

101.11:  
-6115-464-12

**ARMY TECHNICAL MANUAL  
NAVY PUBLICATION  
AIR FORCE TECHNICAL ORDER  
MARINE CORPS TECHNICAL MANUAL**

**TM5-6115-464-12  
NAVFAC P-8-624-12  
TO-35C2-3-445-1  
TM-07523A-12**

**TECHNICAL MANUAL**

**OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL**

**GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL SKID MTD. 15 KW,  
3 PHASE, 4 WIRE, 120/208 AND 240/416 VOLTS**

<u>DOD MODEL</u>	<u>CLASS</u>	<u>HERTZ</u>	<u>NSN</u>
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

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MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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**JANUARY 1975**

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CHANGE }  
 No. 12 }

HEADQUARTERS  
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 WASHINGTON, D.C., 22 April 1988

Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

INCLUDING AUXILIARY EQUIPMENT

DOD MODEL	NOMENCLATURE	NSN
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MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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vii and viii  
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 3-79 and 3-80  
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 3-81 and 3-82  
 3-86A and 3-86B  
 3-93 and 3-94  
 C-3 and C-4

Insert pages

vii and viii  
 2-1 and 2-2  
 2-13 and 2-14  
 3-5 through 3-8  
 3-34C through 3-34E/3-34F  
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 3-93 and 3-94  
 C-3 and C-4

TM 5-6115-464-12  
NAVFAC P-8-624-12  
TO 35C2-3-445-1

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CHANGE }  
 No. 11 }

HEADQUARTERS  
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Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 and 240/416 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

INCLUDING AUXILIARY EQUIPMENT

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-00-096-9015

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2-19 through 2-20A/2-20B	2-19 through 2-20B
2-21 and 2-22	2-21 and 2-22
3-7 and 3-8	3-7 and 3-8

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**TM 5-6115-464-12**  
**NAVFAC P-8-624-12**  
**TO 35C2-3-445-1**  
**TM 07523A-12**

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CHANGE }  
 No. 10 }

HEADQUARTERS  
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 WASHINGTON, D.C., 30 January 1987

**Operator and Organizational Maintenance Manual**

**GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS**

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

**INCLUDING AUXILIARY EQUIPMENT**

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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Remove pages	Insert pages
a/b	a/b
vii and viii	vii and viii
2-15 through 2-18	2-15 through 2-18
2-21 and 2-22	2-21 and 2-22
3-2 and 3-3	3-2 and 3-3
3-8A and 3-8B	3-8A and 3-8B
3-17 and 3-18	3-17 and 3-18
3-23 and 3-24	3-23 and 3-24
3-43 and 3-44	3-43 and 3-44
4-1 and 4-2	4-1 and 4-2
E-1 and E-2	E-1 and E-2
D-3/D-4	D-3/D-4
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**DISTRIBUTION:**

To be distributed in accordance with DA Form 12-25A, Operator and Organizational Maintenance requirements for Generator Set, Diesel Driven, Tactical, Skid Mounted, 120/208V, 240/416V, 15KW, 3PH, 4 Wire (50/60HZ: MEP-004A, MEP-103A; 400HZ; MEP-113A) (TM 5-6115-464 Series)

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Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

INCLUDING AUXILIARY EQUIPMENT

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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i through viii	i through viii
1-1 through 1-10	1-1 through 1-10
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2-13 and 2-14	2-13 and 2-14
2-19 and 2-20	2-19 and 2-20
2-25 and 2-26	2-25 and 2-26
3-7 and 3-8	3-7 and 3-8
3-8A and 3-8B	3-8A and 3-8B
3-13 and 3-14	3-13 and 3-14
3-24A and 3-24B	3-24A and 3-24B
3-59 and 3-60	3-59 and 3-60
C-3 and C-4	C-3 and C-4
FO-1, Sheet 2	FO-1, Sheet 2
FO-1, Sheet 4	FO-1, Sheet 4

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 NO. 8 }

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Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

INCLUDING AUXILIARY EQUIPMENT

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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3-23 and 3-24	3-23 and 3-24
3-25 and 3-26	3-25 and 3-26
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3-85 and 3-86	3-85 and 3-86
-----	3-86A and 3-86B
4-39 through 4-43/4-44	4-39 through 4-43/4-44
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Index 5 and Index 6	Index 5 and Index 6
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TM 5-6115-464-12  
NAVFAC P-8-624-12  
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**DISTRIBUTION:**

To be distributed in accordance with DA Form 12-25D, Operator Maintenance Requirements for Generator Sets, Engine Driven: 15 KW, 60 HZ Precise Power, 15 KW, 400 HZ Precise Power, and 15 KW, 60 HZ Utility.

# URGENT

TM 5-6115-464-12  
NAVFAC P-8-624-12  
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C 7

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NO. 7 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 3 November 1982

## Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
4 WIRE, 120/208 AND 240/416 VOLTS

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MEP-103A	PRECISE	50/60	6115-00-118-1245
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### INCLUDING AUXILIARY EQUIPMENT

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2-19 thru 2-20A/2-20B

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2-19 thru 2-20A/2-20B

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TO-35C2-3-445-1  
TM 07523A-12  
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**DISTRIBUTION:**

To be distributed in accordance with DA Form 12-25D, Operator Maintenance requirements for Generator Sets, Engine Driven: 15KW, 60 HZ Precise Power, 15 KW, 400 HZ Precise Power, and 15 KW, 60 HZ Utility.

**Marine Corps:**  
**MARCORPS CODE: AGC**

CHANGE }  
 No. 6 }

HEADQUARTERS  
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 WASHINGTON, D.C., 3 September 1982

**Operator and Organizational Maintenance Manual**

**GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS**

DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

**INCLUDING AUXILIARY EQUIPMENT**

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
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MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094
	APPLICATIONS KIT	6115-01-096-9015

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2. Remove and insert as indicated below.

	Remove Pages	Insert Pages
Table of Contents	i thru viii	i thru ix/x
Chapter 1	1-3 thru 1-8	1-3 thru 1-8
Chapter 2	2-1 and 2-2 2-5 and 2-6 2-13 and 2-14 2-19 and 2-20 2-23 and 2-24 2-27/2-28	2-1 and 2-2 2-5 thru 2-6A/2-6B 2-13 thru 2-14A/2-14B 2-19 thru 2-20A/2-20B 2-23 and 2-24 2-27/2-28
Chapter 3	3-24A thru 3-26 3-39 and 3-40	3-24A thru 3-26A/3-26B 3-39 and 3-40
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Appendix E	E-1 and E-2	E-1 and E-2
Index	Index 1 thru Index 19/20	Index 1 thru Index 21/22

Remove Pages

F0-1 (Sheet 2)  
F0-2  
F0-3  
F0-4  
F0-5

Insert Pages

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F0-2  
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F0-5

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To be distributed in accordance with DA Form 12-25D, Operator Maintenance requirements for Generator Sets, Engine Driven: 15 KW, 60 HZ Precise Power, 15 KW, 400 HZ Precise Power, and 15 KW, 60 HZ Utility.

**Marine Corps:**

**MARCORPS CODE: AGC**

CHANGE }  
 No. 5 }

HEADQUARTERS  
 DEPARTMENT OF THE ARMY  
 WASHINGTON, DC., 27 May 1981

Operator and Organizational Maintenance Manual

GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
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DOD MODEL	CLASS	HERTZ	NSN
MEP-004A	UTILITY	50/60	6115-00-118-1241
MEP-103A	PRECISE	50/60	6115-00-118-1245
MEP-113A	PRECISE	400	6115-00-118-1244

INCLUDING AUXILIARY EQUIPMENT

DOD MODEL	NOMENCLATURE	NSN
MEP-005AWF	WINTERIZATION KIT, FUEL BURNING	6115-00-463-9083
MEP-005AWE	WINTERIZATION KIT, ELECTRIC	6115-00-463-9085
MEP-004ALM	LOAD BANK KIT	6115-00-291-9201
MEP-005AWM	WHEEL MOUNTING KIT	6115-00-463-9094

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**GENERATOR SET, DIESEL ENGINE DRIVEN,  
 TACTICAL, SKID MTD., 15 KW, 3 PHASE,  
 4 WIRE, 120/208 AND 240/416 VOLTS**

DOD MODEL	CLASS	HERTZ	NSN
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MEP-103A	PRECISE	50/60	6115-00-118-1245
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**GENERATOR SET, DIESEL ENGINE DRIVEN,  
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**DEPARTMENTS OF THE ARMY, THE NAVY,  
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**Operator and Organizational Maintenance Manual  
GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL SKID  
MTD, 30 KW 3 PHASE, 4 WIRE, 120/208 AND 240/416 VOLTS**

<b>DOD MODEL</b>	<b>CLASS</b>	<b>HERTZ</b>	<b>NSN</b>
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<b>MEP-113A</b>	<b>PRECISE</b>	<b>400</b>	<b>6115-00-118-1244</b>

**INCLUDING AUXILIARY EQUIPMENT**

<b>DOD MODEL</b>	<b>NOMENCLATURE</b>	<b>NSN</b>
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<b>MEP-005AWE</b>	<b>WINTERIZATION KIT, ELECTRIC</b>	<b>6115-00-463-9083</b>
<b>MEP-004ALM</b>	<b>LOAD BANK KIT</b>	<b>6115-00-463-9201</b>
<b>MEP-005AWM</b>	<b>WHEEL MOUNTING KIT</b>	<b>6115-00-463-9094</b>

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### **WARNING**

All specific cautions and warnings contained in this manual shall be strictly adhered to. Otherwise, severe injury, death and/or damage to the equipment may result.

### **HIGH VOLTAGE**

is produced when this generator set is in operation.

### **DEATH**

or severe burns may result if personnel fail to observe safety precautions. Do not operate this generator set until the ground terminal stud has been connected to a suitable ground. Disconnect the battery ground cable before removing and installing components on the engine or in the electrical control panel system. Do not attempt to service or otherwise make any adjustments, connections or reconnections of wires or cables until generator set is shut-down and completely de-energized.

### **DANGEROUS GASES**

Batteries generate explosive gas during charging; therefore, utilize extreme caution, do not smoke, or use open flame in vicinity when servicing batteries. Use only Slave Receptacle (SR1) when extra cranking power is required, as incorrect method of slaving could cause arcing at battery terminals. Exhaust discharge contains noxious and deadly fumes. Do not operate generator sets in enclosed areas unless exhaust discharge is properly vented to the outside. When filling fuel tank, maintain metal-to-metal contact between filler nozzle and fuel tank. Do not smoke or use an open flame in the vicinity. Use extreme care, should a selenium rectifier malfunction, to avoid inhalation of poisonous fumes.

### **LIQUIDS UNDER PRESSURE**

are generated as a result of the generator set. Do not expose any part of the body to a high pressure leak in the fuel or hydraulic system of the generator set. Relieve pressure from radiator before removing radiator cap.

### **NOISE**

operating level of this generator can cause hearing damage. Ear protectors, as recommended by the medical or safety officer, must be worn when working near this set.

### **CAUTION**

### **DAMAGE**

to the equipment may result if personnel fail to observe the cautions contained in this manual. If generator set is shut down by the operation of a safety device, do not attempt to operate the unit until the cause has been determined and eliminated.

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## CHAPTER 1 INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope

a. This manual is published for the information and guidance of personnel to whom the 15 KW Diesel Engine Driven Generator Set is issued. It contains instructions for operation and organizational maintenance of 50/60 Hz (Mode I) Tactical Utility (Class 2), 50/60 Hz (Mode I) Tactical Precise (Class 1) and 400 Hz (Mode II) Tactical Precise (Class 1) models of the generator set. Also included are descriptions of major components and their functions in relation to other components.

b. Appendix A contains a list of reference publications applicable to this manual. Appendix B contains a list of maintenance and operating supplies. Appendix C contains the Maintenance Allocation Chart which determines level of maintenance responsibility for Army users.

c. Appendix B (Army only) lists integral components and basic issue items. Appendix C contains the Maintenance Allocation Chart which determines level of maintenance for Army users. Appendix D lists maintenance and operating supplies. Appendix E lists additional items that are authorized.

#### NOTE

Air Force users shall accomplish maintenance at user level consistent with their capability in accordance with policies established by AFM 66-1.

#### 1-2. Forms and Records.

#### NOTE

This manual is used by Army, Air Force, Navy, and Marine Corps personnel. Use of forms as directed in this manual will be accomplished only by personnel of that service to which such forms apply.

a. Maintenance forms and records used by Army personnel will be only those prescribed by TM 38-750. Those to be used by Marine Corps personnel are prescribed in the latest edition of TM 4700-15/1. Air Force forms and records used will be those prescribed by AFB 66-1 and the applicable 00-20 Series Technical Orders. Navy users should refer to their appropriate publications to determine the applicable forms and records to be used.

b. Reports of errors, omissions, and recommendations for improvement of this manual by its user is encouraged. Such reports should be submitted by various service personnel as follows:

(1) Air Force. AFTO Form 22 direct to: Commander, Sacramento Air Materiel Area, MMED, McClellan Air Force Base, California, 95652, in accordance with TO-00-5-1.

(2) Army. DA Form 2028 direct to: Commander, US Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTP, 4300 Goodfellow Blvd., St. Louis, MO. 63120.

(3) Marine Corps. NAVMC 10772 direct to: Commandant, US Marine Corps, ATTN: Code LMO-1, Washington, D.C. 20380.

(4) Navy. By letter direct to: Commander, U. S. Navy, Ships Parts Control Center, ATTN: Code 733, Mechanicsburg, PA 17055.

#### 1-2.1. Hand Receipt (Army Use Only).

Hand receipt for the End/Component of End Item (COEI), Basic Issue Items (BII) and Additional Authorization List (AAL) Items are published in a Hand Receipt Manual. The Hand Receipt Manual numerical designation is the same as the related Technical Manual with the letters HR added to the number. These manuals are published to aid in property accountability and are available through: Commander, U. S. Army Adjutant General Publication Center, ATTN: AGDL-OD. 1655 Woodson Road, St. Louis, MO 63114.

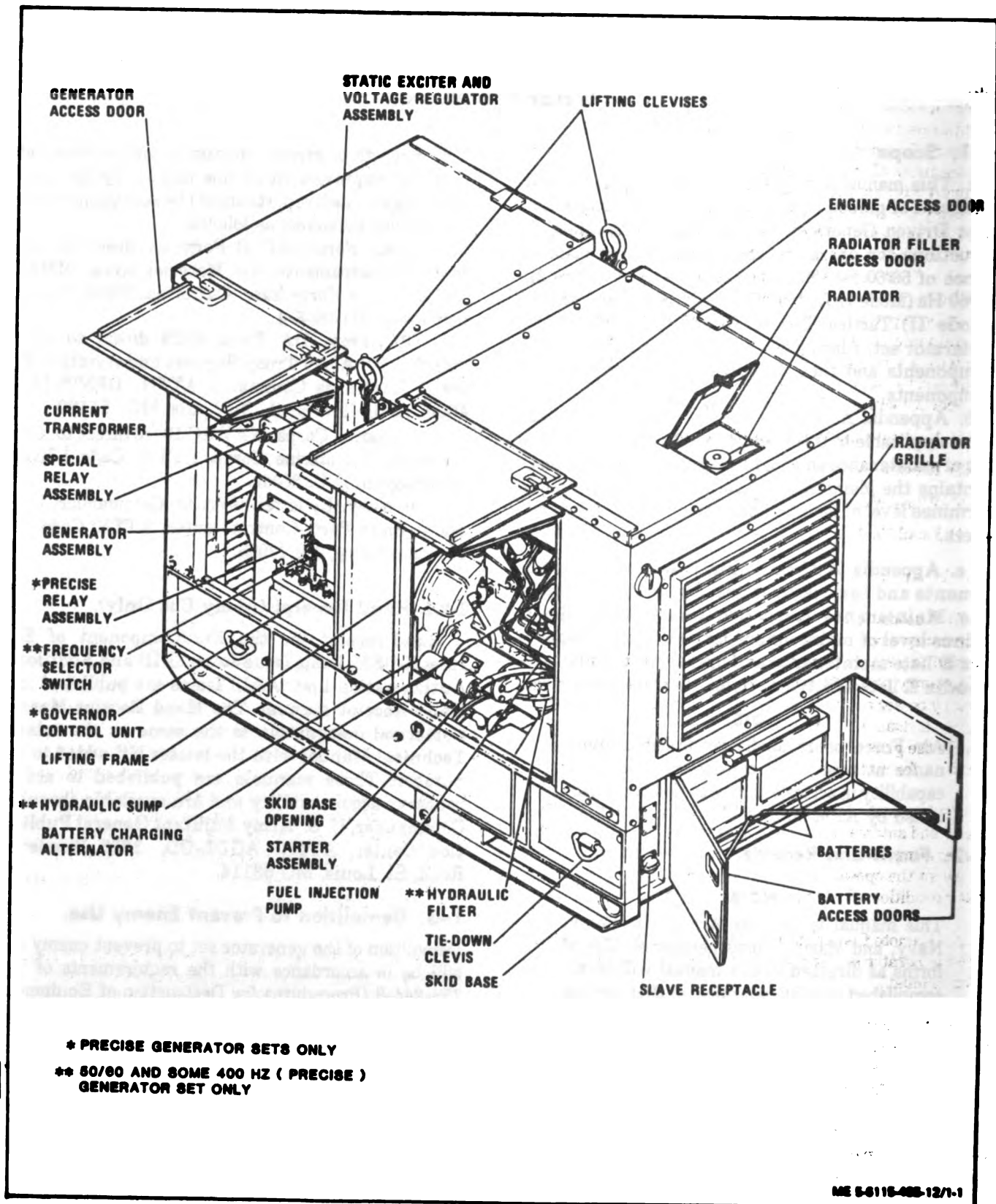
#### 1-3. Demolition to Prevent Enemy Use.

Demolition of the generator set to prevent enemy use will be in accordance with the requirements of TM 750-244-3 (Procedures for Destruction of Equipment to Prevent Enemy Use for U. S. Army and U. S. Marine Corps).

#### 1-4. Shipment and Storage

a. Preparation for shipment and storage of the generator set for U. S. Air Force will be in accordance with TO 35-1-4.

b. Shipment and storage for the US Army and the US Marine Corps will be in accordance with TB 740-97-2 and TM 740-90-1.



**Figure 1-1. Engine Generator Set, Right-Front, Three-Quarter View**

## Section II. DESCRIPTION AND DATA

### 1-5. DESCRIPTION

a. **General.** The generator sets, models MEP-004A, MEP-103A, and MEP-113A (figure 1-1 and 1-2) are fully enclosed, self-contained, skid mounted, portable units. They are equipped with controls, instruments and accessories necessary for operation as single unit or in parallel with one or more units of the same class and mode. Each set is equipped with engine oil pan heating elements and necessary connections for field installation of winterization kits. Lifting clevises for hoisting the generator set are located at the top of the lifting frame and center support assembly. Tubular cross members, that will accept a chain, have been provided at the front and rear of the skid base assembly to permit towing for short distances. Mobility of the units may be obtained by mounting on trailers or equipping with a wheel mounting kit. To extend the capability of the generator sets, they have also been designed to accept and operate with the following optional kits:

- (1) Fuel Burning Winterization Kit (paragraph 4-3).
- (2) Electric Winterization Kit (paragraph 4-9).
- (3) Wheel Mounting Kit (paragraph 4-15).
- (4) Load Bank Kit (paragraph 4-20).

(4.1) Applications Kit (paragraph 4-26).

(5) Automatic Transfer Panel 50/60 Hz: Monitors 50/60 Hz primary power and automatically starts and transfers the load to a standby generator set in the event of abnormal primary power fluctuation or failure. Continues sensing primary power and upon satisfactory resumption, will return the load to the primary power source, shut-off and recycle the generator set to a standby condition. (See Appendix A for manual).

(6) Automatic Transfer Panel 400 Hz: Monitors 400 Hz power and automatically starts and transfers the load from an operating 400 Hz generator set to a like standby set in the event the operating sets load contactor opens due to a faulty condition. (See Appendix A for manual.)

(7) Remote Control Box: Permits starting and stopping of the generator set from a remote location. (See Appendix A for manual.)

(8) Auxiliary Fuel Burning Winterization: Provides a dependable external source of battery power for starting of the generator set in ambient temperatures from  $-25^{\circ}\text{F}$  to  $-65^{\circ}\text{F}$ . (See Appendix A for manual.)

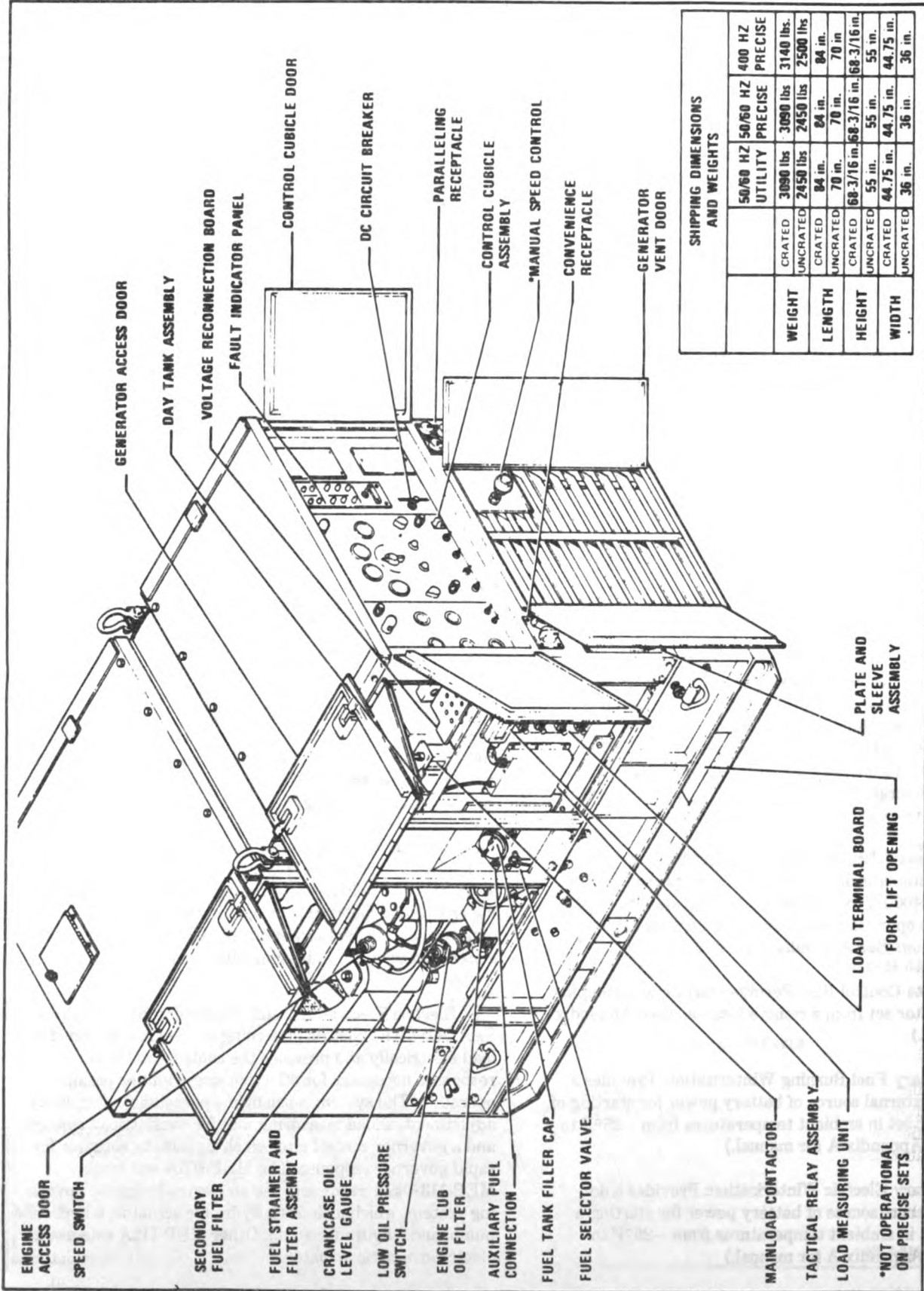
(9) Auxiliary Electric Winterization: Provides a dependable external source of battery power for starting a generator set in ambient temperatures from  $-25^{\circ}\text{F}$  to  $-65^{\circ}\text{F}$ . (See Appendix A for manual.)

b. **Engine.** Power source of the generator set is a four cylinder, four cycle, fuel injected, liquid cooled diesel engine. The engine electrical system contains a cranking motor, two 12 volt batteries in series, and a battery charging alternator with integral rectifier and voltage regulator. The engine is also equipped with a fuel filter and strainer assembly, a secondary fuel filter, a lubricating oil filter, and an air cleaner. Cooling water is circulated through the engine by a water pump. Safety devices automatically stop the engine during conditions of high coolant temperature, low oil pressure, no fuel, over-speed, or over-voltage.

c. **Generators.** The alternating current generators are single bearing, drip-proof, synchronous, brushless, three phase, fan cooled generators. Rated voltages are maintained by excitation of the generator-exciter field by a static exciter mounted on the relay table. The cooling fan, located at the front of the generator, impels cooling air which enters the generator and passes over the windings. Safety devices are provided to protect the generator in the event of short circuit, overload, under-voltage, under-frequency, reverse power, and over-voltage.

d. **Control Cubicle.** The generator set control cubicle is located at the rear top of the generator set and contains controls and instruments for operating the engine and the generator. The control panel is grounded to protect the operator from electrical shock in the event of a short in the equipment. The generator section of the control panel contains meters for monitoring generator output, adjusting knobs for increasing and decreasing frequency (Class 1 only) and voltage, and a circuit breaker switch for interrupting all output from the generator set. Also included on the generator control panel are an operations switch and synchronizing lights for operating the set as a single unit or in parallel with other units. The engine section of the control panel contains switches for priming, starting, and stopping the engine and meters for monitoring set fuel level, oil pressure, and coolant temperature. Also included is an ammeter for the battery charging alternator.

e. **Electric/Electro-Hydraulic Governing System (Precise Sets Only).** The electric governing system senses speed and load electrically and provides the controls and load responses necessary for effective single unit or parallel operation. The system consists of a rheostat for frequency adjustment, a load measuring unit for sensing load changes, and a governor control unit which signals the actuator for rapid governor response. The MEP-103A and some MEP-113A generator sets use an electro-hydraulic governing system, which includes a hydraulic actuator, a hydraulic pump, and a hydraulic sump. Other MEP-113A sets use an electric-magnetic actuator.



ME 5-6115-464-12/1-2

Figure 1-2. Engine Generator Set, Left-Rear, Three Quarter View

f. **Mechanical Governing System (Utility Sets Only).** The mechanical governing system provides the controls and load responses necessary for efficient single unit, or parallel, operation of utility generator sets. Engine rpm and set frequency are controlled by the mechanical governor, an integral part of the fuel injection pump, which actuates the fuel metering valve. Adjustment of engine rpm and set frequency is accomplished by use of a manual speed control located adjacent to the control cubicle. This control is a knob type device which permits rapid frequency adjustment, locking in any position, and vernier adjustment for finer control.

(10) **Engine Identification Plate.** Located on left side of engine block. Specifies manufacturer, manufacturer's specification, model number, serial, date of manufacture, bore, stroke, displacement, maximum continuous speed, maximum set continuous brake horsepower, lube oil pressure, firing order, intake and exhaust valve tappet clearances, and military specification.

(11) **Voltage Reconnection Plate.** Located on terminal guard over voltage reconnection board. Contains instructions for reconnecting the generator from 120/208 to 240/416 volts and reconfiguration back to 120/208 volts.

**1-6. IDENTIFICATION AND TABULATED DATA.**

a. **Identification.** There are eleven major identification and instruction plates on the generator set.

(1) **Generator Set Identification Plate.** Located at the top left side of the front housing assembly. Specifies nomenclature, model number, serial number, stock number, contract number, engine serial number, manufacturer, and shipping weight and dimensions.

(2) **Generator Set Rating Plate.** Located at top left side of front housing adjacent to generator set identification plate. Specifies kilowatt capacity relative to altitude and temperature, hertz rating, rated voltages and phases, voltage adjustment ranges, power factor, type, class, mode and size.

(3) **Fuel System Diagram Plate.** Located on inside face of left side generator compartment access door. Contains diagram of fuel system.

(4) **Operating Instruction Plate.** Located on inside face of right hand control panel access door. Specifies prestart checks, starting sequence, stopping sequence, and instructions for parallel operation.

(5) **Schematic and Troubleshooting Diagram Plates.** Troubleshooting plate is located on inside face of right and left engine compartment doors. A schematic diagram plate is located on the inside of the battery doors of the power generation and control circuits.

(6) **Winterization System Diagram and Caution Plates (furnished with Winterization Kit).** Installed on inside face of left rear upper control and lower left vent door. Specifies installation and operation of winterization systems. Also includes cautions pertinent to operation of winterization kits.

(7) **Lifting and Tie-Down Attachment Information Plate.** Located on lower right gear generator compartment door. Specifies center of gravity, tie-down location, lifting shackle location and capacity and direction of travel.

(8) **Battery Reconnection Instruction Plate.** Located inside face of battery compartment access door. Contains diagram of battery installation and specifies cautions to be observed when replacing batteries.

(9) **Generator Identification Plate.** Located on upper right side of generator housing. Specifies nomenclature, part number, style, rated rpm, frequency, serial number, kva rating, P/F, ampere rating, voltage, and manufacturer.

b. **Tabulated Data.**

(1) **Engine Generator Set (End Item):**

**Model Numbers:**

50/60 Hz Tactical Utility .....	MEP-004A
50/60 Hz Tactical Precise .....	MEP-103A
400 Hz Tactical Precise .....	MEP-113A

**DOD Drawing Numbers:**

MEP-004A .....	70-004
MEP-103A .....	70-103
MEP-113A .....	70-113

**Overall Dimensions and Weights:**

Overall length (MEP-004A, MEP-103A, and MEP-113A) .....	70 inches
Overall width (MEP-004A, MEP-103A, and MEP-113A) .....	36 inches
Overall height (MEP-004A, MEP-103A, and MEP-113A) .....	55 inches

**Dry Weights (less kits and optional equipment):**

MEP-004A .....	2450 pounds
MEP-103A .....	2450 pounds
MEP-113A .....	2500 pounds

(2) **Engine:**

Manufacturer .....	White Engines, Inc. Hercules Engine Div.
Model .....	D-198-ERX51
DOD drawing number .....	72-2222
Type .....	4 cylinder, four cycle, liquid cooled diesel
Rated horsepower at 1500 RPM .....	35 continuous
Rated horsepower at 1800 RPM .....	41 continuous
Rated horsepower at 2000 RPM .....	45 continuous
Altitude degradation, 5000 to 8000 ft. ....	3% per 1000 feet
Firing order .....	1,2,4,3
Winterization kit use .....	When temperature is -25°F or below

**Valve tappet clearance adjustment:**

Hot .....	0.015 Inch
-----------	------------

(3) **Cooling System:**

Type .....	Pressurized radiator and centrifugal pump
Capacity .....	18.6 qts.
Normal operating temperature .....	170°F (75.7°C) to 200°F (93.3°C)



(3) Cooling System (Continued):

Temperature transmitter:

Voltage rating ..... 24Vdc

Resistance (ohms) at temperature °F (°C):

2360 ± 236 ..... 120 (48.9)  
 710 ± 35.5 ..... 200 (93.7)  
 310 ± 24.8 ..... 280 (133)

(4) Lubrication System:

Type system ..... Full flow, circulating pressure  
 Oil pump type ..... Positive displacement gear  
 Normal operating pressure . 30-60 psig  
 Oil filter type ..... Full flow, replaceable element

Pressure transmitter:

Voltage rating ..... 24 Vdc

Resistance (ohms) at pressure (psi):

15.0 ..... 30  
 30.0 ..... 60

Lubrication system

capacity ..... 8.0 quarts

(5) Hydraulic System (Electro-Hydraulic Governor Equipped Precise Sets Only):

Hydraulic pump type ..... Positive displacement gear  
 Hydraulic filter type ..... Full flow, replaceable element  
 System capacity ..... 1 gallon

(6) Fuel System.

Fuel tank capacity ..... 15.0 gallons

Fuel transfer pumps:

Voltage rating ..... 24 Vdc  
 Delivery pressure ..... 7 psig (max)  
 Delivery rate ..... 18 gallons per hr. (max)

Fuel level switch (day tank):

Type ..... Float  
 Current ..... 3.0 amp at 6 to 32 Vdc  
 Pressure ..... 0 to 150 psi

Over travel:

High ..... 0.06 inch (min)  
 Low ..... 0.12 inch (min)

Fuel injection nozzle holder  
 cracking pressure ..... 2500 - 2950 psig

(7) Engine Electrical System:

Batteries ..... Two 12 volt (MS35000-3) connected in series

Starter Assembly:

Manufacturer ..... Delco Remy, Inc.

Model ..... 1113188

Rating:

Voltage ..... 24 Vdc

Drive type ..... Positive indexing with over-run clutch

Battery charging alternator:

Manufacturer ..... Prestolite

Model ..... ANJ-7001

Rating ..... 35 amp at 24 Vdc

Operating

temperature range .... -65°F to 175°F (-53.9°C to 79.4°C)

Current output ..... 0 to 35 amperes at 1900 to 4000 rpm

Protective fuse ..... Buss, AGS, 40 amp

(8) Generator (50/60 Hz Tactical Utility and Tactical Precise).

Manufacturer ..... Electric-Machinery Mfg. Co.

DOD drawing number ..... 72-2400

Type ..... Rotating field synchronous, brushless

Load capacity:

1500 rpm ..... 12.5 kw at 50 Hz

1800 rpm ..... 15 kw at 60 Hz

Current rating:

1500 rpm ..... 43 amp at 120/208 Vac  
 21.5 amp at 240/416 Vac

1800 rpm ..... 52 amp at 120/208 Vac  
 26 amp at 240/416 Vac

Power factor ..... 0.8

Cooling ..... Impeller fan

Lubrication requirements ..... None

Drive type ..... Direct coupling

Duty classification ..... Continuous

(9) Generator (400 Hz Tactical Precise):

Manufacturer ..... Electric-Machinery Mfg.

DOD drawing number ..... 72-2450

(9) Generator (400 Hz Tactical Precise) (Cont):

Type ..... Rotating field synchronous, brushless  
 Load capacity (2000 rpm) .. 15 kw at 400 Hz  
 Current rating (2000 rpm) .. 52 amps at 120/208 Vac or 26 amps at 240/416 Vac  
 Power factor ..... 0.8  
 Cooling ..... Impeller fan  
 Lubrication requirements ..... None  
 Drive type ..... Direct coupling  
 Duty classification ..... Continuous

(10) Electro-hydraulic Governing System (MEP-103A and Some MEP-113A):

Type system ..... Closed loop feedback  
 Load measuring unit:  
 Manufacturer ..... Electromagnetic Industries, Inc.  
 Model No. .... 69-500  
 DOD drawing number ... 69-785  
 Governor control unit:  
 Manufacturer ..... Electromagnetic Industries, Inc.

Model No.  
 50/60 Hz ..... 69-700  
 400 Hz ..... 69-800  
 DOD drawing number ... 69-784

Hydraulic actuator unit:

Manufacturer ..... Electromagnetic Industries, Inc.  
 Model No. .... 69-600-3  
 DOD drawing number ... 69-790

(11) Electric Governing System (MEP-113A only)

Type system ..... Closed loop feedback  
 Load measuring unit:  
 Manufacturer ..... Electromagnetic Industries, Inc.  
 Model No. .... 69-500  
 DOD drawing no. .... 69-785  
 Governor control unit:  
 Manufacturer ..... United Technologies  
 Model no. .... CU 671C-7  
 DOD drawing no. .... 81-4903

Electric actuator:

Manufacturer ..... United Technologies  
 Model no. .... AGB-130-D4  
 DOD drawing no. .... 81-705

(12) Safety Devices:

(a) Low oil pressure switch:  
 Voltage rating ..... 28 Vdc  
 Current rating ..... 10 amps  
 Trip pressure ..... 17 ± 3 psig  
 (b) Coolant high temperature switch:  
 Voltage rating ..... 28 Vdc  
 Current rating ..... 10 amps  
 Trip temperature ..... 220°F ± 3°F (104.8°C ± 1.5°C)

(c) Speed switch:

Type ..... Centrifugal, manual reset  
 Overspeed trip ..... 120 to 122.5 percent continuous engine speed (2400 to 2450 rpm, engine speed is 1200 to 1225 rpm, switch speed).  
 Element trip and reset .... S9-1. Trip - 290-310 rpm  
 Reset - 190 -310 rpm  
 S9-2. Trip - 590-610 rpm (50/60 Hz) 825-850 rpm (400 Hz)  
 Reset - 490-510 rpm (50/60 Hz) 725-750 rpm (400 Hz)  
 S9-3. Trip - 1200-1250 rpm  
 Reset - Manual

(13) Nut and Bolt Torque Data:

Intake manifold mounting nuts ..... 35 lb-ft  
 Exhaust manifold mounting nuts ..... 35 lb-ft  
 Low oil pressure switch ..... 20 lb-ft  
 Oil filter ..... 27 ± 2 lb-ft  
 Oil pressure transmitter ..... 20 lb-ft  
 Fuel injector mounting screws ..... 30-40 lb-ft  
 Fuel filter ..... 17 ± 2 lb-ft  
 Overtemperature switch ..... 12-15 lb-ft  
 Coolant temperature transmitter ..... 12-15 lb-ft

(14) Optional Equipment.

(a) Fuel burning winterization kit:  
 DOD drawing number ..... 72-2837  
 Operating temperature .... -25°F (-31.7°C) to -65°F (-53.9°C)  
 Operating voltage ..... 24 Vdc  
 Operating current:  
 Starting ..... 17.5 amperes  
 Running ..... 7.5 amperes  
 Fuel consumption ..... 20 to 23 cc/min.  
 Duty cycle ..... Continuous

(14) Optional Equipment (Continued):

(b) Electric winterization kit:

DOD drawing number ..... 72-2836  
Operating voltage ..... 208 to 240 volts, 50/60 or  
400 Hz single phase  
Operating current ..... 14.6 to 12.5 amperes  
Operating temperature .... 130°F (54.4°C) to  
155°F (67.4°C)

(c) Wheel mounting kit:

DOD drawing number ..... 72-2833  
Capacity (maximum) ..... 3500 lbs.  
Towing speed (maximum) .. 5 MPH

(d) Load bank kit:

DOD drawing number ..... 72-2803  
Load rating ..... 7.5 KW  
Operating voltage ..... 120/208 or 240/416 Vac  
3 phase, 4 wire

(e) Applications Kit:

MERADCOM drawing  
number ..... 13220E8189  
Load rating ..... 840 watts  
Operating voltage ..... 24 Vdc

(15) Fuel System Diagram. Refer to figure 1-3.

(16) Hydraulic System Diagram. Refer to figure 1-4.

(17) AC and DC, 15 and 30 KW, 50/60 and 400 Hz,  
Precise and Utility, Wiring Diagram, Dwg. No. 72-2205.  
Refer to Figure FO-1.

(18) AC Schematic Diagram, 15 and 30 KW, Precise  
Generator Sets, Dwg. No. 72-2200. Refer to figure FO-2.

(19) DC Schematic Diagram, 15 and 30 KW, Precise  
Generator Sets, Dwg. No. 72-2269. Refer to figure FO-3.

(20) AC Schematic Diagram, 15 and 30 KW, Utility  
Generator Sets, Dwg. No. 72-2295. Refer to figure FO-4.

(21) DC Schematic Diagram, 15 and 30 KW, Utility  
Generator Sets, Dwg. No. 72-2277. Refer to figure FO-5.

(22) Shipping Dimensions and Weights. Refer to figure  
1-2.

1-7. DIFFERENCES BETWEEN MODELS.

The primary differences between the models of the  
generator sets covered in this manual are as follows:

a. Models MEP 004A and MEP 103A are equipped with a  
50/60 Hz generator. Model MEP 113A is equipped with a  
400 Hz generator.

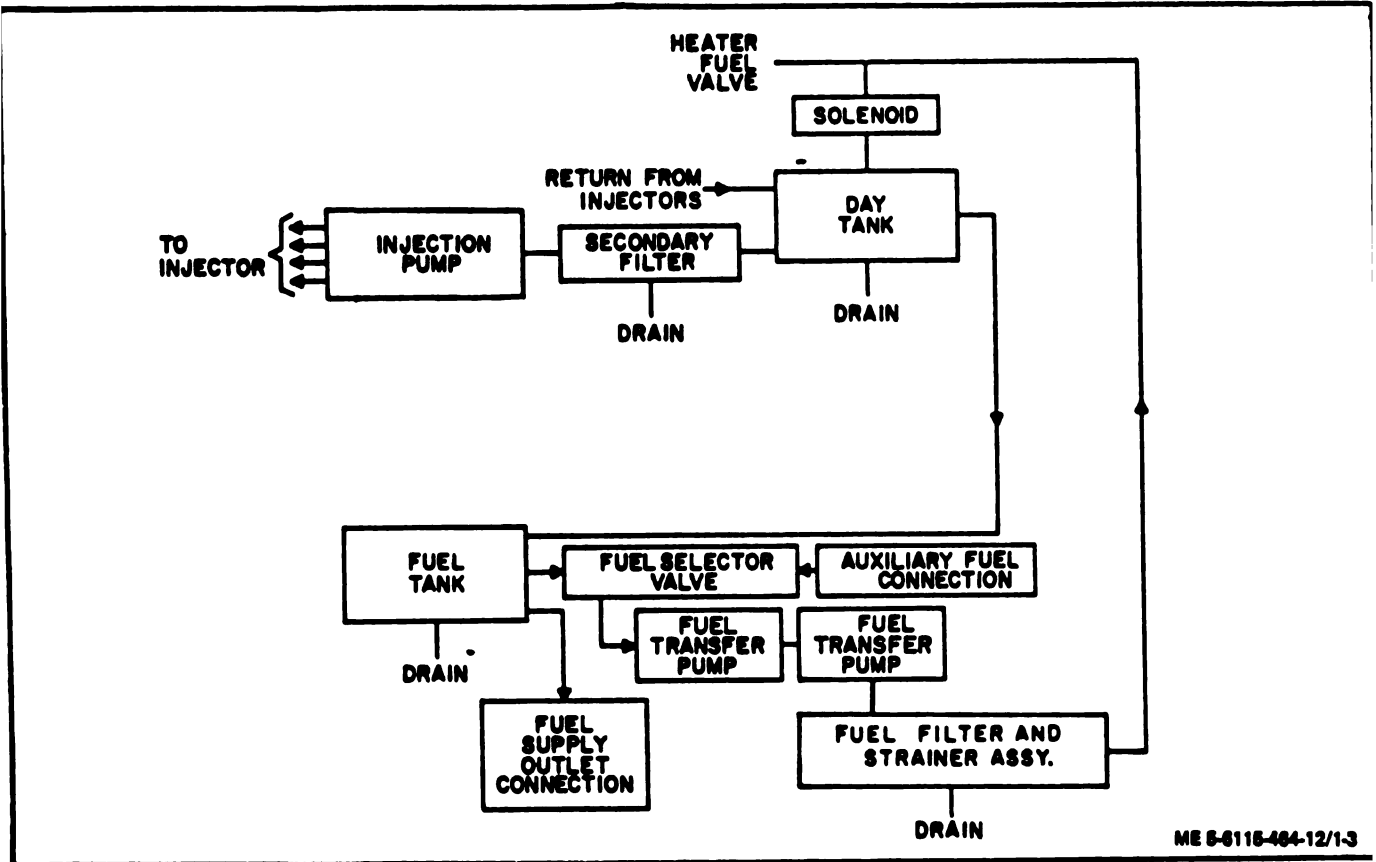
b. Models MEP 103A and some MEP 113A use an electro-  
hydraulic governor. Other Models MEP-113A use an elec-  
tric governor. Model MEP 004A uses a mechanical gover-  
nor which is integral with the fuel injection pump.

c. The control cubicle of all three models have a fre-  
quency adjust rheostat, but it is functional only on models  
MEP 103A and MEP 113A. Model MEP 004A accomplishes  
frequency adjustment through the manual speed control.

d. All three models use the same special relay box, but  
models MEP 103A and MEP 113A are also equipped with a  
precise relay box. The two precise relay boxes are identical  
with the exception that the precise relay box of model MEP  
103A contains a frequency selector switch whereas the  
precise relay box of model MEP 113A does not.

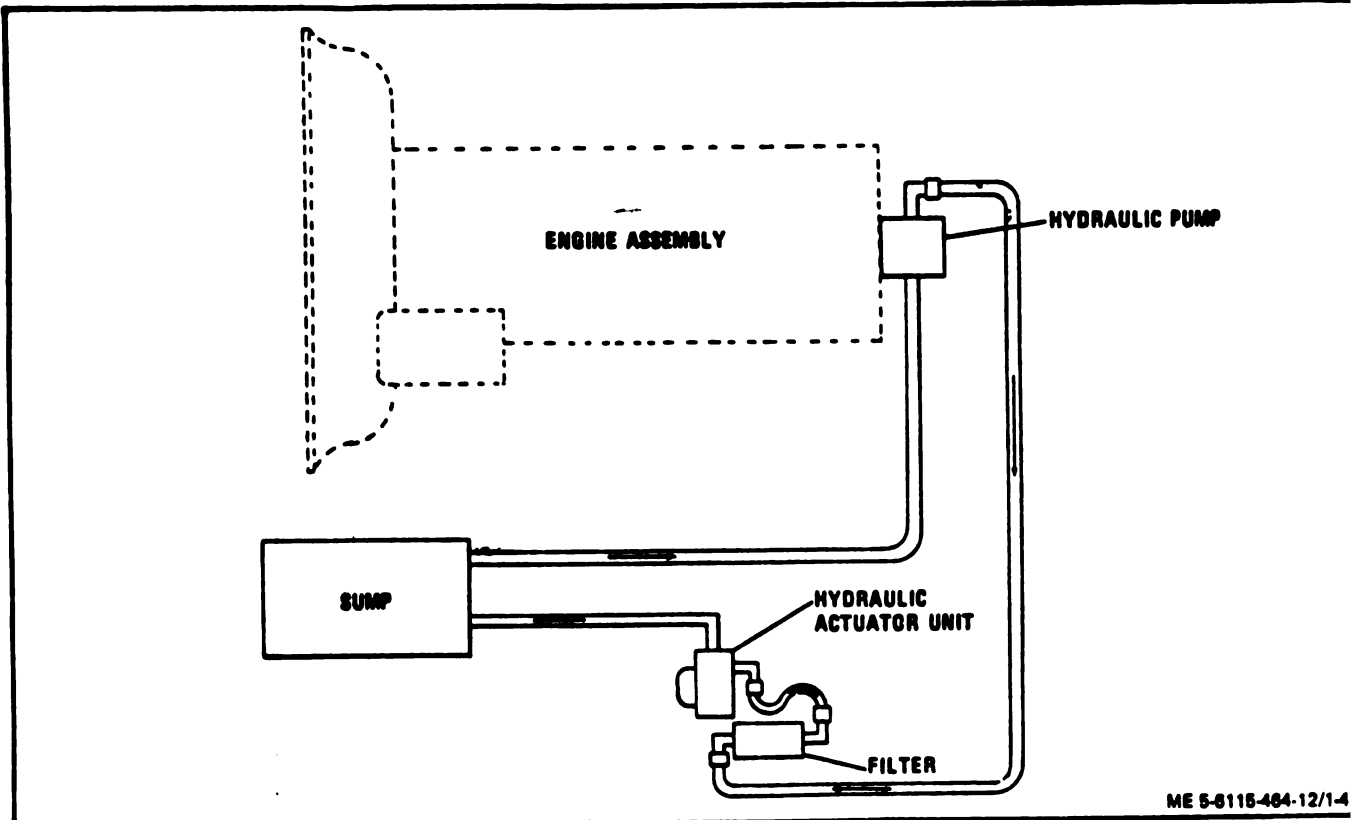
e. Models MEP 103A and MEP 004A use the same ex-  
citer regulator assembly and cross current transformer.  
These components are different on model MEP 113A.

f. Differences in performance characteristics are given in  
table 1-1.



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Figure 1-8. Fuel System Diagram



ME 5-6115-464-12/1-4

Figure 1-4. Hydraulic System Diagram (Electro-Hydraulic Governor Equipped Precise Sets Only)

Table 1-1. Differences in Performance Characteristics

	MEP 004A	MEP 103A	MEP 113A
1. Voltage regulation:			
(a) Dip with application of rated load.	20% (max)	15% (max)	12% (max)
(b) Rise with rejection of rated load.	20% (max)	15% (max)	12% (max)
(c) Dip with application of simulated motor load.	40% (max)	30% (max)	25% (max)
(d) Adjustment range Vac	50 Hz: 380-426 60 Hz: 395-480	50 Hz: 380-426 60 Hz: 395-480	400 Hz: 395-458
2. Frequency:			
(a) Regulation	2.0 to 3.0% of rated frequency	0.25% of rated frequency	0.25% of rated frequency
(b) Short term steady state stability	Within 2.0% bandwidth	Within 0.5% bandwidth	Within 0.5% bandwidth
(c) Long term steady state stability	Within 3% bandwidth	Within 1% bandwidth	Within 1% bandwidth
(d) Undershoot with application of rated load	4% of rated frequency (max)	1.5% of rated frequency (max)	1.5% of rated frequency (max)
(e) Recovery time after application of rated load	3 seconds (max)	1 second (max)	1 second (max)
(f) Overshoot with rejection of rated load	3% of rated frequency (max)	1.5% of rated frequency (max)	1.5% of rated frequency (max)
(g) Recovery time after rejection of rated load	3 second (max)	1 second (max)	1 second (max)
(h) Drift (60°F temperature change)	1% rated frequency (max)	0.5% rated frequency (max)	0.5% rated frequency (max)
(i) Approximate adjustment range)	58 to 62 Hz for 60 Hz operation  (48 to 52 Hz) for 50 Hz operation	58 to 62 Hz for 60 Hz operation  (48 to 52 Hz) for 50 Hz operation	390 to 410 Hz

## CHAPTER 2

### INSTALLATION AND OPERATION INSTRUCTIONS

#### Section I. SERVICE UPON RECEIPT OF MATERIAL

#### 2-1. INSPECTING AND SERVICING THE GENERATOR SET.

##### a. Inspection.

- (1) Check the generator set rating plate for positive identification.
- (2) Make a complete visual inspection of the exterior of the generator set for evidence of damage which may have occurred during shipment.
- (3) Open the battery compartment access doors (figure 1-1) and inspect the batteries for damage.
- (4) Open the control panel access doors (figure 1-2) and check the control panel for damage.
- (5) Open the generator air intake doors (figure 1-2) and inspect the generator vent grill for damage.
- (6) Open the generator compartment access doors (figures 1-1 and 1-2) and check each component for obvious signs of damage and corrosion.
- (7) Open the engine compartment access doors (figures 1-1 and 1-2) and check the engine and its components for visible damage.
- (8) Check the engine air cleaner assembly and exhaust opening for obstruction.
- (9) Check the v-belts for proper adjustment (paragraph 3-90).
- (10) Make a thorough visual inspection of the generator set for loose or missing mounting hardware or damaged or missing parts.
- (11) Check all fuel and hydraulic hoses for loose connections. Tighten any loose connections.
- (12) Check all wiring harnesses for loose connectors and terminals. Tighten any found loose.

##### b. Servicing.

##### (1) Batteries.

- (a) Open battery compartment access doors (figure 1-1).

- (b) Remove battery tray retaining screws and lockwashers and slide battery tray out of battery compartment.

- (c) Remove battery vent caps.

#### **WARNING**

Battery electrolyte contains sulfuric acid which can cause severe burns. Always dilute electrolyte with water. Never pour water into electrolyte as high temperatures will be generated and splattering of the electrolyte may result. If electrolyte comes in contact with skin or clothing, rinse immediately with clean water.

- (d) Fill the battery cells to the slots in the filler wells with electrolyte and install the vent caps. Make sure that the vent holes in the caps are open.

#### NOTE

Batteries are shipped dry charged. Electrolyte must be requisitioned separately.

- (e) Refer to paragraph 3-65 and connect battery cables.
- (f) Apply an approved corrosion preventive compound to battery post and cable terminals.
- (g) Slide battery tray into battery compartment and secure with retaining screws and lockwashers.

#### NOTE

If generator set is not to be operated within 12 hours, batteries must be charged.

- (h) Close the battery compartment access doors.
  - (i) After 30 minutes, check electrolyte level. Add electrolyte as required.
- ##### (2) Cooling System.
- (a) Open the radiator filler cap access door (figure 1-1) and remove the radiator cap.

Table 2-1. Freezing Points, Composition and Specific Gravities of Military Anti-freeze Materials

Lowest expected ambient temp. °F	Pints of inhibited glycol per gal. of coolant <sup>1</sup>	Compound, antifreeze Arctic <sup>2</sup>	Ethylene glycol coolant solution specific gravity at 68°F <sup>3</sup>
+20	1-1/2	Issued full strength and ready mixed for 0° to -65°F temperatures for both initial installation and replenishment of losses.	1.022
+10	2		1.036
0	2-3/4		1.047
-10	3-1/4		1.055
-20	3-1/2		1.062
-30	4		1.067
-40	4-1/4		1.073
-50	Arctic anti-freeze preferred	DO NOT DILUTE WITH WATER OR ANY OTHER SUBSTANCE.	
-60			
-75			

<sup>1</sup> Maximum protection is obtained at 60 percent by volume (4.8 pints of ethylene glycol per gallon of solution).

<sup>2</sup> Military Specification MIL-C-11755 Arctic type, nonvolatile anti-freeze compound is intended for use in the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic regions where the ambient temperature remains for extended periods close to -40°F or drops below, to as low as -90°F.

<sup>3</sup> Use an accurate hydrometer. To test hydrometer, use 1 part ethylene glycol anti-freeze to 2 parts water. This should produce a hydrometer reading of 0°F.

(b) Fill the cooling system with coolant as specified in table 2-1 and replace cap.

NOTE Deleted.

(3) Fuel System.

(a) Check to see that the fuel tank drain valve (84, figure 3-22) is closed and the cap is installed.

(b) Remove the fuel tank filler cap.

