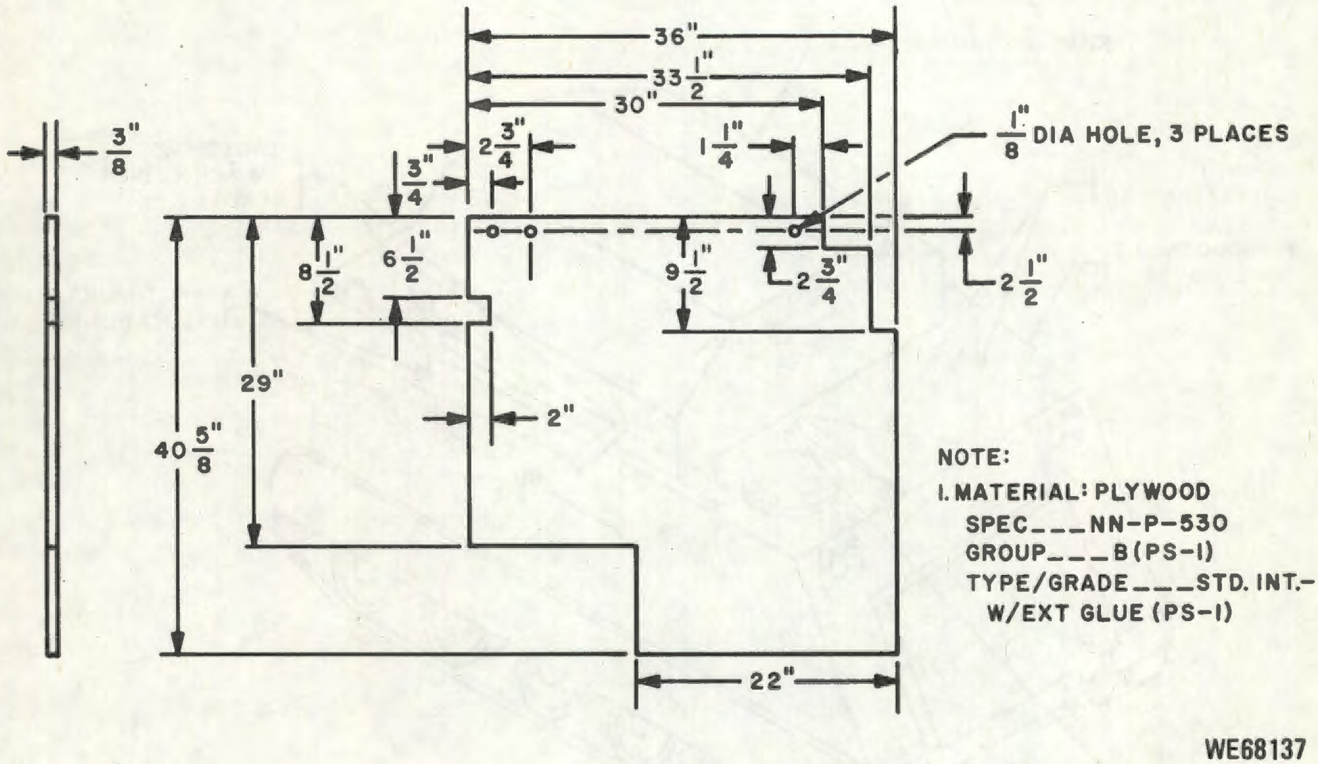
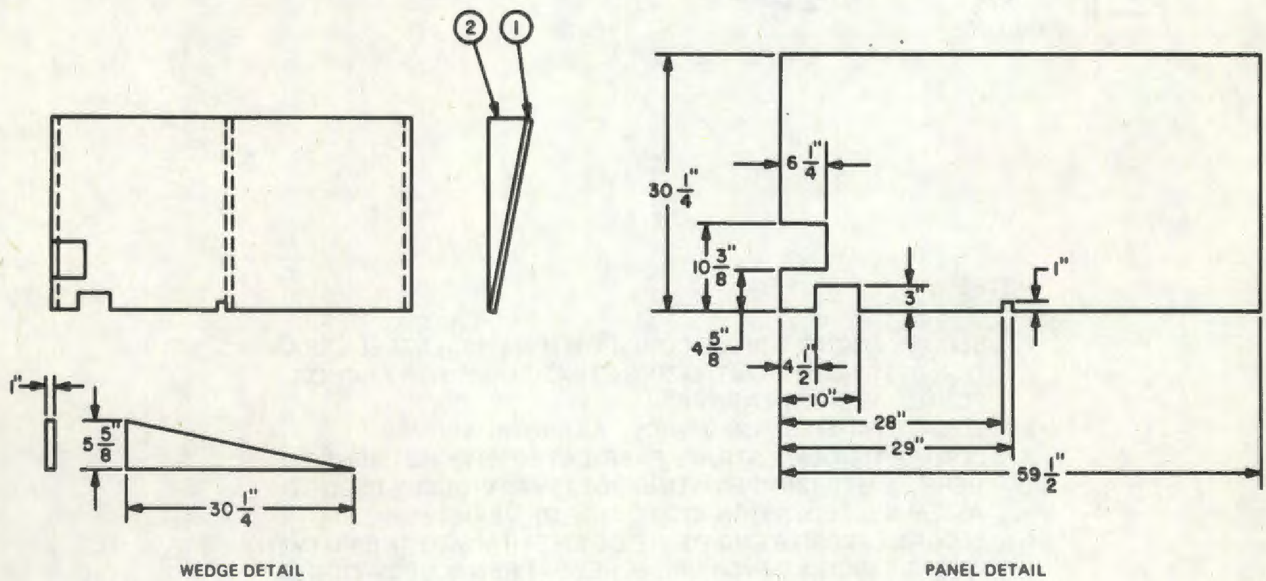