**WARNING**

When filling the fuel tank, maintain metal-to-metal contact between the fuel tank filler neck and the fuel nozzle to prevent sparks from static electricity. There shall be no smoking or open flames in the vicinity of the fueling operation.

**CAUTION**

JP-4 fuel is considered an emergency fuel only.

(c) Fill the fuel tank with fuel.

(d) Install the fuel tank filler cap.

#### (4) Lubrication System.

(a) Check to see that the drain plug is installed in the engine crankcase drain tube and close valve. (See Lubrication Order.)

(b) Fill the crankcase to the proper level with oil. (See paragraph 3-3 for lubrication information.)

(5) Remove cap from hydraulic sump and fill sump to proper level on dipstick with oil conforming to Military Specification MIL-H-5606 (for electro-hydraulic governor equipped Precise Sets only).

(6) Preventive Maintenance. Perform the before operation preventive maintenance checks and services. Refer to table 3-1.

### 2-2. INSTALLATION OF SEPARATELY PACKED COMPONENTS.

There are no separately packed components.

### 2-3. INSTALLATION INSTRUCTIONS.

a. General. The generator set installation site should be as level as possible and should provide adequate ventilation to prevent cooling air from recirculating. The site must be within 25 feet of any generator set to be connected in parallel and within 25 feet from any auxiliary fuel supply. The generator set control cubicle may be removed as a unit and installed up to 500 feet from the remainder of the set. A wiring harness with 40 AWG #16 and 7 AWG #12 conductors installed between connectors P1 and P2 (figures FO-1 and FO-2) allows the generator set to be started, operated, and monitored from the remotely installed control cubicle. Refer control cubicle removal and installation to higher level maintenance. Refer to figure 2-1 for dimensions, clearances, air flow requirements and floor capacity requirements when selecting an installation site.

b. Outdoor Installation. Select the site to make maximum use of natural protective barriers while allowing enough space on all sides for service and maintenance. The soil of the site should be firm and well drained. In areas where the soil will not support the generator set, use planks or other suitable material as dunnage.

c. Indoor Installation.

## **WARNING**

Do not operate the generator set in an enclosed area unless the exhaust fumes are piped outside the enclosure. Inhalation of exhaust gases will result in serious illness or death.

Position the generator set so that a maximum supply of cooling air is available. Never situate the generator set with the radiator near a wall or other object which would impede the free circulation of cooling air. If a free supply of cooling air is not available, provide vents or ducting to the outside of the installation. Insure that the cooling air intake and outlet openings in the installation are at least as large as the cooling air intake and exhaust openings on the generator set. If louvers are used, increase the size of the openings by 35 percent. Install a gas tight metal pipe from the exhaust outlet on the generator set to the outside of the installation. Use as short a pipe as possible with no more than one 90 degree bend and as few lesser bends as possible. Insure that the inside diameter of the exhaust piping is as large or larger than the inside diameter of the exhaust connection on the generator set. The termination of the exhaust pipe shall be such that the hot gases or sparks will be discharged harmlessly and will not be directed against combustible material or into an area containing flammable gases or vapors. Provide an adequate fire-proof shield at the point where the exhaust piping passes through a flammable wall. If the exhaust piping is so positioned that the danger of personnel touching it exists, wrap it with asbestos. Refer to figure 2-1 for dimensions, air flow requirements, and floor loading capacity.

d. Grounding. The generator set may be grounded to an underground metallic water system, a driven metal rod or a buried metal plate. A ground rod must have a minimum diameter of 5/8 inch if solid or 3/4 inch if pipe and must be driven to a minimum depth of 8 feet. A ground plate must have a minimum area of 9 square feet and be buried to a minimum depth of 4 feet. The ground lead must be at least No. 6 AWG copper wire. If ground rod is used, refer to figure 2-2 and connect the generator set to the ground as follows.

## **WARNING**

Do not operate the generator set until it has been connected to a suitable ground. Serious injury or death by electrocution can result from operating an ungrounded generator set.

- (1) Insert ground cable into slot in ground stud and tighten nut.
- (2) Connect coupling to ground rod and install driving stud. Make sure that driving stud seats on ground rod.
- (3) Drive the ground rod into ground until coupling is just above surface.
- (4) Remove driving stud and install another section of ground rod, making sure that it seats on first section.



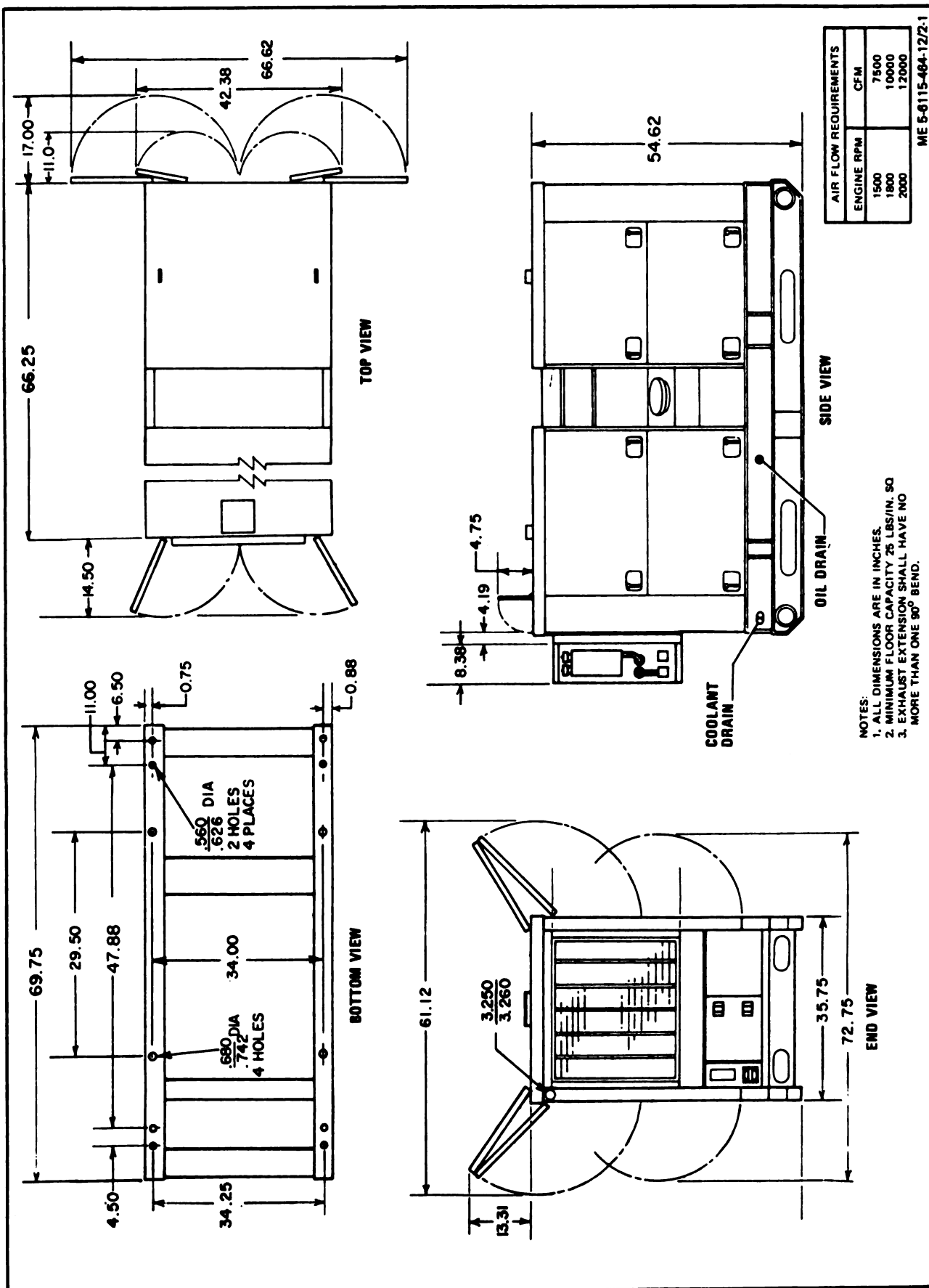
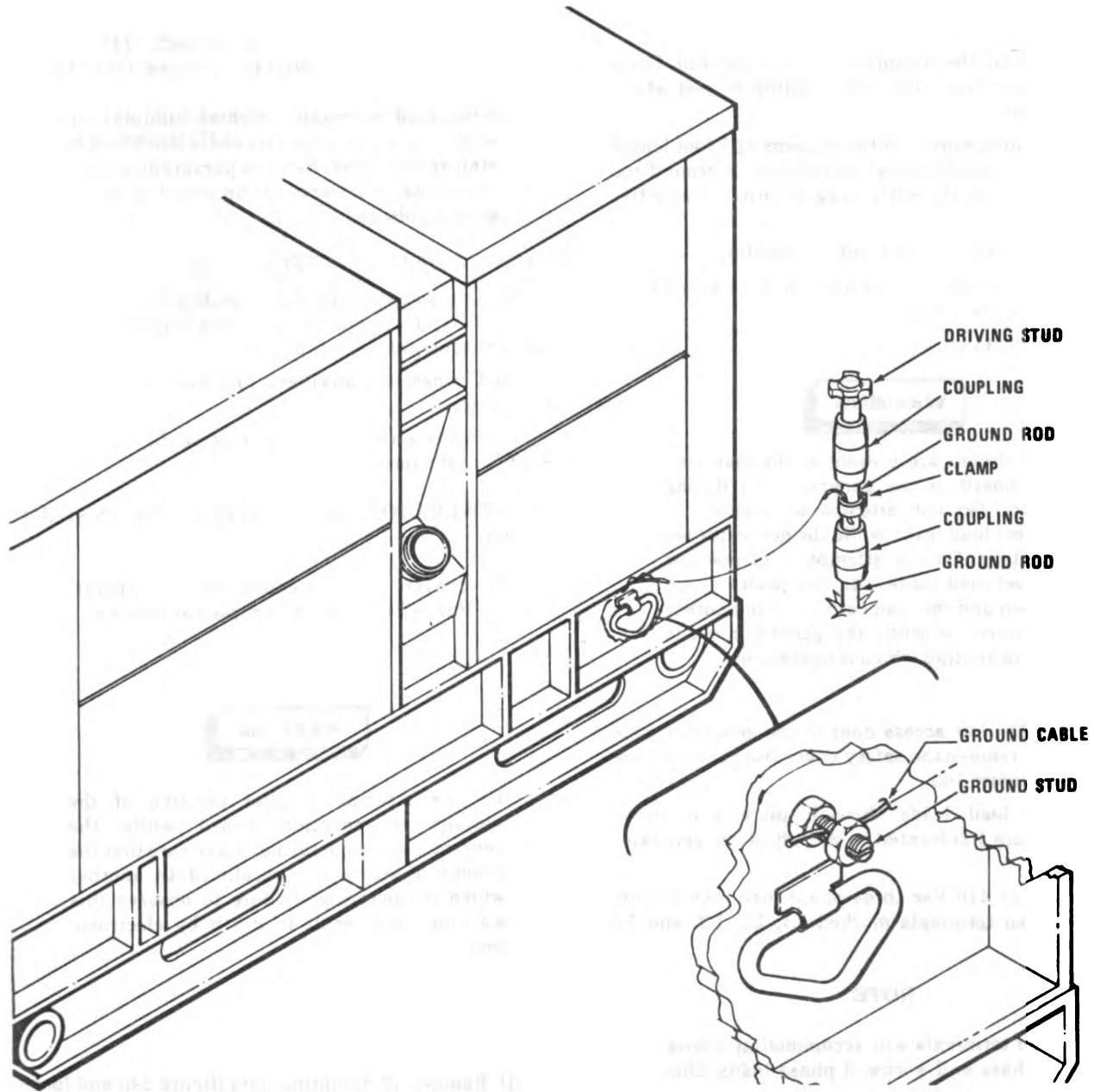


Figure 2-1. Installation Plan



ME 5-6115-464-12/2-2

Figure 2-2. Ground Connections

(5) Install another coupling and driving stud. Drive the ground rod until the new coupling is just above ground surface.

(6) Use a minimum of three sections of 3 foot length ground rods. Add additional sections until ground rod has been driven sufficiently deep to provide effective ground.

(7) Remove driving stud and top coupling.

(8) Connect clamp and ground cable to ground rod and securely tighten screw.

e. Load Connection.

**WARNING**

Lethal voltages are present at the load connection board of the generator set during operation. Do not attempt to connect or disconnect load leads while the generator set is operating. Do not attempt to connect or disconnect load leads with the generator set shut down and the load connected to another power source or while the generator set is parallel to another which is operating.

(1) Open the left access door to the generator compartment and remove the safety cover from the load terminal board (figure 1-2).

(2) Insert load leads through plate and sleeve assembly (figure 1-2) located to the left of the generator set air intake.

(3) A 208 or 416 Vac three phase load may be connected between terminals marked L1, L2, L3, and L0 (figure 2-3).

**NOTE**

The load terminals will accommodate 2-wire single phase and 4-wire, 3 phase loads. One or more single phase loads can be served alone or in combinations with 3 phase loads; but the load on any one phase must not exceed 100 percent of the current rating of that phase.

(4) Phase rotation for three phase loads is L1, L2, L3.

**NOTE**

After load connection, tighten binding nuts with plastic/phenolic box end wrench and install safety cover. Refer to paragraph 2-3 and check that the reconnection board is set for proper voltage.

f. Auxiliary Fuel Source Connection.

(1) Connect the auxiliary fuel line to the generator set auxiliary fuel supply connection (figure 1-2) located below the integral tank filler cap.

(2) Connect the auxiliary fuel line to the auxiliary fuel source.

(3) Position the fuel selector valve (figure 1-2) in the AUXILIARY position.

**2-4. GENERATOR SET CONVERSION INSTRUCTIONS.**

a. To convert the generator set for operation at 120/208 Vac or 240/416 Vac, proceed as follows.

**WARNING**

Do not attempt to alter position of the voltage reconnection board while the generator set is operating. Make sure that the generator set is not paralleled to another which is operating. Failure to observe this warning may result in death by electrocution.

(1) Remove 12 mounting nuts (figure 2-6) and locate the movable board until the arrow at its edge mates with the arrow on the stationary board indicating the desired operator voltage.

(2) Install and tighten the mounting nuts.

b. To convert 50/60 Hz precise set to 50 Hz operation, place frequency select switch (figure 1-1) on precise relay assembly to 50 Hz position.

(2) Connect the auxiliary fuel line to the auxiliary fuel source.

(3) Position the fuel selector valve (figure 1-2) in the AUXILIARY position.

**2-4. GENERATOR SET CONVERSION INSTRUCTIONS.**

a. To convert the generator set for operation at 120/208 Vac or 240/416 Vac, proceed as follows.



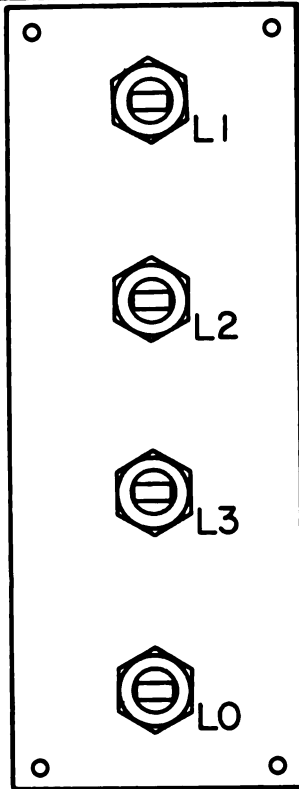
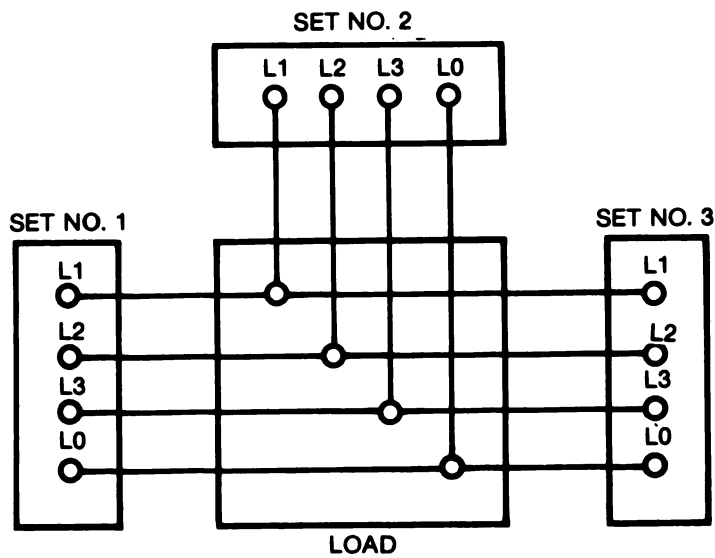


Figure 2-3. Load Terminal Board Assembly



**NOTE:** Connect L1 to L1, L2 to L2, etc.

Figure 2-4. Parallel Connection

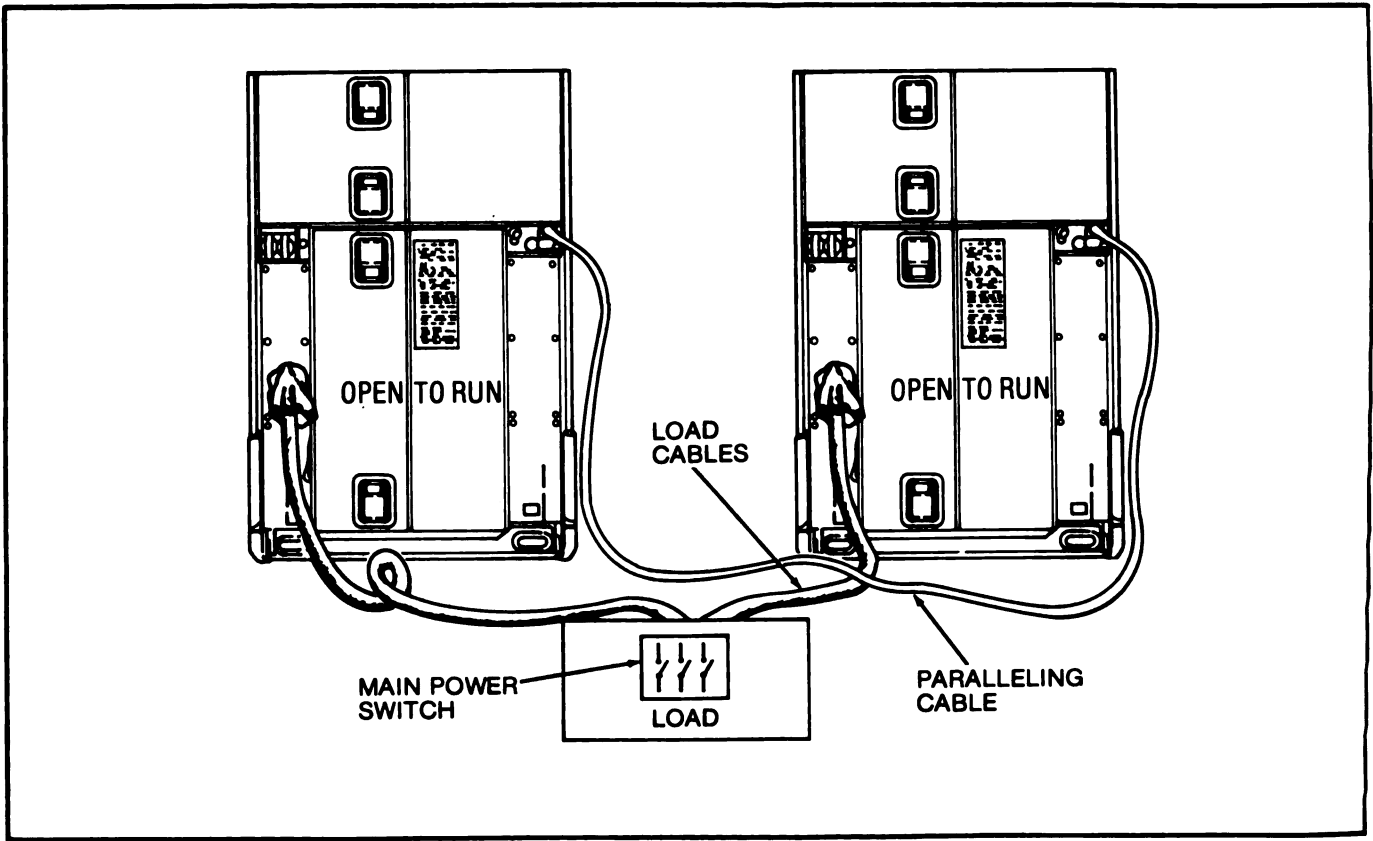
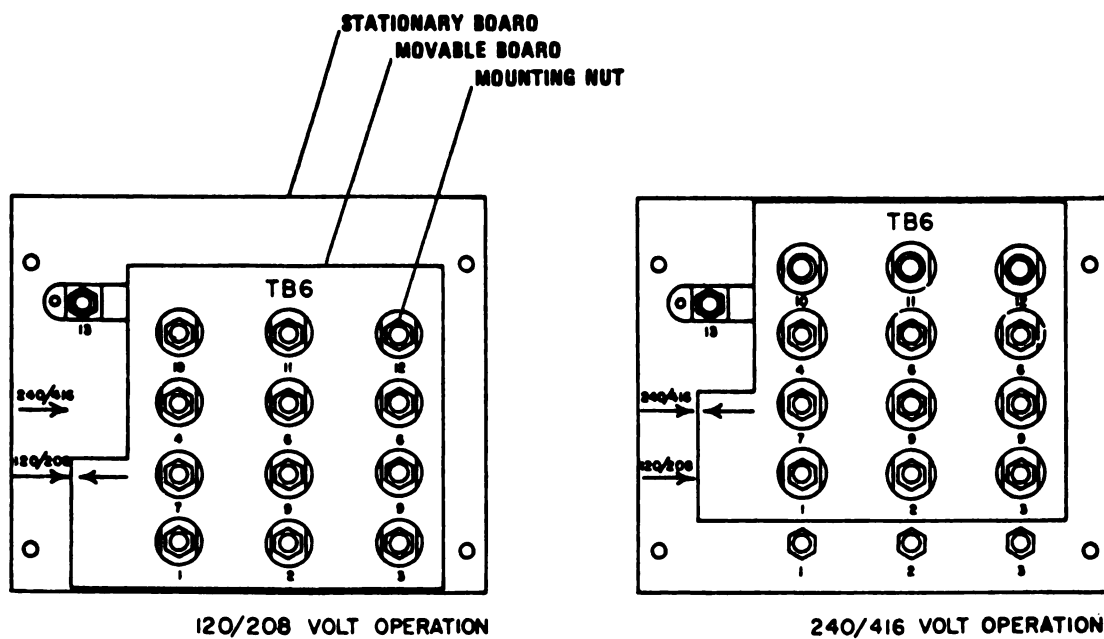


Figure 2-5. Parallel Connection

Figures 2-4A and 2-5A, including pages 2-8A and 2-8B deleted.



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Figure 2-6. Voltage Reconnection Board





Section II. MOVEMENT TO A NEW WORK SITE

**2-5. DISMANTLING THE GENERATOR SET FOR MOVEMENT.**

**a. Preparation for Movement.**

- (1) Disconnect the load leads.
- (2) If exhaust extension was used, remove and install rain cap.
- (3) Disconnect paralleling leads, if used.
- (4) Disconnect auxiliary fuel line, if used, and store on unit.
- (5) Disconnect ground lead, remove ground rods and store on unit.
- (6) Secure all doors and panels.

**b. Movement.**

**WARNING**

Do not use hoisting equipment or transporting vehicle with capacity less than 3200 pounds. Do not allow the generator set to swing when it is suspended. Securely attach the generator set to the transporting vehicle. Failure to observe this warning may result in serious injury or death of personnel or damage or destruction of the generator set.

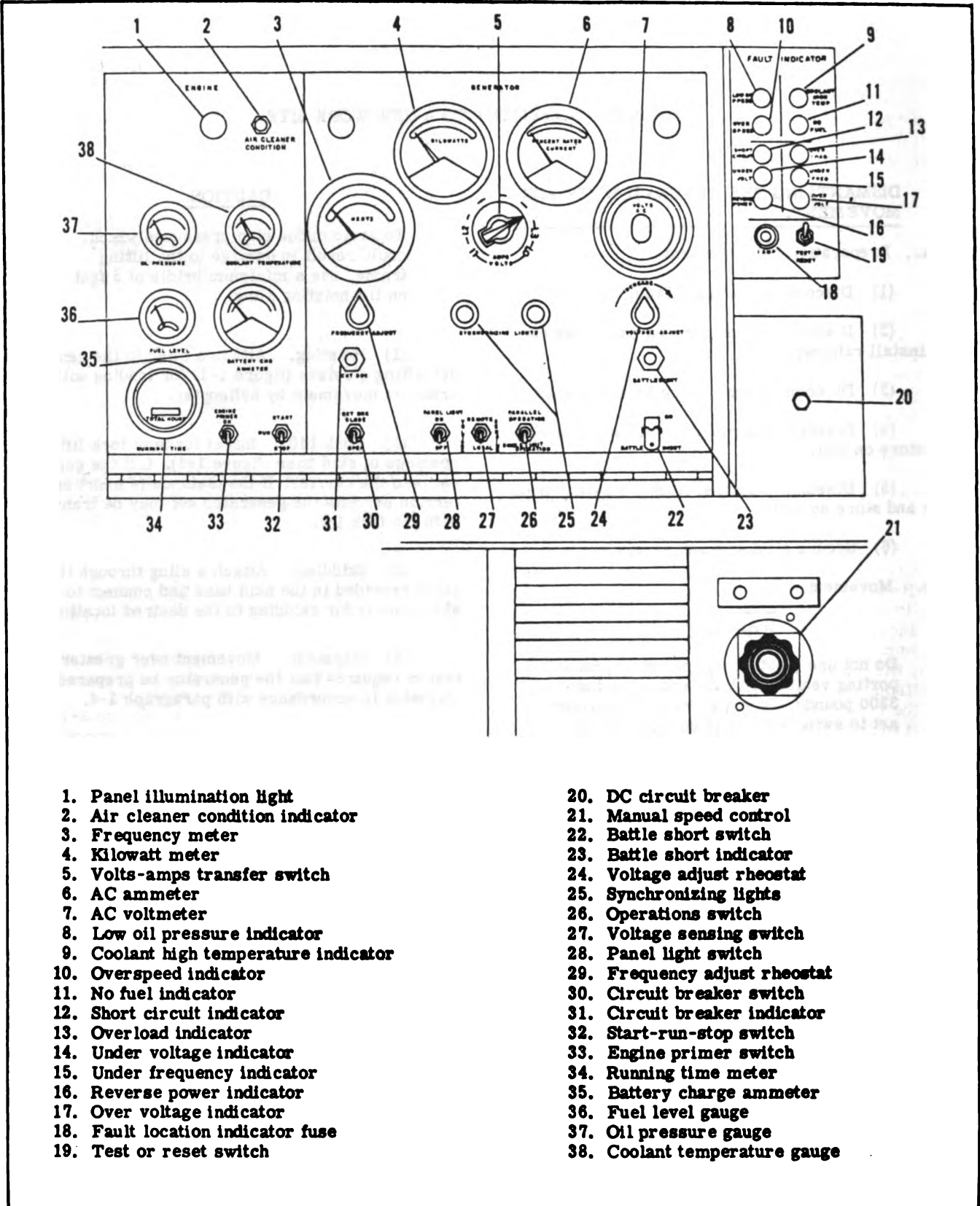
**CAUTION**

To avoid undue side pressures which could result in damage to the lifting frame, use a minimum bridle of 5 feet on the hoisting sling.

- (1) Hoisting. Attach a sling to the generator set lifting clevises (figure 1-1) for loading with a crane or movement by helicopter.
- (2) Fork Lift. Insert forks of fork lift into openings of skid base (figure 1-1). Lift the generator set onto the carrier. If the distance is short and the terrain permits the generator set may be transported with the fork lift.
- (3) Skidding. Attach a sling through the pipes provided in the skid base and connect to a suitable vehicle for skidding to the desired location.
- (4) Shipment. Movement over greater distances requires that the generator be prepared for shipment in accordance with paragraph 1-4.

**2-6. REINSTALLATION AFTER MOVEMENT.**

Refer to paragraph 2-3 and install the generator set in accordance with the instructions provided.



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Figure 2-7. Generator Set Controls and Instruments

### Section III. CONTROLS AND INSTRUMENTS

#### 2-7. GENERAL.

This section describes and illustrates the various controls and instruments and provides the operator with sufficient information to insure proper operation of the generator set.

#### 2-8. CONTROLS AND INSTRUMENTS.

a. General. The generator set controls and instruments are illustrated in figure 2-7.

b. Panel Illumination Light (1, figure 2-7). The panel illumination lights are 30 volt, 0.6 amp, candelabra bayonet base incandescent lamps with a clear finish. Each lamp is fitted with a hood which is slotted on the bottom to direct light onto the control panel. The panel illumination lights are controlled by the PANEL LIGHTS switch.

c. Air Cleaner Condition Indicator (2, figure 2-7). The air cleaner condition indicator is a press-to-test lamp with a red lens. It illuminates to indicate that the engine air cleaner is clogged.

d. Frequency Meter (3, figure 2-7). The frequency meter is a dial indicator type gauge. For the 50/60 Hz tactical precise and tactical utility, the meter is calibrated from 48 to 62 Hertz in 0.1 Hertz increments with the region between 53 and 57 Hertz unmarked. For the 400 Hz tactical precise model, the meter is calibrated in 0.5 Hertz increments from 388 to 412. The frequency meter indicates the frequency of the generator set output. Normal indication is 400 Hz for Mode II generator sets. For Mode I generator sets, normal indication is determined by the manual speed control adjustment (50 or 60 Hz).

e. Kilowatt Meter (4, figure 2-7). The kilowatt meter is a dial indicator type gauge calibrated in percent of rated output from 0 to 133. It indicates the generator set power output. Normal indication depends on applied load.

f. Volts-Amps Transfer Switch (5, figure 2-7). The VOLTS-AMPS transfer switch is a rotary type switch. It selects current in each phase, three line-to-line voltages, and three line-to-neutral voltages which are indicated on the ammeter and voltmeter.

g. AC Ammeter (6, figure 2-7). The ac ammeter is a dial indicator type gauge. For the 50/60 Hz tactical precise and tactical utility models, it is calibrated in percentage or rated current from 0 to 133 for 60 Hz operation and from 0 to 160 for 50 Hz operation. For the 400 Hz tactical precise model, it is calibrated in percentage of rated current from 0 to 133. Normal indication depends upon applied load.

h. AC Voltmeter (7, figure 2-7). The ac voltmeter is a dial indicator type gauge calibrated in 5 volt increments from 0 to 500. It indicates the voltage output of the generator set. Normal indication is 120, 208, 240 or 416, depending upon the position of the reconnection board and the volts-amps transfer switch.

i. Low Oil Pressure Indicator (8, figure 2-7). The low oil pressure indicator is an indicator lamp with a red lens. It illuminates when the oil pressure drops below  $20 \pm 2$  psi and the low oil pressure protective device actuates.

j. Coolant High Temperature Indicator (9, figure 2-7). The coolant high temperature indicator is an indicator lamp with a red lens. It illuminates when the coolant temperature rises above  $217 \pm 3^{\circ}\text{F}$  and the high coolant temperature protective device actuates.

k. Overspeed Indicator (10, figure 2-7). The overspeed indicator is an indicator lamp which has a red lens. It illuminates when the engine speed reaches 2400 to 2450 rpm and the overspeed protective device actuates.

l. No Fuel Indicator (11, figure 2-7). The no fuel indicator is an indicator lamp with a red lens. It illuminates when the day tank contains only enough fuel for one minute of operation and the low fuel protective device actuates.

m. Short Circuit Indicator (12, figure 2-7). The short circuit indicator is an indicator lamp with a red lens. It illuminates with the actuation of the short circuits protective device.

n. Overload Indicator (13, figure 2-7). The overload indicator is an indicator lamp with a red lens. It illuminates when the load on any phase reaches 130% of rated load and the overload protective device actuates.

o. Under Voltage Indicator (14, figure 2-7). The under voltage indicator is an indicator lamp with a red lens. It illuminates instantaneously when voltage drops below 48 volts or 6  $\pm$  2 seconds after voltage drops to  $99 \pm 4$  volts (tactical precise generator sets only).

p. Under Frequency Indicator (15, figure 2-7). The under frequency indicator is an indicator lamp with a red lens. For Mode I sets in 60 Hz operation, it illuminates when frequency drops to  $55 \pm 1$  Hz. For Mode I sets in 50 Hz operation, it illuminates when frequency drops to  $46 \pm 1$  Hz. For Mode II sets, it illuminates when frequency drops to  $370 \pm 5$  Hz. This indicator is operational on tactical precise sets only.

q. Reverse Power Indicator (16, figure 2-7). The reverse power indicator is an indicator lamp with a red lens. It illuminates when reverse power exceeds 20% and the reverse power protective device actuates.

r. Over Voltage Indicator (17, figure 2-7). The over voltage indicator is an indicator lamp with a red lens. It illuminates when voltage exceeds  $153 \pm 3$  volts and remains for 180 milliseconds and the over voltage protective device actuates.

s. Fault Indicator Fuse (18, figure 2-7). The fault indicator fuse is 1-1/4 x 1/4 inch, glass, 1 amp, 250 volt fuse. It protects the fault indicator circuits from overload.

t. Test or Reset Switch (19, figure 2-7). The test or reset switch is a single pole, momentary on, toggle switch. It permits testing of the fault indicator lamps and resetting of fault indicator lights.

u. DC Circuit Breaker (20, figure 2-7). The dc circuit breaker is a push type circuit breaker. It closes the 24 Vdc circuit from the battery to the controls. The DC circuit breaker is depressed (closed) during generator set operation.

v. Manual Speed Control (21, figure 2-7). The manual speed control is a push-pull control. It controls engine speed and thereby frequency output. A vernier type adjustment allows finer control. This control is inoperable on precise models of the generator set.

w. Battle Short Switch (22, figure 2-7). The battle short switch is a four pole on-off toggle switch. It is protected by a plastic guard. It permits emergency operation by bypassing the protective devices circuits (with the exception of the over-speed and short circuit). The battle short switch also locks out the starter circuit. During normal operation, the battle short switch is in the OFF position.

x. Battle Short Indicator (23, figure 2-7). The battle short indicator is a press-to-test indicator lamp with a red lens. It illuminates when the battle short switch is moved to the ON position and the generator set is operating.

y. Voltage Adjust Rheostat (24, figure 2-7). The voltage adjust rheostat allows adjustment of the generator set output voltage.

z. Synchronizing Lights (25, figure 2-7). The synchronizing lights are indicator lights with clear lens. They indicate the synchronization of frequency when the operation switch is placed in the PARALLEL position for paralleling of the generator sets.

aa. Operations Switch (26, figure 2-7). The operations switch is a four pole, two position,

toggle switch. It is placed in the single unit position for single unit operation and in the PARALLEL position for parallel operation.

ab. Voltage Sensing Switch (27, figure 2-7). The voltage sensing switch is a double pole, two position toggle switch. It permits either local or remote monitoring of the voltage regulator circuit.

ac. Panel Light Switch (28, figure 2-7). The panel light switch is a single pole toggle switch. It controls the panel illumination lights.

ad. Frequency Adjust Rheostat (29, figure 2-7). The frequency adjust rheostat increases or decreases the frequency output of the tactical precise generator sets.

#### NOTE

The frequency adjust rheostat is functional on the precise generator sets only.

ae. Circuit Breaker Switch (30, figure 2-7). The circuit breaker switch is a three position, momentary-on-momentary-off toggle switch. It opens and closes the main load contactor. The circuit breaker switch is in the center position during normal operation.

af. Circuit Breaker Indicator (31, figure 2-7). The circuit breaker indicator is a press-to-test indicator light with a yellow lens. It illuminates when the main load contactor is closed.

ag. Start-Run-Stop Switch (32, figure 2-7). The start-run-stop switch is a three position toggle switch, used to start and stop the generator set.

ah. Engine Primer Switch (33, figure 2-7). The engine primer switch is a single pole, two position toggle switch. When the START-RUN-STOP switch is in the START position and the ENGINE PRIMER switch is moved to the ON position, and then released, it actuates the ether starting aid. During operation, the switch remains in the OFF position.

ai. Running Time Meter (34, figure 2-7). The running time meter is a time totalizing meter which indicates total engine operating time in hours and tenths of hours.

aj. Battery Charging Ammeter (35, figure 2-7). The battery charging ammeter is a dial indicator type gauge which measures dc current flow to and from the battery. It is calibrated in 1 ampere increments from -10 to +20. Normal indication of the meter is dependent upon the state of charge of the battery. A low charge such as exists immediately after engine starting, will result in a high reading. When enough charge has been restored to the battery the indicator should move near 0.

ak. Fuel Level Gauge (36, figure 2-7). The fuel level gauge is a liquid quantity indicator gauge which is calibrated 1/4 increments of tank quantity from E (empty) to F (full). It indicates the level of fuel in the main fuel tank.

al. Engine Oil Pressure Gauge (37, figure 2-7). The engine oil pressure gauge is a dial indicator type gauge which is calibrated in psig from 0 to 60. It measures engine lubrication oil pressure. Normal indication is from 20 to 55 psig.

am. Coolant Temperature Gauge (38, figure 2-7). The coolant temperature gauge is a dial indicator type gauge which is calibrated in degrees Fahrenheit from 120 to 240. Normal operation indication is 170<sup>o</sup>F (76.7<sup>o</sup>C) to 200<sup>o</sup>F (93.3<sup>o</sup>C).

an. Fuel Selector Valve (figure 1-2). The fuel selector valve is a three way valve. It selects either the integral tank or the auxiliary source for fuel. It also serves as a shutoff valve.

ao. Frequency Selector Switch (figure 1-1). The frequency selector switch is a two position, positive locking, toggle switch. It is located on the precise relay assembly. The switch changes the generator circuit from 60 Hz to 50 Hz operation. Most applications of the generator set will require that this switch be placed in the 60 Hz position.

#### NOTE

The frequency selector switch is used on the 50/60 Hz Tactical Precise generator sets only.

ap. Shutter Control Assembly. The shutter control assembly is a thermostatically controlled assembly. It is located at the bottom left of the radiator assembly. The assembly retains the shutter louvers (located behind the grille) in the closed position until the engine coolant has reached normal operating temperature.

### Section IV. OPERATION UNDER USUAL CONDITIONS

#### 2-9. GENERAL

a. The instructions in this section are published for the information and guidance of personnel responsible for operation of the generator set.

b. Instructions are provided for starting and stopping the generator set, operation of the generator set, and coordinating the basic motions necessary to perform the specific tasks for which the generator set was designed. Since nearly every application of the generator set presents a different problem, it may be necessary that the operator vary the given procedures to fit the individual job.

#### 2-10. STARTING THE GENERATOR SET.

##### a. Preparation for Starting.

(1) If the generator set is to be operated for the first time, refer to paragraph 2-1 and check that the initial checks and services have been performed.

(2) Refer to paragraph 2-3 and check that the installation instructions have been properly accomplished.

(3) Refer to paragraph 2-4 and check that the reconnection board is in the position corresponding to the voltage requirements of the load and that the frequency selector switch is in the correct position.

(4) Refer to table 3-1 and perform the BEFORE OPERATION checks and services.

(5) If an auxiliary fuel supply is used, position the fuel selector valve handle in the AUXILIARY position. If the generator set tank is to be used, position the handle in the SET TANK position.

(6) Close all access doors with the exception of those for the generator air vent and the control cubicle. Lock the generator set air inlet doors in the open position.

(7) Check that the DC circuit breaker is in the closed position.

(8) If the generator set fuel tank is being used, place the START-RUN-STOP switch in the RUN position and the BATTLE SHORT switch in the ON position. Check the fuel level gauge for sufficient fuel indication.

#### NOTE

On precise generator sets the low oil pressure, under voltage and under frequency indicator lights will illuminate. On utility generator sets, the low oil pressure indicator light will illuminate.

(9) Leave the START-RUN-STOP switch in the RUN position and the BATTLE SHORT switch in the ON position a sufficient length of time to insure that the day tank assembly contains enough fuel for starting.

(10) Place the BATTLE SHORT switch in the OFF position.

(11) Depress the fault location indicator, TEST OR RESET switch and check that all fault location indicator lights illuminate.

(12) On tactical utility generator sets, pull the manual speed control all the way out, then push approximately half way in.

b. Starting. Refer to figure 2-8 for starting instructions.

c. Single Unit Operation.

(1) Rotate the VOLTS-AMPS transfer switch to each phase position while observing the ac ammeter. If more than rated load is indicated in any phase, reduce the load.

(2) Check the kilowatt meter indication. If the indication is more than 100 percent rated load, reduce the load.

#### NOTE

If load cannot be reduced, obtain another generator set and proceed to parallel operation.

### 2-11. STOPPING THE GENERATOR SET.

a. Normal Stopping.

(1) Refer to figure 2-9 for stopping procedures.

(2) Refer to table 3-1 and perform the AFTER OPERATION checks and services.

b. Stopping by Safety Devices.

#### NOTE

If any emergency situation requires continued operation of the generator set, the BATTLE SHORT switch may be used to over-ride any of the safety devices except the over-speed and short circuit devices.

The generator set is equipped with safety devices which will automatically stop the engine and simultaneously open the main load contactor upon the occurrence of engine overheating, loss of engine oil pressure, engine over-speeding, generator overvoltage, or no fuel. The occurrence of short circuits, overloads, generator under voltage, generator under frequency, or reverse power will result in the actuation of a protective device circuit which will automatically open the main load contactor, but will not stop the engine. The actuation of any protective device will result in the illumination of the corresponding indicator light on the fault indicator panel. Actuation ratings for each of the protective devices is given in the tabulated data portion of paragraph 1-6.

### 2-12. PARALLEL OPERATION OF TACTICAL PRECISE GENERATOR SETS.

2-12A. GENERAL. This paragraph provides load connection and operating instructions for parallel operation of the 50/60 Hz and 400 Hz Tactical Precise Generator Sets. Parallel operating procedures are given for Load Sharing and Load Transfer separately.

#### NOTE

Prior to attempting parallel operation, insure all generator sets have the same frequency and voltage output.

### 2-12B. LOAD CONNECTIONS FOR PARALLEL OPERATION.

#### NOTE

Prior to attempting parallel operation, ensure all generator sets have the same frequency and voltage output.

#### WARNING

Lethal voltages are present at the load terminal board of the generator set during operation. Do not attempt to connect or disconnect load leads while the generator set is operating. Do not attempt to connect or disconnect load leads with the generator set shut down and the load connected to another power source, or while the generator set is paralleled to another set which is operating.

#### WARNING

Do not attempt to connect the paralleling cable while either or both of the sets to be paralleled is operating. Make sure that there is no input to the load from another source. Failure to observe this warning may result in death by electrocution.

#### CAUTION

Precise generator sets equipped with the electric governor system cannot be paralleled with sets that have the electrohydraulic governor system.

a. If the generator sets are to share a load greater than the KW rating of a single set, connect load terminal boards as shown in figure 2-4. This arrangement allows for sharing or transferring of the load between generator sets.

b. Open the left access door to the set compartment and remove the safety cover from the terminal board (figure 1-2).

c. Insert load leads through plate and sleeve assembly (figure 1-2) located to the left of the generator set air intake.

#### NOTE

The load terminal boards will accommodate 2-wire single phase and 4-wire three phase loads. One or more single phase loads can be served alone or in combinations with three phase loads; but the load on any one phase must not exceed 100 percent of the current rating of that phase. Be sure that wire sizes are correct for load to be carried.

d. Connect the load to terminals marked L1, L2, L3, and L0 (figure 2-3).

#### NOTE

Make certain that the load terminal boards of the sets to be paralleled are connected properly. Reading left to right, phase rotation for the phase loads is L1, L2, L3. Be sure L1 is connected to L1, L2 is connected to L2, ect.

e. Connect load leads and paralleling cables as shown in figures 2-4 and 2-5.

#### NOTE

After load connection, tighten binding nuts with plastic/phenolic box end wrench and install safety cover.

#### NOTE

Paralleling of tactical precise generator sets requires that paralleling cables be installed and the shorting plug located on one of the paralleling receptacles of each generator set be removed.

### 2-12 C. PARALLEL OPERATION (LOAD SHARING).

a. The first set started shall be designated as "on-line" and the sets in parallel operation shall be designated "on coming". With all sets shut down install the paralleling cable and connect the load terminal boards as described in paragraph 2-3e. Check that the voltage reconnection boards (paragraph 2-4) of the sets are identically positioned.

### CAUTION

Do not place the circuit breaker switch on any of the generator sets in the CLOSE position until specifically directed to do so. Closing the circuit breaker switch at any other time may severely damage one or more of the generator sets.

### CAUTION

Check that the main power switch (figure 2-5) at the load is open before attempting to place a generator set on line.

b. Start the generator sets as described in paragraph 2-10. Do not perform steps 7 & 8 of figure 2-8.

c. Hold the CKT BRK switch (30, figure 2-7) of the "on-line" set in the CLOSE position until the CKT BRK indicator light (31) illuminates. Place the operation switch (26) in the PARALLEL position.

d. Adjust the voltage on both sets to the required value. Adjust the frequency of the "on-line" set to the required value. Place the operation switch (26) of the "on-coming" set in the PARALLEL position.

#### NOTE

Observe the synchronizing lights of the "on-coming" set. The lights should go on and off simultaneously. If the lights go on and off alternately, sets are out of phase. Stop both sets and correct inter-connect cables (figure 2-4). If the problem persists, refer to next higher level of maintenance.

e. Adjust the frequency of the "on-coming" set a little higher than the "on-line" set. Then reduce the frequency slowly with frequency adjust rheostat (29) until the synchronizing lights (25) remain on or off a 2 to 3 second intervals.

f. Carefully observe the synchronizing lights of the "on-coming" set and, at the instant both lights go dark, place the CKT BRK switch (30) of the "on-coming" set to the CLOSE position. When the CKT BRK indicator light (31) illuminates, the sets are operating in parallel.



### CAUTION

The kilowatt meter and AC ammeter indicate percentages and do not indicate true KW and ampere readings.

g. With no external load on the paralleled sets, adjust the frequency adjust rheostat (29) of the "on-coming" set until both rated load meters (kilowatt) read zero. Adjust the voltage adjust rheostat of the "on-coming" set until the percent of rated current meters (ammeters) on both sets read zero. Turning counterclockwise will decrease readings.

h. Apply load to the sets. The kilowatt load should divide so that the load on each set is equal. If the load and current are not shared equally adjust the voltage and frequency rheostats of the "on-coming" set until the load and current are divided equally between the generator sets.

i. The current should divide so that the observed difference between the current on any phase between the "on-line" and "on-coming" sets is not more than 20 percent. If the readings are not within 20 percent, notify higher level maintenance.

### NOTE

If the reverse power indicator (16) of either set illuminates and the main load contactor opens, open the main power switch and reparallel the generator sets.

### CAUTION

When generator sets are being operated in parallel, one or more operators must remain with the sets to monitor the rated load and current meters.

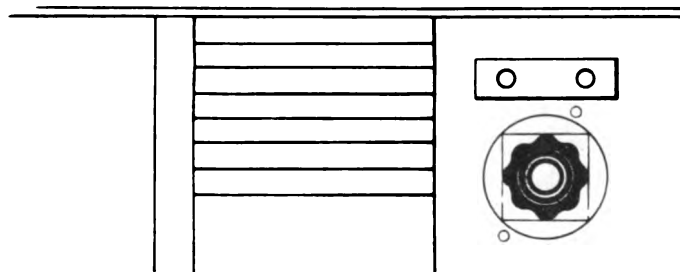
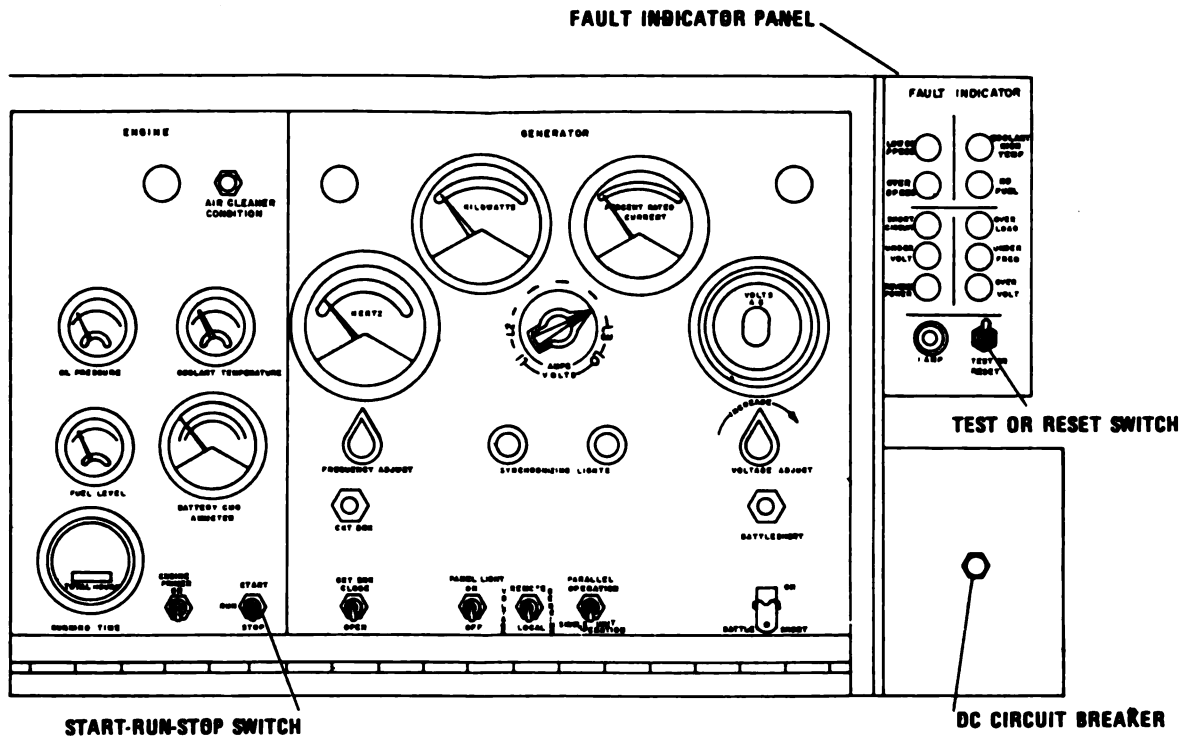
### NOTE

Three generator sets can be operated in parallel. Paralleling procedures are the same as those described above. One generator set at a time is brought on line.

### CAUTION

Prior to removal of generator sets from parallel operation, make sure the load does not exceed the full load rating of generator set(s) remaining on line.

j. To remove a generator set from parallel operation place the circuit breaker switch of the set in the OPE! position. Stop the set described in paragraph 2-11.



**WARNING**

NEVER ATTEMPT TO START THE GENERATOR SET IF IT IS NOT PROPERLY GROUNDED. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN SERIOUS INJURY OR DEATH BY ELECTROCUTION.

**CAUTION**

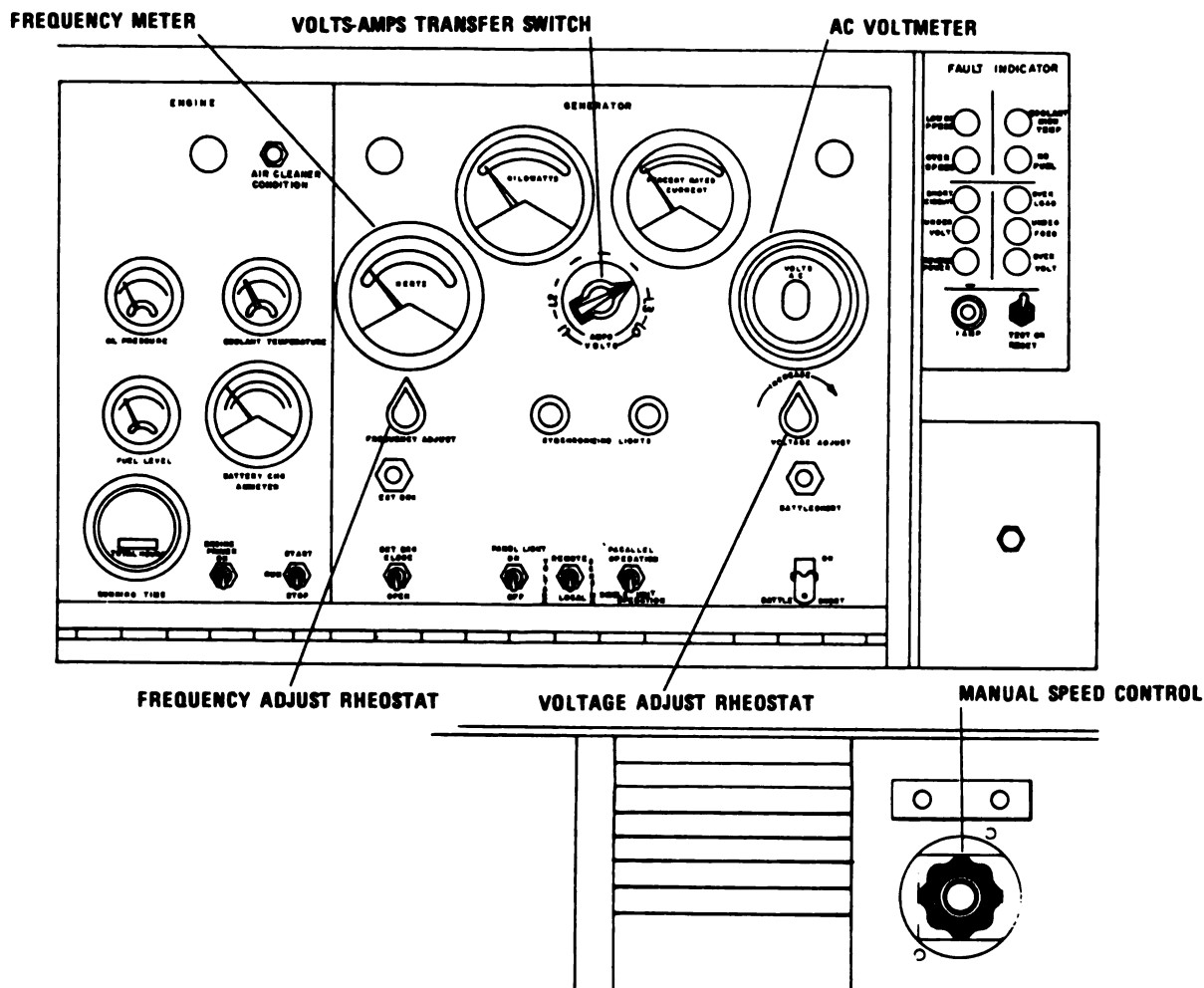
DO NOT CRANK THE ENGINE IN EXCESS OF 15 SECONDS. ALLOW THE STARTER ASSEMBLY TO COOL AT LEAST 15 SECONDS BETWEEN CRANKING.

**WARNING**

SLAVE RECEPTACLE IS TO BE USED WHEN EXTRA CRANKING POWER IS REQUIRED FOR STARTING UNIT. OTHER METHODS ARE NOT AUTHORIZED.

- STEP 1. HOLD THE START-RUN-STOP SWITCH IN THE START POSITION UNTIL THE ENGINE OIL PRESSURE GAUGE INDICATES OIL PRESSURE, AND VOLTMETER INDICATES VOLTAGE. USE SLAVE RECEPTACLE (SR1) WHEN EXTRA CRANKING POWER IS REQUIRED.
- STEP 2. RELEASE THE START-RUN-STOP SWITCH TO THE RUN POSITION.
- STEP 3. IF THE AMBIENT TEMPERATURE IS BELOW 50°F (10°C), USE OF THE START AID ASSEMBLY AS FOLLOWS MAY BE REQUIRED.
  - (a) CRANK THE GENERATOR SET ENGINE.
  - (b) INJECT A "SHOT" OF ETHER INTO THE AIR CLEANER ASSEMBLY BY PLACING THE ENGINE PRIMER SWITCH IN THE ON POSITION, AND THEN RELEASING.

Figure 2-8. Starting the Generator Set (Sheet 1 of 3)



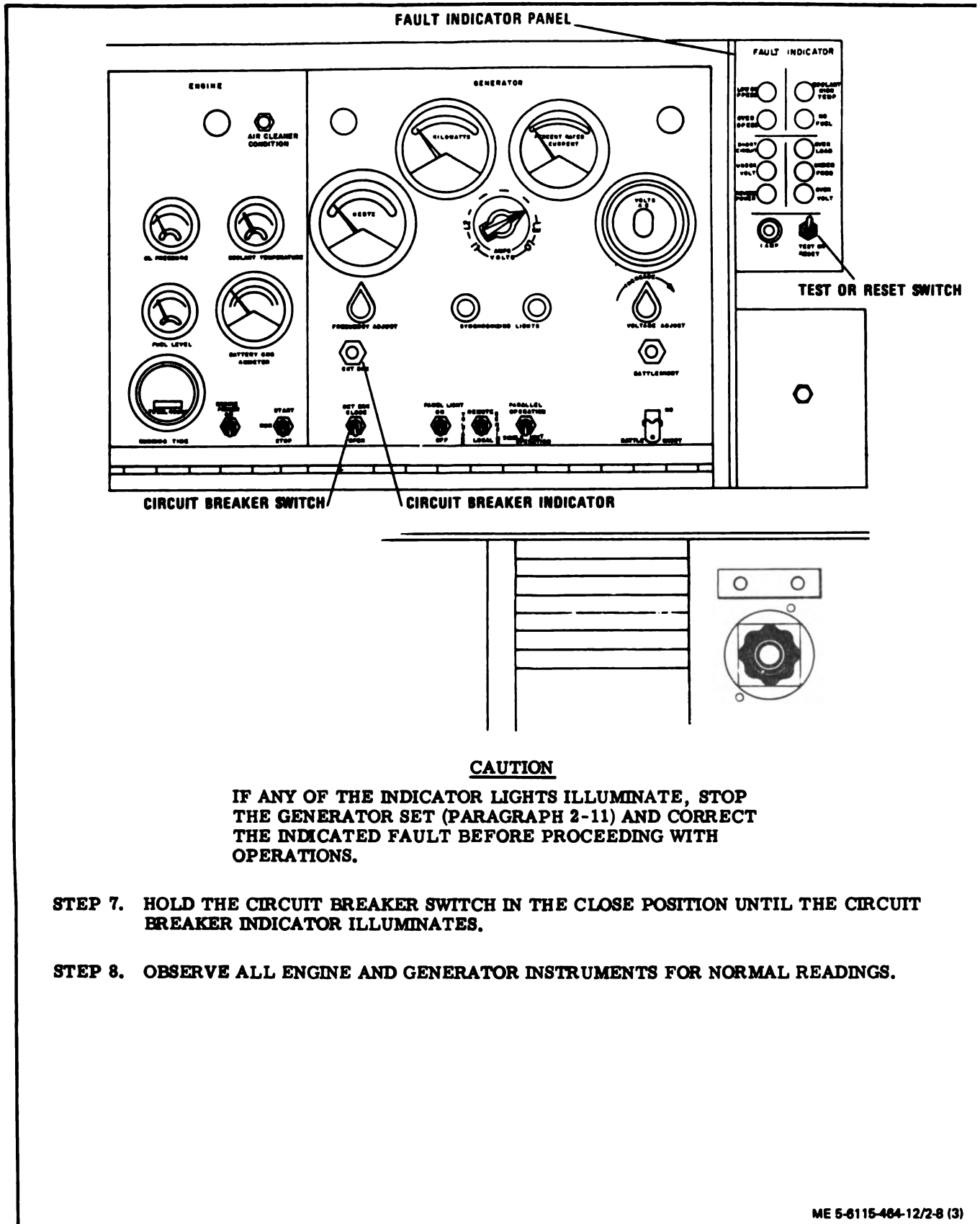
**CAUTION**

IF THE ENGINE FAILS TO START AFTER INJECTING THREE "SHOTS" OF ETHER, CEASE OPERATION AND NOTIFY MAINTENANCE PERSONNEL.

(c) IF THE ENGINE FAILS TO START WITHIN 15 SECONDS, RELEASE THE START-RUN-STOP SWITCH AND ALLOW THE CRANKING MOTOR TO COOL AT LEAST THREE MINUTES. REPEAT STEPS (a) AND (b).

- STEP 4. PLACE THE VOLTS-AMPS TRANSFER SWITCH IN THE DESIRED OPERATING POSITION.
- STEP 5. ROTATE THE VOLTAGE ADJUST RHEOSTAT UNTIL THE DESIRED VOLTAGE IS INDICATED ON THE AC VOLTMETER.
- STEP 6. ADJUST FREQUENCY TO THE DESIRED VALUE AS INDICATED ON THE FREQUENCY METER.

NOTE: ON TACTICAL PRECISE GENERATOR SETS, FREQUENCY IS ADJUSTED WITH THE FREQUENCY ADJUST RHEOSTAT. ON TACTICAL UTILITY GENERATOR SETS, FREQUENCY IS ADJUSTED WITH THE MANUAL SPEED CONTROL.



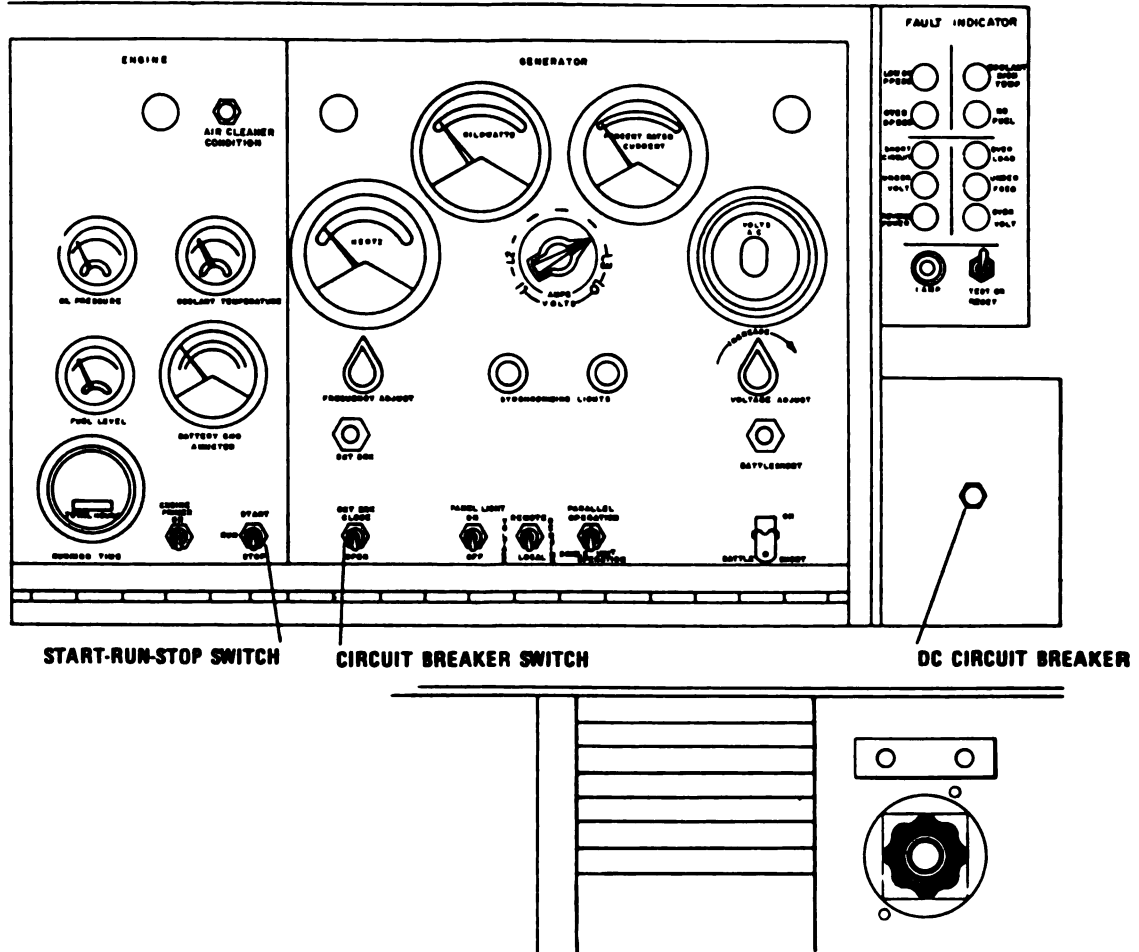
**CAUTION**

IF ANY OF THE INDICATOR LIGHTS ILLUMINATE, STOP THE GENERATOR SET (PARAGRAPH 2-11) AND CORRECT THE INDICATED FAULT BEFORE PROCEEDING WITH OPERATIONS.

**STEP 7. HOLD THE CIRCUIT BREAKER SWITCH IN THE CLOSE POSITION UNTIL THE CIRCUIT BREAKER INDICATOR ILLUMINATES.**

**STEP 8. OBSERVE ALL ENGINE AND GENERATOR INSTRUMENTS FOR NORMAL READINGS.**

Figure 2-8. Starting the Generator Set (Sheet 3 of 3)



- STEP 1. PLACE THE CIRCUIT BREAKER SWITCH IN THE OPEN POSITION.
- STEP 2. ALLOW THE GENERATOR SET TO OPERATE APPROXIMATELY THREE TO FIVE MINUTES WITH NO LOAD APPLIED WHILE OPERATING AT GOVERNED SPEED AND RATED HERTZ (DO NOT READJUST FREQUENCY ADJUST RHEOSTAT OR PUSH IN THE MANUAL SPEED CONTROL PRIOR TO SHUTDOWN).
- STEP 3. PLACE THE START-RUN-STOP SWITCH IN THE STOP POSITION.



Figure 2-9. Stopping the Generator Set

## 2-12D. PARALLEL OPERATION (LOAD TRANSFER).

The following method of parallel operation is to be used when it is necessary to transfer the load from one set to the other without interrupting power.

### NOTE

Visually check that the power cable and parallel cable are in accordance with figure 2-5. If the cables are not attached as indicated, shut down the "on-line" set and follow instructions in paragraph 2-12b.

### CAUTION

Do not attempt load connects in paragraph 2-12b unless all sets are off and no other external voltage is applied to the load.

a. The set in operation shall be designated as "on-line" and the sets placed in parallel operation shall be designated "on-coming".

b. Place the operations switch (26, figure 2-7) on both sets in the PARALLEL OPERATION position.

### CAUTION

Do not close the circuit breaker switch after starting the "on-coming" set as serious damage to one or both generator sets may result.

c. Refer to paragraph 2-10 and start the "on-coming" set. Do not perform steps 7 & 8 of figure 2-8.

d. Note the voltage indicated on the "on-line" set. Adjust the voltage of the "on-coming" set to the voltage noted on the "on-line" set.

e. Adjust the frequency of the "on-coming" set to a higher value than that of the "on-line" set.

f. Slowly reduce the frequency of the "on-coming" set until the SYNCHRONIZING LIGHTS (25, figure 2-7) flash at 2 to 3 second intervals.

### CAUTION

Do not place the circuit breaker switch of the "on-coming" set in the CLOSE position while the SYNCHRONIZING LIGHTS are lit as damage to one or both generator sets may result.

g. Carefully watch the SYNCHRONIZING LIGHTS of the "on-coming" set. At the instant both lights go dark, move the circuit breaker switch of the "on-coming" set to the CLOSE position.

h. Adjust the voltage and frequency rheostats of the "on-coming" set until load and current are divided equally between the two generator sets.

i. Move the circuit breaker switch (30) of the "on-line" set to the OPEN position.

j. Place the operations switch of the "on-coming" set to the SINGLE UNIT OPERATION position.

k. Readjust voltage and frequency of the "on-coming" set as necessary.

l. Refer to paragraph 2-11 and stop the "on-line" set.

## 2-13. OPERATION OF TACTICAL UTILITY GENERATOR SETS.

a. Parallel Operation (Load Sharing).

(1) The first set started shall be designated as "on-line" and the sets in parallel operation shall be designated "on-coming". With all sets shut down connect the load terminal boards as described in paragraph 2-3e. Check that the voltage reconnection boards (paragraph 2-4) of the sets are identically positioned.

### CAUTION

Do not place the circuit breaker switch on any of the generator sets in the CLOSE position until specifically directed to do so. Closing the circuit breaker switch at any other time may severely damage one or more of the generator sets.

## CAUTION

Check that the main power switch (figure 2-5) at the load is open before attempting to place a generator set on line.

(2) Start the generator set as described in paragraph 2-10. Do not perform steps 7 & 8 of figure 2-8.

(3) Hold the CKT BRK switch (30, figure 2-7) of the "on-line" set in the CLOSE position until the CKT BRK indicator light (31) illuminates. Place the operation switch (26) in the PARALLEL position.

(4) Set "Volt-Amps Transfer Switch" (5, figure 2-7) in the LI - LO position. Adjust the voltage adjust rheostat (24) until the AC voltmeter indicates 122 volts for the 120/208 connection and 244 volts for the 240/416 connection. Adjust manual speed control (21) until the frequency meter indicates 61 Hertz. Place the operation switch (26) of the "on-coming" set in the PARALLEL position.

## NOTE

Observe the synchronizing lights of the "on-coming" set. The lights should go on and off simultaneously. If the lights go on and off alternately, sets are out of phase. Stop both set and correct interconnect cables (figure 2-4). If the problem persists, refer to next higher level of maintenance.

(5) Adjust the manual speed control of the "on-coming" set until the synchronizing lights (25), simultaneously, remain on or off at 2 to 3 second intervals.

(6) Carefully observe the synchronizing lights of the "on-coming" set and, at the instant both lights go dark, place the CKT BRK switch (30) of the "on-coming" set to the CLOSE position. When the CKT BRK indicator light (31) illuminates, the sets are operating in parallel.

(7) With no external load on the paralleled sets, adjust the manual speed control (21) of the "on-coming" set until both percent power meters (kilowatt) indicate zero. Adjust the voltage adjust rheostat (24) of the "on-coming" set until the percent of rated current meters (ammeters) on both sets indicate zero. Turning counterclockwise will decrease readings.

(8) Apply load to the sets. The kilowatt load should divide so that the load on each set is equal. If the load and current are not shared equally, adjust the load by observing the set which has the higher reading on the kilowatt meter (4). Decrease the engine speed of this set by adjusting counterclockwise the manual speed control (21) in small increments. Increase the engine speed of the set with the lower kilowatt reading by adjusting clockwise the manual speed control in small increments. Adjustments should be made between both sets until the kilowatt meters are balanced.

(9) The current should divide so that the observed difference between the current on any phase between the "on-line" and "on-coming" sets is not more than 20 percent. If the readings are not within 20 percent, notify higher level maintenance.

## CAUTION

When generator sets are being operated in parallel, one or more operators must remain with the sets to monitor the rated load and current meters. Make further adjustments as required to maintain equal load on the paralleled sets.

## CAUTION

Prior to removal of generator set from parallel operation, make sure the load does not exceed the full load rating of set(s) remaining on line.

(10) To remove a generator set from parallel operation, place the circuit breaker switch of that set in the OPEN position. Stop the set as described in paragraph 2-11.

### b. Parallel Operation (Load Transfer).

The following method of parallel operation is to be used when it is necessary to transfer the load from one set to the other without interrupting power.

## NOTE

Visually check that the power cable and parallel cable are in accordance with figure 2-5. If the cables are not attached as indicated, shut down the "on-line" set and follow instructions in paragraph 2-12b.

## CAUTION

Do not attempt load connects in paragraph 2-12b unless all sets are off and no other external voltage is applied to the load.

(1) The set in operation shall be designated as "on-line" and the sets placed in parallel operation shall be designated "on-coming".

(2) Place the operations switch (26, figure 2-7) on both sets in the PARALLEL OPERATION position.

### CAUTION

Do not close the circuit breaker switch after starting the "on-coming" set as serious damage to one or both generator sets may result.

(3) Refer to paragraph 2-10 and start the "on-coming" set. Do not perform steps 7 & 8 of figure 2-8.

(4) Not the voltage indicated on the "on-line" set. Adjust the voltage of the "on-coming" set to the voltage noted on the "on-line" set.

(5) Adjust the frequency of the "on-coming" set to a higher value than that of the "on-line" set.

(6) Slowly reduce the frequency of the "on-coming" set until the SYNCHRONIZING LIGHTS (25, figure 2-7) flash at 2 to 3 second intervals.

### CAUTION

Do not place the circuit breaker switch of the "on-coming" set in the CLOSE position while the SYNCHRONIZING LIGHTS are lit as damage to one or both generator sets may result.

(7) Carefully watch the SYNCHRONIZING LIGHTS of the "on-coming" set. At the instant both lights go dark, move the circuit breaker switch of the "on-coming" set to the CLOSE position.

(8) Adjust the voltage and frequency rheostats of both sets until load and current are divided equally between the two generator sets, as explained in paragraph 2-13a steps 7 and 8.

(9) Move the circuit breaker switch (30) of the "on-line" set to the OPEN position.

(10) Place the operations switch of the "on-coming" set to the SINGLE UNIT OPERATION position.

(11) Readjust voltage and frequency of the "on-coming" set as necessary.

(12) Refer to paragraph 2-11 and stop the "on-line" set.

### 2-14. EXERCISE OF ENGINE ON STANDBY SERVICE

a. General. The diesel engine of a generator set on standby service which is normally operated under optimum conditions should be exercised at least every 30 days. However, under any extreme environmental condition, the interval between exercise periods should be shortened appropriately. The exercise period should be long enough to enable the engine to attain normal operating temperature.

#### b. Exercise Procedures.

(1) Perform the before operation checks and services of table 3-1.

(2) Refer to paragraph 2-10 and start the engine.

(3) After allowing sufficient warm up time, run the engine at full speed for the period of time required to obtain two consecutive coolant temperature readings at a 15 minute interval of 160°F (71°C) minimum.

(4) Allow the engine to run an additional 30 minutes while performing the during operation checks and services listed in table 3-1.

(5) Refer to paragraph 2-11 and stop the engine.

(6) Perform the after operation checks and services listed in table 3-1.

(7) Correct any deficiencies noted during or after operation.

#### c. Servicing an Engine on Standby.

(1) Change engine oil and oil filter element at a maximum of 6 months.

(2) Replace the fuel filter elements at a maximum of 12 months.



## Section V. OPERATION UNDER UNUSUAL CONDITIONS

### 2-15. OPERATION IN EXTREME COLD (Below -25°F).

a. General. The generator set is designed to operate in ambient temperatures as low as -25°F (-31°C) without special winterization equipment. For operation at lower temperatures, the engine must be heated by either a fuel burning or electric winterization kit. Refer to paragraph 2-22 and 2-23 for operation instructions for these winterization kits.

b. Cleaning. Keep the generator set and surrounding area as free of ice and snow as practical. Pay particular attention to the fuel tank cap and filler neck.

c. Fuel System. Keep the fuel tank as full as possible to prevent condensation of moisture. Service the fuel tank with the proper grade of fuel for the existing ambient temperatures. Service the fuel strainer and filter assembly and secondary fuel filter at more frequent intervals. At the end of operation cycle, drain sediment from the fuel tank, fuel strainer and filter assembly, day tank, and secondary fuel filter.

d. **Engine Electrical System.** Keep the batteries clean and inspect regularly for cracked and damaged cases. Keep the batteries fully charged at all times to avoid freezing. After adding distilled water to the batteries, operate the engine for at least an hour. Inspect the entire electrical system frequently for cracked, broken and frayed insulation. Tighten any loose connections and mounting clamps.

e. **Lubrication.** Make sure that lubricants used are as specified for the prevailing ambient temperature by the current Lubrication Order.

f. **Cooling System.** Use a hydrometer to check the specific gravity of the coolant. Maintain the coolant specific gravity as specified for the prevailing ambient temperature in table 2-1.

## **2-16. OPERATION IN EXTREME HEAT (Up to 125°F).**

a. **Cooling System.** Check coolant level daily. Maintain coolant level approximately two inches below the radiator overflow pipe. Check that radiator louver control is operating properly. Check louvers and radiator air passages for obstructions frequently. Check fan belt for proper tension. Check coolant temperature gauge frequently for any indication of overheating.

b. **Lubrication.** Make sure that lubricants used are as specified for the prevailing ambient temperature in the current Lubrication Order.

c. **Fuel System.** When filling the fuel tank, allow sufficient space for fuel expansion.

d. **Batteries.** Check electrolyte level frequently. Add distilled water as required to compensate for evaporation.

e. **Generator.** Keep the generator clean and free of dirt. Make sure that the generator ventilating screen is free of obstructions which would inhibit air flow.

f. **Engine.** Keep the external surface of the engine as clean as possible.

## **2-17. OPERATION IN DUSTY OR SANDY AREAS,**

a. **General.** If possible, provide a shelter for the generator set. Use available natural barriers to shield the generator set from blowing dust or sand. Keep all access doors closed as much as possible to prevent entry of dust and sand into the enclosure assembly. If water is available, wet down dusty surface areas around the set frequently.

b. **Cleaning.** Wipe dust and sand from the generator set components frequently. When the generator set is not operating, the exterior surface should be thoroughly washed down with clean water.

c. **Engine.** Shorten the service interval for the engine air cleaner and oil filter to compensate for intake of additional dust or dirt. Keep the external surface of the engine as clean as possible.

d. **Fuel System.** Drain sediment from the fuel tank, fuel strainer, and fuel filters frequently. Be particularly careful to prevent dust or dirt from entering the fuel tank. Shorten the service intervals for the fuel filters appropriately.

e. **Lubrication.** Lubrication intervals must be shortened appropriately. Use particular care to keep lubricants from becoming contaminated with dust or dirt.

## **2-18. OPERATION UNDER RAINY OR HUMID CONDITIONS.**

a. **General.** If possible, provide a shelter for the generator set. Keep the generator set doors closed as much as possible. Cover the generator set with canvas or other waterproof material when it is not being operated. Provide adequate drainage to prevent water from accumulating on the operation site.

b. **Lubrication.** Keep the generator set well lubricated to protect components from moisture. Use caution to keep lubricants from becoming contaminated with water.

c. **Fuel System.** Keep the fuel tank as full as is practical to keep moisture condensation to a minimum. Drain water from fuel tank, day tank, and filters daily. Service the fuel filters more frequently than under normal operating conditions.

d. **Electrical System.** Wipe the electrical system components dry before and after each period of operation.

e. **Rust Prevention.** Remove moisture from the generator set components before and after each operating period. Clean and repaint any rusty surfaces. Remove peeling or blistered paint and repaint.

## **2-19. OPERATION IN SALT WATER AREAS.**

a. **Protection.** If possible, provide a shelter for the generator set. Locate the generator set so that the radiator faces into the prevailing winds. Utilize natural barriers or, if possible, fabricate a barrier to protect the generator set from salt spray. Keep the generator set covered when not in use and keep all access doors closed as much as possible.

b. **Cleaning.** When the generator set is not operating, wash the exterior surfaces off frequently with clean water.

c. **Rust Prevention.** Clean and repaint any rusty or corroded surfaces. Remove any defective paint and repaint.

**NOTE:** REFER TO THE FUEL BURNING WINTERIZATION SYSTEM DIAGRAM AND INSTRUCTION PLATE LOCATED ON THE INSIDE FACE OF THE LEFT SIDE ENGINE COMPARTMENT ACCESS DOOR FOR ADDITIONAL INSTRUCTIONS.

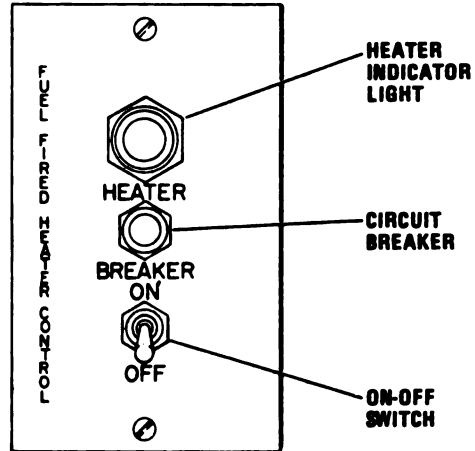
**STEP 1.** TURN THE MANUAL HEATER VALVE IN THE HEATER FUEL SUPPLY LINE AT THE DAY TANK ASSEMBLY TO THE OPEN POSITION.

**STEP 2.** OPEN THE SHUT OFF VALVES IN THE CYLINDER BLOCK COOLANT LINES.

**STEP 3.** IF GENERATOR SET IS EQUIPPED WITH BOTH FUEL BURNING AND ELECTRIC WINTERIZATION KITS, PLACE THREE-WAY VALVE POINTER IN OIL PAN COOLANT LINE IN THE 3 O'CLOCK POSITION.

**STEP 4.** DEPRESS CIRCUIT BREAKER ON HEATER CONTROL PANEL TO ACTIVATE HEATER CONTROL CIRCUITS.

**STEP 5.** PRESS IN ON HEATER INDICATOR LIGHT. IF IT DOES NOT ILLUMINATE, NOTIFY HIGHER LEVEL MAINTENANCE.



**STEP 6.** PLACE THE ON-OFF SWITCH IN THE ON POSITION. IF HEATER INDICATOR LIGHT DOES NOT ILLUMINATE WITHIN FOUR MINUTES, RETURN THE ON-OFF SWITCH TO THE OFF POSITION AND NOTIFY MAINTENANCE PERSONNEL.

**STEP 7.** ALLOW THE HEATER TO OPERATE UNTIL IT CYCLES "OFF" OR FOR 55 MINUTES, WHICHEVER OCCURS FIRST.

**STEP 8.** REFER TO PARAGRAPH 2-10 AND START THE ENGINE.

**STEP 9.** AFTER ENGINE STARTS, PLACE ON-OFF SWITCH IN THE OFF POSITION.

**NOTE:** THE HEATER BLOWER WILL CONTINUE TO OPERATE AFTER COMBUSTION SHUTDOWN TO CLEAR THE COMBUSTION CHAMBER OF RESIDUAL FUEL VAPOR.

**STEP 10.** TURN THE THREE-WAY VALVE HANDLE UNTIL THE POINTER IS IN THE 9 O'CLOCK POSITION.

**STEP 11.** CLOSE THE SHUTOFF VALVES IN THE CYLINDER BLOCK COOLANT LINES.

**STEP 12.** WHEN HEATER INDICATOR LIGHT GOES OUT, PULL OUT CIRCUIT BREAKER TO DE-ENERGIZE HEATER CONTROL CIRCUITS.

**CAUTION**

IF HEATER FAILS TO IGNITE WITHIN THE SPECIFIED TIME, DO NOT ATTEMPT TO RESTART. THE IGNITION OF RESIDUAL FUEL VAPOR IN THE COMBUSTION CHAMBER MAY RESULT IN A MINOR EXPLOSION CAUSING DAMAGE TO THE HEATER.

## 2-20. OPERATION AT HIGH ALTITUDES.

The generator set will operate at elevations up to 5000 feet above sea level without special adjustment or reduction in load.

At 8000 feet above sea level, the kilowatt rating is reduced approximately 10 percent. Refer to paragraph 1-6 for additional information.

## Section VI. OPERATION OF EQUIPMENT USED IN CONJUNCTION WITH THE GENERATOR SET

### 2-21. GENERAL.

This section provides the information and instructions necessary for the effective operation of auxiliary equipment used in conjunction with the generator set. Included are the fuel burning winterization kit, electric winterization kit, wheel mounting kit, load bank, and applications kit.

### 2-22. FUEL BURNING WINTERIZATION KIT.

a. General. The fuel burning winterization kit is utilized to preheat the engine coolant and lubricating oil in extremely cold weather. In ambient temperatures of  $-65^{\circ}\text{F}$  ( $-53.9^{\circ}\text{C}$ ) the winterization kit should be placed in operation a minimum of 55 minutes prior to starting the generator set.

#### b. Controls and Indicators.

(1) Heater Indicator Light (figure 2-10). The heater indicator light is a press-to-test indicator light with a yellow lens. It illuminates when the winterization kit is in operation.

(2) Circuit Breaker (figure 2-10). The circuit breaker is a trip-free, push-pull type circuit breaker. It opens and closes the 24 Vdc circuit to the heater controls.

(3) ON-OFF Switch (figure 2-10). The ON-OFF switch is a double pole, two position toggle switch. When the switch is placed in the ON position, it closes the 24 Vdc circuit to the fuel pump and the igniter.

c. Operation. Refer to figure 2-10 for operating instructions.

### 2-23. ELECTRIC WINTERIZATION KIT.

a. General. The electric winterization kit uses an external power source to maintain the engine coolant and lubricating oil at normal operating temperature in standby situations which require immediate starting of the generator set. The kit will function effectively down to an ambient temperature of  $-65^{\circ}\text{F}$  ( $-53.9^{\circ}\text{C}$ ). Coolant from the radiator is pumped into the heater assembly where it is heated by the heater elements. The heated coolant is circulated through the heat exchanger in the engine oil pan and through the cylinder block. After leaving the cylinder

block, the coolant is returned to the radiator. Power for operation of the electric winterization kit may be obtained from any 208 to 240 volt, 50/60 Hz or 400 Hz, single phase source.

#### b. Controls and Indicators.

(1) Circuit Breaker (figure 2-11). The circuit breaker is a trip-free, push-pull type circuit breaker. It opens and closes the circuit to the winterization kit controls.

(2) POWER ON Indicator (figure 2-11). The power on indicator is a press-to-test type indicator light. It illuminates when power is applied to the heater control circuits.

(3) ON-OFF Switch (figure 2-11). The ON-OFF switch is a two-pole, two position switch. It opens and closes the two heater and the coolant pump motor circuits.

(4) HEATER ON Indicator (figure 2-11). The HEATER ON indicator is a press-to-test type indicator light. It illuminates when the kit is in operation.

c. Operation. Refer to figure 2-11 for operating instructions.

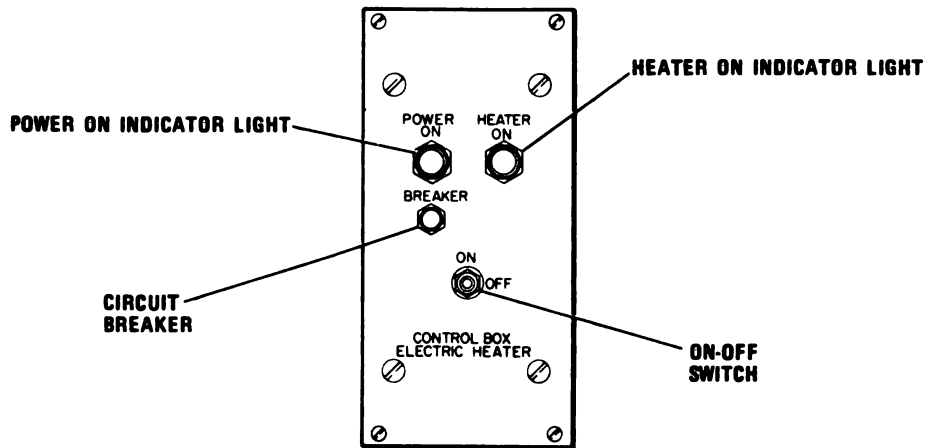
### 2-24. WHEEL MOUNTING KIT.

a. General. The wheel mounting kit extends the mobility of the generator set. It consists of a pair of two-wheeled axles which are bolted to the generator set skid frame. The front axle is equipped with a tow bar and safety chain. The front wheels are swivel mounted for steering. The rear axle is equipped with a parking brake.

b. Using the Wheel Mounting Kit. Refer to figure 2-12 for operating instructions.

### 2-25. LOAD BANK KIT.

a. General. The load bank kit is an air cooled, balanced, three phase resistive load which may be operated at either 120/208 or 240/416 volts. It provides up to 50 percent of the generator set rated load to minimize carbon buildup in the engine while the generator set is carrying a light load. The load bank incorporates protective devices which



**CAUTION**

DO NOT ATTEMPT TO OPERATE THE ELECTRIC WINTERIZATION KIT IF THE GENERATOR SET IS EQUIPPED WITH A FUEL BURNING WINTERIZATION KIT WHICH IS OPERATING.

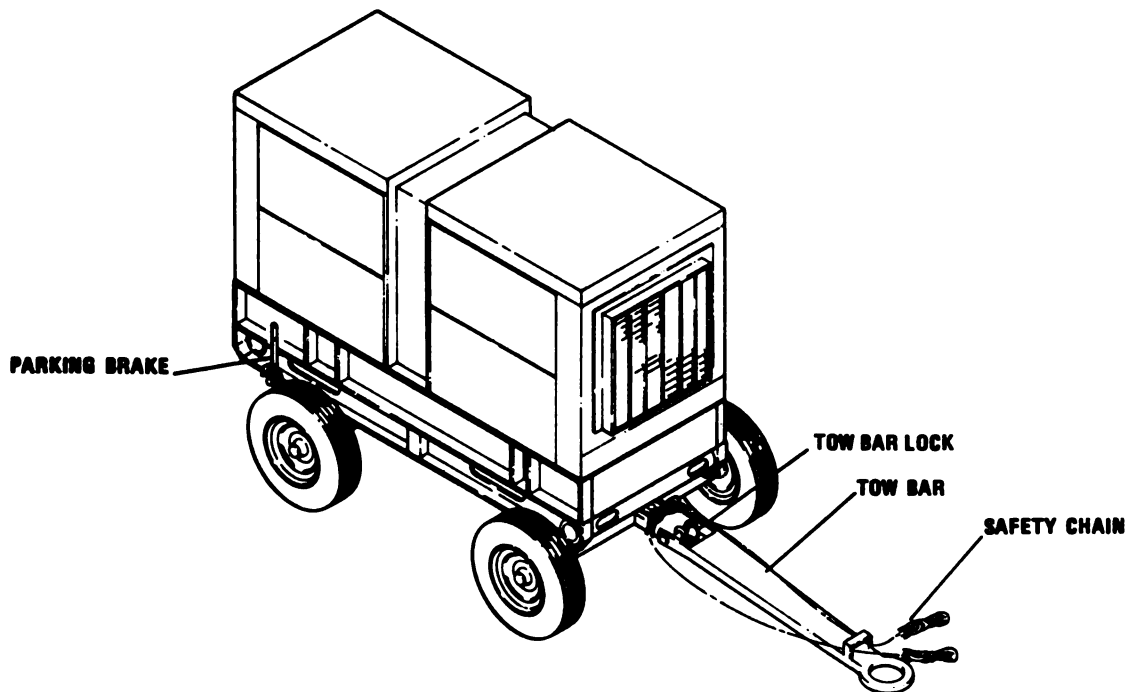
**NOTE:** REFER TO THE ELECTRIC WINTERIZATION SYSTEM DIAGRAM AND INSTRUCTIONS PLATE LOCATED ON THE INSIDE FACE OF THE LEFT SIDE ENGINE COMPARTMENT ACCESS DOOR FOR ADDITIONAL INFORMATION.

- STEP 1.** IF THE GENERATOR SET IS EQUIPPED WITH A FUEL BURNING WINTERIZATION KIT, TURN THE HANDLE OF THE THREE-WAY VALVE IN THE OIL PAN COOLANT LINE UNTIL THE POINTER IS IN THE 12 O'CLOCK POSITION.
- STEP 2.** OPEN BOTH SHUTOFF VALVES IN THE CYLINDER BLOCK COOLANT LINES.
- STEP 3.** DEPRESS THE CIRCUIT BREAKER TO ENERGIZE THE HEATER CONTROL CIRCUITS.
- STEP 4.** DEPRESS POWER ON AND HEATER ON INDICATOR LIGHTS. IF THEY DO NOT ILLUMINATE WHEN DEPRESSED, NOTIFY HIGHER LEVEL MAINTENANCE.
- STEP 5.** PLACE ON-OFF SWITCH IN THE ON POSITION. IF BOTH POWER ON AND HEATER ON INDICATOR LIGHTS DO NOT ILLUMINATE, CHECK FUSE. IF FUSE IS SERVICEABLE, CHECK INDICATOR LAMPS (paragraph 4-13d.). IF LAMPS ARE SERVICEABLE, CEASE OPERATION AND NOTIFY HIGHER LEVEL MAINTENANCE.
- STEP 6.** PRIOR TO STARTING THE GENERATOR SET, TURN THE THREE-WAY VALVE HANDLE UNTIL THE POINTER IS IN THE 9 O'CLOCK POSITION AND CLOSE BOTH SHUTOFF VALVES IN THE CYLINDER BLOCK COOLANT LINES.
- STEP 7.** PLACE THE ON-OFF SWITCH IN THE OFF POSITION.

**CAUTION**

DO NOT START THE GENERATOR SET WHILE THE ON-OFF SWITCH IS IN THE ON POSITION.

- STEP 8.** REFER TO PARAGRAPH 2-10 AND START THE GENERATOR SET.

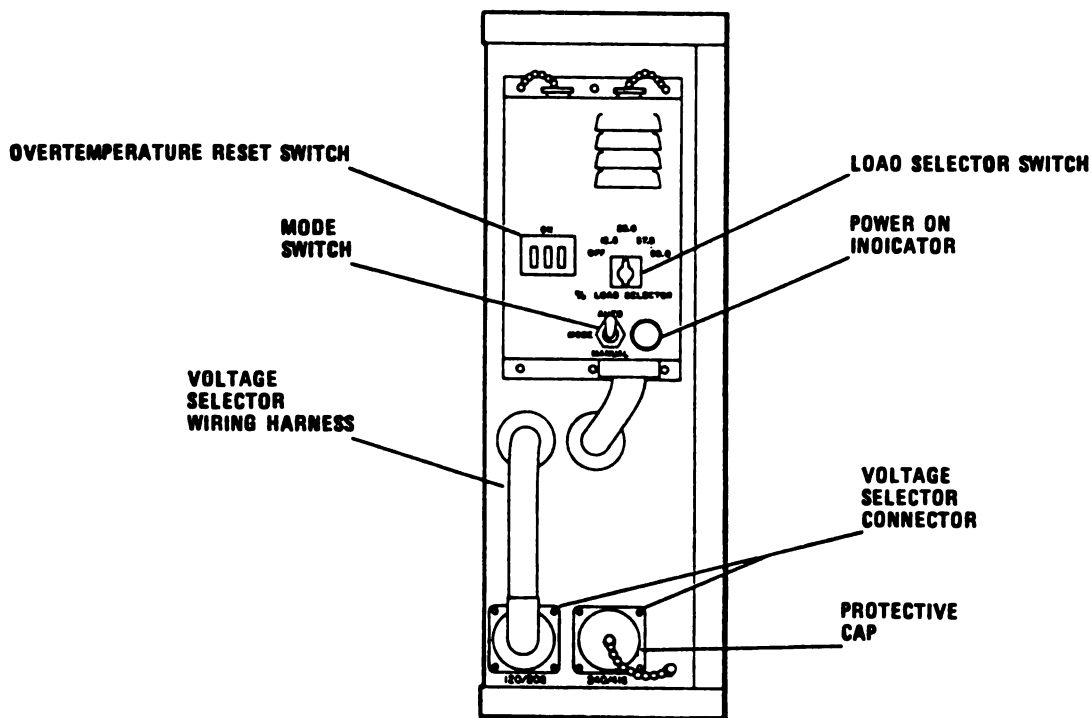


- STEP 1. RELEASE THE TOW BAR LOCK AND LOWER THE TOW BAR.**
- STEP 2. ATTACH THE TOW BAR AND SAFETY CHAINS TO THE TOWING VEHICLE.**
- STEP 3. RELEASE THE PARKING BRAKE.**

**CAUTION**

**DO NOT TOW THE GENERATOR IN EXCESS OF 5 MPH ON PAVED ROADS.**

- STEP 4. TOW THE GENERATOR SET TO THE DESIRED POSITION.**
- STEP 5. ENGAGE THE PARKING BRAKE AND DISCONNECT THE SAFETY CHAINS AND TOW BAR FROM THE TOWING VEHICLE.**
- STEP 6. RAISE THE TOW BAR UNTIL THE TOW BAR LOCK ENAGES.**



**CAUTION**

ALWAYS CHECK THE POSITION OF THE GENERATOR SET VOLTAGE RECONNECTION BOARD BEFORE PLACING THE LOAD BANK IN OPERATION. DAMAGE TO THE LOAD BANK WILL RESULT IF IT IS OPERATED AT A VOLTAGE DIFFERENT FROM THE GENERATOR SET OUTPUT VOLTAGE.

- STEP 1. CONNECT THE VOLTAGE SELECTOR WIRING HARNESS TO THE VOLTAGE SELECTOR CONNECTOR CORRESPONDING TO THE GENERATOR SET OPERATING VOLTAGE.
- STEP 2. INSTALL THE PROTECTIVE CAP OVER THE REMAINING CONNECTOR.

**CAUTION**

DO NOT ALLOW THE GENERATOR SET TO OPERATE UNATTENDED WITH THE MODE SWITCH IN THE MANUAL POSITION.

- STEP 3. PLACE THE MODE SWITCH IN THE DESIRED OPERATING POSITION.
- STEP 4. POSITION THE OVER TEMPERATURE RESET SWITCH TO THE ON POSITION.

**CAUTION**

DO NOT ALLOW LOAD BANK AND GENERATOR SET LOAD TO EXCEED THE RATED LOAD OF THE GENERATOR SET.

- STEP 5. POSITION THE LOAD SELECTOR SWITCH TO THE PERCENT LOAD WHICH, WHEN ADDED TO THE GENERATOR SET LOAD, WILL MOST NEARLY EQUAL, BUT NOT EXCEED, 100 PERCENT OF THE GENERATOR SET RATED LOAD.
- STEP 6. CHECK THAT LOAD BANK POWER ON INDICATOR LIGHT IS LIT. IF IT IS NOT, PRESS IN ON THE LENS. IF THE LAMP ILLUMINATES BUT GOES OUT WHEN RELEASED, RETURN THE LOAD SELECTOR SWITCH TO THE OFF POSITION. NOTIFY MAINTENANCE PERSONNEL.
- STEP 7. TO REMOVE THE LOAD BANK FROM OPERATION, POSITION THE LOAD SELECTOR SWITCH TO THE OFF POSITION AND PLACE THE OVER TEMPERATURE RESET SWITCH TO THE OFF POSITION.

Figure 2-13. Operating the Load Bank

automatically removes its load should the generator become overloaded. The load bank kit will also automatically cease operation in the event that it overheats.

b. Controls and Indicators.

(1) Voltage Selector Connectors (figure 2-13). The voltage selector connectors are electrical connectors. They are used to reconnect the load bank circuits for 120/208 Vac or 240/416 Vac operation.

(2) Over Temperature Reset Switch (figure 2-13). The OVER TEMPERATURE RESET switch is a triple circuit breaker. The switch trips automatically to open the load bank circuits to remove the unit from operation in the event of overheating. It is reset manually.

(3) Load Selector Switch (figure 2-13). The LOAD SELECTOR switch is a five position rotary type switch. It is graduated in 12.5 percent increments which is 1/8 of the generator set rated load. It actuates the load bank power circuits.

(4) Load Bank Power On Indicator (figure 2-13). The LOAD BANK POWER ON indicator is a press-to-test type in-

dicator light with a red lens. It illuminates when power is applied to the load bank.

(5) Mode Selector Switch. The mode selector switch is a two position switch. When placed in the AUTO position, the load bank will automatically dump the load in the event that generator set load exceeds 81% of rated value. When the switch is placed in MANUAL position, the load must be manually removed.

c. Operation. Refer to figure 2-13 for operating instructions.

2-26. APPLICATIONS KIT.

The application kit provides remote control of the emergency stop capability and battle short capability, and remote low fuel monitoring. The kit consists of a connector plate, wiring harness and remote functions assembly (refer to figure 2-14).



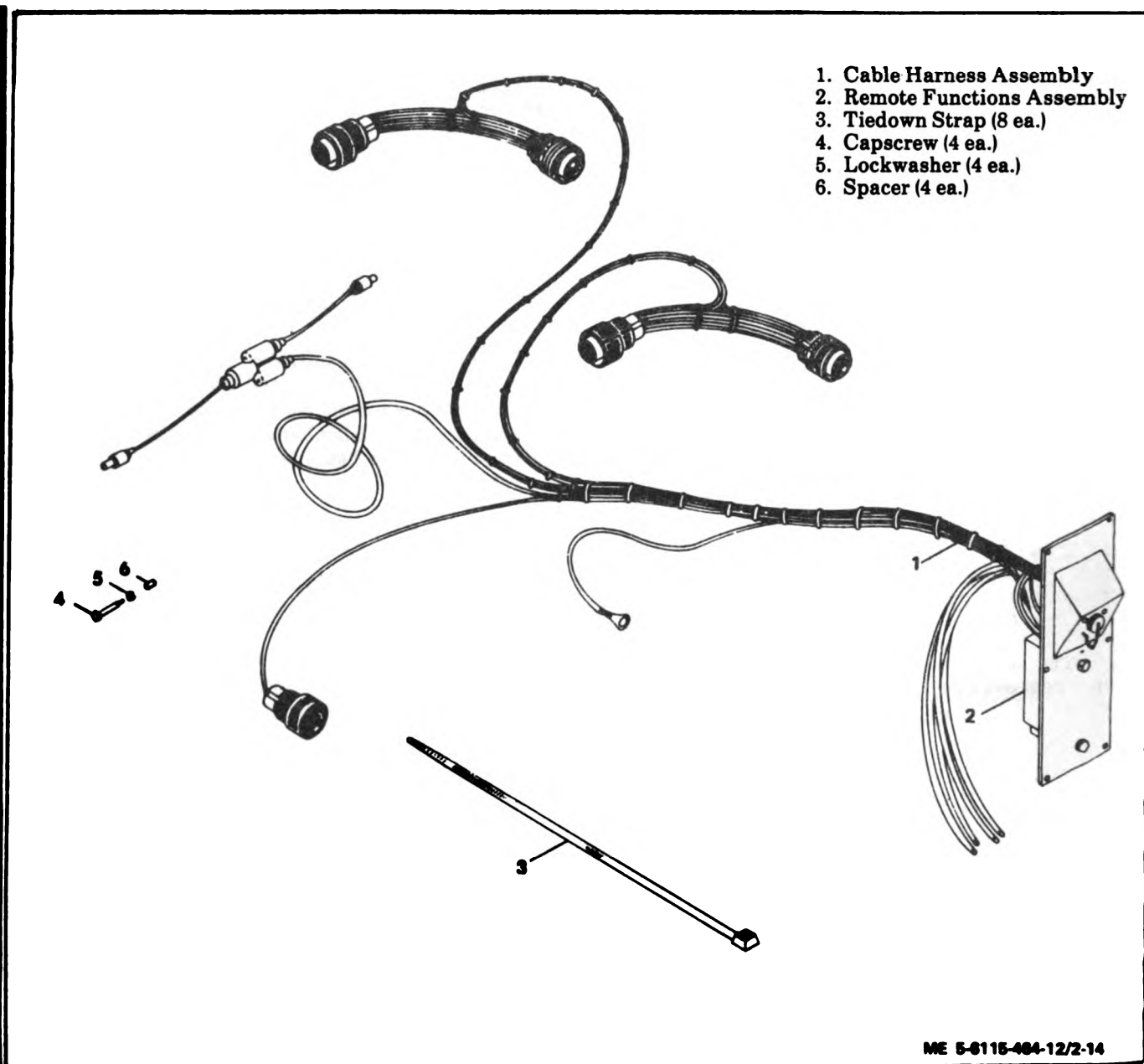


Figure 2-14. Applications Kit Components

## CHAPTER 3

### OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

#### Section I. OPERATOR AND ORGANIZATIONAL MAINTENANCE REPAIR PARTS, TOOLS AND EQUIPMENT

##### 3-1. TOOLS AND EQUIPMENT. (Not Applicable to Air Force.)

The tools required to perform operator and organizational maintenance on the generator set are listed in Appendix C. of this manual.

##### 3-2. ORGANIZATIONAL MAINTENANCE REPAIR PARTS.

Organizational maintenance repair parts are listed and illustrated in the Organizational, Intermediate (Field) (Direct and General Support) and Depot Maintenance Repair Parts and Special Tools List.

#### Section II. LUBRICATION

##### 3-3. GENERAL LUBRICATION INFORMATION.

a. This paragraph contains a reproduction of the lubrication order and lubrication instructions which are supplemental to, and not specifically covered in the Lubrication Order.

b. The Lubrication Order shown in figure 3-1 is an exact reproduction of the approved lubrication order.

##### CAUTION

The dipstick is marked to indicate that the crankcase oil level may be checked and oil added while the engine is running or stopped. Always make sure the correct side of the dipstick is checked. When checking oil with engine running, remove oil filler cap.

c. When changing the engine crankcase oil, never fill the crankcase above the FULL mark on the dipstick. Do not allow the oil level to fall below the ADD mark on the dipstick. Service the oil filter element each time that the crankcase oil is changed.

d. A seal in the dipstick cap prevents oil from leaking from the crankcase and foreign material from entering. Keep the dipstick firmly seated on the adapter tube at all times.

e. Keep the crankcase breather tube open at all times to prevent pressure build-up in the engine crankcase which will cause oil leakage from the crank shaft seals.

##### 3-4. DETAILED LUBRICATION INFORMATION.

a. General. Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready for use.

b. Cleaning. Keep all external parts not requiring lubrication free of lubricants. Before lubricating the generator set, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

##### c. Engine Oil.

(1) The crankcase oil level must be checked at eight hour intervals or more often should oil consumption increase.

(2) A new or reconditioned engine shall have the oil changed after 50 hours of operation. Thereafter, the interval is lengthened to that described dependent on operating conditions.

(3) Before draining the engine crankcase, operate the engine until the engine coolant reaches a minimum of 140°F (80°C) to insure maximum suspension and drainage of particles.

(4) Stop the engine. Remove the oil pan drain plug and open the oil pan drain valve, to drain the crankcase.

**LUBRICATION ORDER**

**LO-07523A-12**

**LO 5-6115-464-12**

24 OCTOBER 1986

(Supersedes LO5-6115-464-12, 23 February 1979)

**GENERATOR SET, DIESEL ENGINE DRIVEN, TACTICAL, SKID MTD,  
 15 KW, 3 PHASE, 4 WIRE, 120/208 AND 240/416 VOLTS**

<b>DOD MODEL</b>	<b>CLASS</b>	<b>HERTZ</b>	<b>NSN</b>
<b>MED-004A</b>	<b>UTILITY</b>	<b>60/60</b>	<b>6115-00-118-1241</b>
<b>MED-103A</b>	<b>PRECISE</b>	<b>50/50</b>	<b>6115-00-118-1245</b>
<b>MED-113A</b>	<b>PRECISE</b>	<b>400</b>	<b>6115-00-118-1244</b>

Reference: TM 5-6115-464-12 and C9100-L

Hard time intervals and the related task-hour times are based on normal operation. The task-hour time specified is the time you need to do all the services prescribed for a particular interval. Change the interval if your lubricants are contaminated or if you are operating the equipment under adverse operating conditions, including longer-than-usual operating hours. The interval may be extended during periods of low activity. If extended, adequate preservation precautions must be taken.

On-condition (OC) intervals for oil changes shall be determined by the Army Oil Analysis Program (AOAP) laboratory and shall be applied unless otherwise notified.

Hard time oil change intervals will be applied in the event AOAP laboratory support is not available.

Clean fittings before lubricating. Lubricate points indicated by dotted arrow shaft on both sides of equipment. Clean parts with dry cleaning SOLVENT (50), type II or equivalent. Dry before lubricating. Drain crankcase when HOT. Fill and check level. The lowest level of maintenance authorized to lubricate a point is indicated by one of the following: (C) Operator/Crew; or (O) Organizational Maintenance.

You can help improve this publication. If you find any mistake or if you know of a way to improve the procedures, please let us know. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed directly to: Commander, US Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Blvd, St. Louis, MO 63120-1796. A reply will be furnished to you.