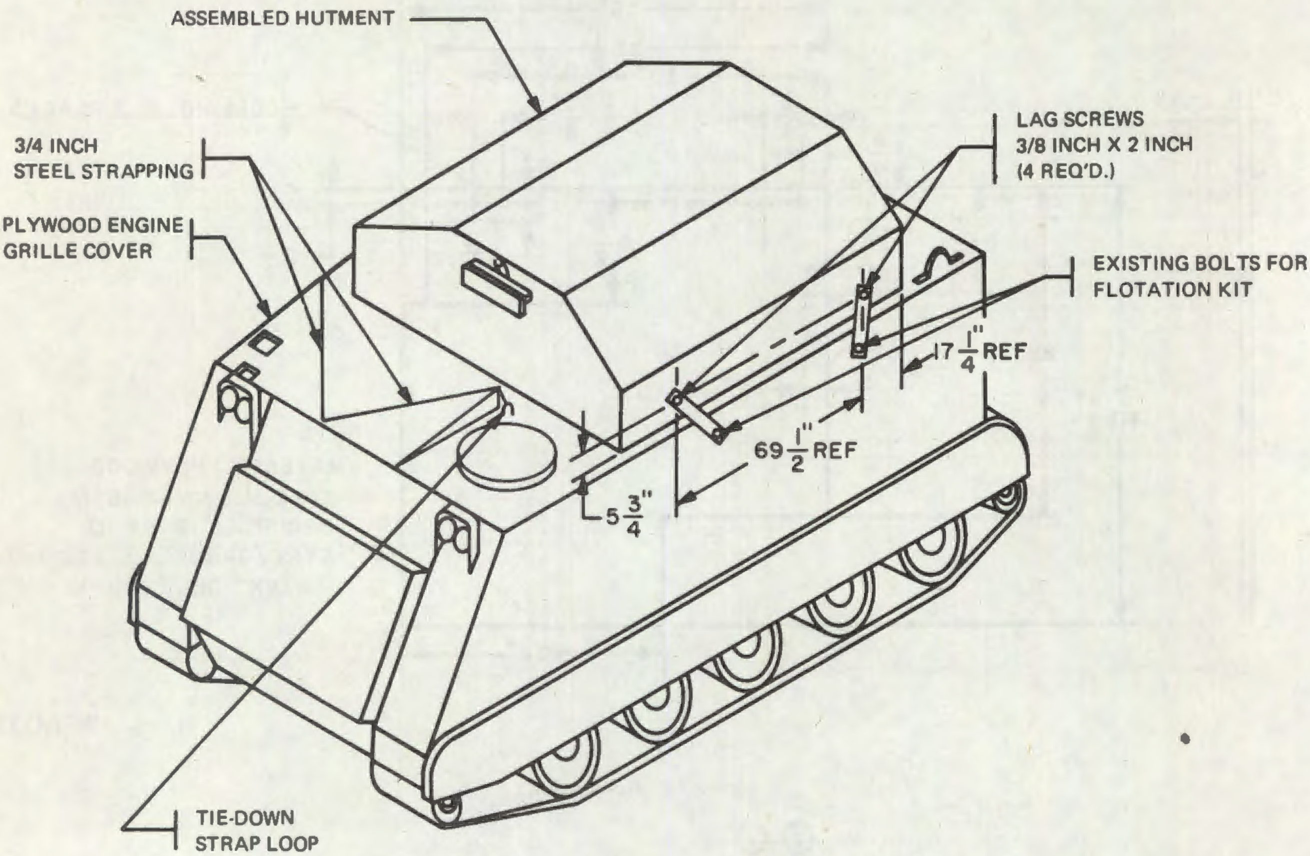
Figure 7-2. Wood panel.