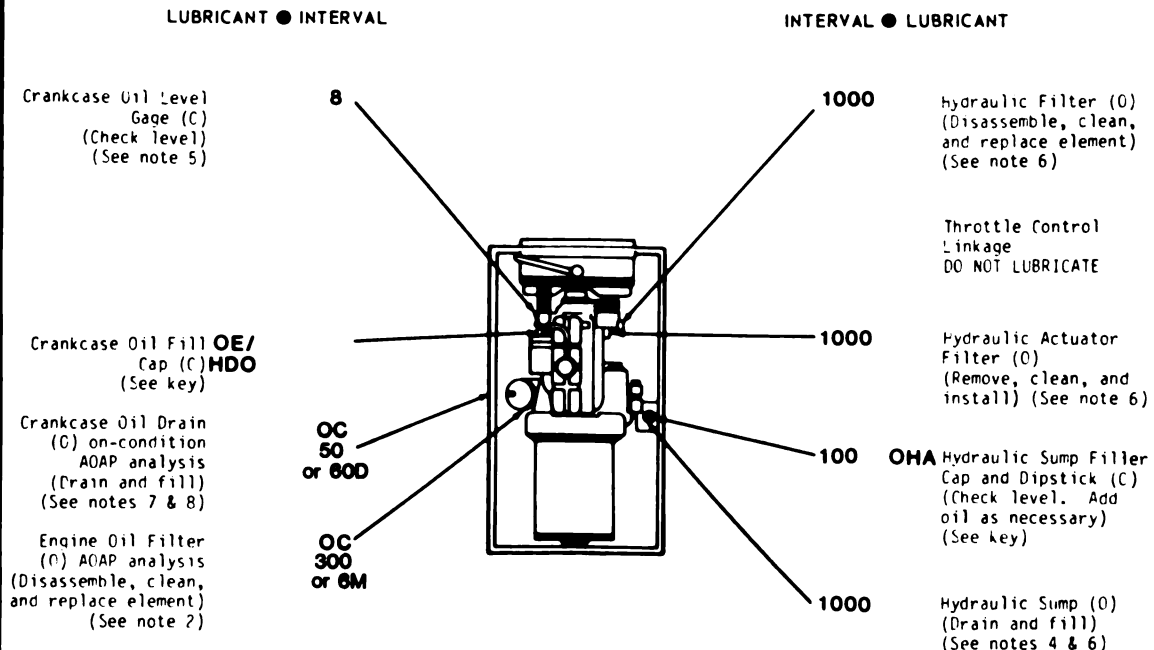


Figure 3-1. Lubrication Order (Sheet 1 of 2)

\*The time specified is the time required to perform all services at the particular interval (on-condition or hard time).

* TOTAL TASK-HR		* TOTAL TASK-HR	
INTERVAL	TASK-HR	INTERVAL	TASK-HR
8	0.1	50H or 60D	0.6
100	0.1	1000	1.0

- KEY -

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		ABOVE +32°F (ABOVE 0°C)	+40°F TO -10°F (+5°C TO -23°C)	0°F TO -65°F (-18°C TO -50°C)	
OE/HDO (MIL-L-2104C) LUBRICATING OIL, Engine Engine Crankcase (Add one additional quart for filter) Oil Can Points	8 qts (7.6L)	OE/HDO 30	OE/HDO 10	OE/A	Intervals given are in hours of normal operation
OE/A (MIL-H-46167) Oil, Engine, Subzero					
OE/A (MIL-H-5606B) HYDRAULIC FLUID Hydraulic Sump	4 qts (3.8L)	OE/A			

For arctic operation refer to FM 9-207

**NOTES:**

- FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F (-23°C). Remove lubricants prescribed in the key for temperatures above -10°F (-23°C). Clean parts with drycleaning SOLVENT (SD), type II or equivalent. Lubricate with lubricants specified in the key for temperature below 0°F to -65°F.
- OIL FILTER. Every 300 hours remove filter element, clean housing, install new element, fill crankcase, operate engine for 5 minutes, check for leaks, check crankcase oil level, and bring to FULL mark. Oil filter replacement interval shall align with on-condition AOAP or hard time oil change requirements. See notes 7 and 8.
- OIL CAN POINTS. Every 100 hours lubricate the hinges, latches, control linkages, and all exposed adjusting threads with OE/HDO.
- HYDRAULIC SUMP. To drain, remove hydraulic lines from actuator and drain oil into a suitable container. Replace hydraulic line, fill tank, and check level.

5. CRANKCASE. Crankcase level may be checked with the engine in either a static or operating condition.

6. HYDRAULIC FILTER, HYDRAULIC ACTUATOR FILTER, AND HYDRAULIC SUMP. Precise sets only.

7. CRANKCASE OIL. A sample of the oil shall be sent to an AOAP laboratory for analysis at an interval of 50 hours or 60 days. Refer to TB 43-0210 for sampling requirements.

9. When AOAP laboratory support is not available, drain and refill crankcase oil at 300 hours or 6 months.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory.

By Order of the Secretaries of the Army and the Marine Corps:

**JOHN A. WICKHAM, JR.**  
*General, United States Army*  
*Chief of Staff*

Official:

**R. L. DILWORTH**  
*Brigadier General, United States Army*  
*The Adjutant General*

**GEORGE B. CRIST**  
*Lieutenant General, USMC*  
*Deputy Chief of Staff for Installations and Logistics*

**DISTRIBUTION:**

To be distributed in accordance with DA Form 12-25A, Operator and Organizational Maintenance requirements for Generator Set, Diesel Driven, Tactical, Skid Mounted, 120/208V, 240/416V, 15KW, 3PH, 4 Wire (50/60HZ; MEP-004A, MEP-103A, 400HZ; MEP-113A) (TM 5-6115-464 Series)

Figure 3-1. Lubrication Order (Sheet 2 of 2)

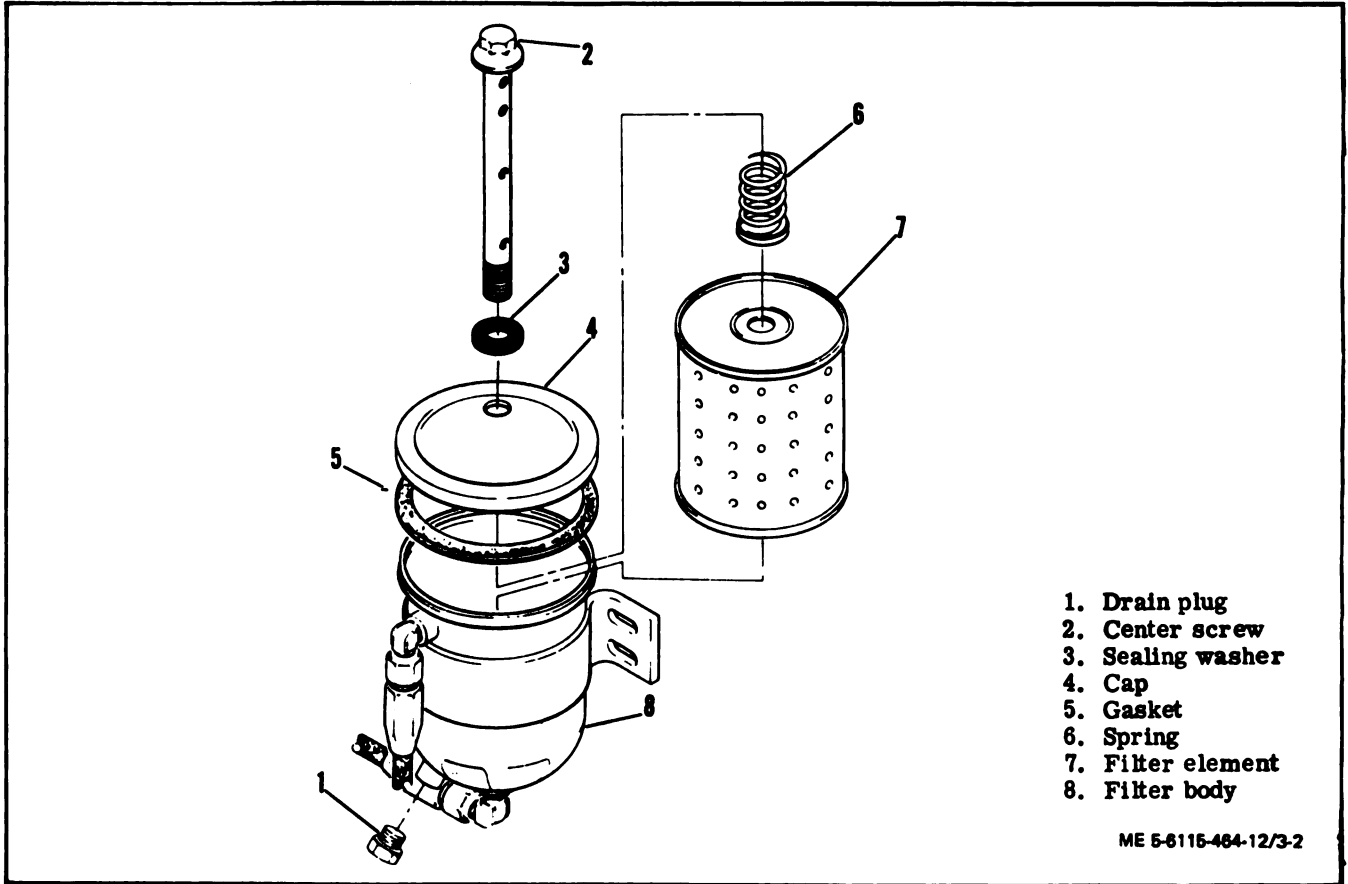


Figure 3-2. Servicing the Engine Oil Filter

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(5) Close the oil pan drain valve and install the drain plug.

(6) Refer to paragraph d. below and service the oil filter.

(7) Fill the crankcase to the FULL mark on the dipstick with oil as specified in the Lubrication Order (paragraph 3-3).

(8) Operate the engine until the coolant reaches normal operating temperature.

**CAUTION**

Make sure that the proper side of the dipstick is checked.

(9) Check the oil level and add oil as necessary to bring it to the FULL level on the dipstick.

(10) Inspect the engine for oil leaks. Repair as necessary.

**d. Oil Filter Service.**

(1) Thoroughly clean the oil filter casings and the surrounding area.

(2) Remove drain plug (1, figure 3-2) and allow the oil to drain into a suitable container.

(3) Remove center screw (2) and sealing washer (3).

(4) Remove cap (4), gasket (5), spring (6), and filter element (7) from filter body (8). Discard gasket and filter element.

(5) Install replacement filter element (7) into filter body (8).

(6) Install spring (6), replacement gasket (5) and cap (4) and secure with washer (3) and center screw (2). Tighten center screw securely to prevent leaks.

(7) Install drain plug (1) and tighten securely

**e. Generators.** The generator is a sealed unit and does not require lubrication.

### Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

#### 3-5. GENERAL

To insure that the generator set is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. Deficiencies discovered during operation of the unit shall be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. All deficiencies and shortcomings shall be recorded together with the corrective action on the applicable form at the earliest possible opportunity. Army and Navy users shall accomplish the necessary preventive maintenance services listed and described in paragraph 3-6. Air Force users shall refer to the applicable inspection manuals and work card sets in the T.O. 35C2-3 Series for periodic requirements and Table 3-1 for detailed procedures. Marine Corps users should refer to the current issue of TM 11275-15/1.

#### 3-6. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (ARMY AND NAVY)

a. Operator. Table 3-1 contains a tabulated listing of preventive maintenance checks and services which must be performed before, during, and after operation and the weekly checks and services to be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 3-1 for checks and services.

b. Organizational Maintenance. Table 3-1 also contains a tabulated listing of preventive maintenance checks and services which must be performed by organizational maintenance personnel at monthly and semi-annual intervals. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 3-1 for checks and services.

TABLE 3-1. OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM NO.	INTERVAL			ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A			
1	•			Generator Set	Visually inspect the generator set for fuel, oil, hydraulic and coolant leaks (para 3-32 thru 3-34). Check for proper ground connections (para 2-3d).	Leakage is detected during inspection, or ground cable missing or not connected.
2	•			Cooling System	Check coolant level. Proper level is two inches below the overflow pipe. Add coolant as required.	
3	•	•		Engine Oil Level	Check oil level. Add oil as necessary.	
4		•		Control Panel	Indications shall be within specified limits.	
				a. Air cleaner condition indicator	Lights up to indicate a clogged air cleaner. Press-to-test (para 2-8c).	Light remains on during operation.
				b. Frequency meter	50/60 Hz, 400 Hz (para 2-8d).	Frequency cannot be properly adjusted.
				c. Kilowatt meter	Indicates applied load not to exceed 100% (para 2-8e).	
				d. A.G. Ammeter	Indicates percentage of rated current. Not to exceed 100%.	No indication when load is applied.
				e. A.C. voltmeter	Indicates 120/208, or 240/416 volts.	Voltage cannot be properly adjusted.
				f. Battery charging ammeter	Normal indication 0 to + 20 amps, depending on battery charging rate. Should read in green portion of scale during normal operation.	Ammeter does not indicate charging current.
				g. Fault indicator panel	All lights out during operation. Check bulb operation with TEST or RESET switch on panel (para 3-113).	Fault light will not extinguish when switch is placed to TEST or RESET position, then released. All bulbs should be lit when switch is in TEST or RESET position.
NOTE						
					The Equipment is not Ready/Available if column does not apply to the Under Voltage and Under Frequency lights on the DOD Model 004A, Utility, 50/60 Hertz, NSN 6115-00-118-1241 generator sets.	

TABLE 3-1. OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES - - continued

ITEM NO.	INTERVAL			B-BEFORE OPERATION D-DURING OPERATION	A-AFTER OPERATION	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	B	D	A	ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	
5				h. Engine oil pressure gage	Normal indication 20 to 55 psi (para 2-8al).	Pressure below 20 psi.
				i. Coolant temperature gage	Normal indication 170-200°F (para 2-8am).	Temperature exceeds 200°F.
				j. Fuel level gage	Indicates quantity of fuel in main tank (para 2-8ak).	
			•	Fuel Tank	Fill fuel tank at completion of operation. (Fig. 3-7, para 3-49).	



TABLE 3-1.1. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM NO.	INTERVAL				ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	W	M	S	H			
1	•				Fluid Levels a. hydraulic sump (electro-hydraulic governor equipped precise sets only)  b. Cooling system	Check fluid levels. Check fluid level. Add fluid as required.  Check coolant level. Proper level is two inches below the overflow pipe. Add coolant as required.	
2	•				Main Fuel Tank	Drain water and sediment.  <b>NOTE</b>  In freezing weather, drain shortly after operation. Allow to drain until fuel runs clear.	
3	•				Fuel Filters and Strainers	Drain water and sediment.  <b>NOTE</b>  In freezing weather, drain shortly after operation. Allow to drain until fuel runs clear.	
3A				•	Fuel Pump Strainers	Change every 100 hours.	

**Table 3-1.1. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (continued)**

ITEM NO.	INTERVAL				ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	W	M	S	H			
4		•			Day Tank	Drain water and sediment.  <b>NOTE</b>  In freezing weather, drain shortly after operation. Allow to drain until fuel runs clear.	
5		•			Generator Set	Check entire unit for missing, loose, or damaged parts and hardware, and for unusual wear or deterioration.	
6		•			Batteries	Check electrolyte level. Check condition with a hydrometer. Add water as required (para 3-8).	
7		•			V-Belt	Inspect for worn, frayed, cracked, or oil-soaked belt. Check adjustment. If adjustment is required, adjust for a 1/2 inch deflection when belt is depressed at a point midway between alternator and water pump pulley (para 3-90).	
8		•			Fuel Filters	Replace filter elements every 100 hours (para 3-79, 3-81, and fig. 3-18 and 3-20).  <b>NOTE</b>  Items 9, 10 and 11 apply to electro-hydraulic governor equipped precise sets only.	
9				•	Hydraulic Sump	Drain and refill (para 3-97). (Refer to LO).	
10				•	Hydraulic Filter	Replace filter (para 3-97). (Refer to LO).	
11				•	Hydraulic Actuator Screen	Clean filter (para 3-98). (Refer to LO).	

Table 3-1.1. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (continued)

ITEM NO.	INTERVAL				ITEM TO BE INSPECTED	PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE IF:
	W	M	S	H			
12				•	Breather and Breather tube	Inspect for damage. Clean breather and breather tube at oil change interval as directed by Army Oil Analysis Program (para 3-103).	Air cleaner missing.
13				•	Engine Oil	As directed by Army Oil Analysis Program.	
14				•	Oil Filters	As directed by Army Oil Analysis Program.	
15				•	Air Cleaner	This unit is equipped with an air filter condition indicator light that will indicate when filter element needs cleaning. Clean element when necessary as indicated by light (para 3-24).	

## Section IV. OPERATOR'S MAINTENANCE

### 3-7. GENERAL.

The instructions in this section are published for the information and guidance of personnel operating the generator set. Deficiencies noted during inspection which are beyond the maintenance scope of the operator shall be reported to higher level maintenance.

### 3-8. BATTERIES (figure 1-1).

#### a. Inspection.

(1) Inspect batteries for cracked or broken cases, corrosion on terminal posts, damaged or frayed cables and loose connections.

(2) Refer to paragraph 3-65 and slide battery tray out from compartment.

(3) Check electrolyte level at eight hour intervals. More often under high temperature conditions.

#### b. Service.

(1) Remove corrosion from battery terminals and apply a light coat of grease.

(2) Maintain electrolyte level to slots in filler wells.

### 3-9. SLAVE RECEPTACLES (figure 1-1).

Inspect the slave receptacles for loose mounting, loose connections, loose or damaged weather covers and other visible damage.

### 3-10. BREATHER TUBE, EXHAUST PIPE AND MUFFLER (figure 3-32 and figure 3-33).

a. Inspect breather tube for cracks, breaks, insecure mounting and clogging.

b. Inspect exhaust pipe and muffler for insecure mounting, cracks, and obstructions.

### 3-11. CONVENIENCE RECEPTACLES AND CIRCUIT BREAKER (figure 1-2).

Inspect convenience receptacles and circuit breaker for insecure mounting, cracks, loose connections, damaged leads and other visible damage.

### 3-12. PLATE AND SLEEVE ASSEMBLY (figure 1-2).

a. Inspect sleeve for tears, deterioration, and missing draw string.

b. Check plate for dents, cracks, and illegible markings.

### 3-13. PARALLELING RECEPTACLES (figure 1-2).

a. Inspect paralleling receptacles for insecure mounting, corrosion, and damage.

b. Check electrical leads for loose connection, frayed insulation, and evidence of shorting.

### 3-14. AC VOLTMETER (7, figure 2-7).

a. Inspection. Inspect ac voltmeter for cracked or broken glass, insecure mounting, bent indicator, corrosion or other damage.

b. Adjustment. With the generator set shut off, rotate the voltmeter "zero" adjusting screw until the indicator points to zero.

### 3-15. KILOWATT (PERCENT POWER) METER (4, figure 2-7).

a. Inspection. Inspect the kilowatt meter for cracked, or broken glass, insecure mounting, bent indicator, corrosion and other damage.

b. Adjustment. With the generator set shut off, rotate the kilowatt meter adjusting screw until the indicator is in the zero position.

### 3-16. AC (PERCENT RATED CURRENT) AMMETER (6, figure 2-7).

a. Inspection. Inspect ac ammeter for cracked or broken glass, insecure mounting, corrosion, loose connections, bent indicator and other damage.

b. Adjustment. With the generator set shut off, rotate the ammeter adjusting screw until the indicator is in the "zero" position.

### 3-17. FREQUENCY METER (3, figure 2-7).

Inspect the frequency meter for cracked or broken glass, insecure mounting, corrosion, loose connections, bent indicator and other damage.

### 3-18. CONTROL PANEL SWITCHES.

Inspect BATTLE SHORT switch (22, figure 2-7), operations switch (26), VOLTAGE SENSING switch (27), PANEL LIGHTS switch (28), circuit breaker switch (30), START-RUN-STOP switch (32), and ENGINE PRIMER switch (33) for cracks, corroded terminals, loose connections and insecure mounting.

### 3-19. CONTROL PANEL GAUGES.

Inspect FUEL LEVEL gauge (36, figure 2-7), OIL PRESSURE gauge (37) and COOLANT TEMPERATURE gauge (38) for cracked or broken glass, corrosion, insecure mounting, loose connections, bent indicator and other damage.

### 3-20. RUNNING TIME METER (34, figure 2-7).

Inspect running time meter for broken glass, insecure mounting, loose connections, corrosion and other damage.

### 3-21. BATTERY CHARGING AMMETER (35, figure 2-7).

Inspect BATTERY CHARGING AMMETER for broken glass, insecure mounting, loose connections, corrosion and damage.

### 3-22. GENERATOR SET HOUSING.

a. Inspect generator set doors, panels and covers for dents, corrosion, defective paint, and other damage.

b. Check that all hinges and latches operate properly.

c. Inspect for loose, damaged, or missing hardware.

### 3-23. WIRING HARNESES.

Inspect engine, generator, and interconnecting wiring harnesses for loose connection, frayed insulation, or other damage.

### 3-24. AIR CLEANER ASSEMBLY.

#### a. Inspection.

(1) Inspect air cleaner housing for dents, defective paint, corrosion, missing hardware and other damage.

(2) Inspect air cleaner condition switch for insecure mounting and evidence of shorting or other damage.

#### b. Service.

(1) Remove nuts, lockwashers, screws and retainer (figure 3-3).

(2) Carefully remove dirty filter element from housing.

### CAUTION

Do not clean air cleaner filter element in gasoline or other petroleum solvents.

(3) Soak and agitate filter element for 15 minutes in a solution of warm water and mild detergent.

### CAUTION

Do not use compressed air to dry a wet filter element.

(4) Rinse filter element until clean and air dry for approximately 24 hours.

(5) The filter element may also be cleaned with low pressure (40 psig MAX), filtered compressed air.

(6) Place a light behind the cleaned filter element and check for holes, tears or other defects. Replace if defective.

(7) Clean interior of housing and install filter element.

(8) Install retainer, screws, lockwashers, and nuts.

### 3-25. DAY TANK ASSEMBLY.

a. Inspection. Inspect day tank assembly (figure 1-2) for cracks, leaks, insecure mounting, loose or damaged fuel lines, and loose electrical connections.

b. Service. Before and after each operation period, open the valve and allow any sediment and water to drain into a suitable container. When clean fuel begins to emerge, close the drain valve. For complete draining of the tank, leave valve open until no more fuel will drain out.

### 3-26. FUEL FILTER AND STRAINER ASSEMBLY.

a. Inspection. Inspect fuel filter and strainer assembly for insecure mounting, cracks, dents, leaks, loose fuel lines, and other discrepancies.

#### b. Service.

(1) Open the drain cocks on the fuel strainer housing and the fuel filter housing and allow the fuel to drain into a suitable container.

(2) Remove center screw (1, figure 3-4) and washer (2) to remove fuel filter housing (3) and gasket (4). Discard gasket.

(3) Withdraw filter element (5) from housing and discard.

(4) Do not remove drain cock (6) unless replacement is necessary.

(5) Remove cup nut (7) and sealing washer (8) to remove strainer housing (9) and gasket (10).

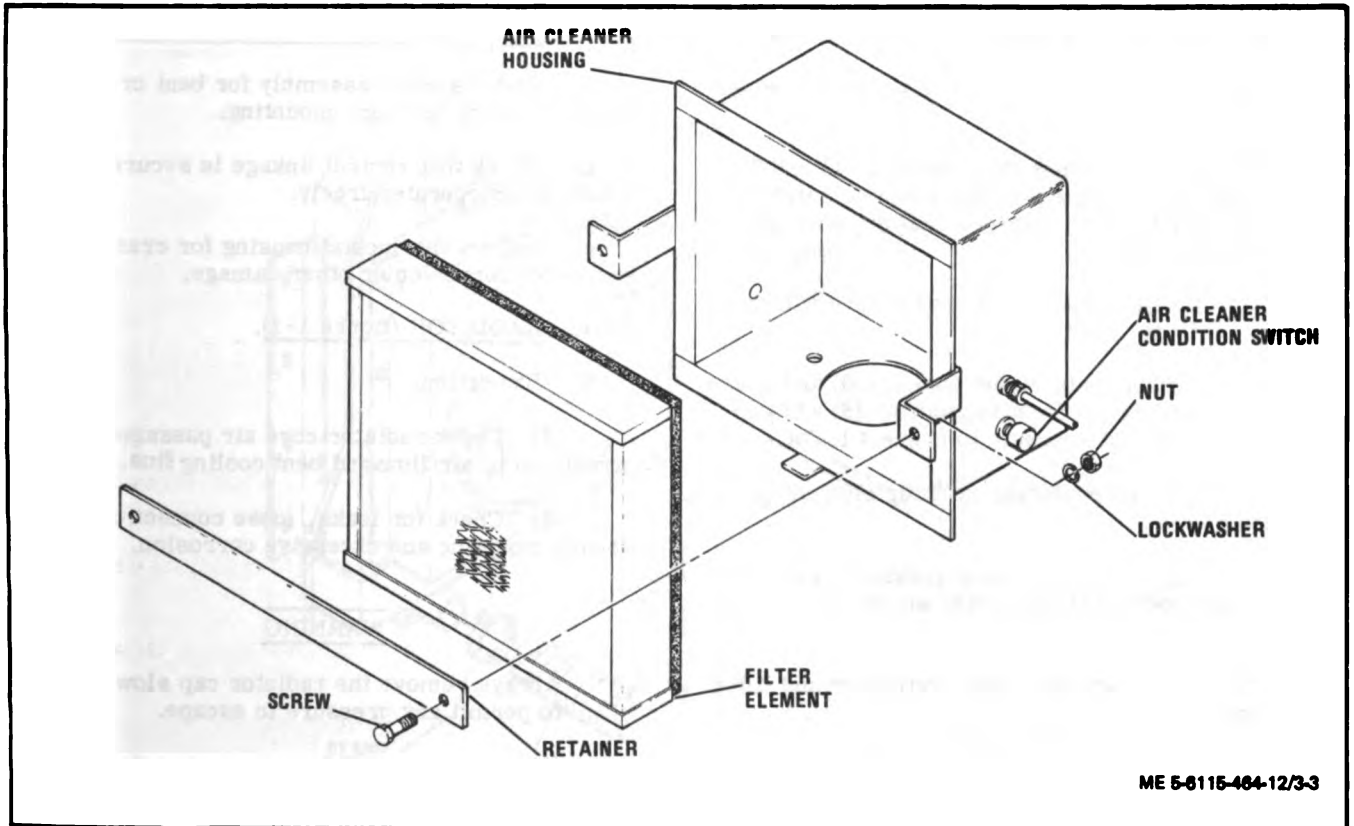


Figure 3-3. Servicing the Engine Air Cleaner

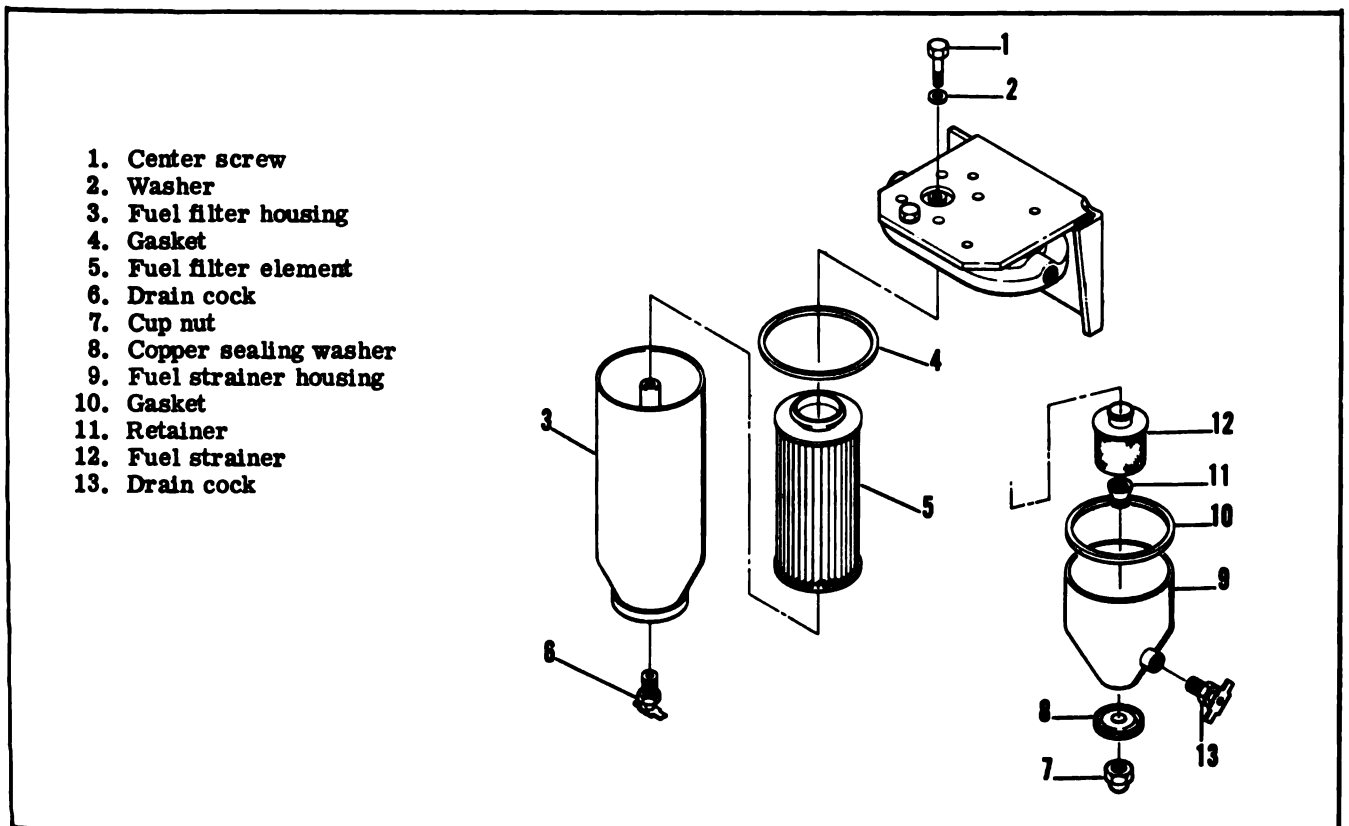


Figure 3-4. Servicing Fuel Strainer and Filter Housing

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Discard gasket. Do not remove drain cock (13) unless replacement is necessary.

(6) Remove retainer (11) to remove strainer (12).

(7) Clean strainer (12), housings (3 and 9), and attaching hardware with dry cleaning solvent (Federal Specification P-D-680) and dry with filtered compressed air.

(8) Install strainer (12) and secure with retainer (11) finger tight.

(9) Install replacement gasket (10) and housing (9) and secure with sealing washer (8) and cup nut (7). Tighten nut securely to prevent leaks.

(10) Install replacement filter element (5) into housing (3).

(11) Install replacement gasket (4) and housing (3) and washer (2) and center screw (1). Torque screw to  $17 \pm 2$  lb-ft.

(12) Close drain cocks on strainer and filter housings.

### 3-27. START AID ASSEMBLY.

a. Inspection.

#### NOTE

Start aid assembly is located on day tank assembly (figure 1-2).

Inspect start aid assembly for damage, insecure mounting, and loose fittings.

b. Service. Replace an unserviceable or empty ether tank as follows:

(1) Open ether tank bracket.

(2) Unscrew ether tank from the solenoid valve and discard.

(3) Inspect threads of replacement tank and solenoid valve for damage.

(4) Screw replacement tank onto solenoid valve hand tight.

(5) Close ether tank bracket.

### 3-28. FUEL TRANSFER PUMPS.

Inspect fuel transfer pumps for damage, leaks, insecure mountings and loose electrical and fuel connections.

### 3-29. RADIATOR GRILLE.

Inspect the radiator grille for dirt, cracks, dents, insecure mounting, corrosion and other damage.

### 3-30. SHUTTER ASSEMBLY AND THERMOSTAT (figure 3-24).

a. Check shutter assembly for bent or dented louvers and for insecure mounting.

b. Check that control linkage is securely mounted and operates freely.

c. Inspect thermostat housing for cracks, leaks, excessive corrosion or other damage.

### 3-31. RADIATOR (figure 1-1).

a. Inspection.

(1) Check radiator core air passages for obstructions to air flow and bent cooling fins.

(2) Check for leaks, loose connections, insecure mounting and excessive corrosion.

#### WARNING

Always remove the radiator cap slowly to permit any pressure to escape.

(3) Open the radiator cap access door, remove the radiator cap and check the coolant level. Check for accumulations of rust or scale in the radiator.

(4) Check radiator hoses and coolant lines for deterioration and leaks.

b. Service.

(1) To add coolant to the radiator, proceed as follows:

(a) Open the radiator cap access door.

(b) Remove the radiator cap.

#### CAUTION

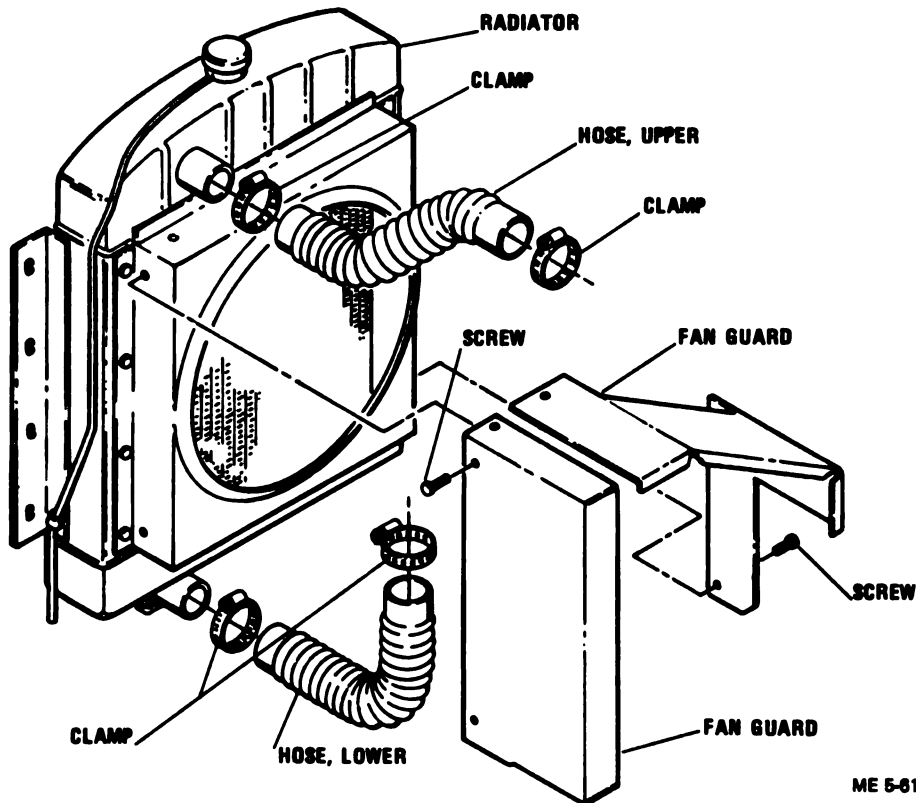
Do not add coolant to an overheated engine unless it is running.

(c) Add coolant, as specified on the coolant specification tag, to the radiator. Leave the coolant level approximately 2 inches below the overflow pipe to allow for expansion.

(2) To flush the radiator, proceed as follows:

(a) Remove the radiator cap to facilitate drainage.

(b) Open the coolant drain cock (17, figure 3-24) at the bottom of the shutter control thermostat housing and allow the coolant to drain into a suitable container.



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Figure 3-5. Radiator Hose Replacement

- (c) Close the coolant drain valve.
- (d) Fill the radiator with clean water and install the radiator cap; approved cleaning compounds may be used.
- (e) Refer to paragraph 2-10 and start the engine.
- (f) Allow the engine to operate until normal operating temperature is reached.
- (g) Refer to paragraph 2-11 and stop the engine. Open the coolant drain valve to drain the water.
- (h) Close the coolant drain valve.
- (i) Fill the radiator with coolant as specified in table 2-1 and attach a tag specifying the coolant used.
- (j) Refer to paragraph 2-10 and start the engine and allow it to operate until normal operating temperature is reached.
- (k) Check coolant level. Add coolant as necessary.

- (3) To replace radiator hoses, proceed as follows:
  - (a) Remove screws and fan guard (figure 3-5).
  - (b) Refer to step (2) (b) above and drain the radiator.
  - (c) Loosen clamps and remove defective radiator hose (figure 3-5).
  - (d) Clean radiator and engine hose connection points.
  - (e) Remove clamps from defective hose and place on replacement.

**CAUTION**

Do not push hose too far in on water pump outlet pipe and orient clamp so that it does not scrape against fan belt.

- (f) Push replacement hose onto engine and radiator connectors and tighten clamps.
- (g) Install fan guard and screws.



(h) Refer to step (2)(i) above and service the radiator.

**3-32. HYDRAULIC ACTUATOR (ELECTRO-HY-  
DRAULIC GOVERNOR EQUIPPED PRE-  
CISE SETS ONLY).**

- a. Inspect hydraulic actuator unit for insecure mounting, dents, cracks, corrosion and other visible damage.
- b. Check electrical connectors for loose connection, bent or broken pins, and signs of shorting or other damage.
- c. Check hydraulic lines for loose connections, leaks, and other damage.
- d. Check governor control linkage for freedom of movement, worn ball joints, cracks, corrosion and other damage.

**3-33. HYDRAULIC SUMP AND FILTER (ELECTRO-  
HYDRAULIC GOVERNOR EQUIPPED PRECISE  
SETS ONLY).**

a. Inspection.

- (1) Inspect hydraulic sump for insecure mounting, cracks, corrosion, and other visible damage.
  - (2) Check filter assembly for insecure mounting, dents, cracks, corrosion, and other visible damage.
  - (3) Check hydraulic lines for loose connections, leaks, and damage.
- b. Service.
- (1) Clean filler cap and surrounding area.
  - (2) Remove filler cap and check oil level as indicated on dipstick.
  - (3) Refer to figure 3-1 and add oil to proper level on dipstick.
  - (4) Install filler cap.

**3-34. ENGINE ASSEMBLY.**

a. Inspection.

- (1) Inspect the engine assembly for fuel, oil, and water leaks. Check for accumulation of dirt. Check for cracks, corrosion and other damage.
- (2) Check for damage, insecure mounting, or missing parts or accessories.

b. Service.

- (1) Keep the external areas of the engine and accessories clean and free of oil and grease.
- (2) Check cylinder block drain plugs and radiator drain cock for evidence of leaking.

**3-35. V-BELT.**

Inspect the v-belt frequently for indications of wear, deterioration, and oil soaking.

**3-36. BATTERY CHARGING ALTERNATOR.**

Inspect the battery charging alternator for cracks, insecure mounting, loose connections, signs of shorting and other damage.

**3-37. SPEED SWITCH AND ADAPTER.**

Inspect speed switch for insecure mounting, loose connector, corrosion, signs of shorting and visible damage. Inspect boot on reset switch S1 for deterioration.

**3-38. HYDRAULIC OIL PUMP (ELECTRO-HY-  
DRAULIC GOVERNOR EQUIPPED PRECISE  
SETS ONLY)**

Inspect hydraulic oil pump for cracks, leaks, loose fittings, insecure mounting and other damage.

**3-39. OIL LEVEL GAUGE AND FILLER TUBE.**

a. Inspection.

- (1) Inspect oil level gauge for legibility of markings, loose fittings, bends and other damage.
- (2) Check for oil leaks at the base of the filler tube and the oil level gauge tube.
- (3) Inspect filler tube for cracks, insecure mounting, dents and other damage.
- (4) Inspect oil seal in filler cap for excessive wear, deterioration, and damage.

b. Replacement.

- (1) Replace oil level gauge by removing and installing a new one.
- (2) To replace oil filler cap, remove the cap and disconnect the captive chain. Connect the captive chain to a new cap and install the cap onto the filler tube.

**3-40. STARTER ASSEMBLY.**

Inspect starter assembly for insecure mounting, loose electrical connections, cracks, and damage to the starter solenoid.

**3-41. OIL PRESSURE TRANSMITTER.**

Inspect the oil pressure transmitter for insecure mounting, leaks, loose electrical connections, cracks, and other damage.

**3-42. LUBE OIL FILTER.**

Inspect the lube oil filter for cracks, dents, and leaks.

**3-43. SECONDARY FUEL FILTER.**

- a. Inspection. Inspect the secondary fuel filter for leaks, cracks, breaks, and other damage.
- b. Service.

(1) Open the drain valve on bottom of day tank assembly (figure 1-2) and allow the fuel to drain into a suitable container.

(2) Open drain cock (1, figure 3-6) and allow fuel to drain into a suitable container.

(3) Remove center screw assembly (2) and washer (3) to remove housing (6) and gasket (7). Discard gasket.

(4) Remove bleeder plug (4) from center screw (5).

(5) Withdraw filter element (8) from housing and discard.

(6) Clean parts in dry cleaning solvent (Federal Specification P-D-680) and dry with filtered compressed air.

(7) Insert replacement filter element (8) into housing.

(8) Install replacement gasket (7) and secure housing (6) with washer (3) and center screw (5). Torque screw  $17 \pm 2$  lbs-ft.

(9) Close drain cock (1) and fill day tank (paragraph 2-10).

(10) Install bleeder plug (4).

### 3-44. FUEL INJECTION PUMP.

Inspect fuel injection pump for insecure mounting, cracks, leaks, loose connections and other damage.

### 3-45. FAN ASSEMBLY.

Inspect fan assembly for bent blades, insecure mounting, cracked mounting bracket, and other damage.

### 3-46. WATER PUMP ASSEMBLY.

Inspect water pump assembly for leaks, cracks, insecure mounting, loose coolant lines and hoses and other damage.

### 3-47. COOLANT TEMPERATURE TRANSMITTER.

Inspect coolant temperature transmitter for insecure mounting, cracks, loose connections and leaks.

### 3-48. OIL PAN ASSEMBLY.

a. Inspect oil pan for dents, loose hardware, and oil leaks.

b. Check oil heater coolant lines for leaks, loose fittings, pinching, cracks and other damage.

c. Inspect drain hose for loose connections, deterioration, tears, and other damage.

### 3-49. MAIN FUEL TANK.

#### a. Inspection.

(1) Inspect for insecure mounting, dents, leaks, cracks and other damage.

(2) Inspect filler cap for damage and corrosion.

(3) Check filler cap gasket for damage or deterioration.

(4) Inspect filler hose for leaks, deterioration, loose connections and other damage.

(5) Check drain valve and captive cap for leaks, damage, and corrosion.

(6) Check fuel lines for loose connections.

(7) Inspect fuel level sensor for loose electrical connections, insecure mounting, corrosion and other damage.

#### b. Servicing.

##### (1) Filler Cap.

(a) Unscrew filler cap (figure 3-7) and disconnect captive chain.

(b) Inspect filler cap gasket for damage and deterioration. Replace gasket if deficiencies are present.

(c) Clean cap in an approved solvent and dry thoroughly.

(d) Inspect vent valve in filler cap for plugging.

(e) Check cap for cracks, corrosion, and other damage. Replace cap if damage is present.

(f) Check captive chain for corrosion and cracked or broken links. Replace chain if damage is noted.

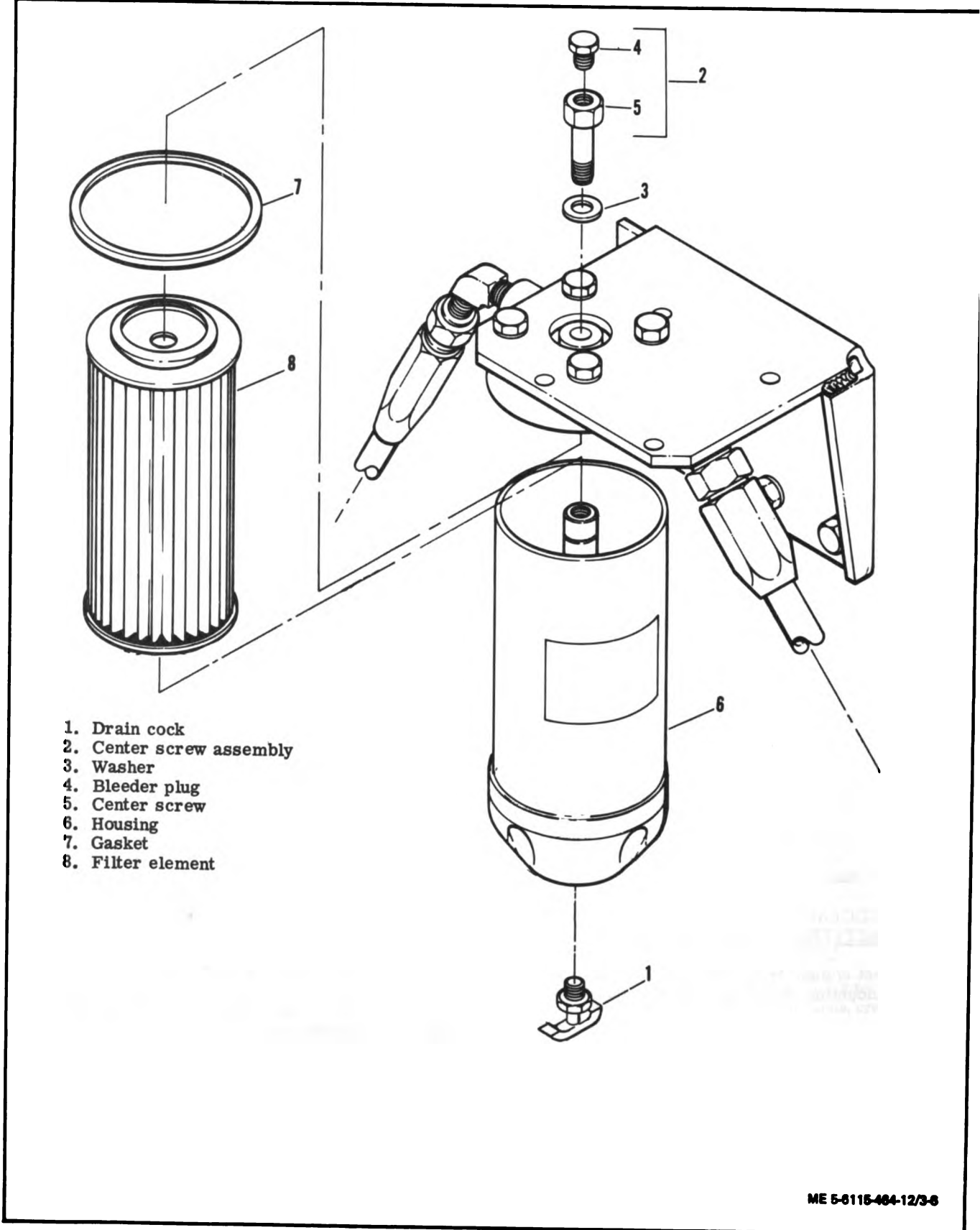
(g) Install gasket onto filler cap.

(h) Connect captive chain to filler neck and install filler cap.

##### (2) Main Fuel Tank.

(a) Remove captive cap from drain valve (figure 3-7).

(b) Install auxiliary fuel line onto drain line and position its free end to drain over board into a suitable container.



- 1. Drain cock
- 2. Center screw assembly
- 3. Washer
- 4. Bleeder plug
- 5. Center screw
- 6. Housing
- 7. Gasket
- 8. Filter element

ME 5-6115-464-12/3-6

Figure 3-6. Servicing Secondary Fuel Filter

ME 5-6115-464-12/3-7

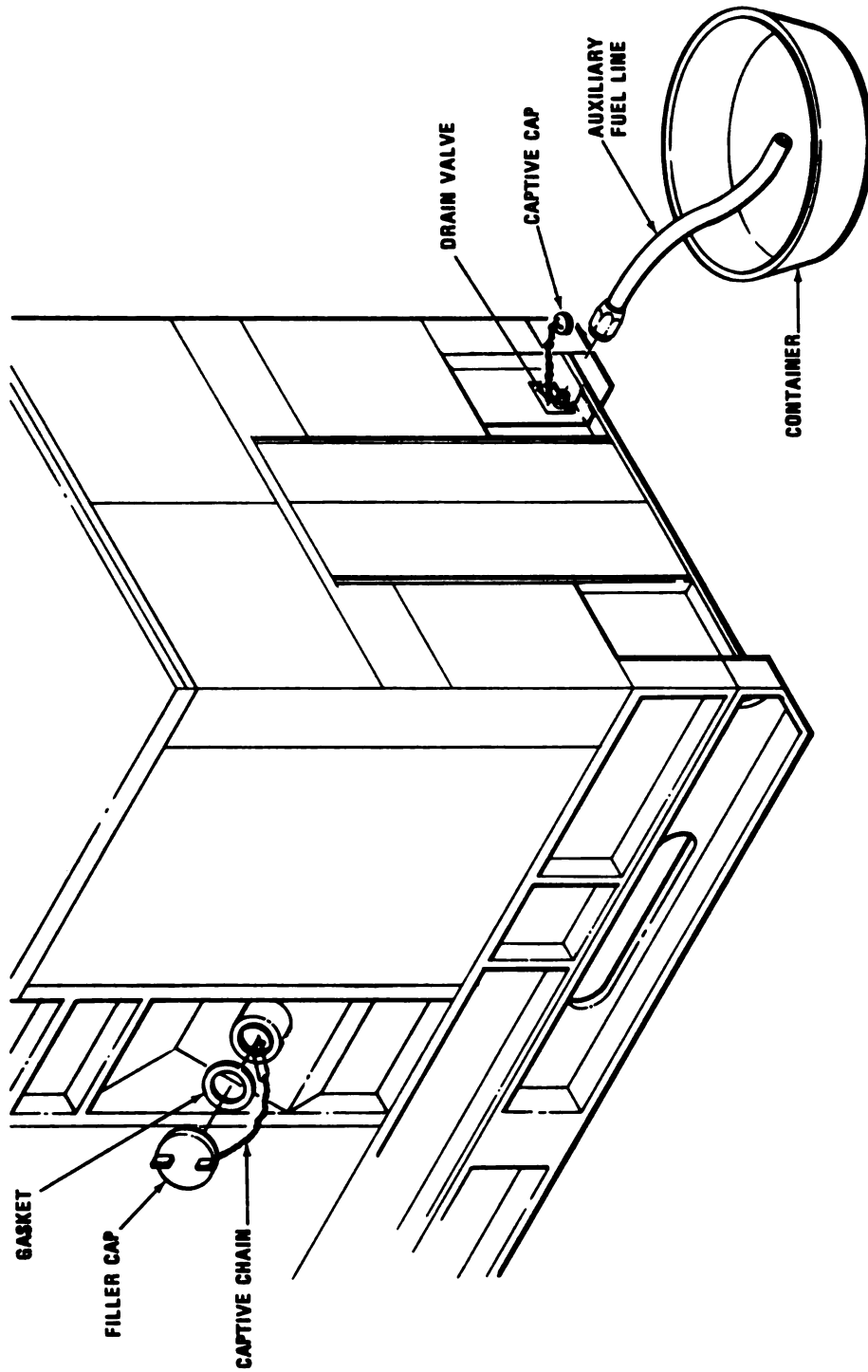


Figure 3-7. Main Fuel Tank Inspection and Service

(c) Open drain valve and allow sediment to drain from fuel tank.

(d) When all sediment has drained, close drain valve. Remove auxiliary fuel line and install captive cap.

(e) Add fuel to tank as required.

(f) For complete draining of the tank, complete steps (a) through (c) above and leave drain valve open until no more fuel will drain out.

**3-50. Paralleling Cable.**

Install paralleling cable for damaged connectors and pins, frayed insulation, indications of shorting, and other damage.

**3-51. Auxiliary Fuel Line.**

Inspect auxiliary fuel line for deterioration, damaged connectors, leaks and other damage.

**Section V. TROUBLESHOOTING**

**3-52. General.**

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the generator set and its components. Malfunctions which may occur are listed in table 3-2. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite each probable cause. Any mal-

function beyond the scope of organizational maintenance shall be reported to higher level maintenance.

**NOTE**

Air Force and Navy users may perform maintenance within the scope of their abilities.

**Table 3-2. Troubleshooting**

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1. Engine fails to crank.	a. Improper starting procedure.	a. Perform starting procedure as outlined in para. 2-10.
	b. Loose or corroded battery cable terminals and battery post.	b. Clean battery post. Clean and tighten battery cable terminals (para. 3-65).
	c. Discharged batteries.	c. Charge or replace batteries (para. 3-65.)
	<b>NOTE</b>	
	Use slave receptacle (SR1) when extra cranking power is required.	
	d. Improperly installed batteries.	d. Install batteries correctly (para. 3-65).
	e. Defective DC circuit breaker.	e. Replace DC circuit breaker (para. 3-115).
	f. Defective START-RUN-STOP switch.	f. Replace START-RUN-STOP switch (para. 3-112).
	g. Loose electrical connection or break in starting circuit.	g. Check starting circuit wiring. Replace any damaged wires. Tighten loose connections.
	h. Worn starter brushes.	h. Replace starter brushes (para. 3-67).
i. Defective starter solenoid.	i. Replace starter solenoid (para. 3-67).	
j. Defective starter motor.	j. Replace starter motor (para. 3-67).	