MATERIAL LIST

PART	QTY	ITEM	NOMINAL SIZE (INCHES)	SPECIFICATION
1	1	PANEL	SEE DETAIL	NN-P-530, GROUP B (PS-1) TYPE - GRADE: STD. INT. W/EXT. GLUE (PS-1)
2	3	SUPPORT, WEDGE	SEE DETAIL	MIL-STD-731, GROUP I OR II

Figure 7-3. Engine grille cover. WE68138



NOTES:

1. SECURE ENGINE GRILLE COVER WITH 3/4 INCH STEEL STRAPPING (FSN 8135-283-0669), UTILIZING STRAP LOOPS FOR ANCHOR POINTS, AS SHOWN ABOVE.
2. LOCATE HUTMENT ON VEHICLE AS SHOWN ABOVE.
3. SECURE TIE-DOWN STRAPS FABRICATED WITH HUTMENT TO VEHICLE UTILIZING EXISTING BOLTS PREVIOUSLY USED TO ASSEMBLE FLOTATION KIT TO SIDE OF VEHICLE'
4. SECURE OPPOSITE END OF TIE-DOWN STRAPS TO THE HUTMENT WITH 3/8 INCH X 2 INCH LAG SCREWS (4 REQ'D.), POSITIONED APPROXIMATELY AS DIMENSIONED ABOVE. NOTE: ADJUST DIMENSIONS, AS REQUIRED, TO LOCATE THE LAG SCREW IN THE CENTER OF THE 2 X 4 FRAMING MEMBER OF THE SIDE PANEL.

WE68139

Figure 7-4. Wood hutment and engine grille cover tie-down pattern.

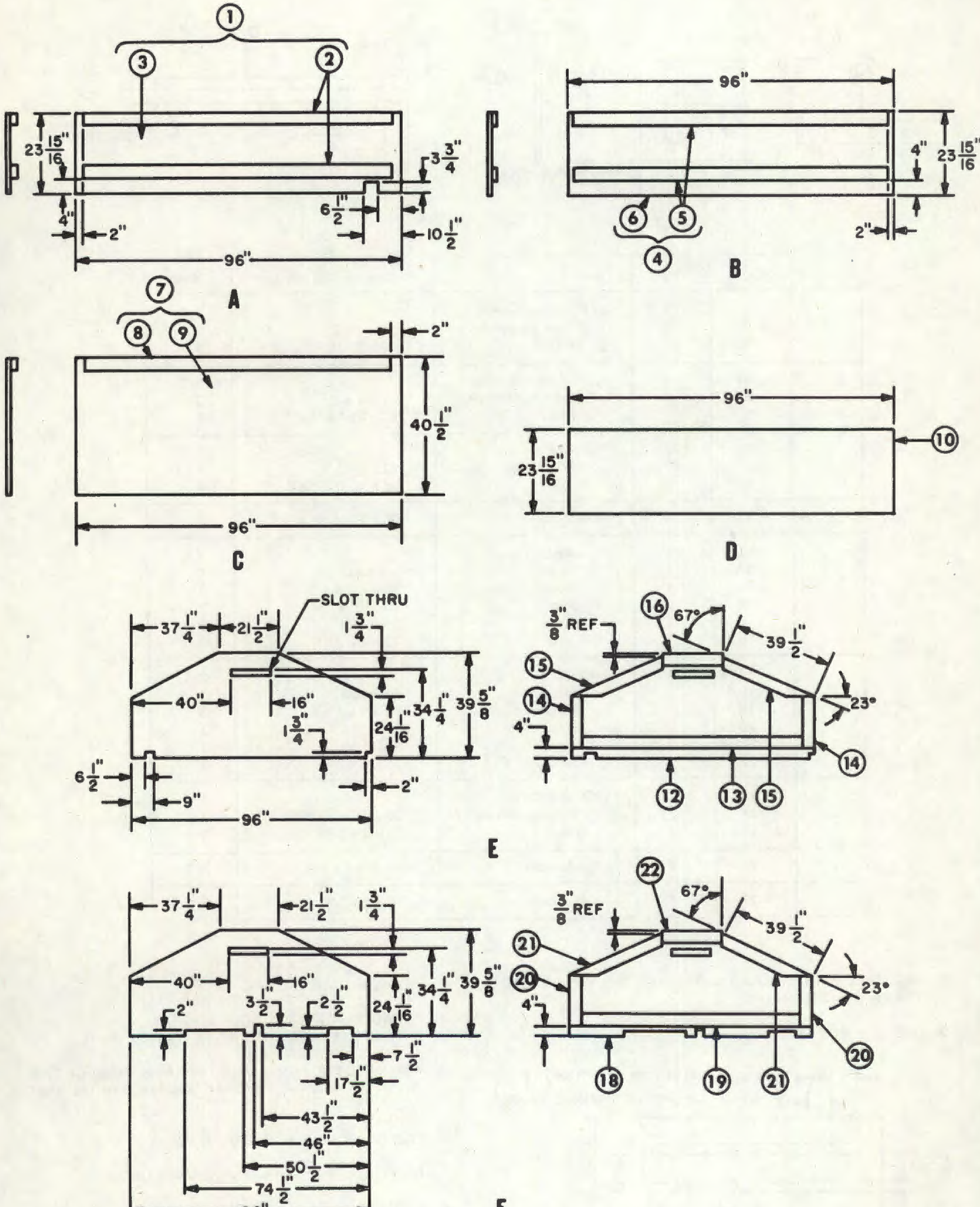


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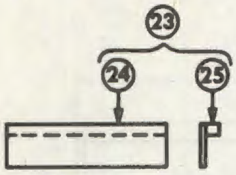
Figure 7-5. Wood hutment fabrication - sheet 1 of 2.



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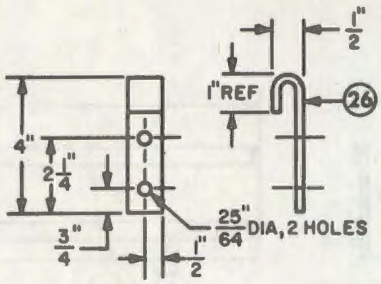

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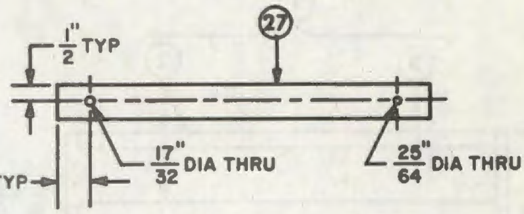

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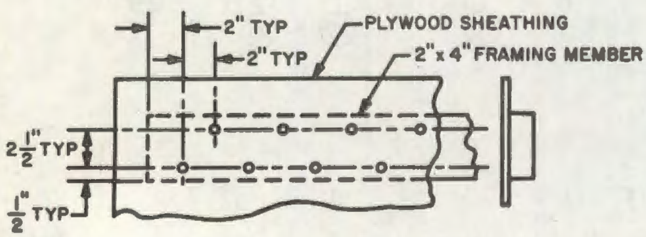
	Part	Qty	Item	Nominal Size (Inches)	Notes
A	1	1	Left hand side panel		1, 2
	2	2	Framing Member	92 x 4 x 2	3
	3	1	Panel	96 x 23-15/16 x 3/8	4
B	4	1	Right hand side panel		1, 2
	5	2	Framing Member	92 x 4 x 2	3
	6	1	Panel	96 x 23-15/16 x 3/8	4
C	7	2	Top panel		1, 2
	8	2	Framing Member	92 x 4 x 2	3
	9	2	Panel	96 x 40-1/2 x 3/8	4
D	10	1	Panel	96 x 23-15/16 x 3/8	4
E	11	1	Forward End Panel		2, 5
	12	1	Panel	See detail	4
	13	1	Framing member	88-3/4 x 4 x 2	3
	14	2	Strut	20-1/16 x 4 x 2	3
	15	2	Brace	See detail	3
	16	1	Joist	23 x 4 x 2	3
F	17	1	Aft End Panel		2, 5
	18	1	Panel	See detail	4
	19	1	Framing member	88-3/4 x 4 x 2	3
	20	2	Strut	20-1/16 x 4 x 2	3
	21	2	Brace	See detail	3
	22	1	Joist	23 x 4 x 2	3
G	23	2	Ventilator Baffle		1
	24	2	Framing member	20 x 1-5/8 x 1-3/4	3
	25	2	Panel	20 x 5 x 3/8	4
H	26	2	Lifting bracket	5-1/2 x 1 x 1/8	6, 7, 8
I	27	4	Tie-down strap	15 x 1 x 1/8	6, 7