Table 3-2. Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
<p>2. Engine cranks but fails to start</p>	<p>a. Improper starting procedure.</p> <p>b. Low or no fuel supply.</p> <p>c. Water in fuel, contaminated or incorrect grade of fuel.</p> <p>d. Air in fuel lines.</p> <p>e. Obstruction in fuel supply line.</p> <p>f. Defective day tank fuel level and low fuel cutoff switch.</p> <p>g. Defective fuel solenoid valve.</p> <p>h. Clogged fuel strainer or filters.</p> <p>i. Defective nozzle holder assembly.</p> <p>j. Dirty air filter element.</p> <p>k. Speed switch not reset after overspeed shutdown.</p>	<p>a. Perform starting procedure as outlined in para. 2-10.</p> <p>b. Service fuel tank (para. 2-1), or use auxiliary fuel supply (para. 2-3).</p> <p>c. Drain entire fuel system. Service with clean fuel of proper grade (para. 3-49). Service fuel filters (para. 3-26 and 3-43). Drain day tank assembly (para. 3-25). Drain fuel tank and service with clean fuel of proper grade (para. 3-49).</p> <p>d. Bleed fuel system (para. 3-25, 3-26, 3-49). Tighten any loose fuel supply line connections (para. 3-83).</p> <p>e. Clean or replace fuel supply line (para. 3-83).</p> <p>f. Replace switch (para. 3-74).</p> <p>g. Replace fuel solenoid valve (para. 3-75).</p> <p>h. Service fuel strainer and filter assembly (para. 3-26). Service secondary fuel filter (para. 3-43).</p> <p>i. Replace nozzle holder assembly (para. 3-82).</p> <p>j. Service air cleaner assembly (para. 3-24).</p> <p>k. Depress reset button on back of overspeed switch (para. 3-69).</p>
<p>3. Engine starts correctly, but stops when START-RUN-STOP switch is released.</p>	<p>a. Switch not held in START position long enough.</p> <p>b. Defective speed switch.</p> <p>c. Defective START-RUN-STOP switch.</p> <p>d. Clogged oil filter assembly.</p> <p>e. Defective low oil pressure switch.</p> <p>f. High coolant temperature.</p>	<p>a. Hold switch in START position until engine oil pressure reaches 20 PSI (para. 2-10).</p> <p>b. Replace speed switch (para. 3-69).</p> <p>c. Replace switch (para. 3-112).</p> <p>d. Service oil filter assembly (para. 3-4).</p> <p>e. Replace low oil pressure switch (para. 3-73).</p> <p>f. Refer to malfunction 11 of this table.</p>

Table 3-2. Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
<p>3. Engine starts correctly, but stops when START-RUN-STOP switch is released. (continued)</p>	<p>g. Low fuel level in day tank.</p>	<p>g. Check main tank fuel level. Check transfer pumps for proper operation. Replace if necessary (para. 3-78). Check fuel solenoid valve for proper operation. Replace if defective (para. 3-75). Check day tank fuel level and low fuel cut-off switch for proper operation. Replace if necessary (para. 3-74).</p>
<p>4. Engine stops suddenly</p>	<p>a. Protective device tripped.            b. Fuel supply exhausted.            c. Air lock in fuel supply line.            d. Obstruction in fuel supply line.            e. Water in fuel.</p>	<p>a. Check fault indicator for malfunction indication. Refer to the appropriate maintenance section.            b. Service fuel tank (para. 3-49).            c. Bleed fuel system (para. 3-25, 3-26, 3-49). Tighten any loose fuel line connections (para. 3-83).            d. Clean or replace fuel supply line (para. 3-83).            e. Drain main fuel tank (para. 3-49), fuel filters (para. 3-43, 3-46) and day tank (para. 3-25). Service fuel system with clean fuel (para. 3-49).</p>
<p>5. Engine runs erratically or misfires.</p>	<p>a. Improper grade or contaminated fuel.            b. Dirty air cleaner.            c. Obstruction in fuel supply line.            d. Valves out of adjustment.            e. Dirty nozzles.</p>	<p>a. Drain entire system. Service with clean fuel of proper grade (para. 3-49). Service fuel filters (para. 3-26 and 3-43).            b. Service air cleaner (para. 3-24).            c. Clean or replace fuel supply line (para. 3-83).            d. Adjust valve tappet clearance (para. 3-109).            e. Clean and replace defective nozzles.</p>
<p>6. Engine does not develop full power</p>	<p>a. One or more cylinders misfiring.            b. Exhaust pipe or muffler restricted.</p>	<p>a. Refer to malfunction 5 of this table.            b. Clean or replace exhaust pipe or muffler (para. 3-102).</p>
<p>7. Engine knocks.</p>	<p>a. Engine overheated.            b. Low lube oil level.            c. Valve tappet clearance too great.            d. Injector nozzle broken.</p>	<p>a. Refer to malfunction 11 of this table.            b. Check oil level. Add oil if necessary. (Lubrication Order, para. 3-3.)            c. Adjust valve tappet clearance (para. 3-109).            d. Replace injector nozzle (para. 3-82).</p>

Table 3-2. Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
7. Engine knocks (Continued)	e. Improper grade of fuel or water in fuel.	e. Drain main fuel tank (para. 3-49), fuel filters (para. 3-26, 3-43), and day tank (para. 3-25). Service system with clean fuel (para. 3-49).
8. Black smoke in exhaust.	a. Improper grade of fuel.  b. Dirty injector nozzles.  c. Dirty air cleaner.  d. Generator set over-loaded.	a. Drain main fuel tank (para. 3-49), fuel filters (para. 3-26, 3-43), and day tank (para. 3-25). Service system with clean fuel (para. 3-49).  b. Clean or replace injector nozzles (para. 3-82).  c. Service air cleaner (para. 3-24).  d. Reduce load to rated level.
9. Blue or white smoke in exhaust	a. Improper grade of fuel.  b. Engine operating temperature too low due to defective thermostat.  c. Crankcase oil level too high.  d. Defective nozzle holder assembly.  e. Improper valve tappet clearance.	a. Drain main fuel tank (para. 3-49), fuel filters (para. 3-26, 3-43) and day tank (para. 3-25). Service system with clean fuel.  b. Replace thermostat (para. 3-93).  c. Drain crankcase and refill to proper level (para. 3-4).  d. Replace nozzle holder assembly (para. 3-82).  e. Adjust valve tappet clearance (para. 3-109).
10. Low oil pressure	a. Low oil level.  b. Defective oil pressure gauge.  c. Defective oil pressure transmitter.  d. Clogged oil filters.  e. Improper viscosity oil.	a. Add oil to proper level on dipstick (para. 3-3).  b. Replace oil pressure gauge (para. 3-112).  c. Replace oil pressure transmitter (para. 3-72).  d. Service oil filter (para. 3-4).  e. Drain crankcase and refill with oil of proper viscosity (lubrication order, para. 3-3).
11. Engine over-heating	a. Low coolant level.  b. V-belt broken or out of adjustment.  c. Defective thermostat.	a. Check coolant level. Add coolant as necessary (para. 3-31).  b. Adjust or replace v-belt (para. 3-90).  c. Replace thermostat (para. 3-93).



Table 3-2. Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
11. Engine over-heating	d. Defective or improperly adjusted shutter and controls. e. Rust or scale clogging radiator. f. Radiator air passages clogged. g. Collapsed radiator hoses. h. Defective water pump. i. Restricted exhaust pipe or muffler.	d. Adjust or replace shutter and control assembly (para. 3-89). e. Replace radiator (para. 3-88). f. Clean radiator air passages (para. 3-31). g. Replace radiator hoses (para. 3-31). h. Replace water pump assembly (para. 3-92). i. Clean or replace exhaust pipe or muffler (para. 3-102).
12. Engine coolant temperature too low	a. Thermostat stuck open. b. Improperly adjusted or defective shutter or control linkage and thermostat. c. Defective temperature transmitter. d. Defective coolant temperature gauge.	a. Replace thermostat (para. 3-93). b. Adjust or replace shutter assembly (para. 3-89). Replace defective control linkage or thermostat (para. 3-87). c. Replace temperature transmitter (para. 3-70). d. Replace coolant temperature gauge (para. 3-112).
13. Battery charging ammeter shows no charge when batteries are low or discharged	a. Defective alternator fuse. b. Improperly adjusted alternator. c. V-belt is out of adjustment or broken. d. Defective alternator. e. Open wire or loose connection in charging circuit. f. Batteries dry.	a. Replace fuse in back of alternator (para. 3-68, figure 3-13). b. Adjust alternator (para. 3-68). c. Adjust or replace v-belt (para. 3-90). d. Replace alternator (para. 3-68). e. Check charging circuit wiring. Replace broken wires and tighten loose connections. f. Refill battery cells with distilled water ( para. 3-65).
14. Battery charging ammeter shows excessive charging after prolonged operation.	a. Improperly adjusted alternator. b. Defective batteries. c. Defective alternator. d. Short in charging circuit. e. Defective battery charging ammeter.	a. Adjust alternator (para. 3-68). b. Replace batteries (para. 3-65). c. Replace alternator (para. 3-68). d. Check charging circuit. Repair or replace shorted wiring. e. Replace battery charging ammeter (para. 3-112).

Table 3-2. Troubleshooting (Cont)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
15. AC voltmeter does not indicate voltage.	a. Battery Charging Alternator defective. b. Defective VOLT-AMP transfer switch. c. Defective voltage adjust rheostat. d. Defective ac voltmeter.	a. Refer to Table 3-2 item 13. b. Replace switch (para. 3-112). c. Replace defective voltage adjust rheostat (para. 3-112). d. Replace ac voltmeter (para. 3-112).
16. AC voltmeter indicates voltage, but frequency meter is off scale.	a. Engine speed too slow. b. Defective frequency meter. c. Defective frequency transducer.	a. Adjust frequency rheostat (Precise Sets Only) (para. 2-10). Increase engine speed with manual speed control (Utility Sets Only) (para. 2-10). b. Replace frequency meter (para. 3-112). c. Replace frequency transducer (para. 3-112).
17. AC voltage fluctuates.	a. Loose electrical connection. b. Defective VOLT-AMPS selector switch. c. Defective voltage adjust rheostat. d. Defective ac voltmeter.	a. Inspect electrical system and make any repairs necessary (figures FO-1 and FO-2). b. Replace VOLT-AMPS SELECTOR switch (para. 3-112). c. Replace voltage adjust rheostat (para. 3-112). d. Replace ac voltmeter (para. 3-112).
18. Frequency fluctuates.	a. Erratic engine operation b. Defective frequency adjust rheostat (Class 1 sets only). c. Defective frequency meter. d. Defective frequency transducer.	a. Refer to malfunction 5 of this table. b. Replace frequency adjust rheostat (para. 3-112). c. Replace frequency meter (para. 3-112). d. Replace frequency transducer (para. 3-112).
19. Main AC contactor (CB2) will not close	a. Defective circuit breaker switch S3. b. Defective main load contactor (fig. 3-43A).	a. Inspect test S3. Replace if defective (para. 3-112u). b. Disconnect electrical connector (P & J41, FO-1, sheet 4) from main load contactor (CB2). Start generator set, while holding circuit breaker switch (S3) in closed position. Using a voltmeter, test for 28 VDC at J41, receptacle A(+) and receptacle B(-). If 28 VDC is present, inspect and test CB2 (para 3-121). Replace if defective. If 28 VDC is not present notify higher level maintenance.

Section VI. FIELD EXPEDIENT REPAIRS

3-53. GENERAL.

Organizational maintenance troubles may occur while the generator set is operating in the field where supplies and repair parts are not available and normal corrective action cannot be performed. When this condition exists, the following expedient repairs may be used in emergencies, upon the decision of the unit commander. Equipment so repaired must be removed from operation and properly repaired as soon as conditions permit.

3-54. FUEL IS NOT STRAINED.

<u>TROUBLE</u>	<u>EXPEDIENT REMEDY</u>
Fuel strainer and filters defective.	Remove strainer and filters and operate the generator set until replacements are obtained.

3-55. HOUSING FILLED WITH SMOKE.

<u>TROUBLE</u>	<u>EXPEDIENT REMEDY</u>
Defective exhaust pipe.	Operate the generator set with defective exhaust pipe until a replacement is obtained.

3-56. ENGINE OVERHEATING.

<u>TROUBLE</u>	<u>EXPEDIENT REMEDY</u>
Shutter control assembly not operational.	Manually open shutter with lever or install a temporary brace to hold shutters open.
Defective thermostat (stuck closed).	Remove thermostat and operate the generator set without one until a replacement can be obtained.
Loss of oil pressure.	Check oil level and add, if necessary. If oil supply is adequate, stop the engine, and check for defective oil pressure gauge. If the gauge is proven to be defective, continue to operate the engine. If oil supply and gauge are satisfactory, check for defective oil pump.

3-57. LOSS OF COOLANT.

<u>TROUBLE</u>	<u>EXPEDIENT REMEDY</u>
Leaking coolant line or radiator hose.	Tightly wrap the leaking area with plastic electricians tape.

TROUBLE

EXPEDIENT REMEDY

Leaking coolant line or radiator hose (Cont)

If necessary, stop the engine and drain the coolant to perform the taping. Check the taped area frequently while the generator set is operating until a replacement hose is obtained.

Leaking radiator.

Remove radiator cap to release pressure in cooling system. Liberally apply epoxy, tar, putty, or any other insoluble substance to the leaking area. Operate the generator set until a replacement radiator is obtained, adding coolant as necessary.

Leaking water pump.

Loosen the radiator cap to prevent pressure build-up in the cooling system. Continue operation, adding coolant as necessary to maintain coolant level above top of radiator core, until a replacement water pump is obtained.

3-58. BATTERY CHARGING AMMETER SHOWS NO CHARGE.

TROUBLE

EXPEDIENT REMEDY

Battery charging alternator.

Continue engine operation with defective alternator until replacement is obtained or until engine can be shutdown and repairs performed.

3-59. LOSS OF FREQUENCY CONTROL (TACTICAL PRECISE SETS ONLY).

TROUBLE

EXPEDIENT REMEDY

Governor fails to operate properly.

Use manual speed control to control frequency until necessary repairs can be made. For changeover procedures see paragraph 3-59a.

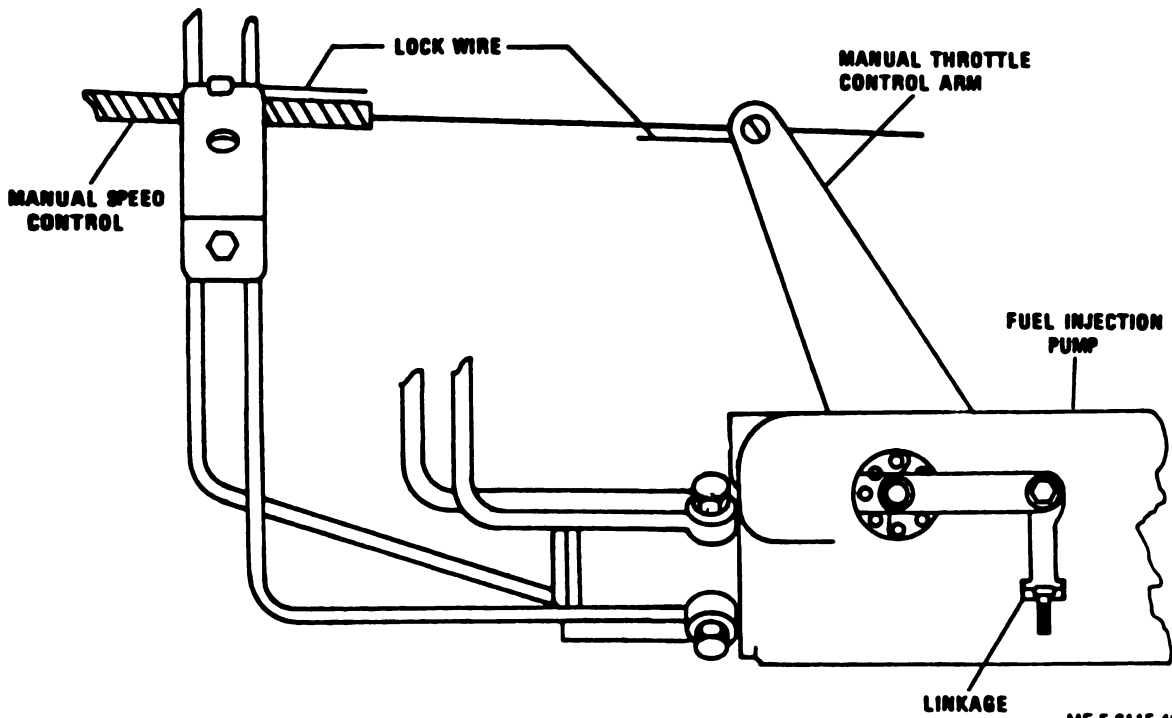


Fig. 3-7A. Emergency Conversion Connections

**NOTE**

Conversion to utility set should be done only in extreme emergency.

**Changeover Procedures.** The following paragraphs contain procedures for changing the configuration of a tactical precise generator set to a tactical utility set, and procedures for restoring the set to a tactical precise configuration.

(1) **Tactical Precise to Tactical Utility.** Disconnect the wiring harness from the special relay box, located on the relay table. Install the shorting plug, attached to the special relay box, into the connector on the special relay box. Disconnect the linkage between the actuator and the fuel injection pump (figure 3-7A). Remove the lockwire. Adjust the manual speed control and manual throttle control arm so that with the control knob fully in, the manual throttle control arm is at the low idle setting.

(2) **Tactical Utility to Tactical Precise.** With the manual speed control knob fully in, install a lockwire (figure 3-7A) on the manual throttle control arm so that the arm is in the approximate position shown in figure 3-7A. Remove the shorting plug from the receptacle on the special relay box. Connect the wiring harness to the special relay box receptacle. Do not detach the shorting plug from the special relay box. Connect the linkage between the actuator and the fuel injection pump.

**NOTE**

Desired speeds must be obtained by trial and error adjustments of linkage, position of control arm, and governor control unit adjustments.

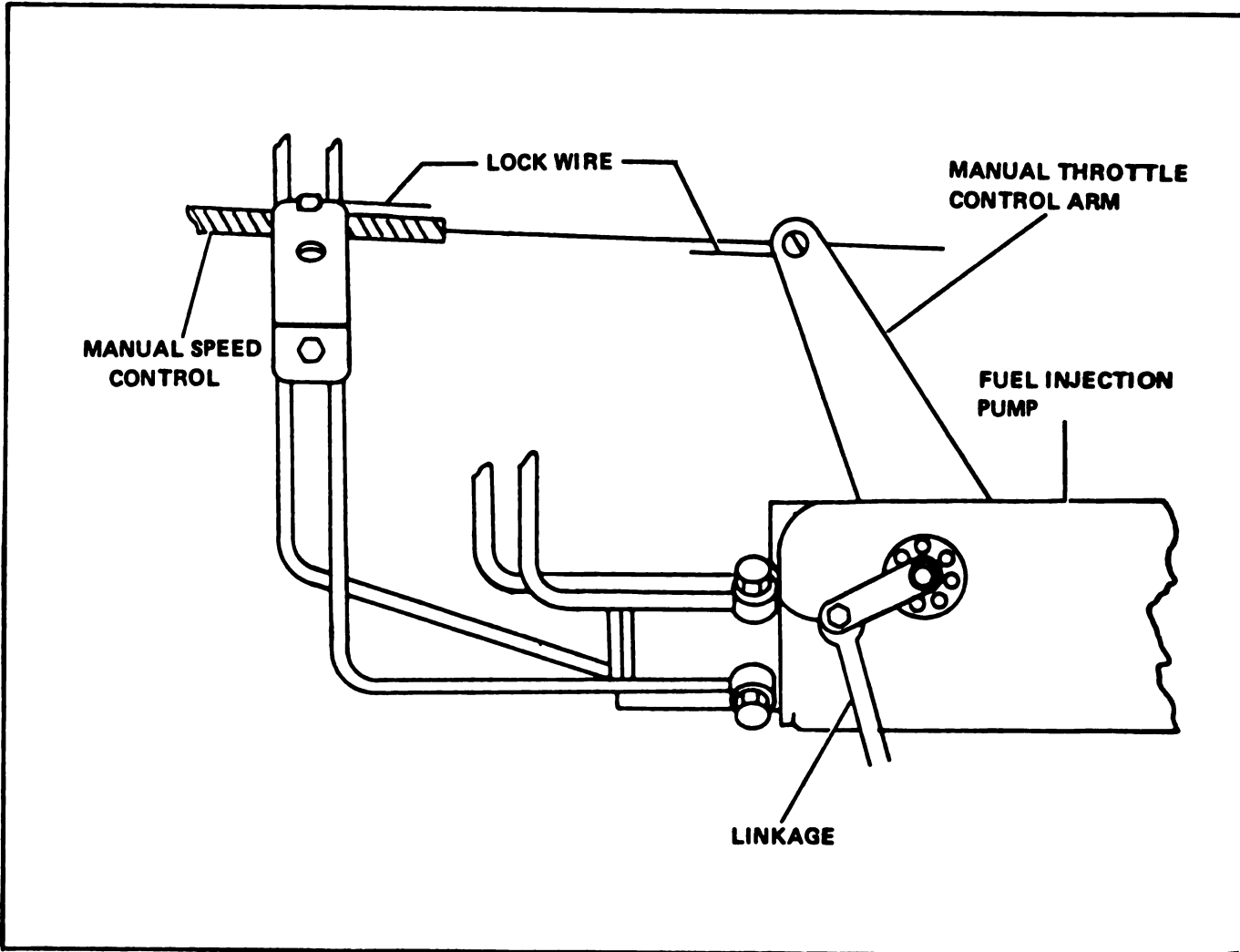


Figure 3-7B. Emergency Conversion Connections (effective with serial nos. KZ00001 thru KZ201226 and RZ60001 and up)

Section VII. ELECTROMAGNETIC INTERFERENCE SUPPRESSION

**60. GENERAL METHODS USED TO OBTAIN PROPER SUPPRESSION.**

Essentially, suppression is obtained by providing a path to ground for stray currents. The methods used include shielding high frequency wires, grounding the frame with bonding straps, and using capacitors, inductors and resistors.

**3-61. INTERFERENCE SUPPRESSION COMPONENTS.**

**a. Primary Interference Suppression Components.**  
The primary interference components are those whose primary function is the suppression of electromagnetic interference. Those components are located at three different assemblies. The assemblies are the exciter regulator, the load terminal board, and are an integral part of the fuel transfer pumps. The suppression components located on the load terminal board and the exciter regulator are effective for generator sets designed serial number KZ00001 and RZ60001 and up.

**b. Secondary Interference Suppression Components.** These components have electromagnetic interference suppression functions which are incidental or secondary to their primary function. The generator set contains no secondary suppression components.

**3-62. Deleted.**

**3-63. TESTING OF INTERFERENCE SUPPRESSION COMPONENTS.**

Test electromagnetic suppression components as follows:

**a.** Place START-RUN-STOP switch (paragraph 2-10) in RUN position and allow fuel transfer pumps to run until day tank float switch cuts them off.

**b.** Start the generator set (paragraph 2-10) and check for electromagnetic interference.

**c.** If interference is present, and the fuel transfer pumps are not operating, the transfer pumps are not the source.

**d.** If interference is not present, allow the generator set to operate until the day tank float switch turns the fuel transfer pumps on.

**e.** If interference is present with fuel transfer pumps operating, shut down the generator set (paragraph 2-11) and replace the pumps.

**f.** If the foregoing test indicates interference is caused by defective components other than those within the fuel pumps, replace one at a time, each of the four capacitors on the load terminal board assembly while observing the effect on interference.

**g.** If the above tests do not eliminate the interference, the fault may be in the exciter regulator. Refer to higher level maintenance.

Section VIII. ORGANIZATIONAL MAINTENANCE OF THE ENGINE ELECTRICAL SYSTEM

3-64. GENERAL.

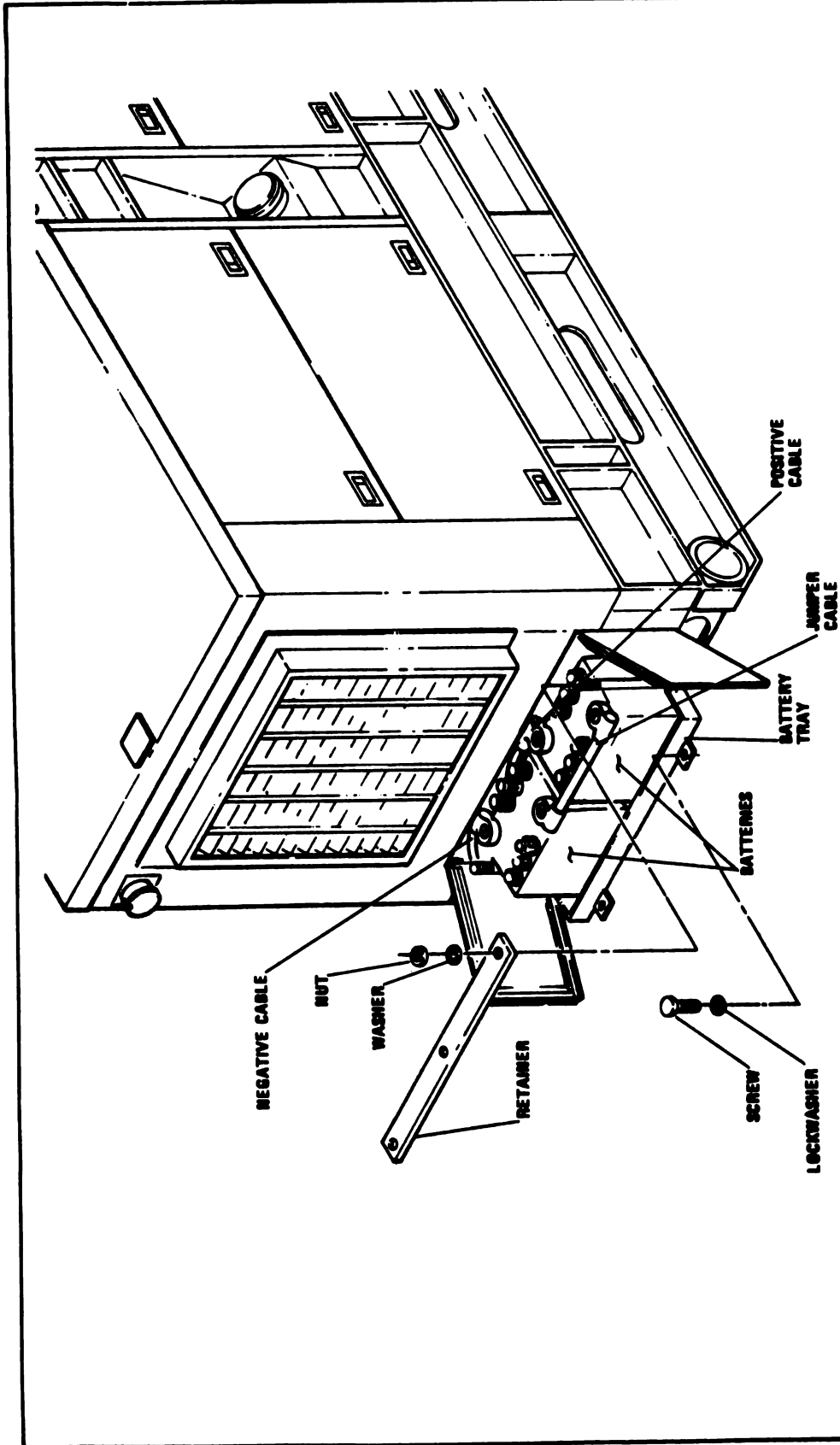
This section contains organizational maintenance instructions for the engine electrical system. Electrical power for starting the generator set engine is supplied by two 12 volt, 100 amp-hour, lead-acid type batteries connected in series. A slave receptacle facilitates external connection to the batteries. The starting motor is a 24 volt, heavy duty unit equipped with a positive indexing drive and an overrun type clutch. An integral solenoid switch is connected to the clutch shift lever by linkage and engages the clutch pinion gear with the flywheel and holds it in mesh during engine cranking. A 28-volt, continuous duty, alternator with integral voltage regulator and diode rectifier supplies electrical power for recharging the batteries after cranking. A manually reset speed switch driven by the camshaft provides sequence control of circuits during starting and also provides automatic shutdown in the event of engine overspeeding.

Coolant temperature is read through a temperature transmitter. An over-temperature switch provides automatic shutdown in the event that coolant temperature exceeds  $220 \pm 3^\circ$  F. The engine lube oil pressure is read through a pressure transmitter. A low oil pressure switch provides automatic shutdown in the event that oil pressure falls below  $20 \pm 2$  psig. The day tank is equipped with a double float switch which controls the fuel solenoid valve and provides automatic shutdown when only enough fuel remains for one minute of operation. The components of the engine electrical system are connected electrically through the engine wiring harness.

3-65. BATTERIES.

a. Installation.

- (1) Refer to paragraph 3-8 and service the batteries.







**WARNING**

Battery electrolyte contains sulfuric acid which can cause severe burns. Handle batteries with care. If electrolyte should contact the skin or clothing, rinse immediately with clean water.

(2) Install batteries and connect as shown in figure 3-8.

**NOTE**

When installing battery cables, always connect ground (negative) cable last.

(3) Install retainer and secure with washers and nuts.

(4) Apply an approved corrosion preventive compound to battery posts and cable terminals.

**b. Replacement.**

**(1) Removal.**

(a) Remove battery tray retaining screws and washers (figure 3-8) and slide battery tray out from compartment.

(b) Remove nuts, washers, and retainer (figure 3-8).

(c) Remove battery cables.

**NOTE**

When removing battery cables, always disconnect ground (negative) cable first.

(d) Remove batteries from battery tray.

(2) Installation. Refer to subparagraph a. above for installation instructions.

**c. Testing.**

(1) Test specific gravity of electrolyte in each battery cell with a hydrometer. Refer to table 3-3 for specific gravity temperature corrections. Refer to table 3-4 for state of charge with specific gravity corrected to 80°F.

**WARNING**

Batteries generate hydrogen, a highly volatile gas, during charging. There shall be no smoking or open flame in the vicinity.

(2) Recharge or replace batteries as necessary.

Table 3-3. Specific Gravity Temperature Corrections

Temperature °F	Correction Factor
+120	+0.016
+115	+0.014
+110	+0.012
+105	+0.010
+100	+0.008
+95	+0.006
+90	+0.004
+85	+0.002
+80	0
+75	-0.002
+70	-0.004
+65	-0.006
+60	-0.008
+55	-0.010
+50	-0.012
+45	-0.014
+40	-0.016
+35	-0.018
+30	-0.020
+25	-0.022
+20	-0.024
+15	-0.026
+10	-0.028
+5	-0.030
0	-0.032
-5	-0.034
-10	-0.036
-15	-0.038
-20	-0.040

Table 3-4. State of Charge With Specific Gravity Corrected to 80°F

Specific Gravity	Percent Charge
1.280	100
1.250	75
1.220	50
1.190	25
1.160	Little useful capacity
1.130	Discharged

**3-66. SLAVE RECEPTACLE.**

**a. Removal.**

(1) Tag and disconnect electrical leads to the slave receptacle.

(2) Remove nuts (1, figure 3-9), screws (2) and washers (3) to remove slave receptacle (4).

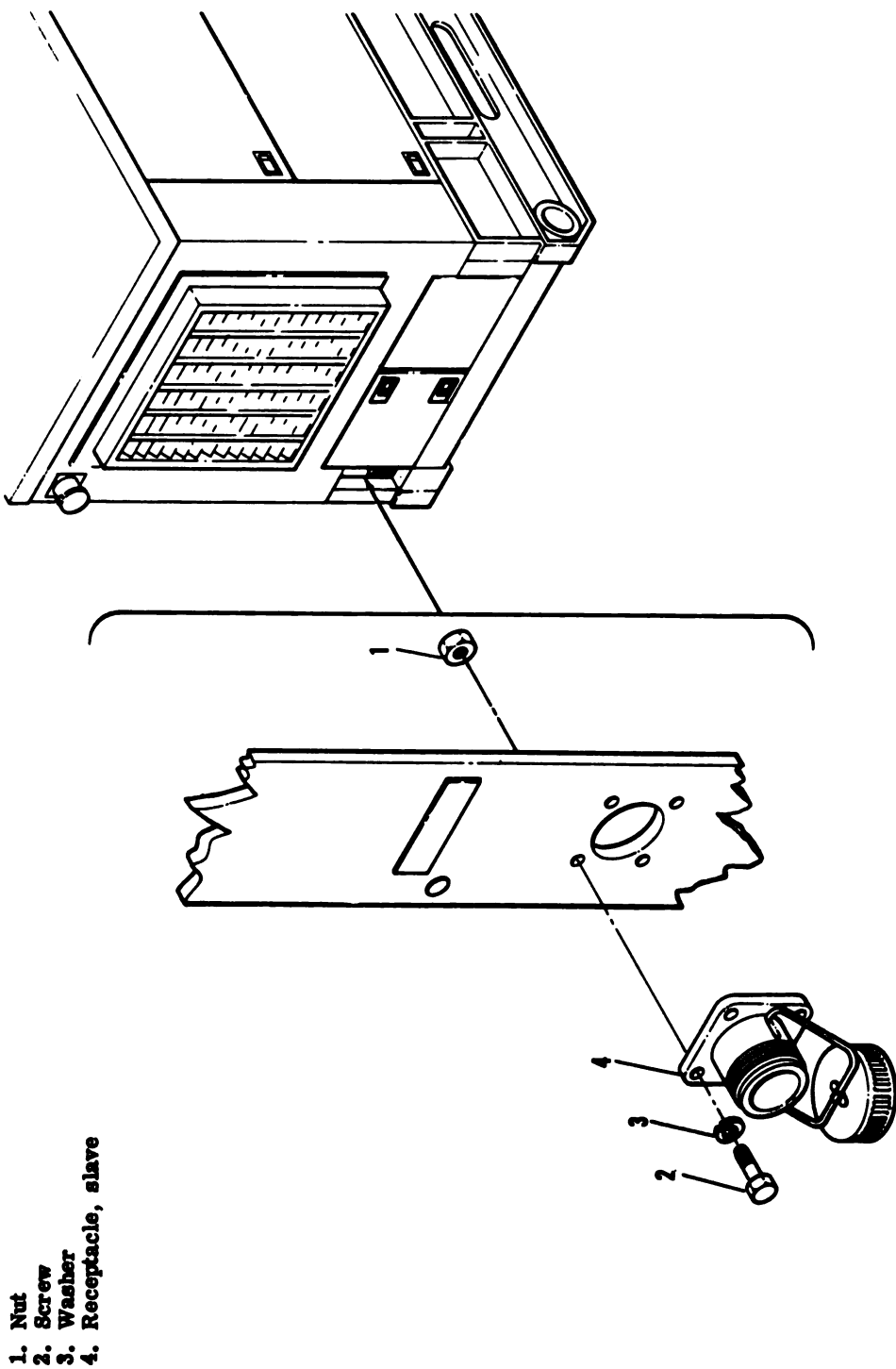


Figure 3-9. Slave Receptacle, Removal and Installation

- 1. Nut
- 2. Screw
- 3. Washer
- 4. Receptacle, slave

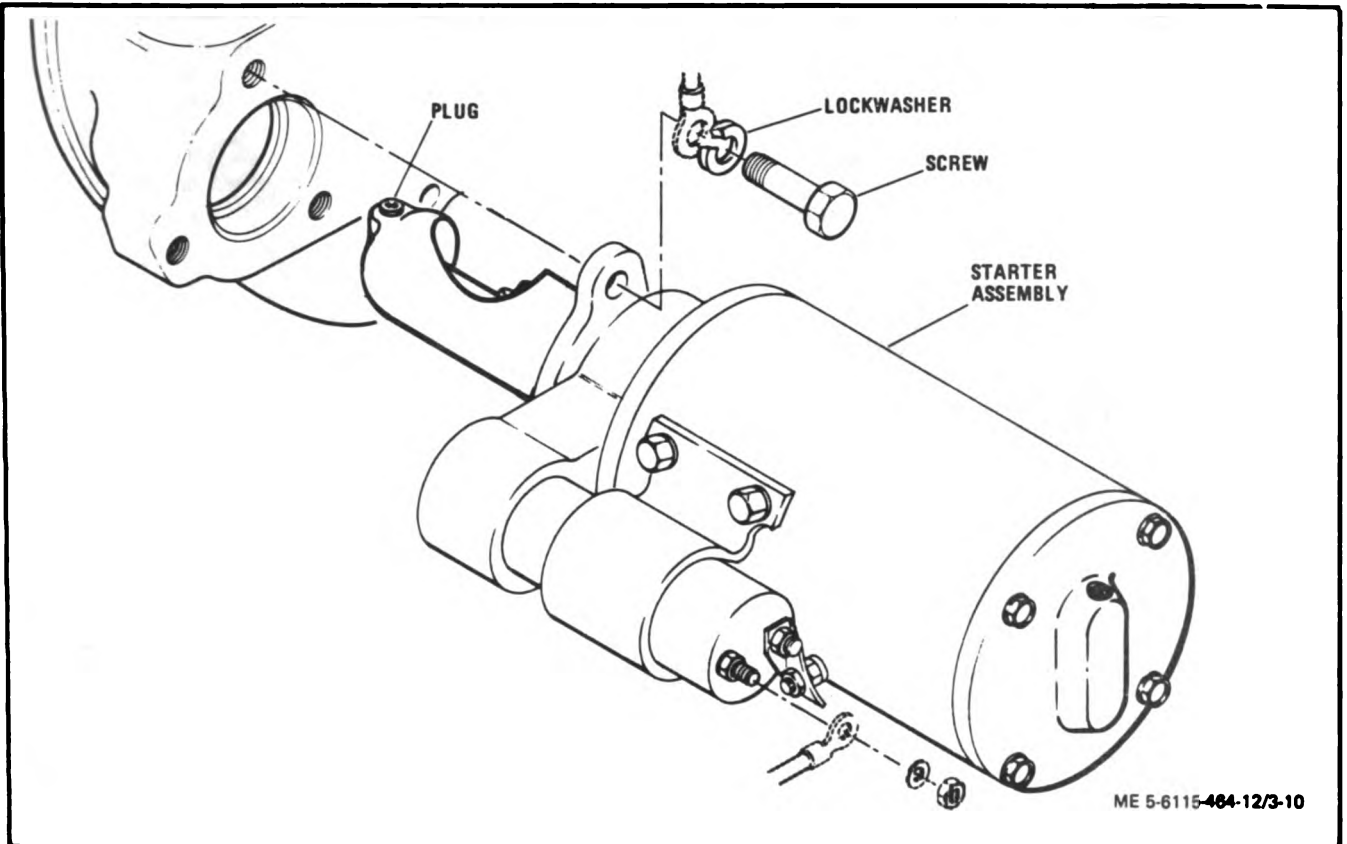


Figure 3-10. Starter Assembly, Removal

**b. Cleaning and Inspection.**

(1) Clean receptacle with filtered compressed air and a soft bristle brush.

(2) Clean receptacle box with a clean, lint-free cloth moistened with an approved solvent.

(3) Inspect receptacle for bent or broken pins, stripped terminal threads, corrosion or other damage.

(4) Inspect wiring of receptacle for frayed or deteriorated insulation, evidence of shorting and other damage.

(5) Inspect receptacle box for dents, corrosion and other damage.

(6) Replace any parts damaged beyond simple repair.

**c. Installation.** Install slave receptacle in reverse order of removal procedures.

**3-67. STARTER ASSEMBLY.**

**a. Removal.**

(1) Tag and disconnect electrical leads to starter assembly (figure 3-10).

(2) Remove three bolts and lockwashers to remove starter from bell housing.

**b. Cleaning and Inspection.**

(1) Clean starter assembly with a clean, lint-free cloth moistened with an approved solvent.

(2) Inspect starter assembly for cracks, corrosion, evidence of shorting and other damage.

(3) Inspect solenoid assembly for cracks, corrosion, evidence of shorting and other damage.

(4) Inspect all threaded parts for stripped or damaged threads.

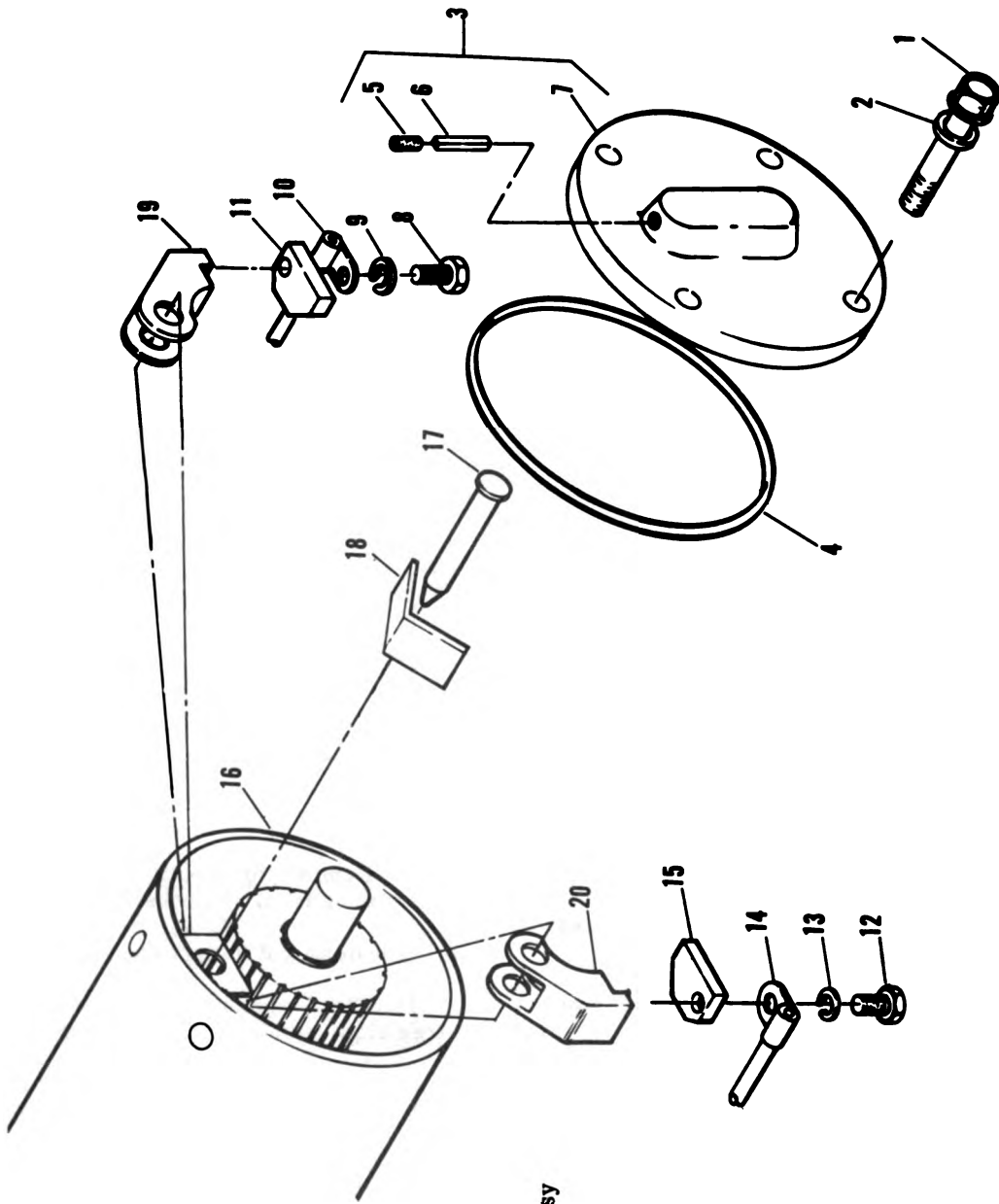
**c. Repair.**

(1) Brush replacement.

**NOTE**

It is not necessary to remove the starter assembly from the engine to replace the brushes.

(a) Remove screws (1, figure 3-11), and lockwashers (2)



1. Screw
2. Lockwasher
3. Commutator end frame assy
4. O-ring
5. Pipe plug
6. Oil wick
7. End frame
8. Screw
9. Lockwasher
10. Electrical lead
11. Brush
12. Screw
13. Lockwasher
14. Electrical lead
15. Brush
16. Starter assy
17. Brushholder pin
18. Brushholder spring
19. Brushholder
20. Brushholder

Figure 3-11. Starter Brushes Replacement

(b) Carefully remove commutator end frame assembly (3) and o-ring (4). Remove pipe plug (5) and oil wick (6) from end frame (7).

(c) Remove screws (8 and 12) and lockwashers (9 and 13) to remove electrical leads (10 and 14) and brushes (11 and 15).

(d) Remove brushholder pin (17) to remove brushholder spring (18) and brushholders (19 and 20) from brush support.

(e) Clean commutator end frame, brush support, brushholders, and brushholder springs in an approved solvent and dry thoroughly.

(f) Soak oil wick in a small container of approved cleaning solvent to remove oil. Remove from container, squeeze out excess solvent and allow to air dry.

(g) Measure brush length. Replace brushes if length is  $3/8$  inch or less.

#### CAUTION

Use extreme care to avoid enlarging commutator slots.

(h) Inspect starter armature commutator slots for thrown solder. Remove any found with a narrow blunt instrument.

(i) Check bronze bushing in commutator end frame and armature shaft for deep wear patterns, scoring, or other damage. Replace starter assembly if damage exists.

(j) Check brushholders and brush support for corrosion, cracks, breaks, and other damage. Replace any defective parts.

(k) Inspect electrical leads and visible starter assembly wiring for burned insulation, bare wires and rub marks. Replace starter assembly if damage is present.

(l) Check all attaching hardware for stripped, crossed or otherwise damaged threads. Replace any damaged or defective parts.

(m) Install brushholders (19 and 20) and spring (18) and secure with pin (17).

(n) Install brushes (11 and 15) and electrical leads (10 and 14) and secure with lockwashers (9 and 13) and screws (8 and 12).

#### CAUTION

Use care when installing end frame to avoid damaging the bronze armature shaft bushing.

(o) Install commutator end frame (7) and o-ring (4) and secure with lockwashers (2) and screws (1).

(p) Install oil wick (6), saturate with oil and secure with pipe plug (5).

(2) Solenoid replacement.

#### NOTE

It is not necessary to remove the starter assembly from the generator set to replace the solenoid assembly.

(a) Remove nut (1, figure 3-12) and lockwasher (2) to disconnect electrical lead (3).

(b) Remove nut (4), lockwasher (5), nut (6), lockwasher (7) and terminal lead (8).

(c) Loosen clamp (9) and remove screws (10) to remove solenoid frame assembly (11). Remove sleeve (12).

(d) Remove drive housing plug (13).

(e) Remove retaining ring (14) and lever pin (15) to remove plunger assembly (16) from starter assembly (17).

(f) Remove retaining ring (18) to separate spring retainer (19), spring (20), seal (21), seal retainer (22), and spring retainer (23) from plunger (24).

(g) Clean solenoid frame assembly with filtered compressed air and a soft bristle brush.

(h) Using an ohmmeter, check for continuity between solenoid frame assembly terminals. Replace entire solenoid assembly if discontinuity is noted.

(i) Clean all other parts in an approved solvent and dry thoroughly.

(j) Inspect plunger for cracks, corrosion, and other damage.

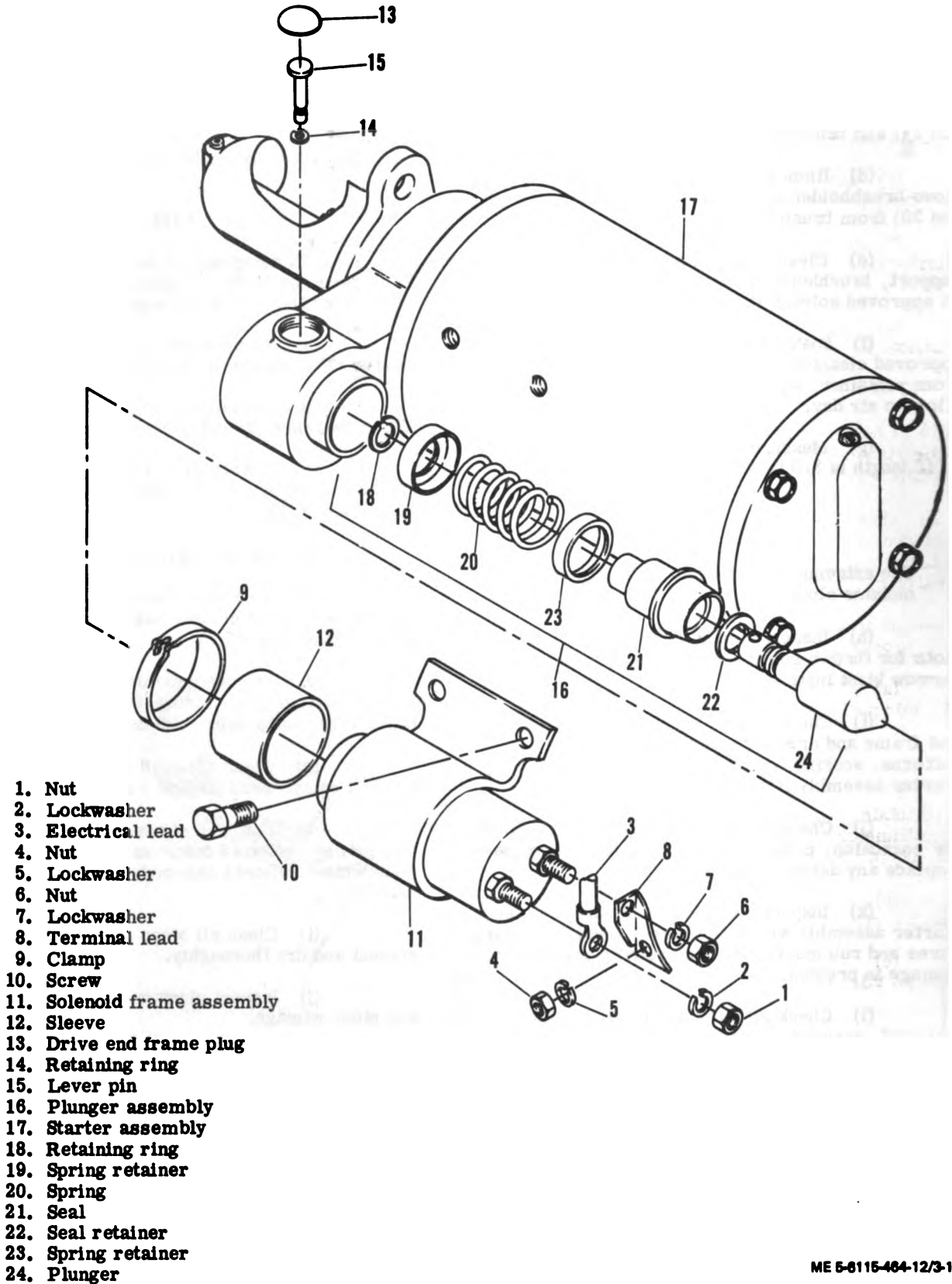
(k) Inspect seal for damage and deterioration.

(l) Inspect spring for cracks, breaks, and distortion.

(m) Replace any defective parts.

(n) Install spring retainer (23), seal retainer (22), seal (21), spring (20), and spring retainer (19) onto plunger (24) and secure with retaining ring (18).

(o) Install plunger assembly (16) into drive end housing.



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Figure 3-12. Starter Solenoid Replacement

(p) Install lever pin (15) and secure with retaining ring (14).

(q) Install plug (13).

(r) Install sleeve (12) and clamp (9) onto drive end housing.

(s) Install solenoid frame assembly (11) and screws (10). Tighten clamp (9).

(t) Install terminal lead (8) and secure with lockwasher (7), nut (6), lockwasher (5) and nut (4).

(u) Install electrical lead (3) and secure with lockwasher (2) and nut (1).

#### d. Testing.

(1) Check specific gravity of batteries to determine state of charge (paragraph 3-65). Charge or replace batteries if necessary.

(2) Open the right side engine compartment access door. Listen for audible evidence of solenoid actuation while someone attempts to start the generator set (paragraph 2-10).

(3) If no sounds of solenoid actuation are heard, proceed as follows:

(a) Set selector switch of a multimeter to the 50 Vdc position.

#### CAUTION

Maintain proper polarity when connecting multimeter. Electrical lead (3, figure 3-12) is positive lead.

(b) Connect multimeter between positive solenoid terminal and starter ground terminal.

(c) If multimeter does not indicate approximately 24 Vdc, trouble is in wiring and not the solenoid.

#### CAUTION

Always disconnect negative (ground) cable first.

(d) If multimeter indicates approximately 24 Vdc, disconnect leads from starter.

(e) Using multimeter as an ohmmeter, check for indication of open circuit across solenoid terminals.

(f) If multimeter indicates open circuit, replace solenoid (subparagraph c. (2) above).

(g) If multimeter indicates continuity, reconnect electrical leads.

(4) If solenoid actuates, but starter will not rotate engine, proceed as follows:

(a) Set selector switch of multimeter to the 50 Vdc position.

#### CAUTION

Maintain proper polarity when connecting multimeter.

(b) Connect multimeter between starter-to-solenoid terminal and ground terminal.

(c) Observe multimeter while assistant attempts to start the generator set.

(d) If multimeter does not indicate approximately 24 Vdc, replace solenoid assembly (paragraph c. (2) above).

(e) If multimeter indicates correct voltage, check brush length (paragraph b. (1) above). Replace brushes if necessary.

(5) If trouble persists, replace starter assembly.

e. Installation. Install starter assembly in reverse order of removal procedures.

#### 3-67A. STARTER ASSEMBLY.

##### NOTE

Effective with serial numbers KZ00001 through KZ01226 and RZ60001 and up.

##### a. Removal.

(1) Tag and disconnect electrical leads to starter assembly (figure 3-12A).

(2) Remove three bolts and lockwashers to remove starter from bell housing.

##### b. Cleaning and Inspection.

(1) Clean starter assembly with a clean, lint-free cloth moistened with an approved solvent.

(2) Inspect starter assembly for cracks, corrosion, evidence of shorting and other damage.

(3) Inspect solenoid assembly for cracks, corrosion, evidence of shorting and other damage.

(4) Inspect all threaded parts for stripped or damaged threads.