NOTES

1. ASSEMBLE USING 6d NAILS THROUGH THE PLYWOOD INTO THE FRAMING MEMBER.
2. USE NAILING PATTERN.



3. WOOD, MIL-STD-731, GROUP I OR II.
4. PLYWOOD, NN-P-530, GROUP B (PS-1) TYPE-GRADE: STD. INT. WITH EXT. GLUE (PS-1).
5. ASSEMBLE END PANEL USING 6d NAILS THROUGH THE PLYWOOD INTO THE FRAMING MEMBER, STRUTS, BRACES AND JOIST.
6. LOW CARBON STEEL STRAP.
7. DRILL HOLES IN STRAP AS SHOWN IN DETAIL.
8. FORM BRACKET AS SHOWN IN DETAIL.

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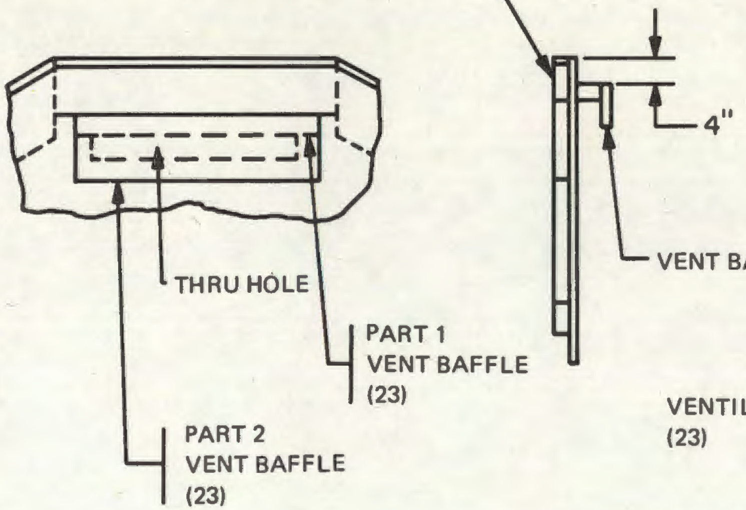
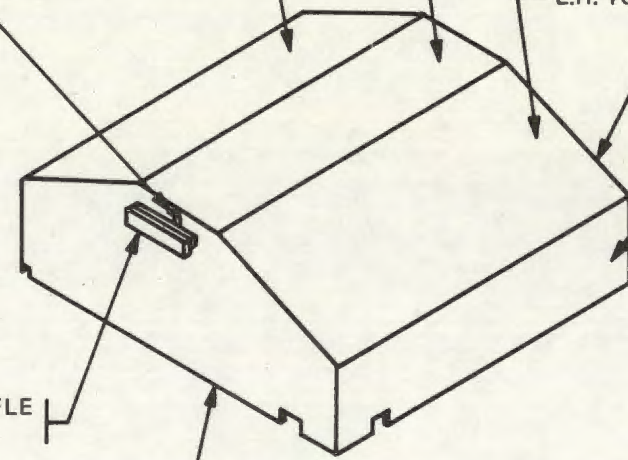
Figure 7-5. Wood hutment fabrication - sheet 2 of 2.