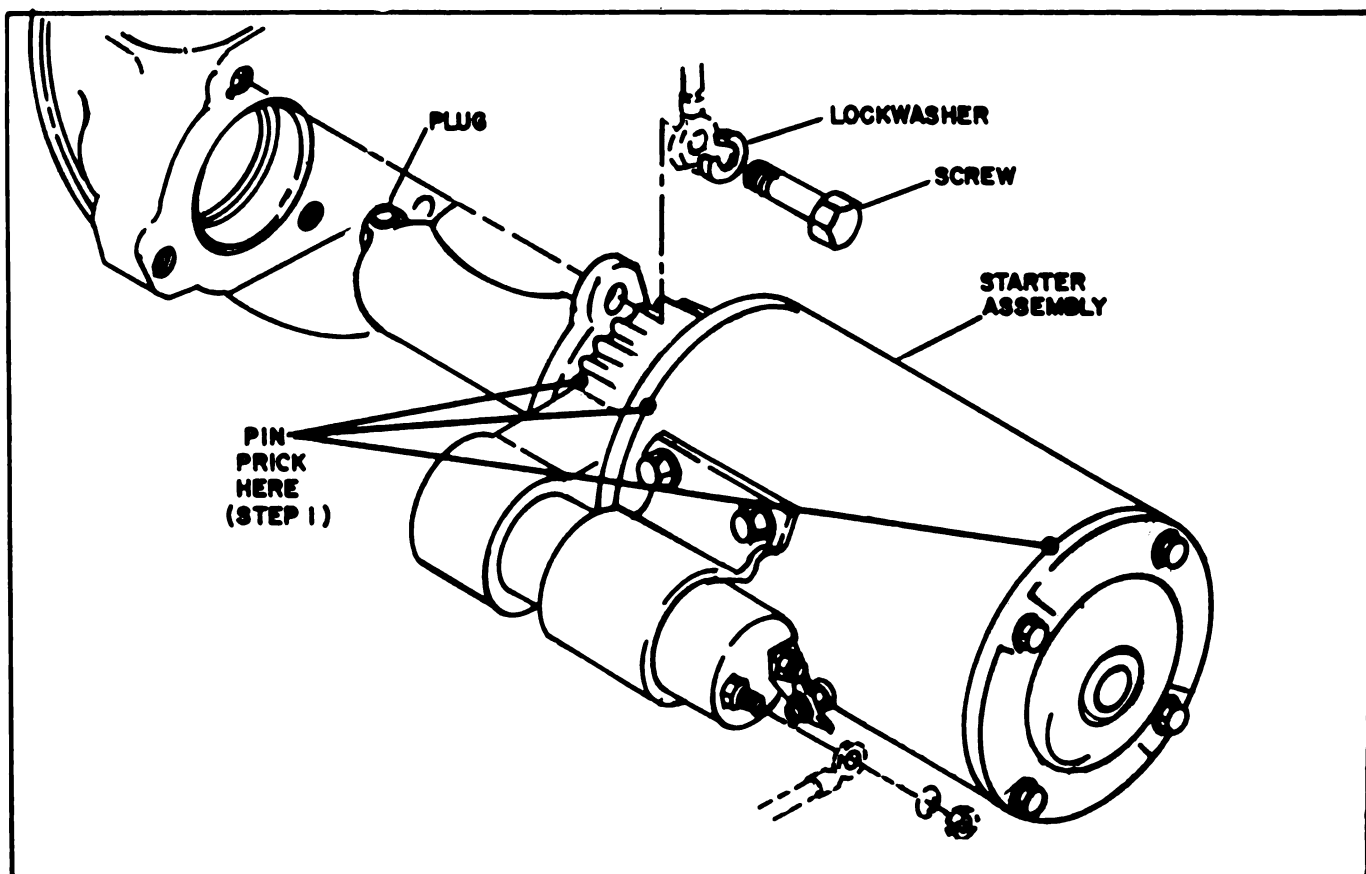
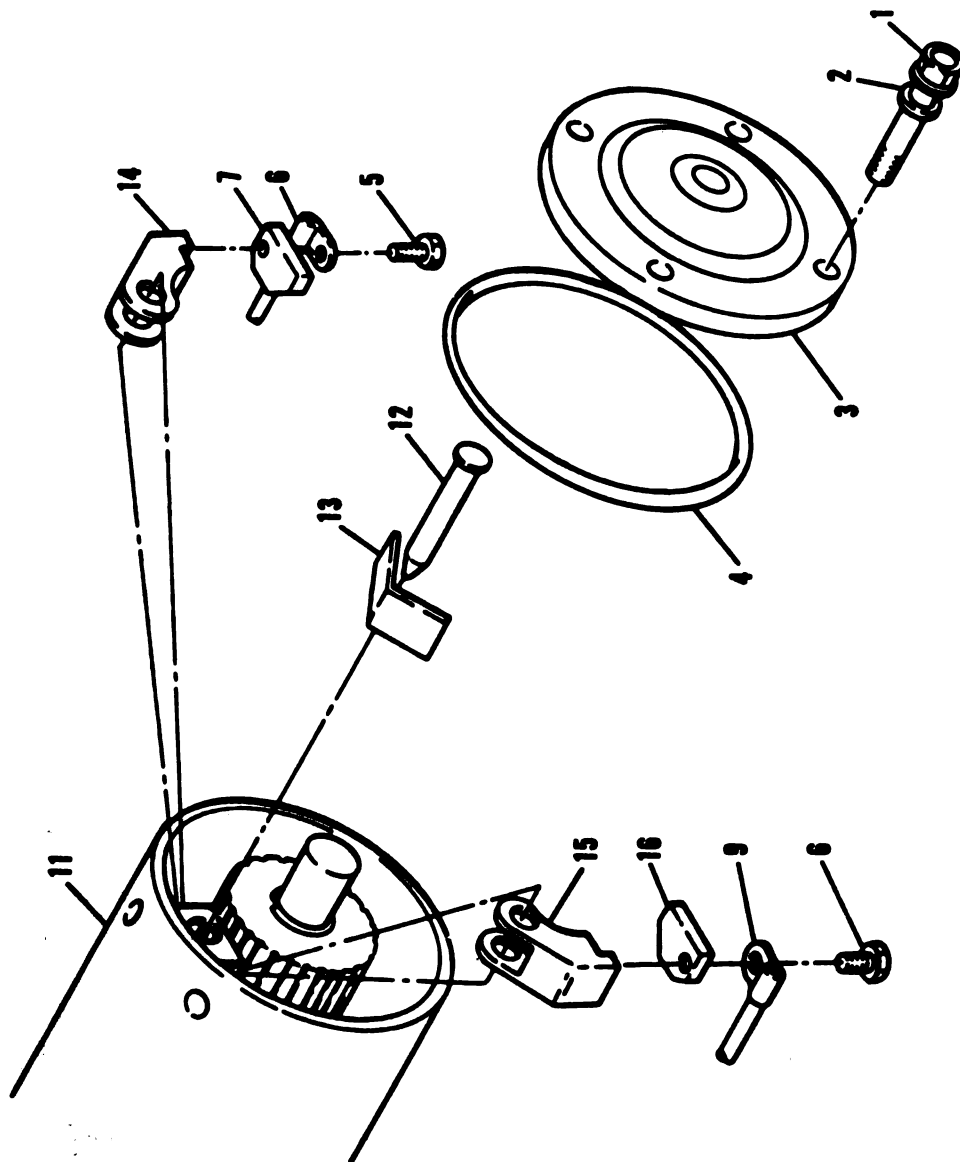


Figure 3-12A. Starter Assembly Removal

**NOTE**

Using prick punch, pin prick mark points of contact between the drive housing and shifter (lever) housing, and main housing and commutator end frame so that parts may be realigned accurately when reassembling. Refer to fig. 3-12A.



- 1. Screw
- 2. Lockwasher
- 3. Commutator end frame
- 4. O-ring
- 5. Screw
- 6. Electrical lead
- 7. Brush
- 8. Screw
- 9. Electrical lead
- 10. Brush
- 11. Starter assy
- 12. Brushholder pin
- 13. Brushholder spring
- 14. Brushholder
- 15. Brushholder

Figure 3-12B. Starter Brushes Replacement (effective with serial no. KZ00001 through KZ01226 and RZ00001 and up)

c. Repair

(1) Brush replacement.

**NOTE**

It is not necessary to remove the starter assembly from the engine to replace the brushes.

- (a) Remove screws (1, figure 3-12B) and lockwashers (2).
- (b) Carefully remove commutator end frame (3) and o-ring (4).
- (c) Remove screws (5 and 8) to remove electrical leads (6 and 9) and brushes (7 and 10).
- (d) Remove brushholder pin (12) to remove brushholder spring (13) and brushholders (14 and 15) from brush support.
- (e) Clean commutator end frame, brush support, brushholders, and brushholder springs in an approved solvent and dry thoroughly.
- (f) Measure brush length. Replace brushes if length is 3/8 inch or less.

**CAUTION**

Use extreme care to avoid enlarging commutator slots.

- (g) Inspect starter armature commutator slots for thrown solder. Remove any found with a narrow blunt instrument.
- (h) Check bronze bushing in commutator end frame and armature shaft for deep wear patterns, scoring, or other damage. Replace starter assembly if damage exists.
- (i) Check brushholders and brush support for corrosion, cracks, breaks, and other damage. Replace any defective parts.
- (j) Inspect electrical leads and visible starter assembly wiring for burned insulation, bare wires and rub marks. Replace starter assembly if damage is present.
- (k) Check all attaching hardware for stripped, crossed or otherwise damaged threads. Replace any damaged or defective parts.
- (l) Install brushholders (14 and 15) and spring (13) and secure with pin (12).
- (m) Install brushes (7 and 10) and electrical leads (6 and 9) and secure with screws (5 and 8).

**CAUTION**

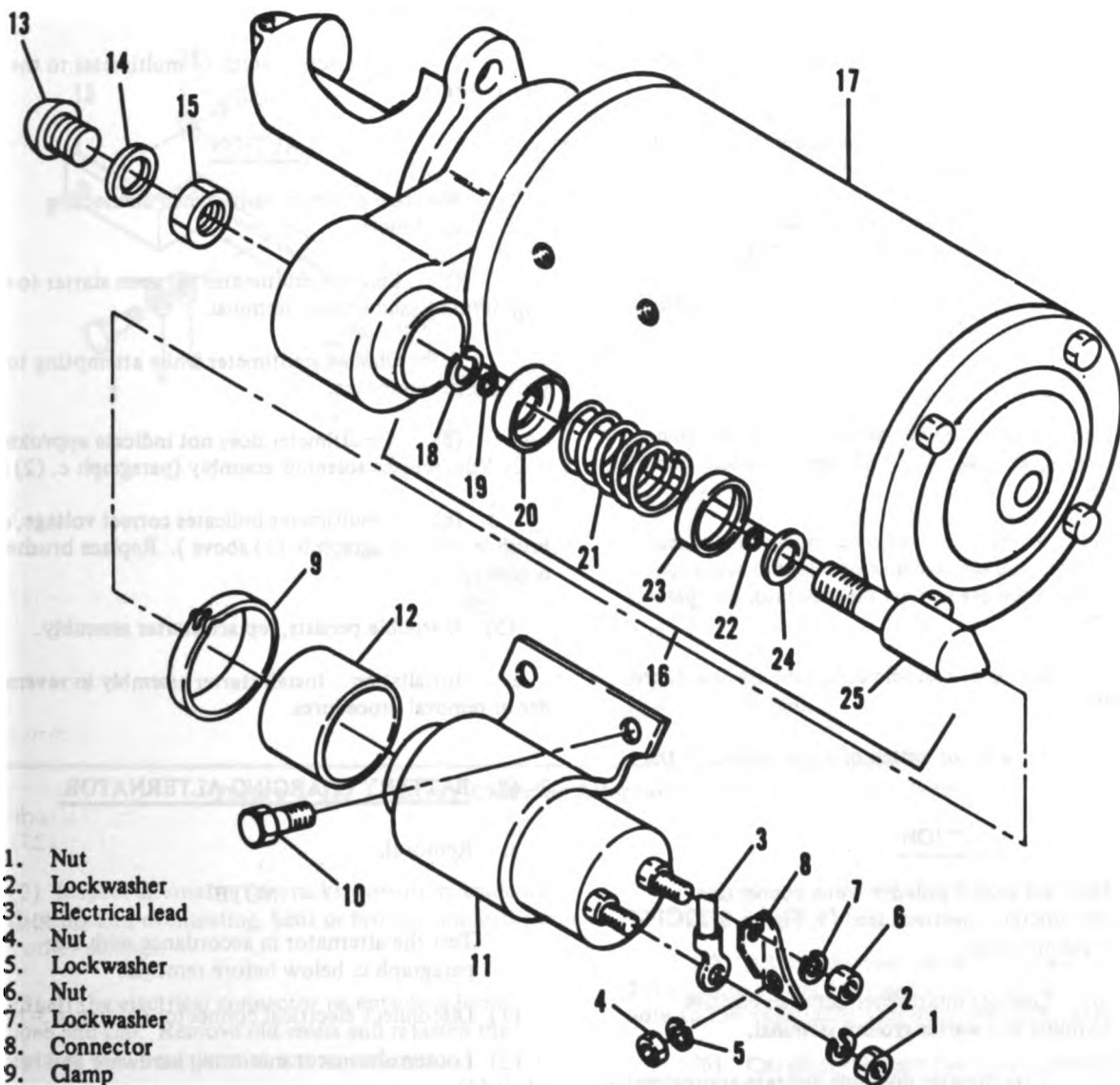
Use care when installing end frame to avoid damaging the bronze armature shaft bushing.

- (n) Install commutator end frame (3) and o-ring (4) and secure with lockwashers (2) and screws (1).
- (2) Solenoid replacement.

**NOTE**

It is not necessary to remove the starter assembly from the generator set to replace the solenoid assembly.

- (a) Remove nut (1, figure 3-12C) and lockwasher (2) to disconnect electrical lead (3).
- (b) Remove nut (4), lockwasher (5), nut (6), lockwasher (7) and connector (8).
- (c) Loosen clamp (9) and remove screws (10) to remove solenoid assembly (11). Remove boot (12).
- (d) Remove inspection plug (13) and gasket (14).
- (e) Remove adjusting nut (15) and remove plunger assembly (16) from starter assembly (17).
- (f) Remove snap ring (18), o-ring (19), spring retainer (20), spring (21), o-ring (22), spring retainer (23), and washer (24) from plunger (25).
- (g) Clean solenoid frame assembly with filtered compressed air and a soft bristle brush.
- (h) Using an ohmmeter, check for continuity between solenoid frame assembly terminals. Replace entire solenoid assembly if discontinuity is noted.
- (i) Clean all other parts in an approved solvent and dry thoroughly.
- (j) Inspect plunger for cracks, corrosion, and other damage.
- (k) Inspect seal for damage and deterioration.
- (l) Inspect spring for cracks, breaks, & distortion.
- (m) Replace any defective parts.
- (n) Install washer (24), spring retainer (23), o-ring (22), spring (21), spring retainer (20), and o-ring (19) onto plunger (25) and secure with snap ring (18).
- (o) Install plunger assembly (16) into lever housing.



1. Nut
2. Lockwasher
3. Electrical lead
4. Nut
5. Lockwasher
6. Nut
7. Lockwasher
8. Connector
9. Clamp
10. Screw
11. Solenoid frame assembly
12. Boot
13. Inspection plug
14. Gasket
15. Adjusting nut
16. Plunger assembly
17. Starter assembly
18. Snap ring
19. O-ring
20. Spring retainer
21. Spring
22. O-ring
23. Spring retainer
24. Washer
25. Plunger

**Figure 3-12C. Starter Solenoid Replacement (effective with serial no, KZ00001 through KZ01226 and RZ60001 and up)**

(p) Install adjusting nut (15) and install gasket (14) and inspection plug (13).

(q) Install boot (12) and clamp (9) onto lever, housing.

(r) Install solenoid frame assembly (11) and screws (10). Tighten clamp (9).

(s) Install connector (8) and secure with lockwasher (5), nut (4), lockwasher (7) and nut (6).

(t) Install electrical lead (3) and secure with lockwasher (2) and nut (1).

d. Testing.

(1) Check specific gravity of batteries to determine state of charge (paragraph 3-65). Charge or replace batteries if necessary.

(2) Open the right side engine compartment access door. Listen for audible evidence of solenoid actuation while someone attempts to start the generator set (paragraph 2-10).

(3) If no sounds of solenoid actuation are heard, proceed as follows:

(a) Set selector switch of a multimeter to the 50 Vdc position.

**CAUTION**

Maintain proper polarity when connecting multimeter. Electrical lead (3, Figure 3-12C) is positive lead.

(b) Connect multimeter between positive solenoid terminal and starter ground terminal.

(c) If multimeter does not indicate approximately 24 Vdc, trouble is in wiring and not the solenoid.

**CAUTION**

Always disconnect negative (ground) cable first.

(d) If multimeter indicates approximately 24 Vdc, disconnect leads from starter.

(e) Using multimeter as an ohmmeter, check for indication of open circuit across solenoid terminals.

(f) If multimeter indicates open circuit, replace solenoid (subparagraph c.(2) above).

(g) If multimeter indicates continuity, reconnect electrical leads.

(4) If solenoid actuates, but starter will not rotate engine, proceed as follows:

(a) Set selector switch of multimeter to the 50 Vdc position.

**CAUTION**

Maintain proper polarity when connecting multimeter.

(b) Connect multimeter between starter-to-solenoid terminal and ground terminal.

(c) Observe multimeter while attempting to start the generator set.

(d) If multimeter does not indicate approximately 24 Vdc, replace solenoid assembly (paragraph c. (2) above).

(e) If multimeter indicates correct voltage, check brush length (paragraph b. (1) above). Replace brushes if necessary.

(5) If trouble persists, replace starter assembly.

e. Installation. Install starter assembly in reverse order of removal procedures.

**3-68. BATTERY CHARGING ALTERNATOR.**

a. Removal.

**NOTE**

Test the alternator in accordance with subparagraph c. below before removal.

(1) Disconnect electrical connector (1, figure 3-13).

(2) Loosen alternator mounting hardware and remove v-belt (2).

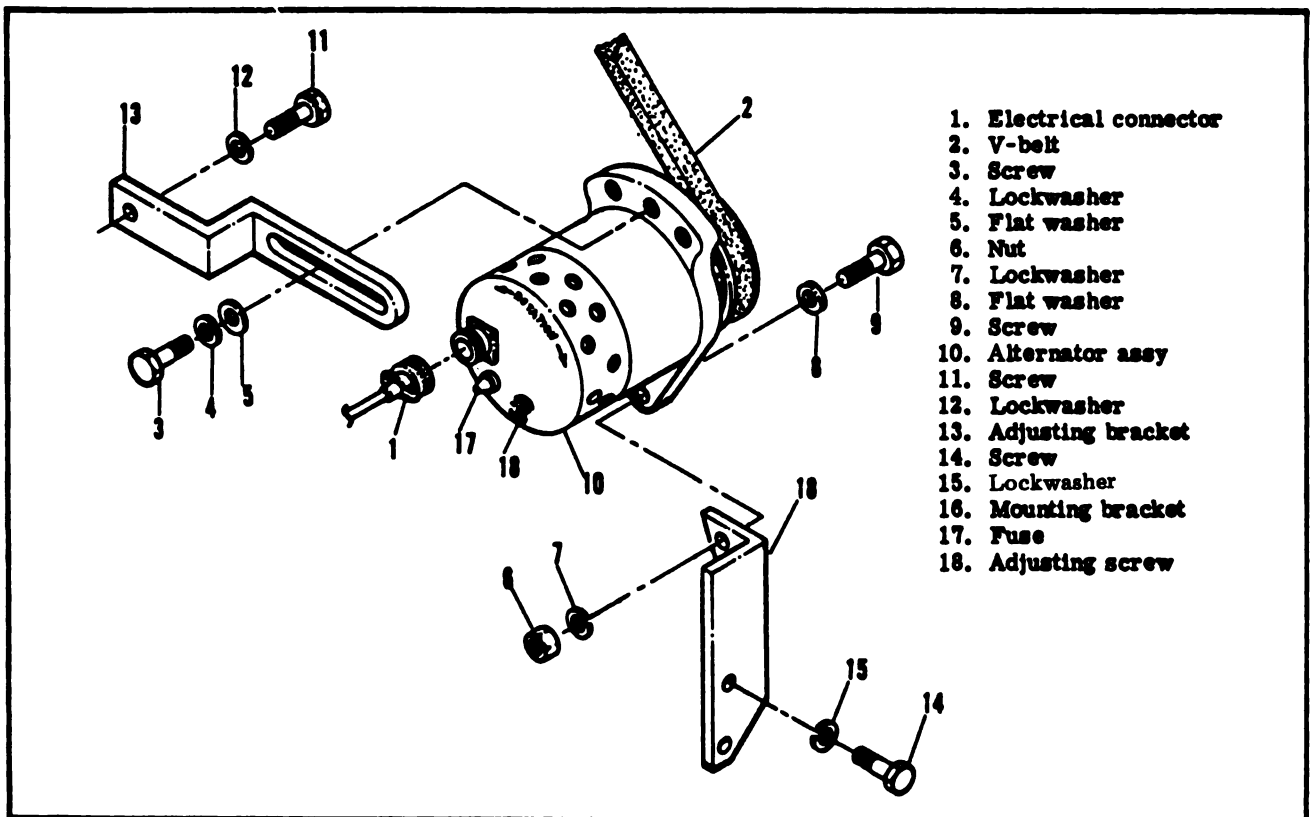
(3) Remove screw (3), lockwasher (4), and flat washer (5).

(4) Remove nut (6), lockwasher (7), flat washer (8) and screw (9) to remove alternator assembly (10).

(5) Do not remove screws (11 and 14), lockwashers (12 and 15), adjusting bracket (13) and mounting bracket (16) unless inspection reveals damage.

b. Cleaning and Inspection.

(1) Clean alternator with dry, filtered, compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.



1. Electrical connector
2. V-belt
3. Screw
4. Lockwasher
5. Flat washer
6. Nut
7. Lockwasher
8. Flat washer
9. Screw
10. Alternator assy
11. Screw
12. Lockwasher
13. Adjusting bracket
14. Screw
15. Lockwasher
16. Mounting bracket
17. Fuse
18. Adjusting screw

**Figure 3-13. Battery Charging Alternator Removal and Installation**

(2) Inspect alternator for cracks, corrosion, evidence of shorting and overheating, bent or broken connector pins and other damage.

(3) If the electrical connector receptacle is loose, remove end cap. Remove old rivets and refasten the receptacle with new rivets or screws and nuts.

**c. Testing and Adjustment.**

(1) Remove four screws attaching the rear cover plate to the alternator.

(2) Carefully pull the cover plate away from the alternator assembly.

(3) Fabricate two test leads as follows:

(a) Cut two pieces of No. 8 or No. 10 insulated wire; one 5 inches long and the other 10 inches long.

(b) Strip both ends of each wire and tin with solder (Federal Specification QQ-S-571).

(c) Attach a No. 10 ring terminal to one end of the 10 inch test lead.

(d) Attach a No. 10 ring terminal to one end of the 5 inch wire.

(4) Attach the test leads as shown in figure 3-14 and pass the free end of each lead through a hole in the ventilated shield of the alternator housing.

(5) Carefully install the rear cover plate and secure with screws.

(6) If alternator is still installed in the generator set, connect wiring harness connector to the alternator.

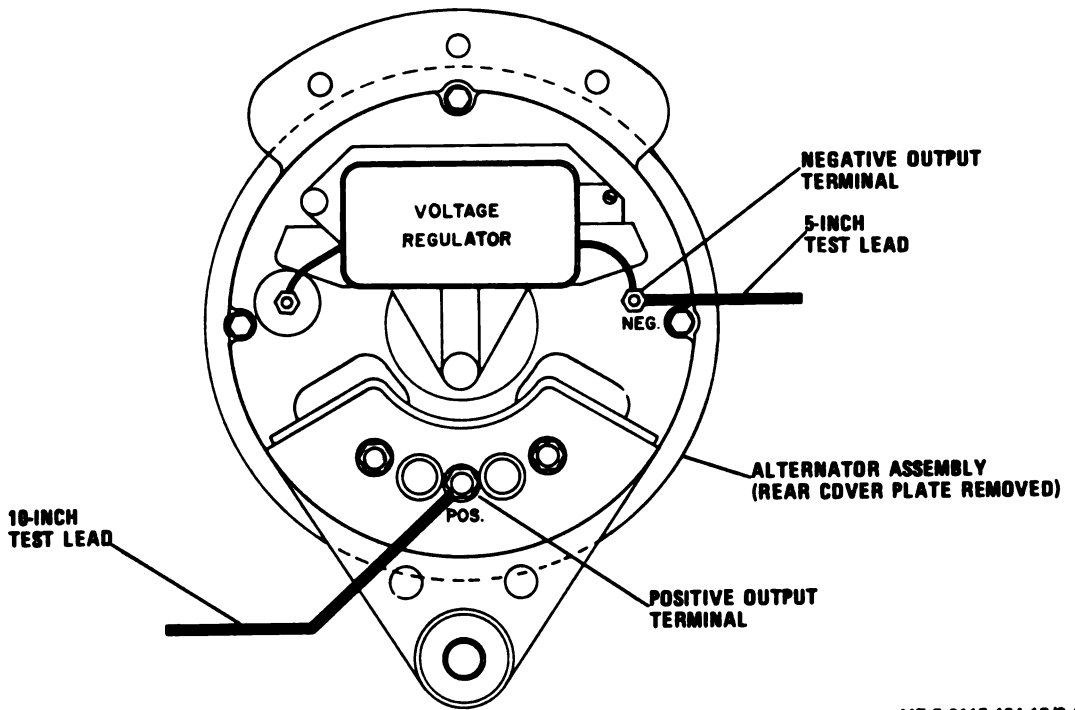
(7) If alternator has been removed, install it in test setup as shown in figure 3-15 and provide a means of rotation at approximately 2500 rpm.

(8) Place multimeter selector in the 50 Vdc position.

(9) Operate alternator at the required rpm and note the reading on the multimeter.

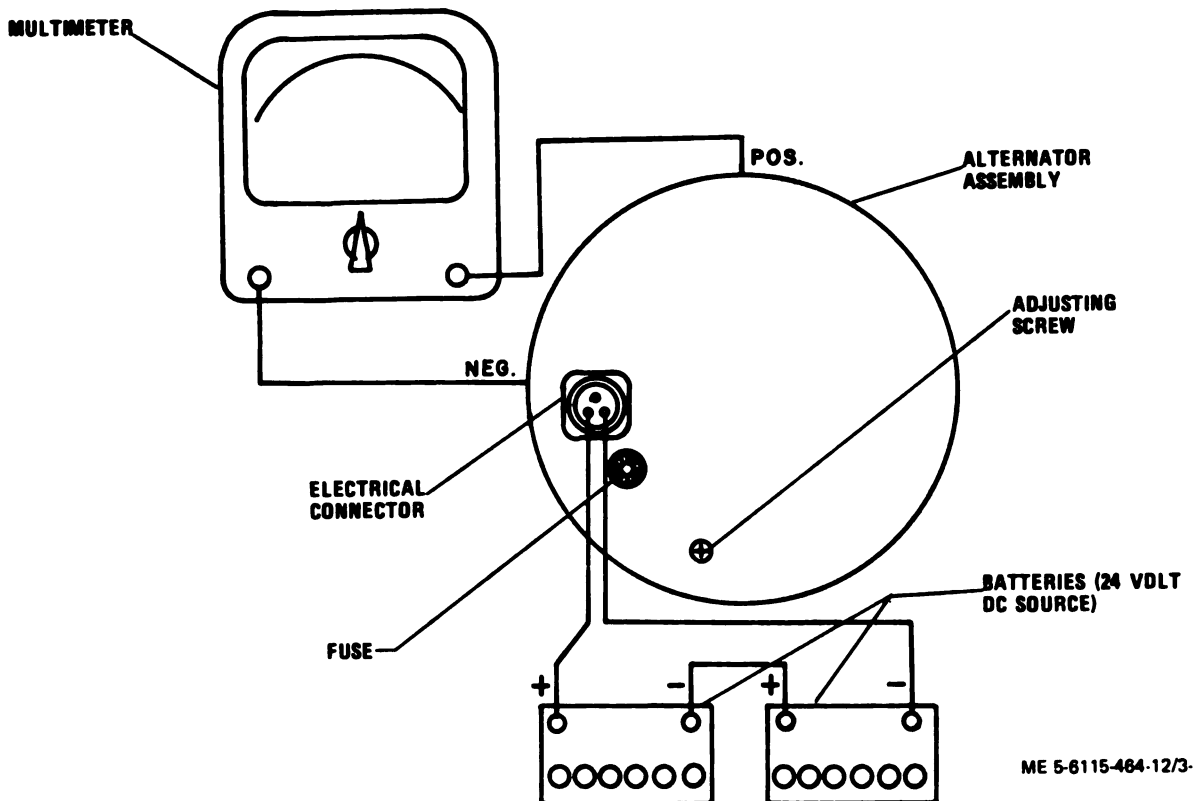
(10) If multimeter reading is not in accordance with table 3-5, rotate adjusting screw to obtain proper reading.





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Figure 3-14. Alternator Test Leads Attachment



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Figure 3-15. Alternator Test Circuit



Table 3-5. Alternator Voltages at Ambient Temperature

Ambient Temperature	DC Voltage Minimum - Maximum
0° (-18°)	29.20 - 30.12
20° (-6.6°)	28.86 - 29.73
40° (4.5°)	28.64 - 29.36
60° (15.5°)	28.32 - 28.98
80° (26.6°)	28.00 - 28.60
100° (38°)	27.68 - 28.32
120° (49°)	27.32 - 28.04

**NOTE**

Rotating adjusting screw clockwise increases voltage output. Rotating adjusting screw counterclockwise decreases output.

(11) If proper voltage cannot be obtained with adjusting screw, replace alternator.

d. Installation. Install battery charging alternator in reverse order of removal procedures.

**3-69. SPEED SWITCH.**

**NOTE**

Test speed switch in accordance with paragraph c. below before removal.

**a. Removal.**

(1) Remove wiring harness connector from speed switch connector (figure 1-2).

(2) Use 1-1/8 inch wrench to loosen and remove the speed switch.

**b. Cleaning and Inspection.**

(1) Clean speed switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Inspect speed switch for cracked casing, corrosion, bent or broken connector pins and stripped or damaged threads.

c. Testing. Replace the speed switch, if any of the following continuity or discontinuity checks are not verified.

(1) Continuity between connector pins A and B and between pins G and H.

(2) Discontinuity between pins A and C, between D and E and between F and J.

d. Installation. Install speed switch in reverse order of removal procedures.

**3-70. COOLANT TEMPERATURE TRANSMITTER.**

**a. Removal.**

**NOTE**

Test coolant temperature transmitter in accordance with paragraph c. below prior to removal. Coolant temperature transmitter is located on the engine thermostat housing.

(1) Refer to paragraph 3-31 and drain coolant from the radiator.

(2) Unscrew the wiring connector from the temperature transmitter.

(3) Unscrew the temperature transmitter from the thermostat housing.

**b. Cleaning and Inspection.**

(1) Clean temperature transmitter with filtered compressed air and a soft bristle brush or with a clean lint-free cloth lightly moistened with an approved solvent.

(2) Inspect temperature transmitter for cracked casing, corrosion and damaged threads and connector.

**c. Testing.**

(1) Disconnect wiring harness connector from coolant temperature transmitter.

(2) Connect an ohmmeter or similar device between the connector and casing.

(3) Refer to paragraph 2-10 and start the engine.

(4) Allow the engine to operate while observing the ohmmeter.

(5) Resistance should increase to a reading of 680 to 745 ohms when the engine reaches normal operating temperature.

(6) Refer to paragraph 2-11 and stop the engine.

(7) Replace coolant temperature transmitter if resistance is not within specified limits.

*d. Installation.*

- (1) Install temperature transmitter into thermostat housing spacer and tighten to 12-15 lbs-ft torque.
- (2) Refer to paragraph 3-31 and service the radiator.

### 3-71. Over-Temperature Switch

*a. Removal.*

- (1) Refer to paragraph 3-31 and drain the coolant from the radiator.
- (2) Unscrew wiring connector from the over-temperature switch connector.

**NOTE**

The over-temperature switch is located on the left rear side of the engine cylinder head assembly.

- (3) Unscrew over-temperature switch from cylinder head assembly.

*b. Cleaning and Inspection.*

- (1) Clean over-temperature switch with filtered compressed air and a soft bristle brush or with a clean, lint-free cloth lightly moistened with an approved solvent.
- (2) Inspect over-temperature switch for cracked casing, corrosion, stripped or damaged threads, and bent or broken connector pins.

*c. Testing.*

- (1) Suspend over-temperature switch in a container of clean oil so that sensing element is completely immersed but not touching the sides or bottom of the container.
- (2) Suspend a reliable thermometer in the container. Do not allow the end of the thermometer to rest on the bottom of the container.
- (3) Using an ohmmeter, check continuity between pins A and D (figures FO-1 and FO-2) and between pins B and C of the switch connector. A and D should indicate continuity and B and C should indicate discontinuity.
- (4) Attach the ohmmeter leads to pins A and D.

**WARNING**

Do not exceed 250°F. (121.1°C.) as oil may ignite.

- (5) Gradually heat the oil, stirring so that heat will be evenly distributed, and observe the thermometer and ohmmeter.

- (6) At 220°F.  $\pm 3^\circ\text{F}$ . (104.8 + 1.5°C.) the ohmmeter should indicate discontinuity.

- (7) Check continuity between pins B and C. Ohmmeter should indicate continuity.

- (8) Replace the over-temperature switch if it fails to operate within the above limits.

*d. Installation.*

- (1) Install overtemperature switch into cylinder block and tighten to 12 to 15 lbs-ft torque.
- (2) Refer to paragraph 3-31 and service radiator.

### 3-72. Oil Pressure Transmitter

(fig. 1-2)

*a. Removal.*

**NOTE**

Test oil pressure transmitter in accordance with paragraph c. below prior to removal.

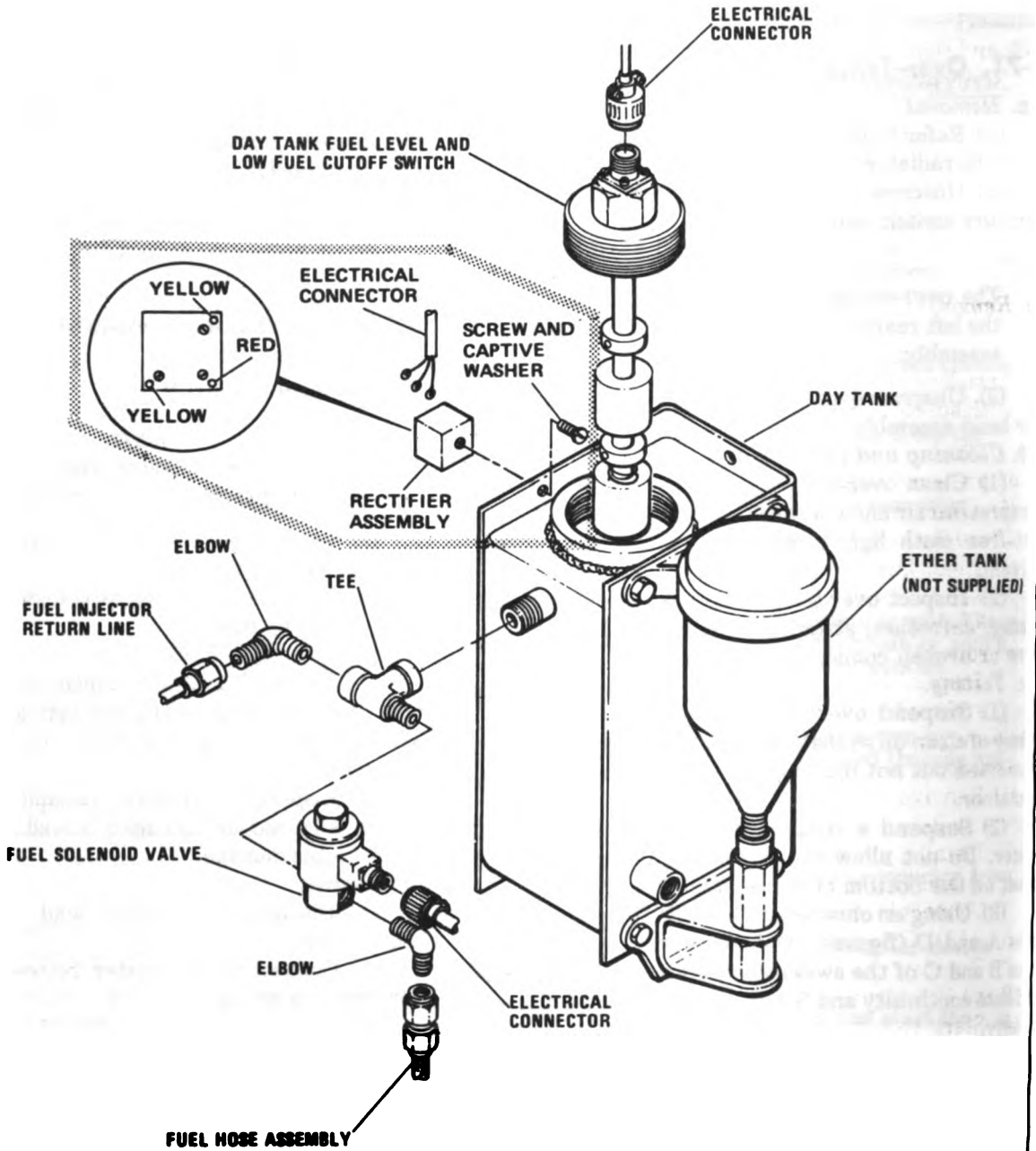
- (1) Remove nut, washer, and electrical lead from oil pressure transmitter.
- (2) Unscrew oil pressure transmitter from coupling in engine block.

*b. Cleaning and Inspection.*

- (1) Clean oil pressure transmitter with dry, filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.
- (2) Inspect oil pressure transmitter for cracked casing, stripped or damaged threads, corrosion, or other visible damage.

*c. Testing.*

- (1) Disconnect electrical lead to oil pressure transmitter.
- (2) Connect an ohmmeter between transmitter terminal and casing.
- (3) Refer to paragraph 2-10 and start the engine.
- (4) Allow the engine to operate until normal operating temperature is indicated on the temperature gauge.
- (5) Observe ohmmeter. Resistance shall be as specified in paragraph 1-6b(4).



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Figure 3-16. Day Tank Fuel Level, Low Fuel Cutoff Switch, Fuel Solenoid Valve and Rectifier Assembly, Removal and Installation

- (6) Refer to paragraph 2-11 and stop the engine.
- (7) Replace oil pressure transmitter if the above resistance requirements are not met.

*d. Installation.*

- (1) Screw oil pressure into coupling in engine block and tighten to 20 lbs-ft torque.
- (2) Install electrical lead and secure with washer and nut.

- (8) Stop the generator set (para 2-11) and return the BATTLE SHORT switch to the OFF position.

- (9) If switch meets continuity requirements, install wiring harness connector.

- (10) If switch fails to meet continuity requirements, replace.

*d. Installation.*

- (1) Install low oil pressure switch into block adapter and tighten to 20 lbs-ft torque.
- (2) Install electrical connectors.

### 3-73. Low Oil Pressure Switch

*a. Removal.*

**NOTE**

Test low oil pressure switch in accordance with subparagraph c. below before removal.

- (1) Tag and disconnect electrical connectors from low oil pressure switch (fig. 1-2).

- (2) Unscrew switch from block adapter.

*b. Cleaning and Inspection.*

- (1) Clean low oil pressure switch with dry, filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

- (2) Inspect low oil pressure switch for cracked casing, stripped or damaged threads, corrosion, or other damage.

*c. Testing.*

- (1) Remove wiring harness connector from low pressure switch.

- (2) Install a jumper across wiring harness connector pins A and B (figures FO-1 and FO-2).

- (3) Connect an ohmmeter across switch connector pins A and D. Ohmmeter shall indicate open circuit.

- (4) Connect ohmmeter across switch connector pins B and C. Ohmmeter shall indicate continuity.

- (5) Start the generator set (para 2-10). Place BATTLE SHORT switch in the ON position before releasing START-RUN-STOP switch.

- (6) Check that ohmmeter indicates open circuit.

- (7) Connect ohmmeter across pins A and D. Ohmmeter shall indicate continuity.

**NOTE**

Test day tank fuel level and low fuel cutoff switch in accordance with paragraph c. below prior to removal.

*a. Removal.*

- (1) Disconnect electrical connector (fig. 3-16).

- (2) Unscrew fuel level and low fuel cutoff switch from day tank.

*b. Cleaning and Inspection.*

- (1) Clean day tank fuel level and low fuel cutoff switch with filtered compressed air and a soft bristle brush or wipe with a clean lint-free cloth lightly moistened with an approved solvent.

- (2) Inspect switch for cracked casing, corrosion, damaged floats, stripped or damaged threads and bent or broken connector pins.

*c. Testing.*

- (1) Open the drain on the bottom of the day tank and allow the fuel to drain into a suitable container.

- (2) Disconnect electrical connector from day tank fuel level and low fuel cutoff switch.

- (3) Using an ohmmeter, check for continuity between switch connector pins A and B and between pins C and D. Continuity should exist indicating switches are closed.

- (4) Connect fuel solenoid connector and float switch connector.

- (5) Place START-RUN-STOP switch (32, fig. 2-7) in RUN position and BATTLE SHORT switch in ON position.

### 3-74. Day Tank Fuel Level and Low Fuel Cutoff Switch

(6) When fuel transfer pumps have refilled day tank, return both switches to the original position.

(7) Disconnect fuel solenoid connector and float switch connector.

(8) Check for open circuit between pins A and B and between pins C and D.

(9) Replace switch if the above continuity requirements are not met.

*d. Installation.* Install day tank fuel level and low fuel cutoff switch in reverse order of removal procedures.

### 3-75. Fuel Solenoid Valve and Rectifier Assembly

#### *a. Removal.*

#### **NOTE**

Test fuel solenoid valve in accordance with paragraph c. below before removal.

(1) Disconnect fuel supply hose, electrical connector and injector return line (fig. 3-16).

(2) Unscrew tee from day tank assembly.

(3) Remove elbows and tee from fuel solenoid valve.

(4) Disconnect electrical connector from rectifier assembly.

(5) Remove screw and captive washer and remove rectifier assembly.

#### *b. Cleaning and Inspection.*

(1) Clean solenoid valve with dry, filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Clean rectifier assembly with a clean, lint-free cloth.

(3) Inspect solenoid valve for cracks, corrosion, stripped or damaged threads, bent or broken connector pins and evidence of shorting or other damage.

(4) Inspect rectifier assembly for cracks, corrosion, stripped or damaged threads, and evidence of shorting or other defects.

#### *c. Testing.*

(1) Open drain on bottom of day tank and allow fuel to drain into a suitable container.

(2) Place START-RUN-STOP switch in RUN position and BATTLE SHORT switch in ON position (32, fig. 2-7).

(3) If day tank does not refill, check that fuel transfer pumps and day tank fuel level and low fuel cutoff switch and interconnecting wire harnesses are operational.

(4) If fuel transfer pumps and day tank fuel level and low fuel cutoff switch are operational, fuel solenoid valve is defective and must be replaced.

(5) Check the diodes in the rectifier assembly by placing the positive lead of an ohmmeter on the red coded terminal and the negative lead on one of the yellow coded terminals (fig. 3-16). The ohmmeter should indicate a low resistance.

(6) Reverse the ohmmeter leads. The ohmmeter should read a high resistance (not infinity).

(7) Perform the checks in paragraphs (5) and (6) above using the opposite yellow coded terminal.

*d. Installation.* Install the fuel solenoid valve and rectifier assembly in reverse order of removal procedures.

### 3-76. Engine Wiring Harness Assembly

*a. Removal.* Prior to removal, tag or otherwise identify electrical terminals, connectors, and wiring and location of support clamps to facilitate installation. Remove wiring harness terminals, wires, and connectors as required for access to other components and to replace damaged parts.

#### *b. Cleaning and Inspection.*

(1) Clean engine wiring harness with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth moistened with an approved solvent.

(2) Visually inspect wiring harness for burned, bent, corroded or otherwise damaged connectors and terminals.

(3) Inspect insulation for burns, chafing, and deterioration.

*c. Testing.* Check continuity of individual wires using a multimeter or continuity light. Refer to figures FO-1 and FO-2 for wire routing.

#### **NOTE**

If more than 30 percent of the wires are damaged, or have been repaired, replace the wiring harness and forward it to higher level maintenance for rebuilding.

#### **CAUTION**

Do not use acid core solder on electrical components.

*d. Repair.* Replace damaged wire, terminals, and connectors by unsoldering connections, installing replacement parts and soldering connections.

*e. Installation.* Install wiring harness terminals, electrical leads, and connectors in reverse order of removal procedures.

## Section IX. ORGANIZATIONAL MAINTENANCE OF THE ENGINE FUEL SYSTEM

### 3-77. GENERAL.

This section contains organizational maintenance instructions for the engine fuel system. Fuel is stored in the main fuel tank located in the generator set skid base. Two electrically driven pumps which are controlled by the day tank fuel level and low fuel cutoff switch transfer the fuel from the fuel tank to the day tank. Before entering the day tank, the fuel passes through the fuel strainer and primary fuel filter. From the day tank the fuel passes through the secondary fuel filter to the fuel injection pump. The fuel injection pump forces the fuel to the injectors in the cylinder head. Excess fuel is returned to the day tank through the fuel return line. The entire fuel system is vented through the main fuel tank filler cap.

### 3-78. FUEL TRANSFER PUMPS.

#### a. Removal.

#### NOTE

Test fuel transfer pumps in accordance with subparagraph d. below prior to removal.

- (1) Disconnect electrical leads at pump.
- (2) Disconnect fuel supply hose (1, figure 3-17) and remove elbow (2).
- (3) Disconnect fuel discharge hose (3) and remove elbow (4).
- (4) Remove tube assembly (5) and elbows (6 and 7).
- (5) Remove nuts (8), lockwashers (9), flat washers (10) and screws (11) to remove fuel transfer pumps (12).

#### b. Cleaning and Inspection.

- (1) Clean fuel transfer pumps with a clean, lint-free cloth moistened with an approved cloth.
- (2) Inspect fuel transfer pumps for cracked casing, corrosion, stripped threads or other damage.

#### c. Service.

- (1) Remove cover (13, figure 3-17) and gasket (14).
- (2) Carefully remove filter (15) from pump body (16).

(3) Wash filter in dry cleaning solvent (Federal Specification P-D-680).

(4) Inspect filter for tears or other damage. Replace if defective.

(5) Position filter in pump body; install gasket, and secure with cover.

#### d. Testing.

(1) Disconnect fuel line from fuel solenoid valve (paragraph 3-75) and position to drain into a suitable graduated container.

(2) Disconnect electrical connector from day tank fuel level and low fuel cutoff switch (paragraph 3-74).

(3) Place START-RUN-STOP switch in RUN position and BATTLE SHORT switch in ON position (32, figure 2-7).

(4) Fuel transfer pump should deliver 3 gallons of fuel in 10 minutes when operating properly.

(5) Replace fuel transfer pump if it fails to operate properly.

e. Installation. Install fuel transfer pumps in reverse order of removal procedures.

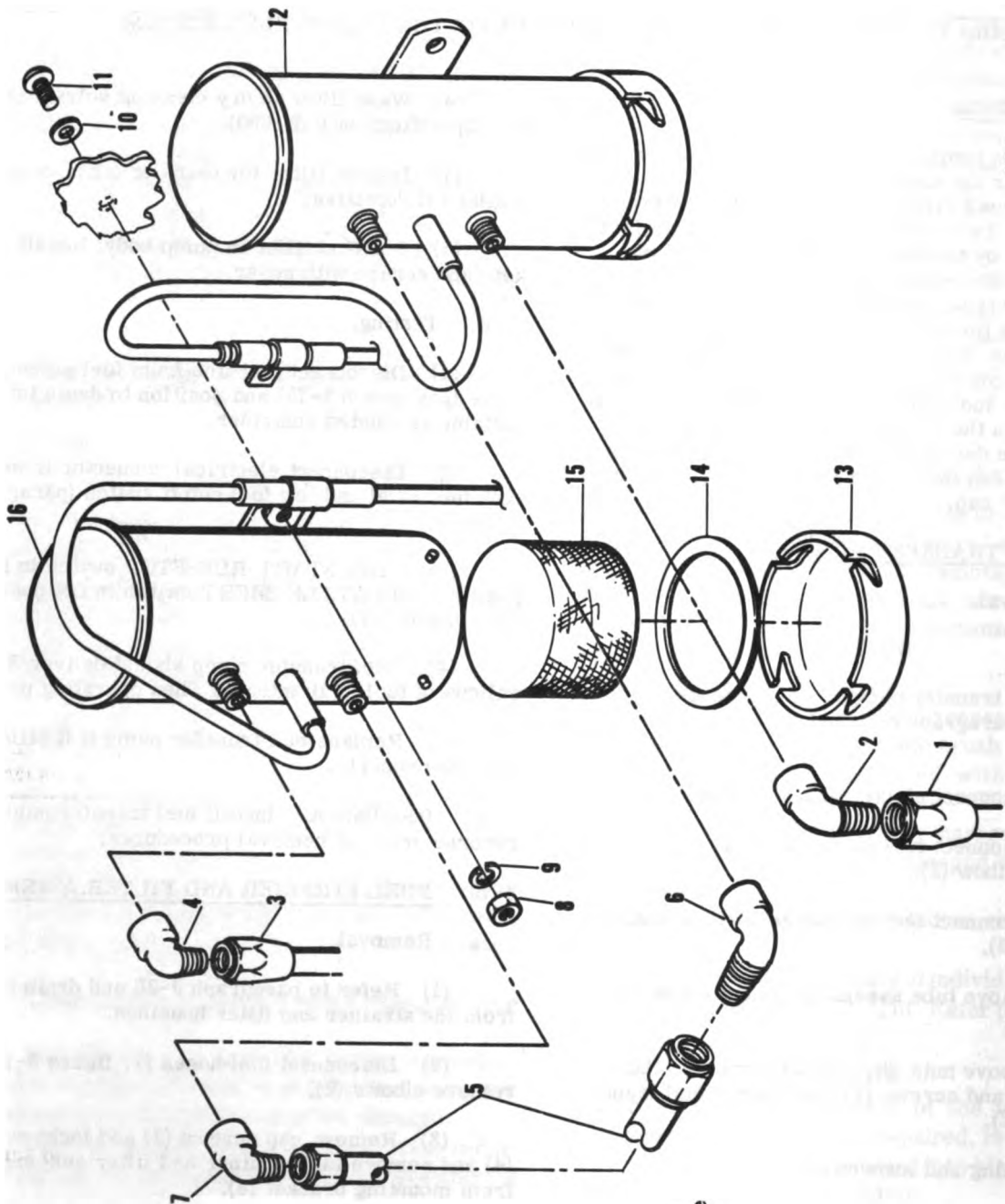
### 3-79. FUEL STRAINER AND FILTER ASSEMBLY.

#### a. Removal.

- (1) Refer to paragraph 3-26 and drain the fuel from the strainer and filter housings.
- (2) Disconnect fuel hoses (1, figure 3-18) and remove elbows (2).
- (3) Remove cap screws (3) and lockwashers (4) and remove fuel strainer and filter assembly (5) from mounting bracket (8).
- (4) Do not remove capscrews (6), lockwashers (7), mounting bracket (8) or gasket (9) unless inspection reveals damage.
- (5) Refer to paragraph 3-26 and disassemble fuel strainer and filter assembly.

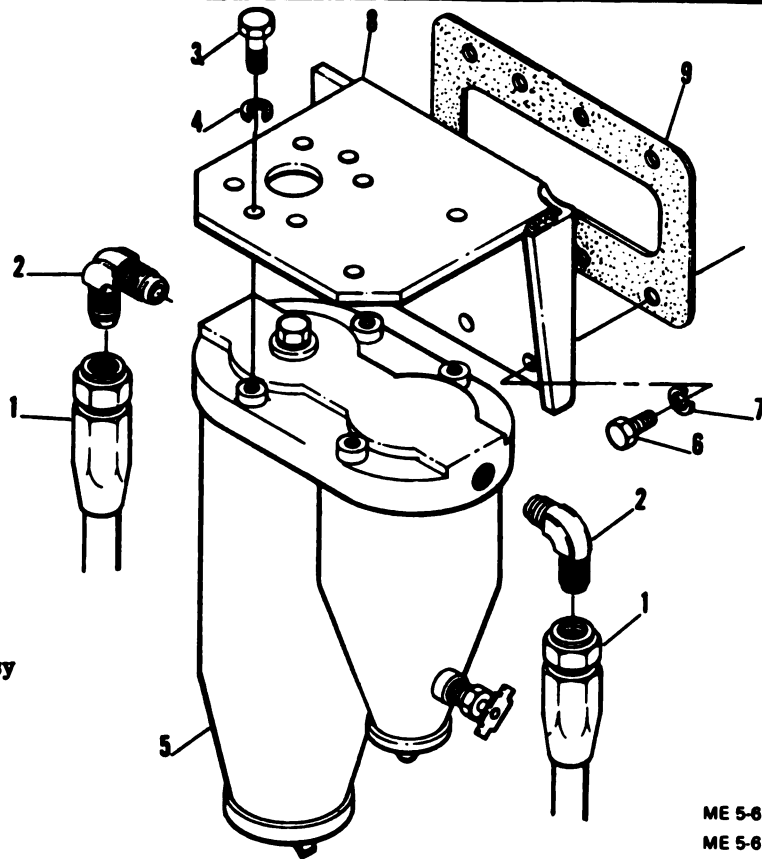
#### b. Cleaning and Inspection.

- (1) Clean fuel strainer and filter assembly and mounting bracket in an approved solvent and dry thoroughly.



- 1. Fuel supply hose
- 2. Elbow
- 3. Fuel discharge hose
- 4. Elbow
- 5. Tube assembly
- 6. Elbow
- 7. Elbow
- 8. Nut
- 9. Lockwasher
- 10. Flat washer
- 11. Screw
- 12. Fuel transfer pump
- 13. Cover
- 14. Gasket
- 15. Filter
- 16. Pump body

Figure 3-17. Fuel Transfer Pumps, Service and Replacement



1. Fuel hose assembly
2. Elbow
3. Capscrew
4. Lockwasher
5. Fuel strainer and filter assy
6. Capscrew
7. Lockwasher
8. Mounting bracket
9. Gasket

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Figure 3-18. Fuel Strainer and Filter Assembly, Removal and Installation

(2) Inspect fuel strainer and filter assembly and mounting bracket for cracks, corrosion, and other damage.

(3) Inspect all threaded parts for stripped or otherwise damaged threads.

(4) Replace any damaged or defective parts.

c. *Installation.* Install fuel strainer and filter assembly in reverse order of removal procedures.

### 3-80. Day Tank Assembly

#### a. *Removal.*

(1) Refer to paragraph 3-25 and drain the day tank.

(2) Refer to paragraph 3-75 and remove fuel solenoid valve and rectifier assembly.

(3) Refer to paragraph 3-74 and remove day tank fuel level and low fuel cutoff switch.

(4) Refer to paragraph 3-84 and remove starting aid ether tank and solenoid valve.

(5) Loosen spring clamp (1, fig. 3-19) and remove vent tube (2).

(6) Disconnect fuel hose assembly (3).