VENT BAFFLE ASSEMBLY



HUTMENT ASSEMBLY

NOTES:

1. TO ASSEMBLE HUTMENT, USE 8d NAILS. NAIL THROUGH PLYWOOD INTO THE EDGE GRAIN OF STRUTS, BRACES, JOISTS AND FRAMING MEMBERS ONLY. DO NOT USE END GRAIN NAILING.
2. ORDER OF ASSEMBLY:
   A. SECURE VENTILATOR BAFFLE (23) TO END PANELS (11 AND 17). FOR LOCATION, SEE DETAIL ABOVE. NAIL FROM INSIDE OF END PANELS (11 AND 17) THROUGH PLYWOOD INTO BAFFLE ASSEMBLY.
   B. SECURE SIDE PANELS (1 AND 4) TO END PANELS (11 AND 17).
   C. SECURE L. H. AND R. H. TOP PANELS (7) TO THE END PANELS (11 AND 17) AND SIDE PANELS (1 AND 4).
   D. SECURE TOP PANEL (10) TO THE END PANELS (11 AND 17) AND L. H. AND R. H. TOP PANELS (7).
   E. SECURE LIFTING BRACKET (26) TO END PANELS (11 AND 17) WITH LAG SCREWS 3/8 DIA. X 2 (4 REQ'D.) THROUGH THE BRACKET INTO THE END PANEL JOIST. NOTE: KEEP BRACKETS FLUSH WITH TOP PANEL.

WE68141

Figure 7-6. Wood hutment assembly pattern.

APPENDIX A

REFERENCES

For publications referenced in this manual, refer to TM 9-2350-300-L (List of Applicable Publications For Gun, Antiaircraft Artillery, Self-Propelled: 20-MM, XM163 (2350-999-4392)). TM 9-2350-300-L contains a listing of current publications, including supply manuals, technical manuals, technical bulletins, etc., applicable to the XM163 system.

APPENDIX B
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

The maintenance allocation chart (MAC) given in section II prescribes for all levels of maintenance the lowest level authorized to perform each maintenance operation.

B-2. Maintenance Functions.

Maintenance functions are limited to and defined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

c. Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air.

d. Adjust. To rectify to the extent necessary to bring into proper operating range.

e. Align. To adjust specified variable elements of an item to bring to optimum performance.

f. Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of comparison of two instruments, one of which is certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

g. Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

h. Replace. To replace unserviceable items with serviceable assemblies, subassemblies, modules, or parts.

i. Repair. Those maintenance operations necessary to restore an item to serviceable condition through correction of materiel damage or a specific failure. Repair may be accomplished at each category of maintenance.

j. Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time, work-in-process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. Rebuild. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors, and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

B-3. Explanation of Format.

The purpose and use of each column of the chart are as follows:

a. Column 1, Group Number. Column 1 lists the reference numbers assigned to each unit, assembly, subassembly, and module; the purpose of these reference numbers is to identify the items with the next higher assembly.

b. Column 2, Component Assembly Nomenclature. Column 2 lists the noun names of each unit, assembly, subassembly, and module.

c. Column 3, Maintenance Function. Refer to paragraph B-2 of this appendix for an explanation of the format and data in this column. Refer to paragraph B-4 of this appendix for an explanation of the symbols used.

d. Column 4, Tools and Equipment. Column 4 is used to specify those tools and test equipment required to perform the designated function. Tools and test equipment are as follows:

(1) Refer to table 2-1 for organizational maintenance tools and equipment.

(2) Refer to TM 9-2350-300-34 for DS, GS, tools and equipment.

e. Column 5, Remarks. Column 5 gives a reference code for specific comments related to the maintenance functions and assignments for particular items in the chart. The reference codes are as follows:

(1) Repair limited to motor or microswitch replacement at organizational level.

(2) Repair limited to mixer diode replacement at organizational level.

(3) Repair limited to spark-gap tube and zener diode replacement.

(4) Repair limited at direct support. Fine/fine delay circuit repair is at depot level.

(5) Item to be returned to U.S. Army Depot, Red River, marked Condition Code (F).

(6) Test Set, Antenna AN/VPM-1, because of mainly having mechanical test fixtures, will be located in a mechanical shop set.

(7) Matched pair of doppler filters must be replaced as a set.

B-4. Symbols.

The symbols placed in the maintenance function column of the chart are as follows:

Symbol	*Maintenance Category*	*Echelon*
C	Operator Maintenance	1
O	Organization Maintenance	2
F	Direct Support Maintenance	3
H	General Support Maintenance	4
D	Depot Maintenance	5