(7) Remove nuts (4), lockwashers (5) and screws (6) to remove day tank with assembly parts.

#### b. *Disassembly.*

(1) Remove fuel hose assembly adapter (7).

(2) Remove drain cock (8) from day tank (9).

#### c. *Cleaning and Inspection.*



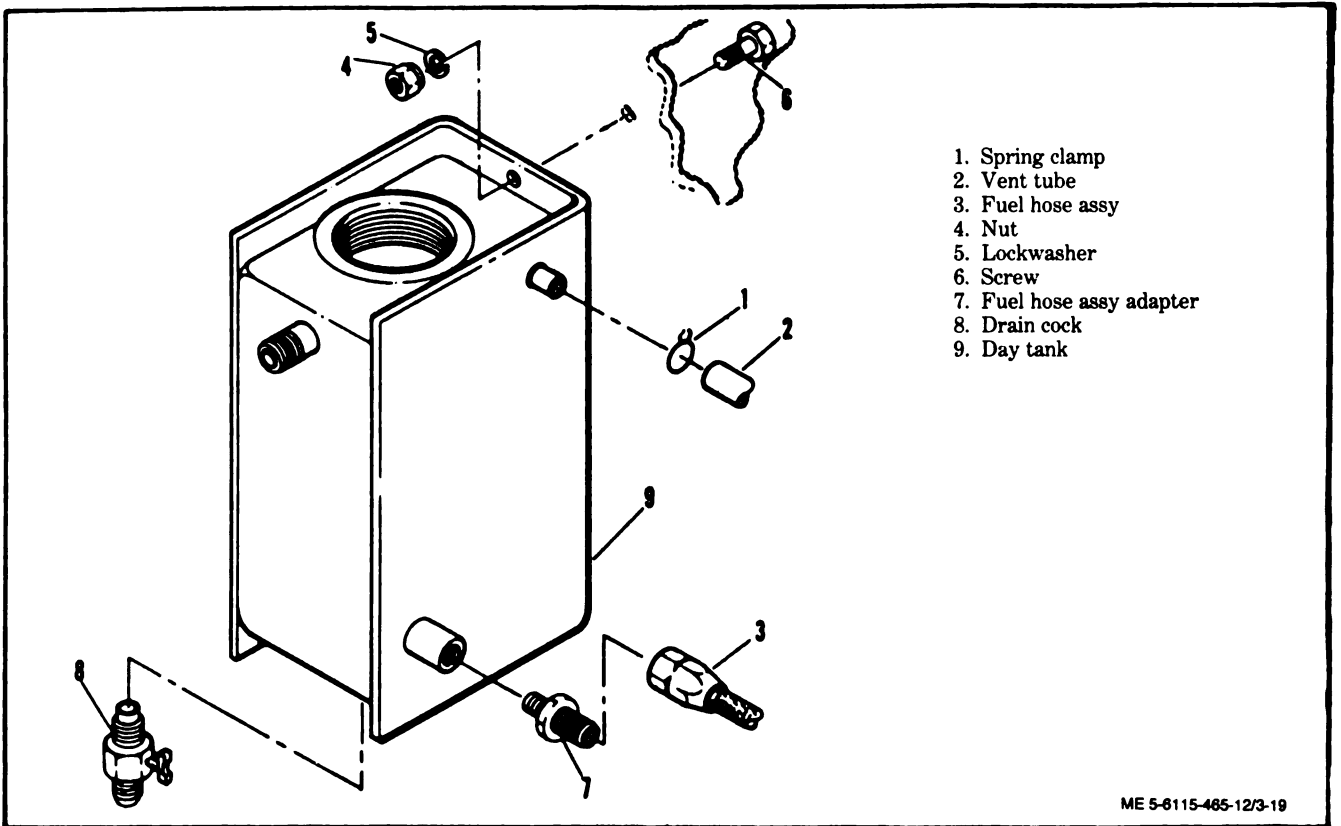


Figure 3-19. Day Tank Assembly, Removal and Installation

(1) Clean day tank with a clean, lint-free cloth moistened with an approved cleaning solvent.

(2) Inspect day tank for cracks, corrosion, stripped or damaged threads or other damage.

*d. Assembly.*

(1) Install drain cock (8).

(2) Install fuel hose assembly adapter (7).

*e. Installation.* Install day tank in reverse order of removal procedures.

**3-81. Secondary Fuel Filter**

*a. Removal.*

(1) Drain day tank assembly (para 3-25).

(2) Open drain cock (1, fig. 3-20) and allow fuel to drain into a suitable container.

(3) Disconnect fuel hose assemblies (2 and 3).

(4) Remove cap screws (4) and lockwashers (5) to remove secondary fuel filter (6).

(5) Remove elbows (7).

(6) Do not remove cap screws (8), lockwashers (9), mounting bracket (10) and gasket (11) unless replacement is necessary.

(7) Refer to paragraph 3-43 and disassemble fuel filter assembly.

*b. Cleaning and Inspection.*

(1) Clean fuel filter assembly parts and mounting bracket in an approved solvent and dry thoroughly.

(2) Inspect filter head and casing for cracks, corrosion and other damage.

(3) Inspect mounting bracket for cracks, corrosion, and cracked or broken welds.

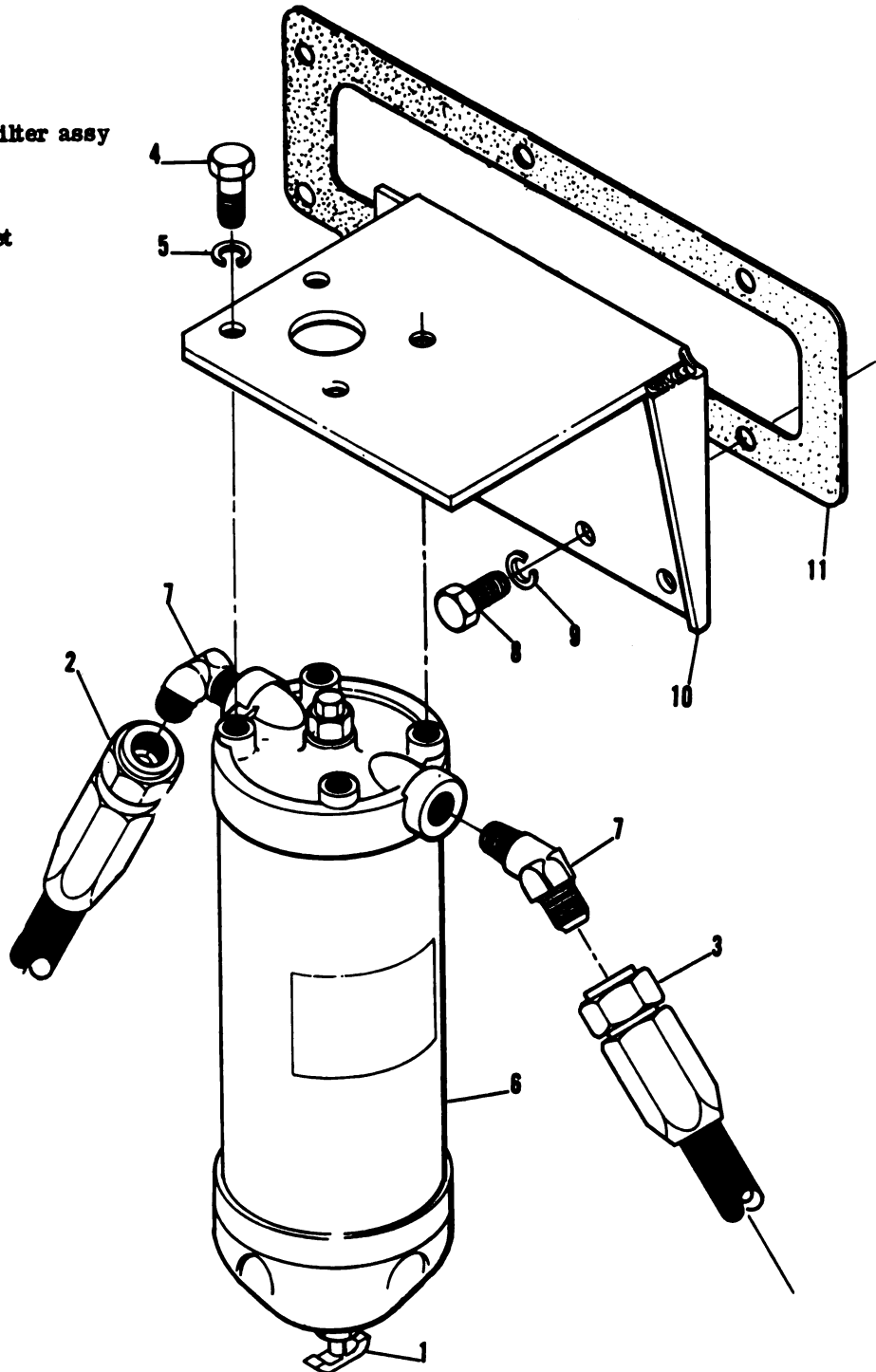
(4) Replace any defective parts.

**CAUTION**

Remove old filter gasket before installing new gasket. Failure to do so could result in cracking head assembly.

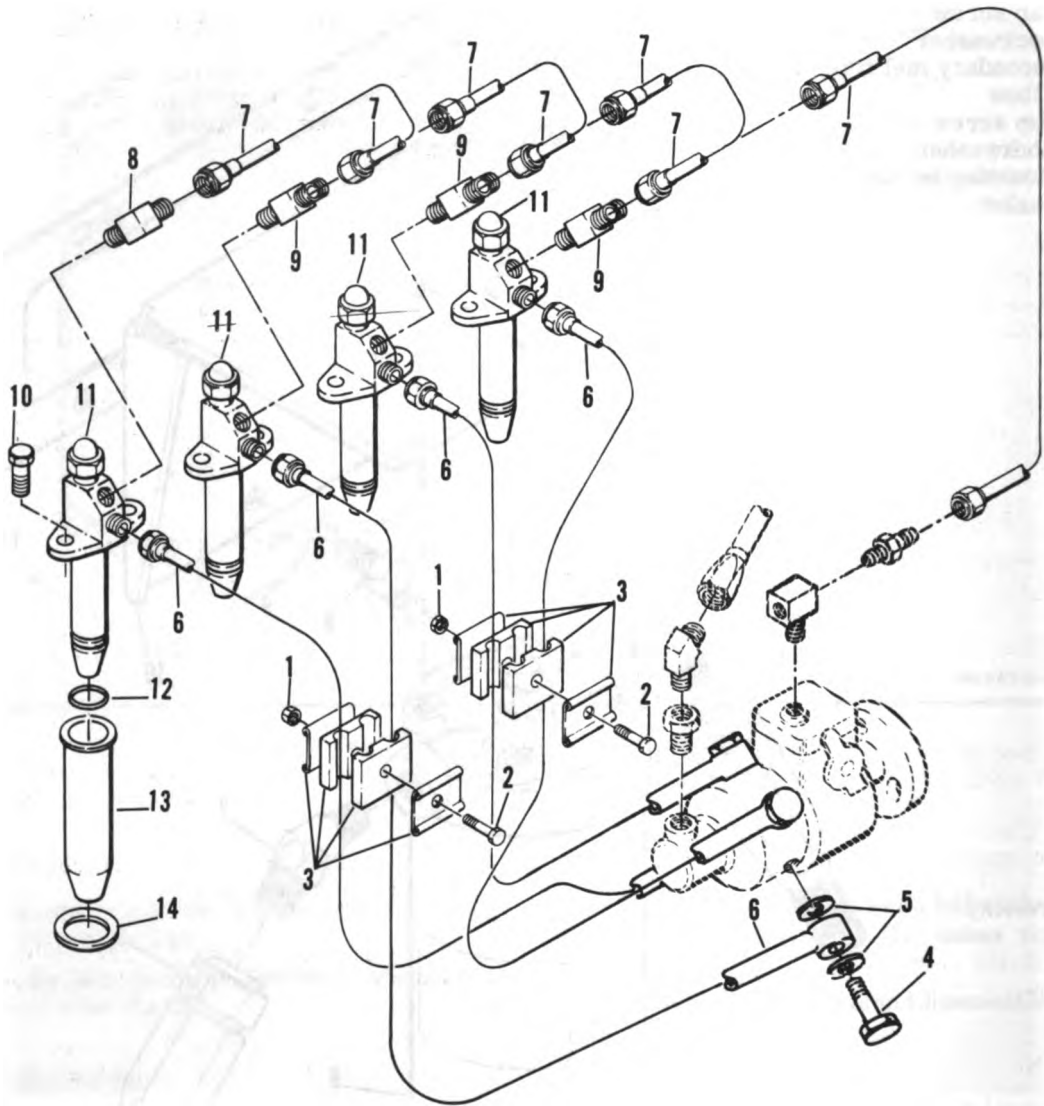
*c. Installation.* Install secondary fuel filter assembly in reverse order of removal procedures.

1. Drain cock
2. Fuel hose assy
3. Fuel hose assy
4. Cap screw
5. Lockwasher
6. Secondary fuel filter assy
7. Elbow
8. Cap screw
9. Lockwasher
10. Mounting bracket
11. Gasket



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Figure 3-20. Secondary Fuel Filter Assembly, Removal and Installation



- |                       |                        |
|-----------------------|------------------------|
| 1. Nut                | 8. Elbow               |
| 2. Screw              | 9. Tee                 |
| 3. Clamp assembly     | 10. Screw              |
| 4. Bolt               | 11. Nozzle holder assy |
| 5. Sealing washer     | 12. Seal               |
| 6. Injector fuel line | 13. Sleeve             |
| 7. Return line        | 14. Seal               |

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Figure 3-21. Fuel Injection Nozzle Holders and Lines, Exploded View

### 3-82. FUEL INJECTION NOZZLE HOLDERS AND LINES.

#### a. Removal.

##### NOTE

Locate faulty injectors as directed in subparagraph c. below.

(1) Remove injector and return lines and fittings (1 through 7, figure 3-21).

##### NOTE

Tag or otherwise identify lines and fittings and the location of support clamps to facilitate installation.

(2) Remove screws (10) to remove injector nozzle holders (11), seals (12), sleeves (13) and seals (14).

#### b. Cleaning and Inspection.

(1) Clean nozzle holders and lines with an approved solvent and dry thoroughly.

(2) Inspect nozzle holder assemblies for cracks, corrosion, signs of leaking, or other defects.

(3) Inspect lines for pinching, cracks, corrosion, and other damage.

(4) Check all threaded parts for stripping or otherwise damaged threads.

#### c. Testing.

(1) Refer to paragraph 2-10 and start the generator set.

(2) Loosen the fuel line at the injector on cylinder No. 1 until fuel flows freely from the break.

(3) If engine performance is affected, the injector is functioning properly.

(4) If engine performance is not affected, the injector is faulty and must be replaced.

(5) Tighten the injector fuel line.

(6) Repeat steps (2) through (5) for each injector.

(7) Refer to paragraph 2-11 and stop the generator set.

(8) Remove faulty injectors in accordance with subparagraph a. above.

d. Installation. Install nozzle holders and lines in reverse order of removal procedures. Sealing washers (5, figure 3-21) must be replaced at each removal.

### 3-83. FUEL LINES AND FITTINGS.

a. Removal. Remove damaged fuel lines and fittings by following the ascending numerical sequence of index numbers, 1 through 84, assigned to figure 3-22.

##### NOTE

It is not necessary to remove all fuel lines and fittings to replace a single part. Only those parts requiring replacement need be removed.

b. Installation. Install fuel lines in reverse order of removal procedure.

### 3-84. START AID ASSEMBLY.

#### a. Removal.

(1) Remove tube assembly (1, figure 3-23) and unscrew spray nozzle (2) from air cleaner housing.

(2) Remove ether tank and install protective cap (4) on solenoid valve assembly (8).

(3) Disconnect electrical connector (3) from solenoid valve assembly.

(4) Remove nuts (5), screws (6), and lock-washers (7) to remove solenoid valve assembly (8).

(5) Remove nuts (9), screws (10), and lock-washers (11) to remove clamp bracket (12) from day tank assembly (13).

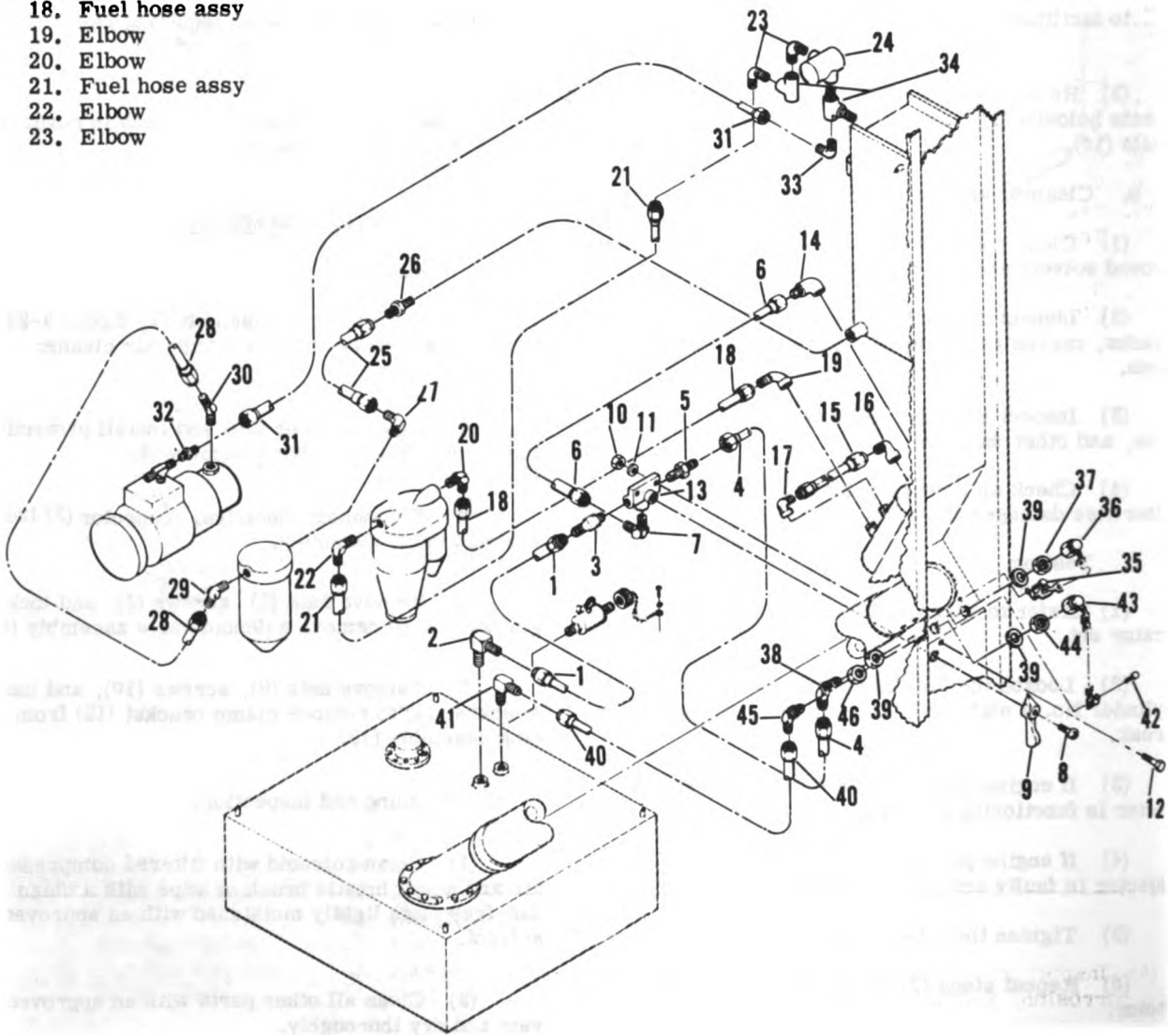
#### b. Cleaning and Inspection.

(1) Clean solenoid with filtered compressed air and a soft bristle brush or wipe with a clean lint-free cloth lightly moistened with an approved solvent.

(2) Clean all other parts with an approved solvent and dry thoroughly.

(3) Visually inspect start aid solenoid valve for cracks, corrosion, stripped or damaged threads and evidence of shorting or other damage.

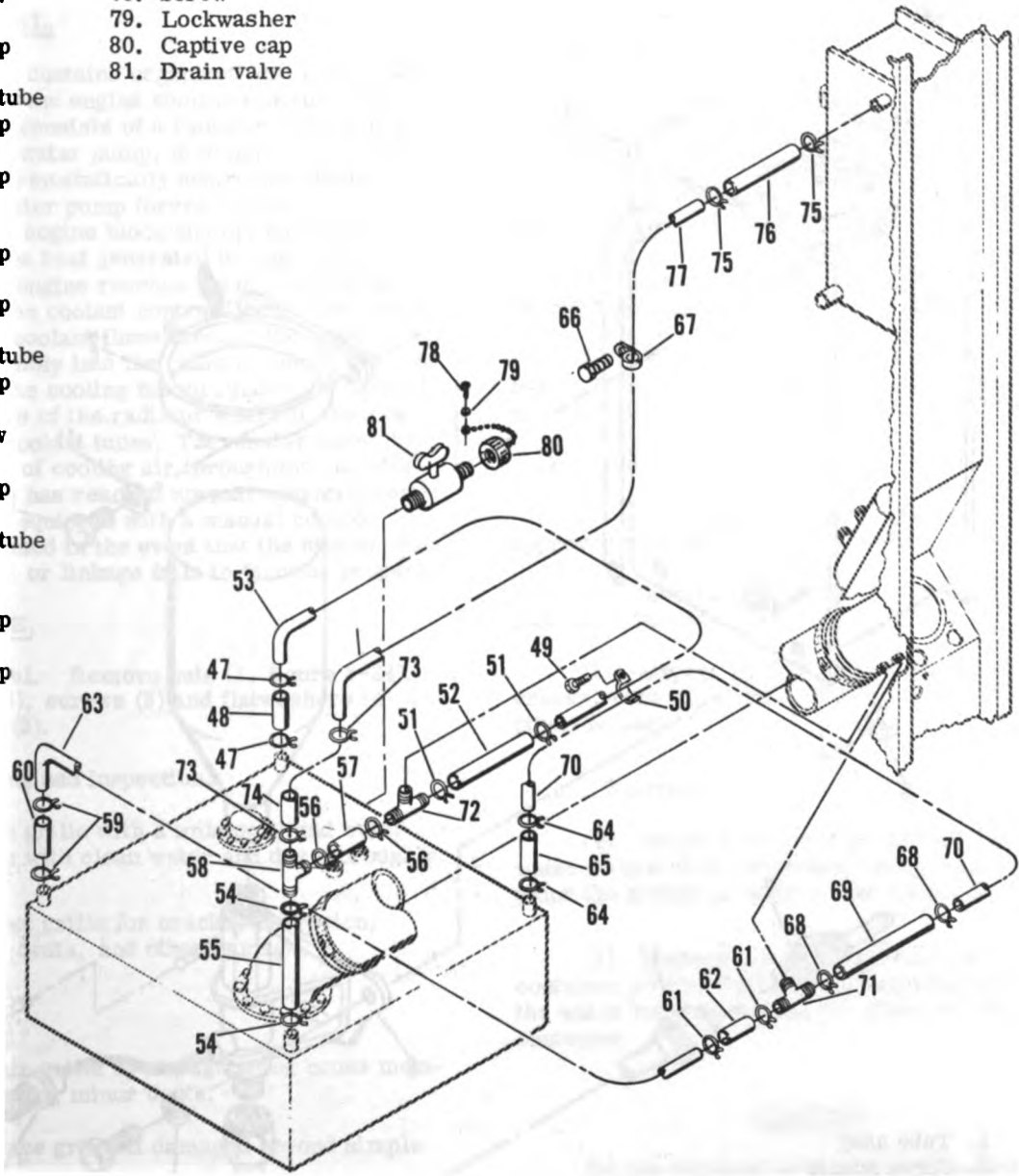
- |                             |                         |                    |
|-----------------------------|-------------------------|--------------------|
| 1. Fuel supply hose assy    | 24. Fuel solenoid valve | 40. Fuel hose assy |
| 2. Elbow                    | 25. Fuel hose assy      | 41. Elbow          |
| 3. Elbow                    | 26. Connector           | 42. Screw          |
| 4. Auxiliary fuel hose assy | 27. Elbow               | 43. Tube cap assy  |
| 5. Adapter                  | 28. Fuel hose assy      | 44. Nut            |
| 6. Fuel hose assy           | 29. Elbow               | 45. Bulkhead union |
| 7. Elbow                    | 30. Elbow               | 46. Nut            |
| 8. Screw                    | 31. Fuel hose assy      |                    |
| 9. Valve handle             | 32. Connector           |                    |
| 10. Nut                     | 33. Elbow               |                    |
| 11. Lockwasher              | 34. Tee                 |                    |
| 12. Screw                   | 35. Screw               |                    |
| 13. Three-way valve         | 36. Tube cap assy       |                    |
| 14. Elbow                   | 37. Nut                 |                    |
| 15. Tube assy               | 38. Bulkhead union      |                    |
| 16. Elbow                   | 39. Washer              |                    |
| 17. Elbow                   |                         |                    |
| 18. Fuel hose assy          |                         |                    |
| 19. Elbow                   |                         |                    |
| 20. Elbow                   |                         |                    |
| 21. Fuel hose assy          |                         |                    |
| 22. Elbow                   |                         |                    |
| 23. Elbow                   |                         |                    |



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Figure 3-22. Fuel Lines and Fittings, Exploded View (Sheet 1 of 2)

- |               |                 |
|---------------|-----------------|
| 47. Clamp     | 76. Hose        |
| 48. Hose      | 77. Vent tube   |
| 49. Screw     | 78. Screw       |
| 50. Clip      | 79. Lockwasher  |
| 51. Clamp     | 80. Captive cap |
| 52. Hose      | 81. Drain valve |
| 53. Vent tube |                 |
| 54. Clamp     |                 |
| 55. Hose      |                 |
| 56. Clamp     |                 |
| 57. Hose      |                 |
| 58. Tee       |                 |
| 59. Clamp     |                 |
| 60. Hose      |                 |
| 61. Clamp     |                 |
| 62. Hose      |                 |
| 63. Vent tube |                 |
| 64. Clamp     |                 |
| 65. Hose      |                 |
| 66. Screw     |                 |
| 67. Clip      |                 |
| 68. Clamp     |                 |
| 69. Hose      |                 |
| 70. Vent tube |                 |
| 71. Tee       |                 |
| 72. Tee       |                 |
| 73. Clamp     |                 |
| 74. Hose      |                 |
| 75. Clamp     |                 |



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Figure 3-22. Fuel Lines and Fittings, Exploded View (Sheet 2 of 2)

(4) Inspect ether tank bracket for cracks, breaks, corrosion, and other damage.

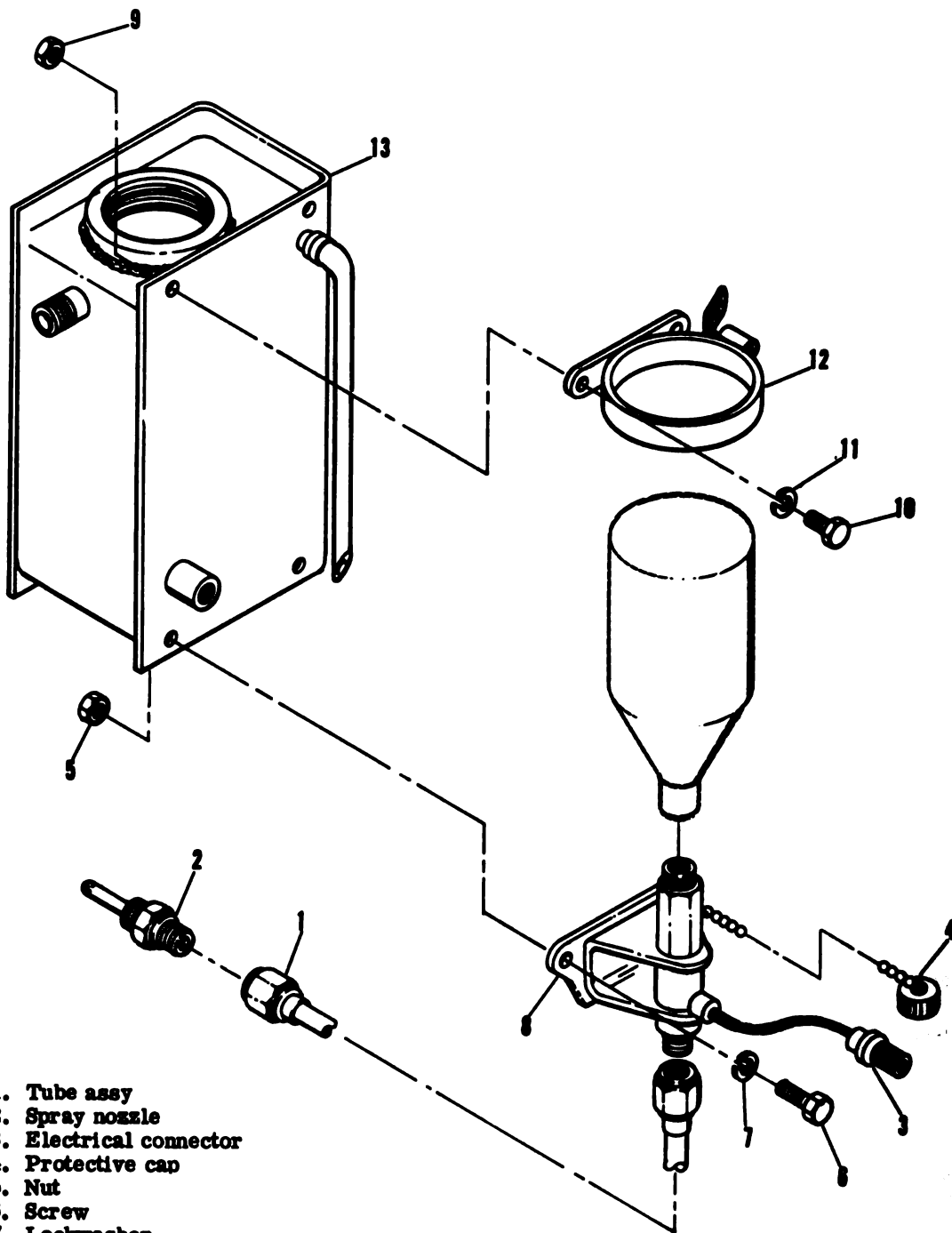
(7) Check all threads for stripping or other damage.

(5) Inspect tube assembly for cracks, breaks, pinching, stripped or damaged threads, and other damage.

(8) Replace any parts found defective.

(6) Inspect spray nozzle for cracks, corrosion, wear, clogging, or other damage.

c. Installation. Install start aid assembly in reverse order of removal procedures.



1. Tube assy
2. Spray nozzle
3. Electrical connector
4. Protective cap
5. Nut
6. Screw
7. Lockwasher
8. Solenoid valve assy
9. Nut
10. Screw
11. Lockwasher
12. Clamp bracket
13. Day tank assy

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## Section X. ORGANIZATIONAL MAINTENANCE OF THE ENGINE COOLING SYSTEM

### 3-85. GENERAL.

This section contains organizational maintenance instructions for the engine cooling system. The cooling system consists of a radiator, a belt driven cooling fan and water pump, a coolant control thermostat and a thermostatically controlled shutter assembly. The water pump forces coolant through passages in the engine block and cylinder head where it absorbs heat generated by engine operation. When the engine reaches normal operating temperature, the coolant control thermostat opens and the heated coolant flows through the upper radiator hose assembly into the radiator where the heat is dissipated. The cooling fan circulates air through the air passages of the radiator where it absorbs heat from the coolant tubes. The shutter assembly blocks the flow of cooling air through the radiator until the engine has reached normal operating temperature. It is equipped with a manual control which may be used in the event that the shutter control thermostat or linkage fails to function properly.

### 3-86. GRILLE.

a. Removal. Remove nuts (1, figure 3-24), lockwashers (2), screws (3) and flatwashers (4) to remove grille (5).

#### b. Cleaning and Inspection.

(1) Clean grille with a mild soap and water solution, rinse with clean water and dry thoroughly.

(2) Inspect grille for cracks, corrosion, broken welds, dents, and other damage.

#### c. Repair.

(1) Repair grille by straightening cross members and removing minor dents.

(2) Replace grille if damaged beyond simple repair.

d. Installation. Install grille in reverse order of removal procedures.

### 3-87. SHUTTER CONTROL THERMOSTAT.

#### a. Removal.

(1) Drain radiator and disconnect radiator hoses (paragraph 3-31).

(2) Loosen clamp (6, figure 3-24) and remove drain tube (7).

(3) Remove cotter pin (8) to disconnect shutter control linkage.

(4) Remove screws (9) and lockwashers (10) to remove control assembly and gasket (11). Discard gasket.

(5) Remove screws (12) to separate thermostat housing (13) from linkage (14).

(6) Remove gasket (15) and thermostat (16). Discard gasket.

(7) Do not remove drain cock (17) and adapter bushing (18) unless damage is present and replacement is necessary.

#### b. Cleaning and Inspection.

(1) Clean shutter control thermostat with an approved solvent and dry thoroughly.

(2) Inspect thermostat for cracks, corrosion, and other damage.

(3) Inspect shutter control assembly for cracks, corrosion, bent manual control lever and other damage.

#### c. Testing.

(1) Suspend the thermostat in a container of water so that it is completely immersed but does not touch the bottom or sides of the container.

(2) Suspend a reliable thermometer in the container so that the temperature sensing end is in the water but not touching the sides or bottom of the container.

### CAUTION

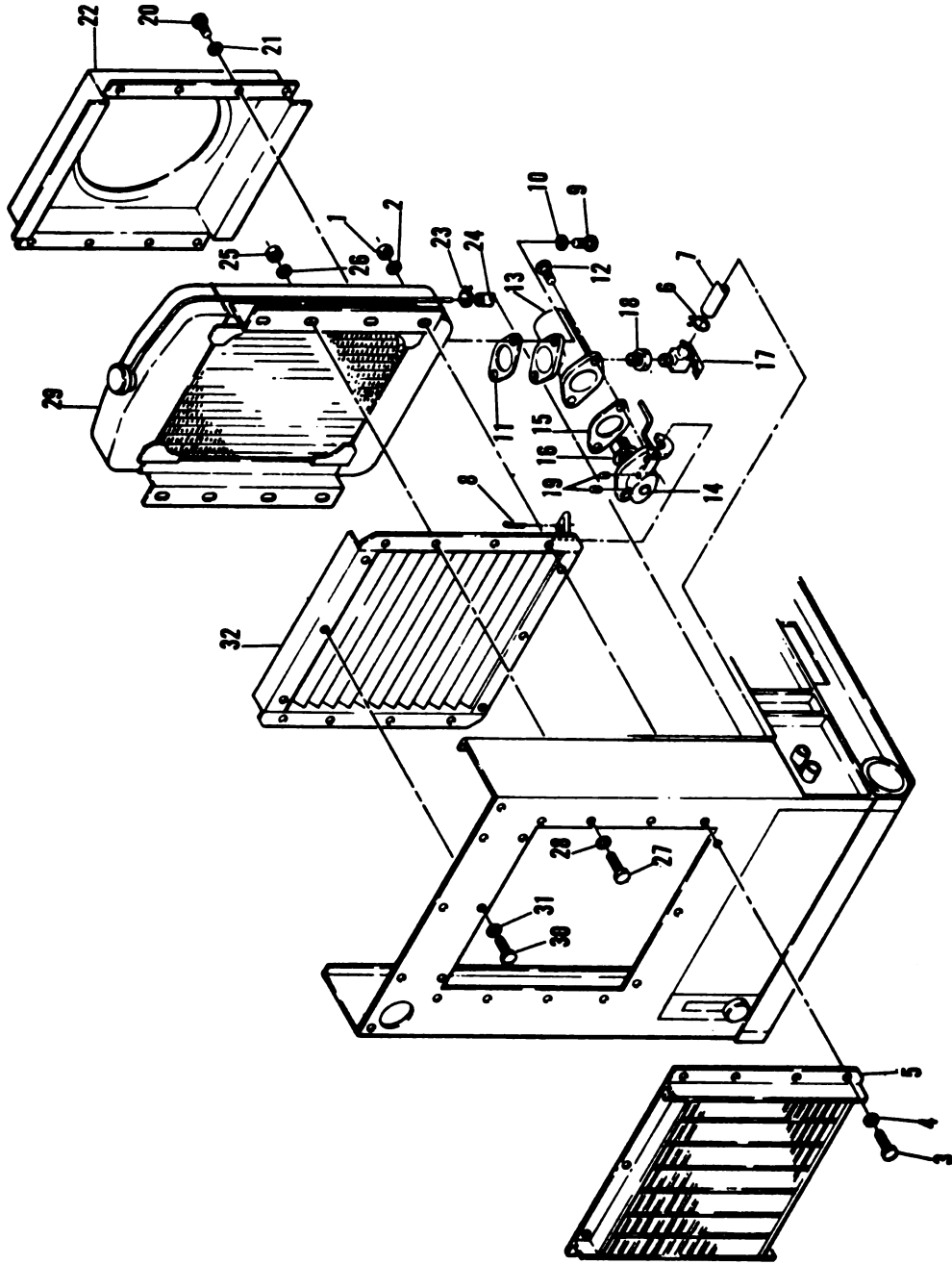
Do not overheat as damage to the thermostat may result.

(3) Gradually heat the water while stirring to distribute the heat evenly.

(4) Observe both the thermometer and the thermostat. If the thermostat is operating properly, it should begin opening when the water temperature reaches 162°F (72.2°C) and be fully open when the water temperature reaches 178°F (81.1°C).

(5) Replace the thermostat if it fails to operate properly.





1. Nut
2. Lockwasher
3. Screw
4. Flat washer
5. Grille
6. Clamp
7. Drain tube
8. Cotter pin
9. Screw
10. Lockwasher
11. Gasket
12. Screw
13. Thermostat housing
14. Linkage
15. Gasket
16. Thermostat
17. Drain cock
18. Adapter bushing
19. Set screw
20. Screw
21. Flat washer
22. Radiator shroud
23. Clamp
24. Overflow tube
25. Nut
26. Lockwasher
27. Screw
28. Flat washer
29. Radiator
30. Screw
31. Lockwasher
32. Shutter assy

Figure 3-24. Grille, Radiator, and Shutter Assembly, Exploded View

**d. Installation.**

(1) Install shutter control thermostat in reverse order of removal procedures. Install new gaskets (11 and 15).

(2) Loosen screws (20, figure 3-24). Push up on shutter control linkage manual control until shutter vanes are sealed, then tighten screws.

**3-88. RADIATOR.**

**a. Removal.**

(1) Drain coolant from radiator and disconnect radiator hoses (paragraph 3-31).

(2) Remove front top housing panel and doors (paragraph 3-134).

(3) Remove shutter control thermostat and housing (paragraph 3-87).

(4) Remove fan guards (paragraph 3-31).

(5) Loosen clamps (23, figure 3-24) and disconnect overflow tube (24).

(6) Remove grille (paragraph 3-86).

(7) Remove nuts (25, figure 3-24), lockwashers (26), screws (27) and flat washers (28) to remove radiator (29).

**b. Cleaning and Inspection.**

(1) Clean radiator air passages with filtered compressed air.

(2) Clean exterior surfaces with a cloth moistened with an approved solvent.

(3) Inspect radiator for corrosion, dents, bent cooling fins.

(4) Check for accumulations of rust or scale in radiator openings.

(5) Refer to paragraph 3-31 and flush radiator if necessary.

**c. Installation.**

(1) Install radiator in reverse order of removal instructions.

(2) Fill radiator with coolant as specified in table 2-1.

**3-89. SHUTTER ASSEMBLY.**

**a. Removal.**

(1) Remove grille (paragraph 3-86).

(2) Remove radiator assembly (paragraph 3-88).

(3) Remove screws (30, figure 3-24) and lockwashers (31) to remove shutter assembly (32).

**b. Cleaning and Inspection.**

(1) Clean shutter assembly with a mild soap and water solution, rinse with clean water and dry thoroughly.

(2) Inspect shutter assembly for cracks, corrosion, bent vanes and other damage.

(3) Inspect neoprene seal on leading edge of shutter vanes for damage or deterioration.

(4) Check vane support brackets for loose or missing rivets.

(5) Check control rod and linkage for damage or binding.

(6) Replace shutter assembly if damaged beyond simple repair.

**c. Installation.** Install shutter assembly in reverse order of removal procedures.

**d. Adjustment.** Adjust shutter control linkage as outlined in paragraph 3-87d. above.

**3-90. V-BELT.**

**a. Removal.**

(1) Remove screws (20, figure 3-24), flat washers (21), and shroud (22).

(2) Loosen battery charging alternator mounting hardware (paragraph 3-68).

(3) Rotate alternator toward cooling fan until v-belt is slack enough to slip over alternator pulley.

(4) Remove v-belt (1, figure 3-25) from fan pulley and crankshaft pulley.

(5) Slip v-belt between cooling fan and radiator.

**b. Installation.**

(1) Install fan belt in reverse order of removal procedures.

(2) Adjust fan belt tension as outlined in subparagraph c. below.

**c. Adjustment.**

(1) Loosen alternator mounting hardware.

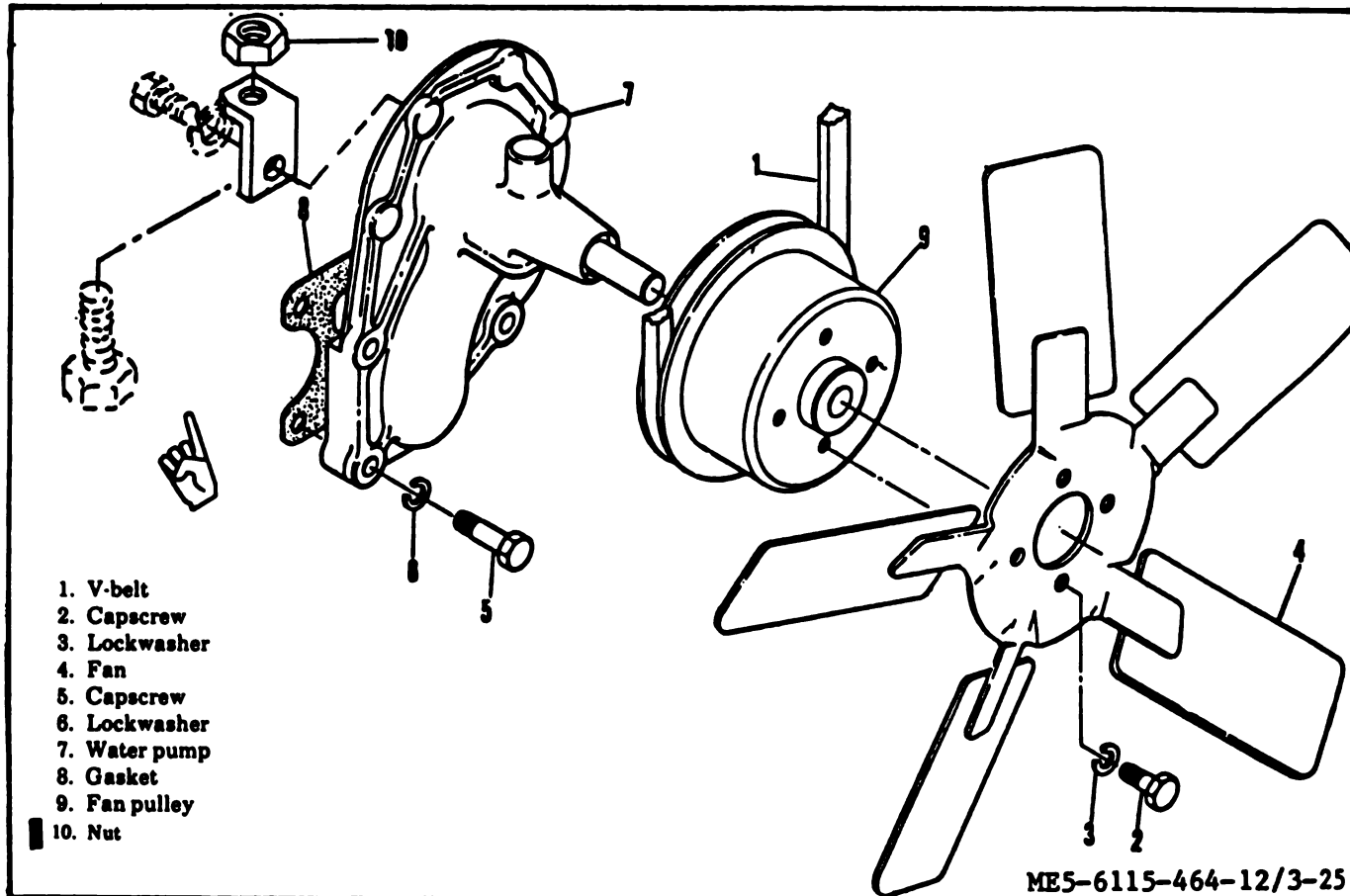


Figure 3-25. Water Pump, Cooling Fan and V-Belt, Removal and Installation

(2) Rotate alternator on pivot bolt until firm pressure on v-belt midway between alternator pulley and water pump pulley will depress it approximately 1/2 inch.

(3) Tighten alternator mounting hardware.

### 3-91. COOLING FAN.

#### a. Removal.

(1) Remove right side fan guard (paragraph 3-31b. (3)).

(2) Remove v-belt as outlined in paragraph 3-90.

(3) Remove cap screws (2, figure 3-25), lockwashers (3) and fan (4).

#### b. Cleaning and Inspection.

(1) Clean cooling fan with a clean lint-free cloth moistened with an approved solvent.

(2) Inspect fan for bent blades, dents, cracks, corrosion and other damage.

(3) Check all threaded parts for stripped or otherwise damaged threads.

(4) Replace fan if damaged beyond simple repair.

#### c. Installation.

(1) Install cooling fan in reverse order of removal procedures.

(2) Install and adjust v-belt as outlined in paragraph 3-90 above.

### CAUTION

When installing cooling fan, use the following procedures to insure that the fan is not installed backward.

(3) When standing in front of the engine, rotation of the fan will be clockwise. Install the fan so that the leading edges of the fan blades will be toward the radiator. The trailing edge (concave side) must be toward the engine.

**NOTE**

After installation of the fan, and prior to tightening the belt and starting the engine, rotate the fan to insure that the fan blades have sufficient clearance.

**3-92. WATER PUMP.**

**a. Removal.**

- (1) Drain radiator (paragraph 3-31).
- (2) Remove radiator hoses from water pump (paragraph 3-31).
- (3) Remove cooling fan as described in paragraph 3-91 above.
- (4) Remove cap screws (5, figure 3-25), lockwashers (6) and nut (10) to remove water pump (7) and gasket (8).
- (5) Do not remove fan pulley (9) unless inspection reveals damage.

**b. Cleaning and Inspection.**

- (1) Clean water pump with a stiff-bristle brush and an approved solvent.
- (2) Inspect water pump for cracks, corrosion, evidence of leaks, and other damage.

- (3) Check all threaded parts for stripped or otherwise damaged threads.

**c. Installation.**

- (1) Install water pump in reverse order of removal procedures.
- (2) Install cooling fan as outlined in paragraph 3-91 above.

**3-93. COOLANT THERMOSTAT AND HOUSING.**

**a. Removal.**

- (1) Remove left side fan guard (paragraph 3-31b.(3)).
- (2) Refer to paragraph 3-31 and drain the radiator.
- (3) Refer to paragraph 3-70 and remove the coolant temperature transmitter.
- (4) Loosen clamp (1, figure 3-26) and remove radiator hose (2).
- (5) Remove screws (3) and lockwashers (4) to remove thermostat housing (5), thermostat (6) gasket (7), spacer (8), and gasket (9).

**c. Cleaning and Inspection.**

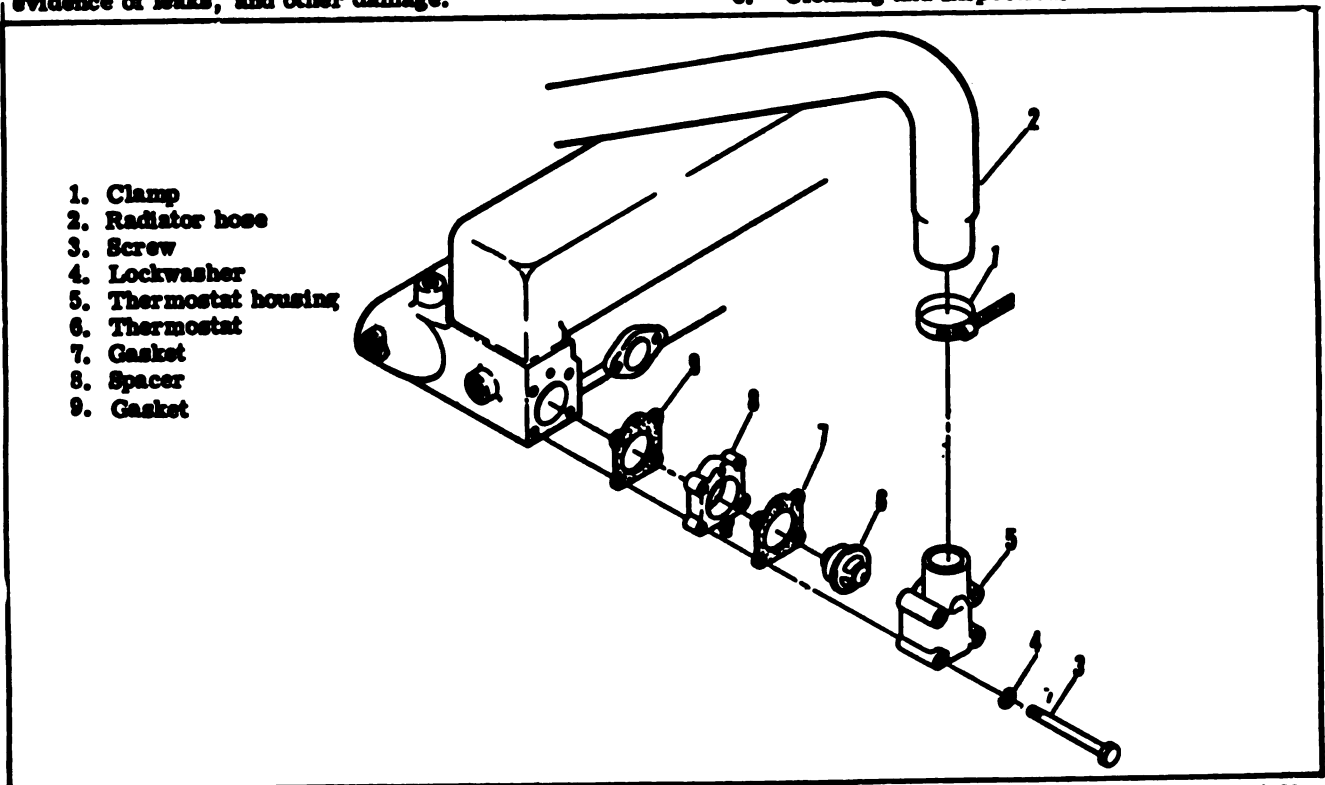


Figure 3-26. Coolant Thermostat, Removal and Installation

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(1) Clean thermostat and housing with an approved solvent.

(2) Inspect thermostat for cracks, corrosion, accumulations of scale or rust, and other damage.

(3) Inspect housing for cracks, corrosion, and other damage.

c. Testing.

(1) Suspend thermostat in a container of water so that it is completely immersed but not touching the bottom or sides of the container.

(2) Suspend a reliable thermometer so that its temperature sensing end is immersed but not touching the bottom or sides of the container.

**CAUTION**

Do not overheat as damage to the thermostat may result.

(3) Gradually heat the water while stirring to evenly distribute the heat.

(4) Observe the thermometer and the thermostat. If the thermostat is operating properly, it should begin opening when the water temperature reaches 17.7°F (80.6°C) and be fully open at (205°F (96.1°C).

(5) Replace the thermostat if it fails to function properly.

d. Installation. Install thermostat in reverse order of removal procedures.

**Section XI. ORGANIZATIONAL MAINTENANCE OF THE ENGINE LUBRICATION SYSTEM**

**3-94. GENERAL.**

The oil pan serves as a cover for the bottom of the crankcase and, also, as a reservoir for engine lubricating oil. It is equipped with a bayonet type oil gauge which is used to measure the oil level in the pan. Oil is drawn into a gear type, positive displacement pump through a large screen which prevents the entry of coarse abrasives. The oil pump forces the oil through a full flow type oil filter which removes minute abrasive particles. A pressure transmitter, located between the oil pump and oil filter, measures the pump output pressure and transmits it electrically to the engine oil pressure gauge. From the oil filter, the oil enters the header, a drilled passage in the engine block. A pressure switch measures the oil pressure in the header and automatically shuts down the engine if the pressure falls to a dangerously low level. From the header, the oil is distributed to the internal moving parts of the engine. No organizational maintenance is allocated for the oil pan and oil pump. Refer to paragraph 3-72 for organizational maintenance of the oil pressure transmitter and to paragraph 3-73 for organizational maintenance of the low oil pressure switch.

**3-95. LUBRICATION OF OIL FILTER ASSEMBLY.**

a. Removal.

(1) Remove drain plug (1, figure 3-27) and allow the oil to drain into a suitable container.

(2) Disconnect hose assemblies (2 and 3) from the filter assembly.

(3) Remove nuts (4), lockwashers (5), flat washers (6) and screws (7).

(4) Do not remove screws (8), lockwashers (9) and mounting bracket (10) unless inspection reveals damage.

b. Disassembly.

(1) Remove elbows (11 and 12).

(2) Remove square nut (13), flat-washer (14) and screw (15) to remove clamp (16) from filter assembly (17).

(3) Refer to paragraph 3-4 and disassemble the oil filter assembly.

c. Cleaning and Inspection.

(1) Clean oil filter assembly parts with dry cleaning solvent (Federal Specification P-D-680).

(2) Inspect mounting bracket (10) for cracks, corrosion, and other damage.

(3) Inspect oil line assemblies for clogging, deterioration, or other damage.

(4) Check all threads for stripping or other damage.