Section II. MAINTENANCE ALLOCATION CHART

(1) Group no.	(2) Component assembly nomenclature	(3) Maintenance function: Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	(4) Tools* & equipment	(5) Remarks
	20-MM ANTIAIRCRAFT CANNON XM 168 GUN													
	Cannon	C		C					O	O				
	Adapter assembly, recoil	C							O	F				
	Barrel	C							O					
	Bolt assembly	C	O	C					O	O				
	Clamp assembly, mid-barrel	C							O	F				
	Clamp assembly, muzzle	C							C	F				
	Contact assembly, firing	O	O						O	F				
	Housing assembly, rear	F							F	F				
	Retainer assembly	F							F					
	Rotor assembly	F		O						F				
	20-MM GUN MOUNT XM157													
	Mount, gun	C	O	C						O	D			
A2	Control assembly	C	O		O				O	O				
	Elevation control assembly	O	O						F	O				
	Panel assembly	O	O						F	O				
	Chute, assembly, loading	C							O	O				
	Chute, feed	C							O	O				
	Chute, return	C							O	O				
	Conveyor unit assembly	O							O	O	H	D		
A1	Distribution box	C	O		O				O	O	H	D		
A17	Drive assembly, azimuth	O							O	F				
A16	Drive assembly, elevation	O							O	F				
A7	Drum assembly	O	O						F	O	H	D		
	Aft cover assembly	O							F					
	Switch assembly, full	O	O											
	Detection assembly, conveyor	C	O							O				
	Drive assembly, drum	O							O	O				
	Loading switch assembly	O	O						O	O				

(1) Group no.	(2) Component assembly nomenclature	(3) Maintenance function: Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	(4) Tools* & equipment	(5) Remarks
	Drum assembly, internal	F							F	F				
	Cover assembly, exit	F							F	F				
	Scoop disc assembly	F							F	F				
	Drum assembly, outer	F								F				
	Exit unit assembly	C							O	F				
	Partition and switch assembly	F	O						F	F				
	Element conveyor	O							O					
	Equilibrator guide, spring, and support	O							O	O				
	Feeder assembly, declutching	C	O	C					O	F	H	D		
	Flexible shaft assembly	O							O					
A6	Gun drive assembly	O	O						O	O				
A5	Inverter	O	O						O	D	D	D		
	Motor (drive, elev, az and drum)	F	O		O				O	F				
	Saddle assembly	O							F	F				
A15	Servo amplifier assembly	O	O						O	F	H			
A21	Sight current generator	O	O						O	O	H	D		
A14	Slip ring assembly	O	O						O	O	H			
A4	Storage batteries (mount)	O	O						F	F				
A19	Switch assembly, azimuth	O	O		O				O					
A18	Switch assembly, elevation limit	O	O		O				O					
A24	Switch assembly, radiate foot	O	O						O	O				
	Transfer drive assembly	O							O	F				
	Universal joint	O							O					
	AUTOMATIC LEAD COMPUTING SIGHT XM61													
A3	Sight, lead computing, automatic, XM61	C	O	O	C	D			O	C	D	D		
	Caging device and cover assembly													
	Light, indicator lamp (BILL)	C							C					
	Valve, aircheck	C	O						D	O	D			
	Lamp socket assembly (reticle)	O	O						F	F				
	Lamp, incandescent (reticle)	C							C					
	Cover (lamp)	C							O	O				

(1) Group no.	(2) Component assembly nomenclature	(3) Maintenance function: Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	(4) Tools* & equipment	(5) Remarks
	Post and ring sighting	C							O	F				
	Support, cell	C		C					O	D	D			
	Knob (cage)	C							O					
	Cover (boresight)	C							O	O				
	Radar Set AN/VPS-2	C	O	C		C				O	H			
A1	Antenna AS-2049/VPS-2	O	O	C		C			O	O	H			
A1A1	Reflector and feed	O	O						O	D	D			
A1A2	Elevation servo drive	O	O		F				O	O	H			
A1A2MG1	Motor-generator	O	O						O	F	H			
A1A3	Traverse servo drive	O	O		F				O	O	H			
A1A3MG1	Motor-generator	O	O						O	F	H			
A2	Transmitter-receiver RT860/VPS-2	O	O	C					O	O	H			
A2A1	Waveguide chassis	O	O						O	F	H			
A2A1AT1	Variable attenuator	F	F						F					
A2A1AT2, A2A1AT3, and A2A1AT5	Ferrite isolator	F	F						F					
A2A1DC1	Directional coupler	F	F						F					
A2A1FL1	Harmonic filter	F	F						F					
A2A1FL2	Preselector filter	F	F						F					
A2A1HY1	Circulator	F	F						F					
A2A1A1	X-band local oscillator	F	F						F					5
A2A1A1A1	Crystal oscillator	O	O						O					
A2A1A2	Double sideband modulator	F	F						F					5
A2A1A3	Klystron power amplifier	F	F						F					5
A2A1A4	Power monitor	F	F						F					
A2A1A5	Mixer preamplifier	F	F						F	O				2
A2A1A6	TR, limiter and shutter	F	F						F					5
A2A1A7	Diode switch	F	F						F	F	H			
A2A1A8	Switch driver	F	F						F	F	H			
A2A2	Klystron power supply	O	O						O	F	H			
A2A3	60-Hz oscillator	O	O						O					

(1) Group no.	(2) Component assembly nomenclature	(3) Maintenance function											(4) Tools* & equipment	(5) Remarks
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
A2A5	Transmit gate	O	O						O	F	H			
A2A6	Klystron beam power supply	O	O						O	O	H			3,5
A2A7	Pulse shaper	O	O						O	F	H			
A3	Receiver R-1475/VPS-2	O	O	C					O	O	H			
A3A1	I-f amplifier	F	F						F					
A3A2	AGC circuit	F	F						F	F	H			
A3A5	Multiple gate circuits	F	F						F	F	H			
A3A6	Doppler detector	F	F						F	F	H			
A3A6A1	Doppler amplifier	F	F						F					
A3A6A2	Doppler amplifier	F	F						F					
A3A6A3	Doppler filter	F	F						F					7
A3A6A4	Doppler filter	F	F						F					7
A3A6A5	Balanced mixers	F	F						F					
A3A6A6	Balanced mixers	F	F						F					
A3A9	I-f gate	F	F						F	F	H			
A3A11	Doppler oscillator	F	F						F					
A3A12	Doppler modulator	F	F						F					
A3A13	I-f filter	F	F						F					
A4	Range computer	O	O	C		O			O	O	H			
A4A1	Master clock	O	O						O					
A4A2	PRF counter	O	O						O	F	H			
A4A3	Modulator trigger generator	O	O						O	F	H			
A4A4	Computer timing generator	O	O						O	F	H			
A4A5	RCFD decoder	O	O						O	F	H			
A4A6	Range counter	O	O						O	F	H			
A4A7	RCFD generator	O	O						O	F	H			
A4A8	Range register A	O	O						O	F	H			
A4A9	Range register B	O	O						O	F	H			
A4A10	Search/track and gain control	O	O						O	F	H			
A4A11	Range rate counter A	O	O						O	F	H			
A4A12	Range rate counter B	O	O						O	F	H			
A4A13	Rate scaler	O	O						O	F	H			
A4A14	Rate integrator	O	O						O	F	H			

(1) Group no.	(2) Component assembly nomenclature	(3) Maintenance function Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	(4) Tools* & equipment	(5) Remarks
A4A15	Phase detector	O	O						O	F	H			
A4A16	Range D/A converter	O	O						O	F	H			
A4A17	Range rate D/A converter	O	O						O	F	H			
A4A18	4 V filter	O	O						O	F	H			
A4A19	15 V regulator	O	O						O	F	H			
A4A20	25 V regulator	O	O						O	F	H			
A4A21	Control amplifier	O	O						O	F	H			
A4A22	Fine/fine delay	O	O						O	F	H			4
A4A23	Universal board	O	O						O	F	H			
A5	Power supply, PP-4812/VPS-2	O	O	C					O	O	H			
A5A1	Servo electronics	O	O						O	F	H			
A5A2	Servo electronics	O	O						O	F	H			
A5A3	Converter	O	O						O	F	H			
A6	Distribution box	O	O	C					O	O	H			
W101 thru W108	System cabling	O	O	C					O					
W109	Interconnecting waveguide	O	O	C					O	O				
W110	Ground strap	O	O	C					O					
	Antenna mounting bracket	O		C					O					

*Refer to paragraph B-3.

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NOTE

Figures 3-1 through 3-76, on pages 3-27 through 3-123, are located in TM 9-2350-300-20/2; all other items are located in TM 9-2350-300-20/1.

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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
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Distribution:
To be distributed in accordance with DA Form 12-37, (qty rqr block no. 202) Organizational maintenance requirements for Gun, Antiaircraft, Artillery, Self-Propelled: 20-MM, XM163.

The correct supersession NOTE should read:

This manual together with TM 9-2350-300-20/2, 31 August 1971, supersedes TM 9-2350-300-20, 4 November 1968, including all changes and TM 9-2350-300-20/1, 18 December 1969.

★ U. S. GOVERNMENT PRINTING OFFICE : 1974 O 580-851