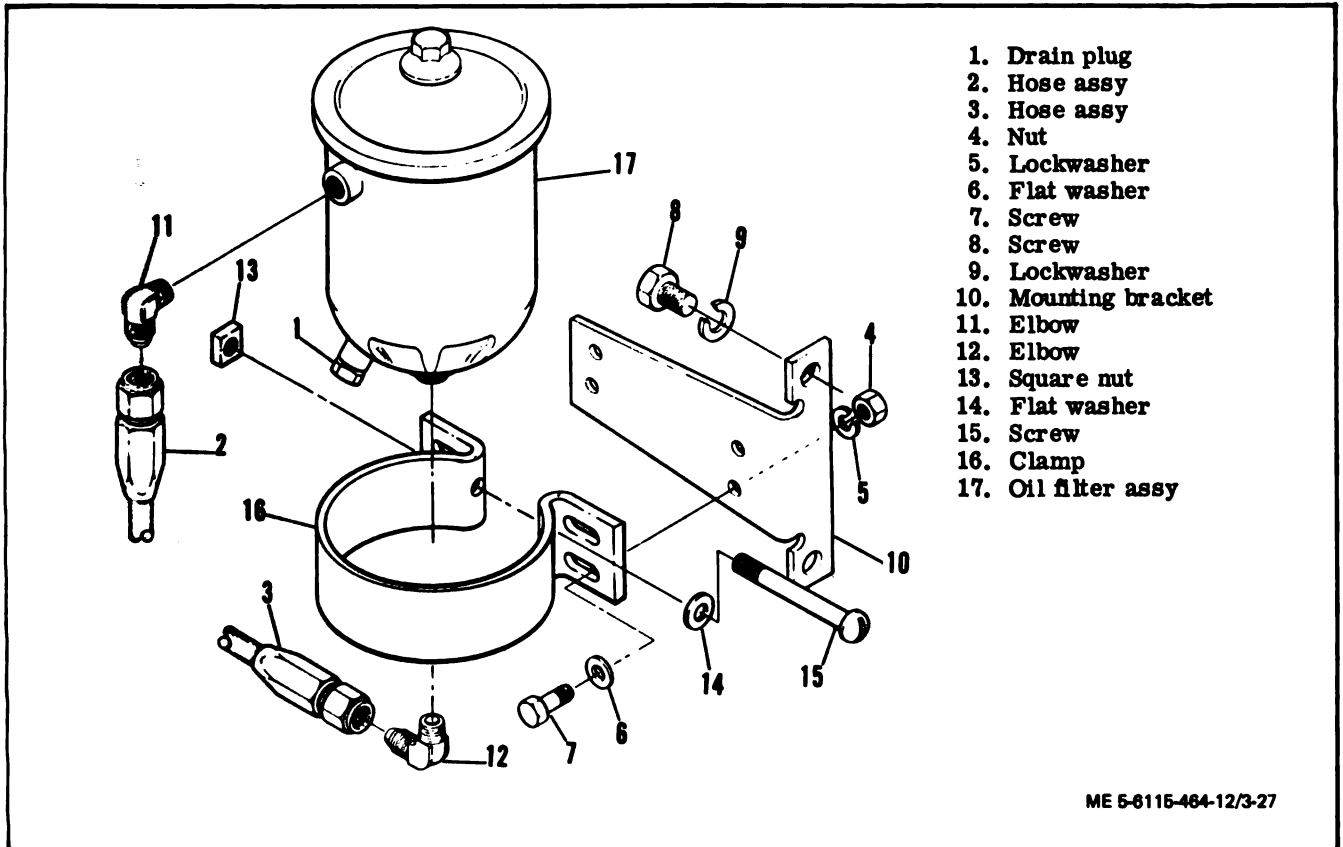


Figure 3-27. Lubrication Oil Filter Assembly, Removal and Installation

d. **Repair.** Repair of oil filter assembly is limited to replacement of defective parts.

e. **Assembly.**

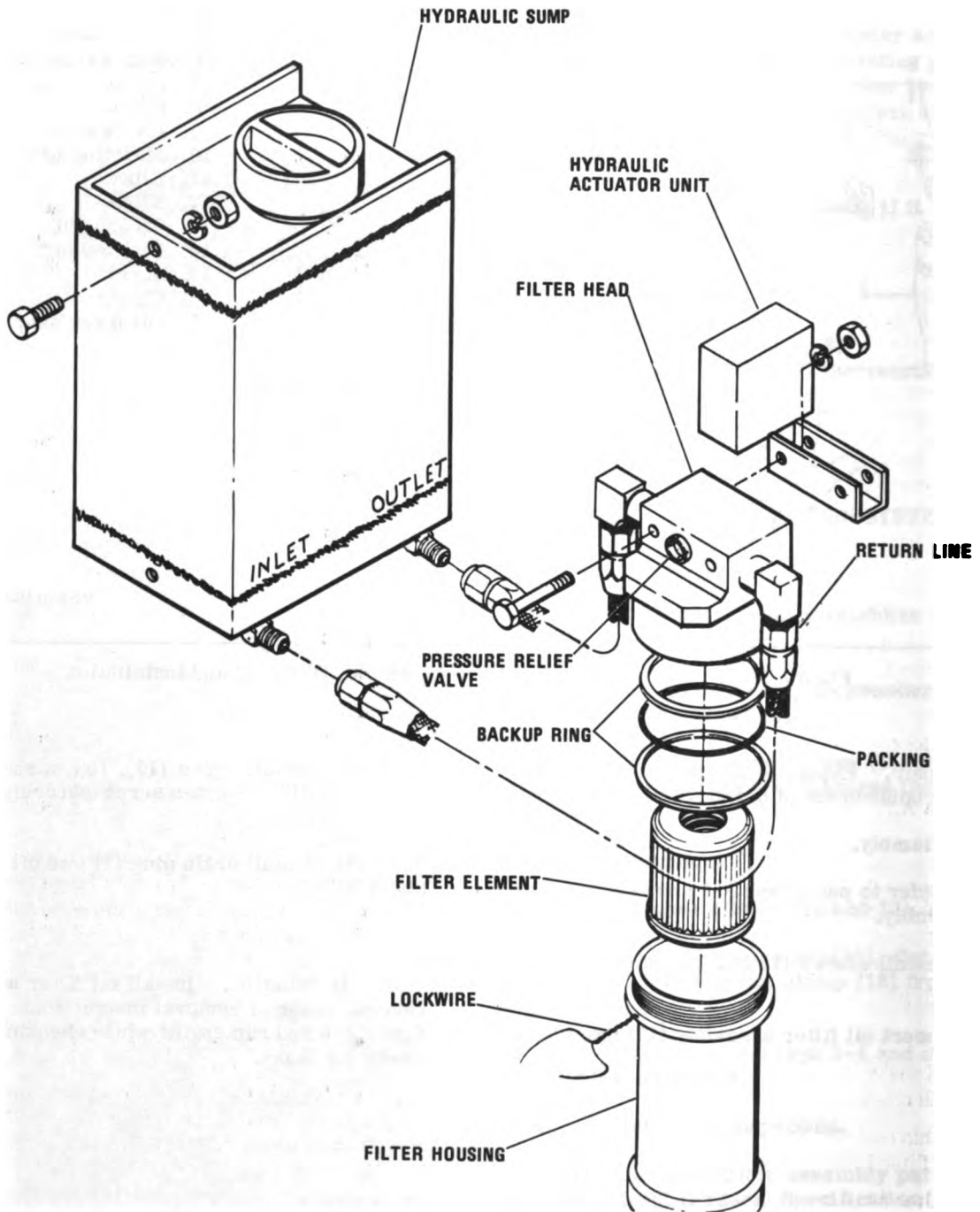
- (1) Refer to paragraph 3-4 and assemble oil filter assembly.
- (2) Install elbows (11 and 12) into filter assembly (17).
- (3) Insert oil filter assembly (17) into clamp (16).

(4) Install screw (15), flat washer (14) and square nut (13). Tighten screw securely.

(5) Install drain plug (1) into oil filter assembly (17).

f. **Installation.** Install oil filter assembly in reverse order of removal instructions. Refer to figure 2-8 and run engine while checking oil level. Check for leaks.

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Figure 3-28. Hydraulic Sump and Filter Service

## Section XII ORGANIZATIONAL MAINTENANCE OF THE HYDRAULIC SYSTEM

### 3-96. GENERAL.

The hydraulic system is used only on MEP-103A and some MEP-113A Precise Generator Sets equipped with electro-hydraulic governors. Its function is to provide a means of precise frequency control. The system consists of a sump, a replaceable element type filter, a gear driven positive displacement type pump, a pressure relief valve, a hydraulic actuator and interconnecting lines. The actuator hydraulically operates the governor control linkage to change the governor setting. Changing the governor setting increases or decreases the engine speed causing a corresponding increase or decrease in generator output frequency.

### 3-97. HYDRAULIC SUMP AND FILTER.

a. Disconnect return line from hydraulic actuator unit and allow the oil to drain into a suitable container (figure 3-28).

#### NOTE

Drain oil while it is at operating temperature to insure maximum suspension and drainage of particles.

- b. Remove lockwire and unscrew filter housing from filter head.
- c. Withdraw filter element and discard.
- d. Remove and discard packing and back-up rings.
- e. Clean filter housing with dry cleaning solvent (Federal Specification P-D-680) and dry with filtered compressed air.
- f. Soak replacement filter element in oil conforming to Military Specification MIL-H-5606.
- g. Install replacement packing and back-up rings.
- h. Insert oil soaked filter element into filter housing and fill housing with clean oil.
- i. Apply a thin coating of oil to packing, backup ring, and threads of filter head and housing.
- j. Thread filter housing onto head hand tight and secure with lockwire.

k. Connect return line to hydraulic actuator unit and fill hydraulic sump as directed in paragraph 3-83.

#### NOTE

No maintenance is required on the pressure relief valve. If the valve is damaged or fails to relieve pressure, replace the valve.

### 3-98. HYDRAULIC ACTUATOR UNIT FILTER.

- a. Disconnect hydraulic hose assembly (figure 3-29).
- b. Remove elbow, adapter, and filter.
- c. Clean filter with dry cleaning solvent (Federal Specification P-D-680) and dry thoroughly.
- d. Inspect filter for holes, tears, and other damage. Replace filter if defects are noted.
- e. Install filter and elbow.
- f. Install hydraulic hose.

### 3-99. HYDRAULIC LINES.

a. Removal. Drain hydraulic system (see paragraph 3-97a.). Remove damaged hydraulic lines by following the ascending numerical sequence of index numbers (1 through 16) assigned to figure 3-30.

#### NOTE

It is not necessary to remove all hydraulic lines to replace a single part. Only those hydraulic lines requiring replacement need be removed.

b. Installation. Install hydraulic lines in reverse order of removal procedures.



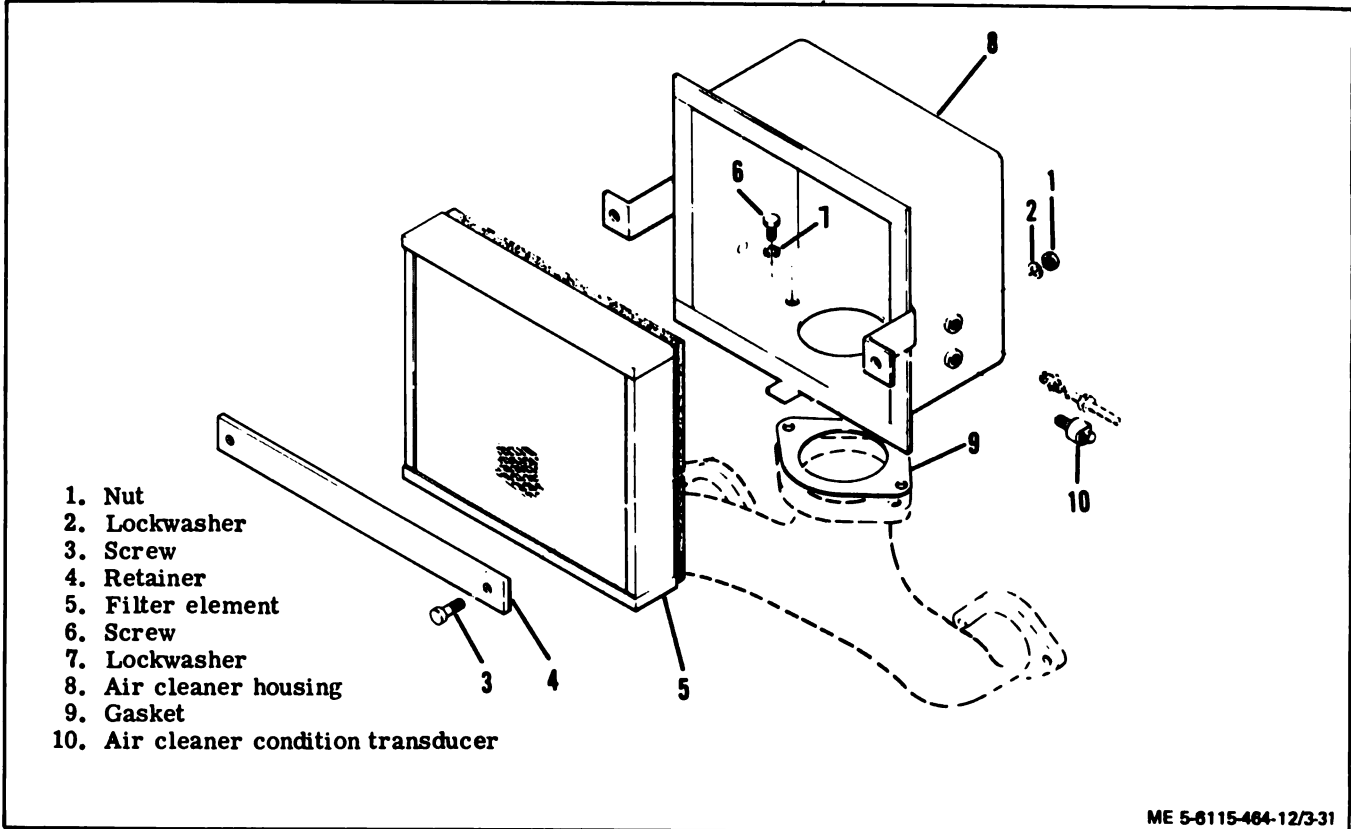


Figure 3-31. Air Cleaner Assembly, Exploded View

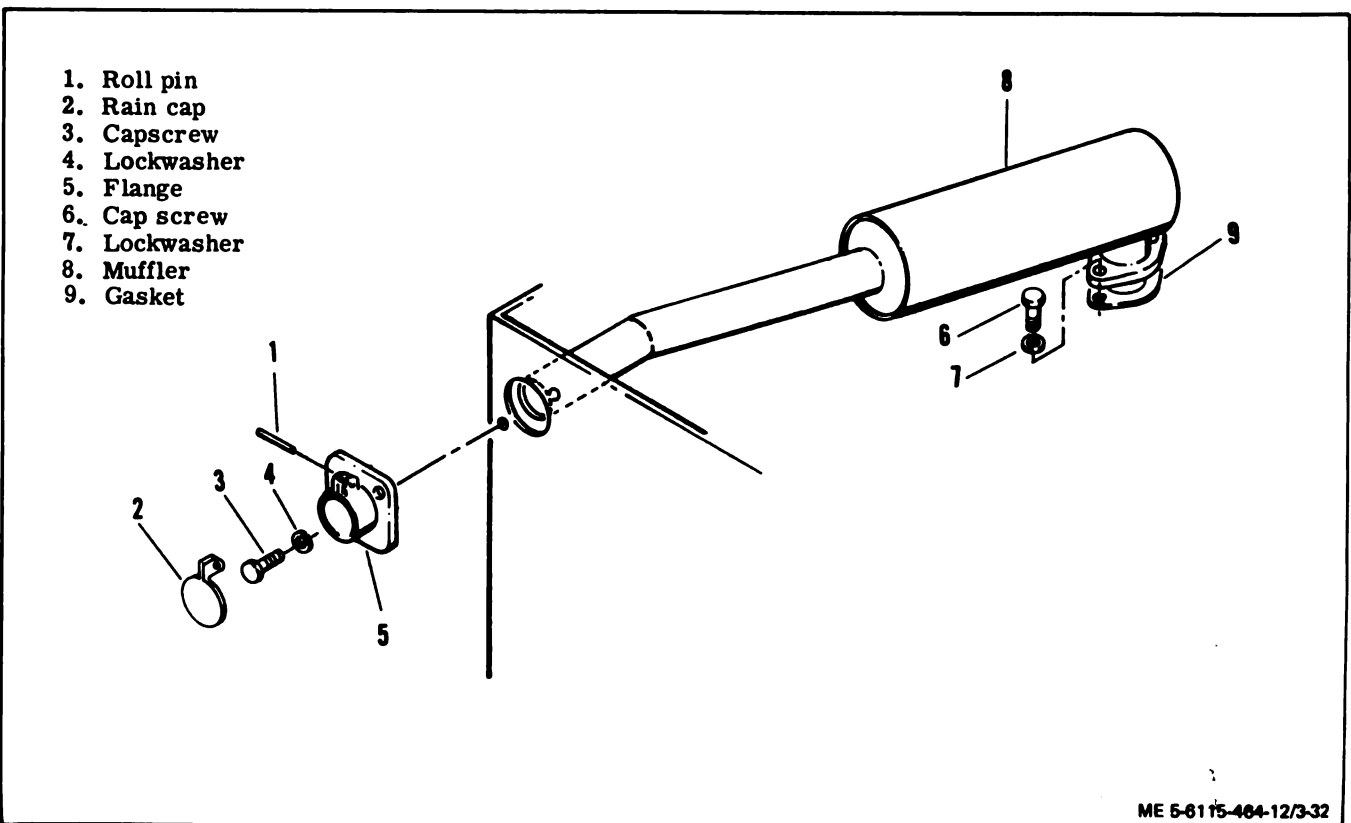


Figure 3-32. Muffler, Exploded View

Section XIII. ORGANIZATIONAL MAINTENANCE OF THE INTAKE AND  
EXHAUST SYSTEMS AND BREATHER TUBE

3-100. GENERAL.

a. The intake system consists of a dry type air cleaner assembly with a replaceable filter element which removes dust and dirt from the engine combustion air. The air cleaner assembly is equipped with a condition transducer. The air cleaner condition transducer measures the vacuum created by the filter element, but it transmits an electrical impulse which illuminates the AIR CLEANER CONDITION indicator lamp on the engine control panel when the filter element becomes unserviceable.

b. The exhaust system provides a means of expelling exhaust fumes from the engine and muffles much of the noise generated by engine operation.

c. The breather tube provides an escape route for gases which accumulate in the crankcase during engine operation. The gases pass through the breather, located in the engine valve cover, and are expelled into the air cleaner housing through the breather tube.

3-101. AIR CLEANER ASSEMBLY.

a. Removal.

(1) Disconnect electrical leads from air cleaner condition transducer.

(2) Disconnect start aid tube assembly and remove spray nozzle (paragraph 3-64).

(3) Disconnect breather tube assembly (paragraph 3-103).

(4) Remove nuts (1, figure 3-31), lockwashers (2) and screws (3) to remove retainer (4) and filter element (5).

(5) Remove screws (6) and lockwashers (7) to remove housing (8) and gasket (9).

(6) Remove condition transducer (10).

b. Cleaning and Inspection.

(1) Clean filter element as directed in paragraph 3-24.

(2) Clean all other parts with a clean, lint-free cloth moistened with an approved solvent.

(3) Inspect air cleaner housing for dents, cracks, corrosion and other damage.

(4) Inspect air cleaner condition transducer for cracked casing, corrosion, evidence of shorting and other damage.

(5) Check all threaded parts for stripped or otherwise damaged threads.

(6) Replace any parts damaged beyond simple repair.

c. Assembly. Assemble air cleaner assembly in reverse order of disassembly procedures.

d. Installation. Install air cleaner assembly in reverse order of removal procedures.

3-102. MUFFLER.

a. Removal.

(1) Remove roll pin (1, figure 3-32) to remove rain cap (2).

(2) Remove cap screws (3), lockwashers (4) to remove flange (5).

(3) Remove cap screws (6) and lockwashers (7) to remove muffler (8) and gasket (9). Discard gasket.

b. Cleaning and Inspection.

(1) Clean exhaust pipe and muffler with a stiff bristle brush and an approved solvent.

(2) Inspect exhaust pipe and muffler for dents, cracks, excessive corrosion, clogging, and other damage.

(3) Check all threaded parts for stripped or otherwise damaged threads.

(4) Replace any parts damaged beyond simple repair.

c. Installation. Install muffler in reverse order of removal procedures.

d. When a spark arrester is required, the installation instruction will be on the instruction sheet furnished with the spark arrester kit, TM 5-6115-464-24P.

3-103. BREATHER AND BREATHER TUBE.

a. Removal.

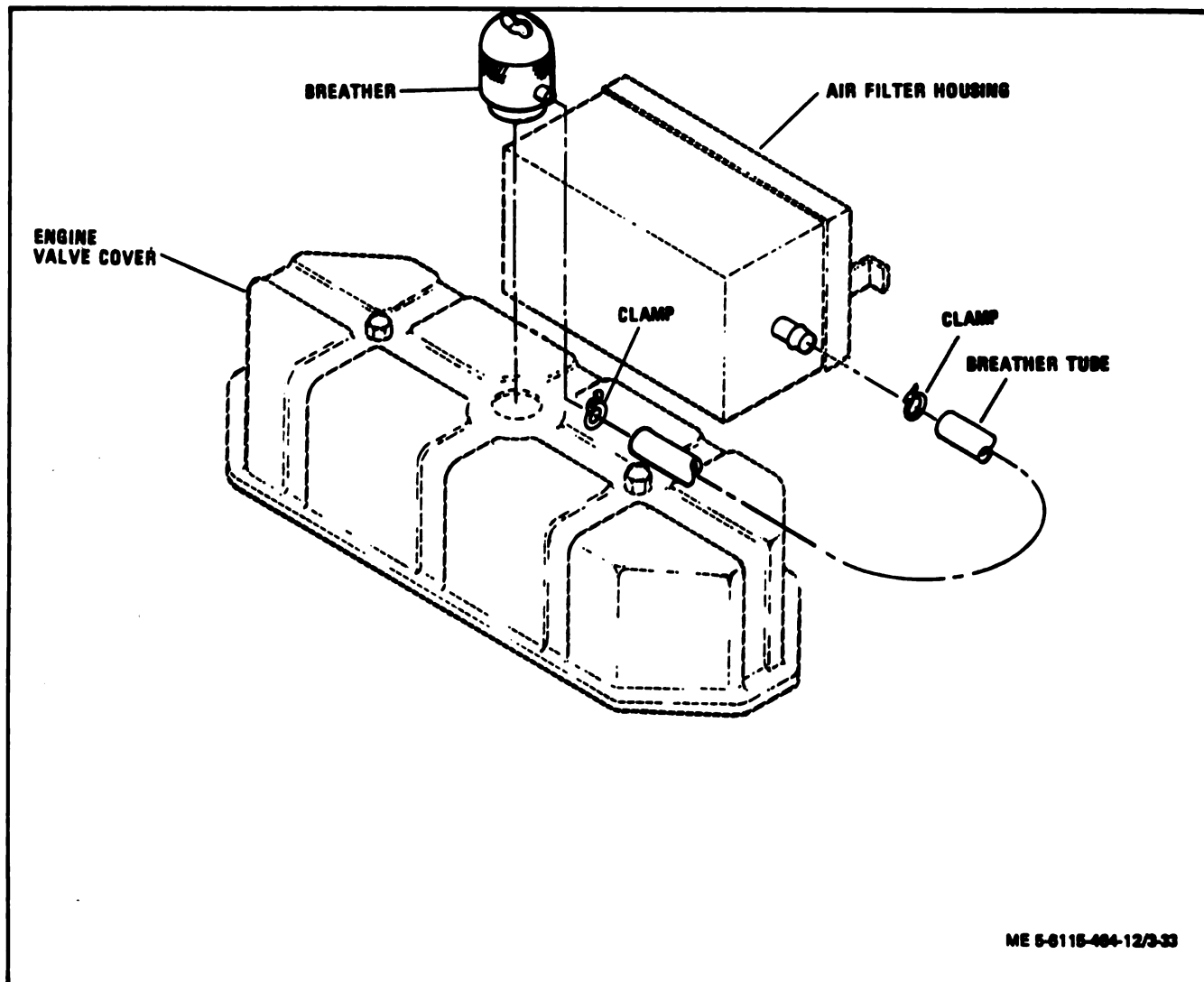


Figure 3-33. Breather and Breather Tube, Exploded View

(1) Remove clamps (figure 3-33) and breather tube.

(2) Loosen wing nut on breather, unscrew slotted stud and remove breather.

**b. Cleaning and Inspection.**

(1) Clean breather tube with a clean, lint-free cloth moistened with an approved solvent.

(2) Clean breather with an approved solvent and dry with filtered compressed air.

(3) Inspect breather tube for cracks, corrosion, clogging and other damage.

(4) Check all threaded parts for stripped or otherwise damaged threads.

(5) Replace any parts damaged beyond simple repair.

**c. Installation.** Install breather and breather tube in reverse order of removal procedures.

Section XIV. ORGANIZATIONAL MAINTENANCE OF THE ENGINE ASSEMBLY

3-104. GENERAL.

Rotational power for driving the generator is developed by a water cooled, four cylinder, four cycle, compression ignition diesel engine. Organizational maintenance of the engine assembly is limited to inspecting the crankshaft pulley, inspecting and replacing the intake and exhaust manifolds, inspecting the rocker arm assembly, adjusting the valve tappet clearance, and testing the engine assembly.

3-105. CRANKSHAFT PULLEY.

a. General. The crankshaft pulley is mounted on the front end of the engine crankshaft and pulls the drive belt for the water pump, radiator cooling fan, and alternator.

b. Inspection.

(1) Inspect v-belt groove for "step" wear along side and bottom of groove which would indicate excessive wear.

(2) Check for cracks in v-belt groove and around crankshaft hub.

3-106. INTAKE MANIFOLD.

a. Removal.

(1) Refer to paragraph 3-101 and remove air cleaner assembly.

(2) Remove nuts and lockwashers (figure 3-34) to remove intake manifold and gaskets. Discard gaskets.

b. Cleaning and Inspection.

(1) Clean intake manifold with a stiff bristle brush and an approved solvent.

(2) Scrape all gasket remains from the mating surfaces of intake manifold and cylinder head.

(3) Inspect intake manifold for cracks, excessive corrosion and other damage.

(4) Check all threaded parts for stripped or otherwise damaged threads.

c. Installation. Install intake manifold in reverse order of removal procedures. Torque nuts to 35 lbs-ft.

3-107. EXHAUST MANIFOLD.

a. Removal.

(1) Refer to paragraph 3-102 and remove the muffler.

(2) Remove nuts and washers (figure 3-35) to remove exhaust manifold and gaskets. Discard gaskets.

b. Cleaning and Inspection.

(1) Clean exhaust manifold with a stiff bristle brush and an approved solvent.

(2) Scrape all gasket remains from mating surfaces of exhaust manifold and cylinder.

(3) Inspect exhaust manifold for cracks, excessive corrosion and other damage.

(4) Check all threaded parts for stripped or otherwise damaged threads.

c. Installation. Use new gaskets and install exhaust manifold in reverse order of removal procedures. Torque nuts to 35 lbs-ft.

3-108. ROCKER ARM ASSEMBLY.

a. Remove air cleaner assembly (paragraph 3-101).

b. Thoroughly clean the valve cover and surrounding area.

c. Remove capscrews and washers to remove valve cover and gasket. Discard gasket.

d. Inspect valve rocker arm assembly as follows (figure 3-36).

(1) Check adjusting screw, rocker arms, and shaft for cracks and indications of excessive wear.

(2) Inspect springs for distortion, cracks, and breaks.

(3) Check the oil hole in each rocker arm for plugging. Use a small wire and compressed air to clean plugged oil holes.

e. If damage or excessive wear of the rocker arm assembly is present, notify higher level maintenance.

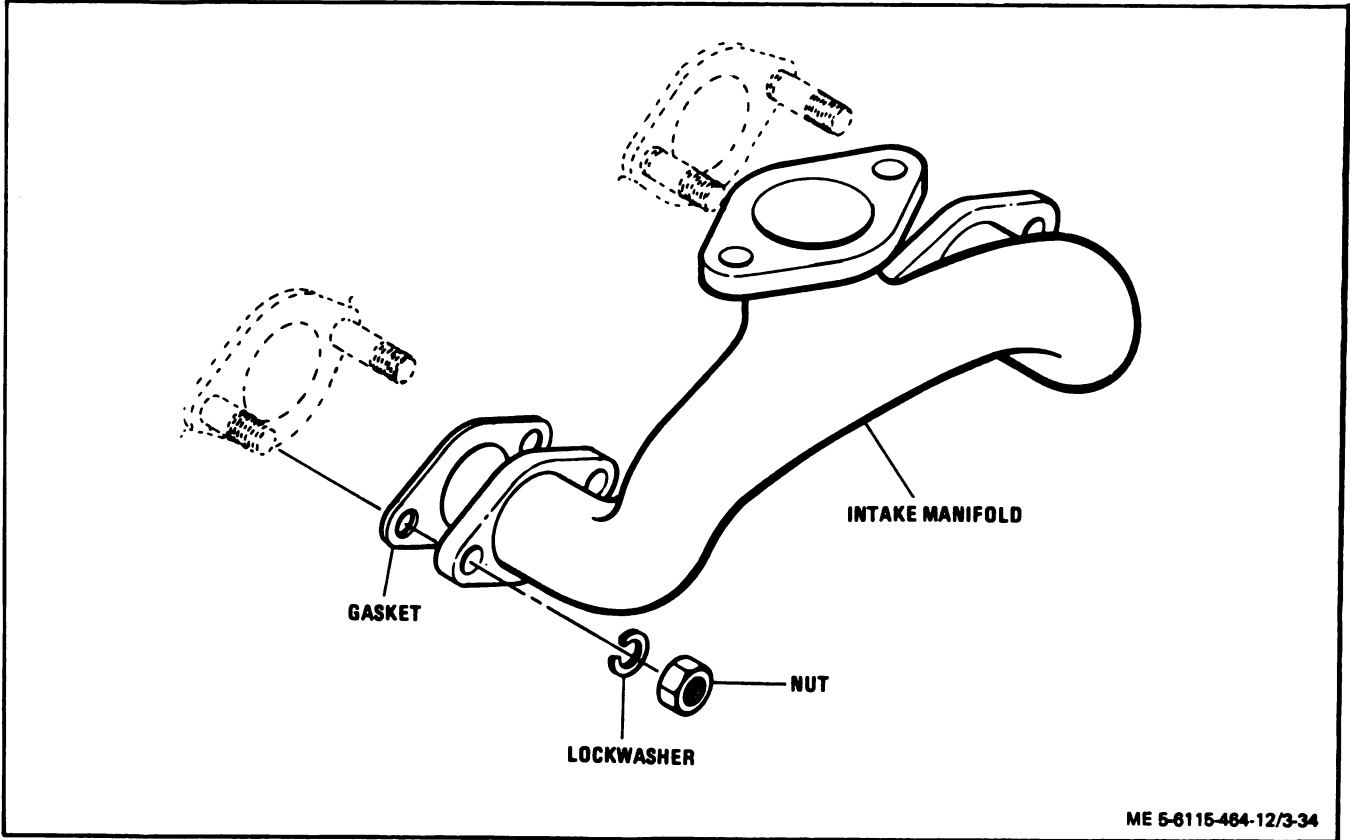


Figure 3-34. Intake Manifold, Removal and Installation

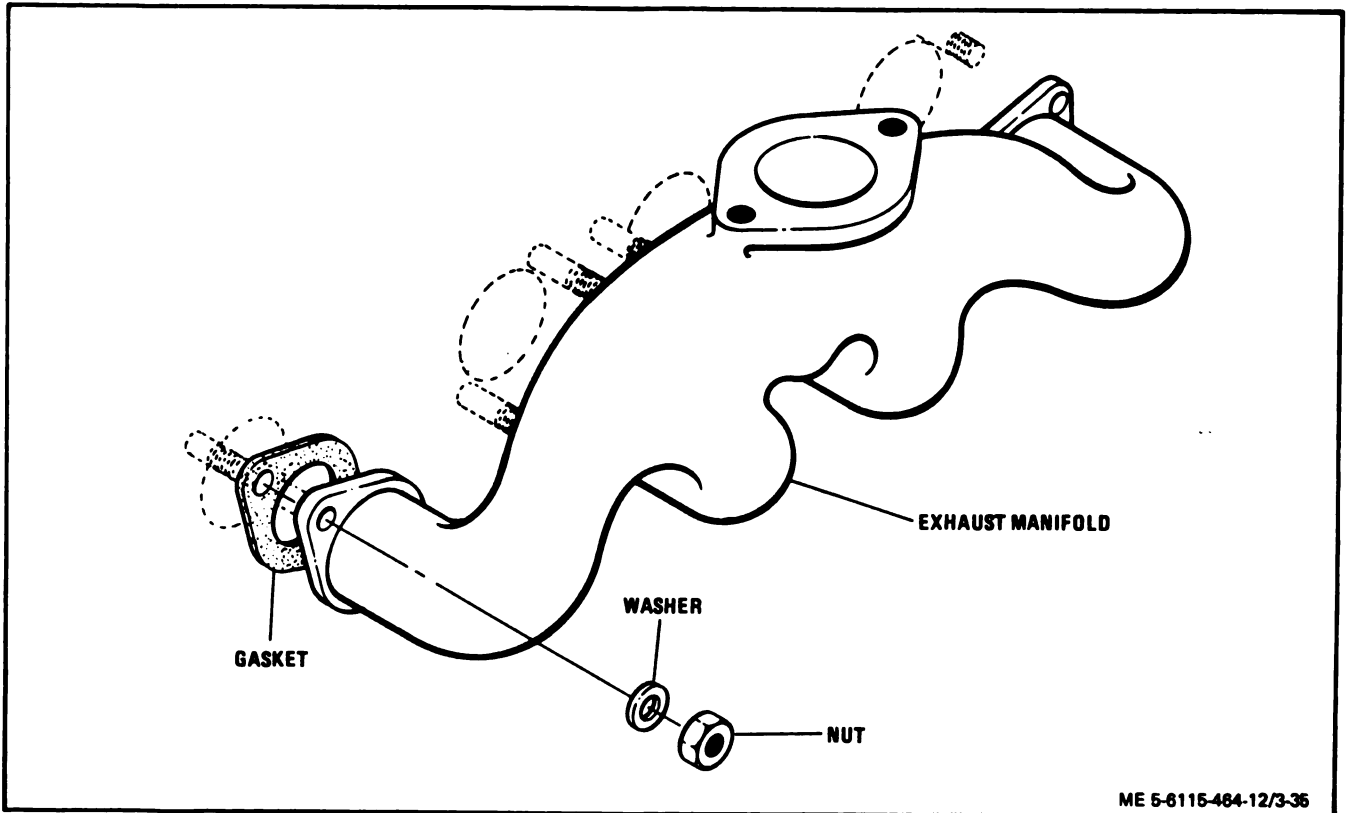


Figure 3-35. Exhaust Manifold, Removal and Installation

f. Install gasket and valve cover and secure with washers and cap screws.

g. Install breather and breather tube.

### 3-109. Valve Tappet Clearance Adjustment

a. Refer to paragraph 2-10 and operate the engine until the coolant temperature gauge indicates normal operating temperature.

b. Refer to paragraph 3-108 and remove the valve cover.

c. Bar the engine over by hand until both the intake and exhaust valves on No. 1 cylinder are completely closed.

d. Using a feeler gauge, check clearance between the valve stem and the rocker arm on both intake and exhaust valves (fig. 3-36). Clearance should be 0.015 hot.

e. If the clearance is not as specified, use a suitable wrench to rotate adjusting screw until proper clearance is obtained.

f. Check and, if necessary, adjust the clearance of the valves on the remaining cylinders as outlined in paragraphs c., d., and e. above, following the firing order of 1, 2, 4, 3.

g. When all valves are properly adjusted, refer to paragraph 3-108 and install the valve cover.

### 3-110. Engine Testing

a. Check that the generator set is properly grounded (para 2-3d.).

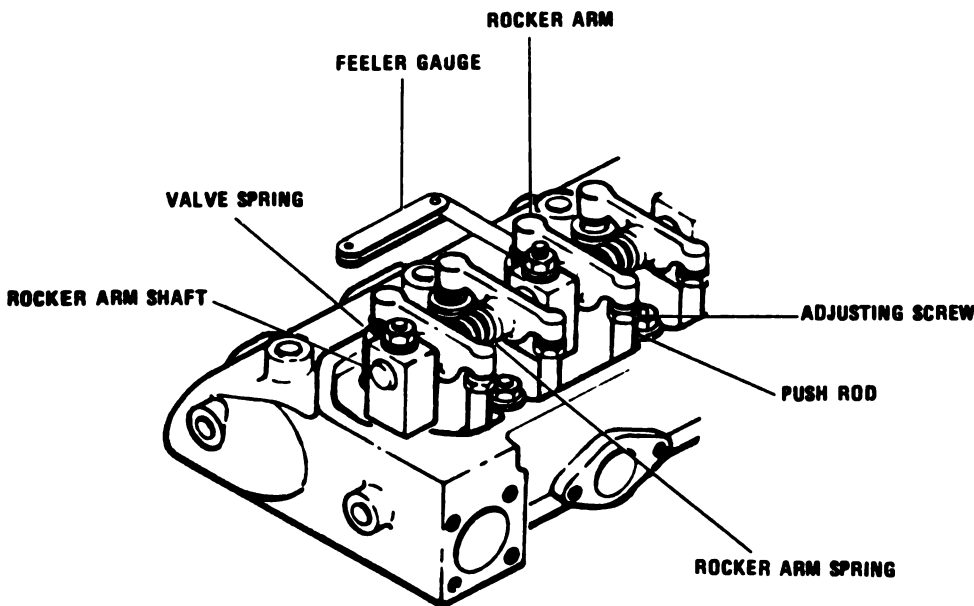
b. Connect a 15 kW load to the load terminal board (para 2-3e.).

c. Start the engine (para 2-10) and allow it to operate approximately 15 minutes at no load governed speed.

d. Refer to paragraph 2-8 and check that all engine instruments indicate normal operation.

e. Listen for abnormal sounds, such as "knocking", while the engine is operating.

f. Observe the exhaust for excessive smoke.



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Figure 3-36. Rocker arm assembly inspection and valve tappet clearance adjustment.

*g.* Visually check for excessive vibration while the engine operates.

*h.* Refer to paragraph 2-10 and apply the load to the generator.

*i.* Repeat steps *d.* through *g.* above.

*j.* Stop the generator set (para 2-11).

*k.* If any abnormalities were noted during test operation, refer to table 3-2 for reference to the applicable maintenance paragraph.

*l.* Test cylinder compression pressure as follows:

(1) Disconnect fuel pump solenoid (pump will be in off position and will not pump fuel).

(2) Refer to paragraph 3-82 and remove fuel injection nozzle holders.

(3) Use fully charged batteries and take readings at cranking speed (150 to 200 RPM).

(4) Do not operate starter more than 15 seconds at a time to prevent overheating of starter. Allow one (1) minute between cranking cycles to allow starter to cool.

(5) Readings on the gage can be used as reference between cylinders. Maximum pressure difference between cylinders is 20 percent. An extremely low reading in any one cylinder would indicate valve, head gasket or piston ring blow-by.

(6) Refer to paragraph 3-82 and install fuel injection nozzle holders.

(7) Connect fuel pump solenoid.

## Section XV. ORGANIZATIONAL MAINTENANCE OF THE GENERATOR SET CONTROLS

### 3-111. General

This paragraph contains organizational maintenance instructions for the generator set controls. The control cubicle assembly and the fault locator panel contain the controls, instruments, and indicators for controlling and monitoring the operation of the generator set. The 400 Hz and 50/60 Hz tactical precise models incorporate a governor control unit which operates the hydraulic actuator to change the governor setting. This function is fulfilled by the manual speed control on the tactical utility model. The interconnecting wiring harness provides electrical connection between the major assemblies and the control cubicle and fault indicator panel.

### 3-112. Control Cubicle Assembly

#### WARNING

The generator shall be shut off and the battery disconnected prior to performing maintenance on the control cubicle assembly. Failure to observe this warning may result in electrical shock or death by electrocution.

#### NOTE

Access to the interior of the control cubicle assembly is obtained by loosening three fasteners at the top of the panel and swinging

the panel forward on the hinge at its lower side until its weight is supported by the door holders.

#### *a.* Oil Pressure Gauge.

##### (1) Removal.

(a) Tag and remove electrical leads to oil pressure gauge.

(b) Remove nuts (1, figure 3-37), lockwashers (2) and clamp (3).

(c) Remove oil pressure gauge (4) from panel.

##### (2) Inspection and cleaning.

(a) Clean oil pressure gauge with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect oil pressure gauge for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, and evidence of other damage.

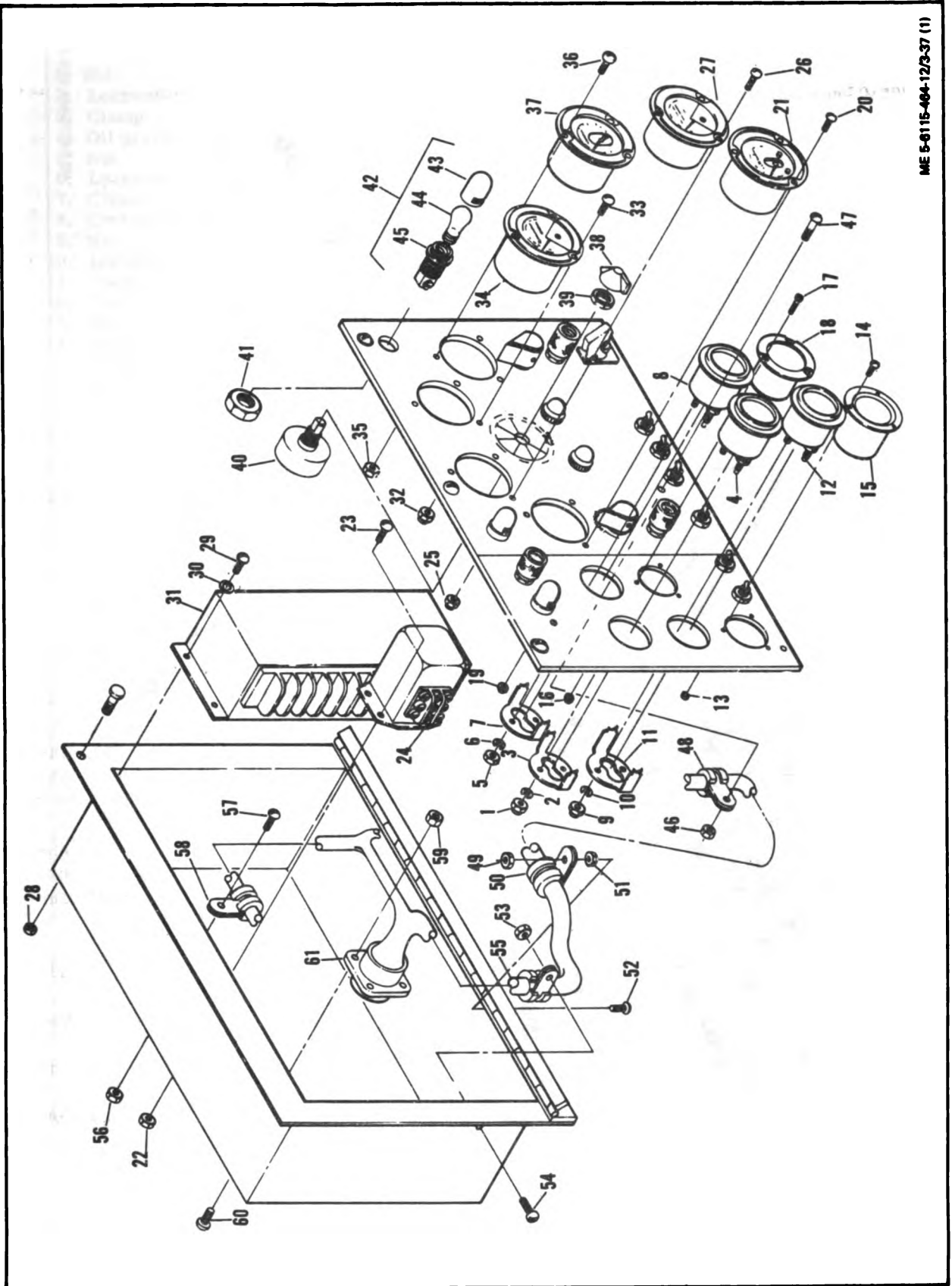
##### (3) Testing.

(a) Connect a multimeter across the terminals of a rheostat.

(b) Adjust rheostat until multimeter indicates 30 ohms resistance.

(c) Disconnect multimeter, but do not disturb rheostat adjustment.

(d) Connect rheostat to terminal of oil pressure gauge marked SEND.



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Figure 3-37. Control Cubicle Assembly, Exploded View (Sheet 1 of 3)



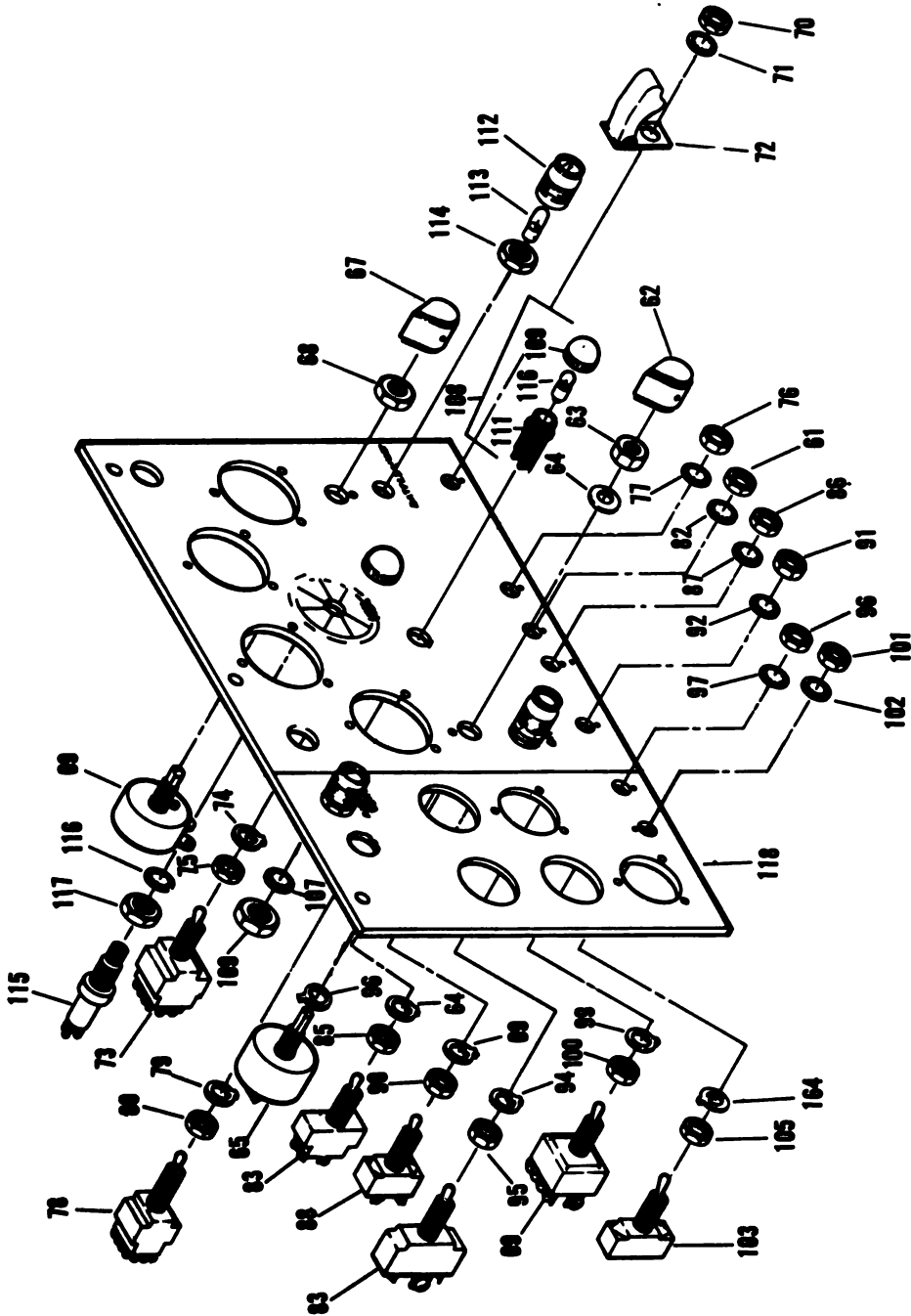


Figure 3-37. Control Cubicle Assembly, Exploded View (Sheet 2 of 3)

1. Nut
2. Lockwasher
3. Clamp
4. Oil pressure gauge
5. Nut
6. Lockwasher
7. Clamp
8. Coolant temperature gauge
9. Nut
10. Lockwasher
11. Clamp
12. Fuel level gauge
13. Self-locking nut
14. Screw
15. Hourmeter
16. Self-locking nut
17. Screw
18. Battery charging ammeter
19. Self-locking nut
20. Screw
21. Frequency meter
22. Self-locking nut
23. Screw
24. Frequency transducer
25. Self-locking nut
26. Screw
27. Kilowatt meter
28. Self-locking nut
29. Screw
30. Washer
31. Thermal watt converter
32. Self-locking nut
33. Screw
34. AC current meter
35. Self-locking nut
36. Screw
37. AC voltmeter
38. Control knob
39. Nut
40. Switch
41. Nut
42. Panel light assembly
43. Cover
44. Lamp
45. Base
46. Self-locking nut
47. Screw
48. Clamp
49. Self-locking nut
50. Clamp
51. Self-locking nut
52. Screw
53. Self-locking nut
54. Screw
55. Clamp
56. Self-locking nut
57. Screw
58. Clamp
59. Self-locking nut
60. Screw
61. Wiring harness assembly
62. Control knob
63. Nut
64. Washer
65. Frequency adjust rheostat
66. Key washer
67. Control knob
68. Nut
69. Voltage adjust rheostat
70. Nut
71. Tooth lockwasher
72. Switch guard
73. Battle short switch
74. Key washer
75. Nut
76. Nut
77. Tooth lockwasher
78. Operations switch
79. Key washer
80. Nut
81. Nut
82. Tooth lockwasher
83. Voltage sensing switch
84. Key washer
85. Nut
86. Nut
87. Tooth lockwasher
88. Panel light switch
89. Key washer
90. Nut
91. Nut
92. Tooth lockwasher
93. Circuit breaker switch
94. Key washer
95. Nut
96. Nut
97. Tooth lockwasher
98. START-RUN-STOP switch
99. Key washer
100. Nut
101. Nut
102. Tooth lockwasher
103. Engine primer switch
104. Key washer
105. Nut
106. Nut
107. Tooth lockwasher
108. Synchronizing light assembly
109. Lens
110. Lamp
111. Base
112. Lens
113. Lamp
114. Nut
115. Base
116. Tooth lockwasher
117. Nut
118. Control cubicle assembly panel

Figure 3-37. Control Cubicle Assembly, Exploded View (Sheet 3 of 3) ME 5-6115-464-12/3-37 (3)

(e) Connect rheostat and oil pressure gauge in series with a 24 Vdc source with negative lead to oil pressure gauge terminal marked IGN.

(f) Oil pressure gauge should indicate 60 PSI.

(g) Replace oil pressure gauge if it does not function properly.

(4) Installation. Install oil pressure gauge in reverse order of removal procedures.

b. Coolant Temperature Gauge.

(1) Removal.

(a) Tag and disconnect electrical leads to coolant temperature gauge.

(b) Remove nuts (5, figure 3-37, sheet 1 of 3), lockwashers (6) and clamp (7).

(c) Remove coolant temperature gauge (8) from panel.

(2) Cleaning and Inspection.

(a) Clean coolant temperature gauge with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect coolant temperature gauge for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, and evidence of other damage.

(3) Testing.

(a) Connect an ohmmeter across the wiper arm terminal and any other terminal of 10-500 ohm potentiometer.

(b) Adjust potentiometer until ohmmeter indicates 460 ohms resistance.

(c) Disconnect ohmmeter but do not disturb potentiometer adjustment.

(d) Connect potentiometer to coolant temperature gauge terminal marked SEND.

(e) Connect potentiometer and coolant temperature gauge in series with a 24 Vdc source with negative lead to temperature gauge terminal marked IGN.

(f) Coolant temperature gauge should indicate 240° F. If it does not, replace it.

(4) Installation. Install coolant temperature gauge in reverse order of removal instructions.

c. Fuel Level Gauge.

(1) Removal.

(a) Tag and disconnect electrical leads to fuel level gauge.

(b) Remove nuts (9, figure 3-37, sheet 1 of 3), lockwashers (10) and clamp (11).

(c) Remove fuel level gauge (12) from panel.

(2) Cleaning and Inspection.

(a) Clean fuel level gauge with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect fuel level gauge for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, and evidence of other damage.

(3) Testing.

(a) Connect an ohmmeter across the wiper arm terminal and any other terminal of a potentiometer.

(b) Adjust potentiometer until ohmmeter indicates 30 ohms resistance.

(c) Remove ohmmeter, but do not disturb potentiometer adjustment.

(d) Connect the fuel level gauge in series with a 24 Vdc source with the negative lead to fuel level gauge terminal marked IGN.

(e) Fuel level gauge should indicate **EMPTY**.

(f) Disconnect 24 Vdc positive lead from fuel level gauge SEND terminal and connect potentiometer adjusted to 30 ohms resistance.

(g) Fuel level gauge should indicate **FULL**.

(h) Replace fuel level gauge if it fails to function properly.

(4) Installation. Install fuel level gauge in reverse order of removal procedures.

d. Hourmeter.

(1) Removal.

(a) Tag and disconnect electrical leads to hourmeter.

(b) Remove self-locking nuts (13, figure 3-37, sheet 1 of 3), and screws (14).

(c) Remove hourmeter (15) from panel.

(2) Cleaning and Inspection.

(a) Clean hourmeter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect hourmeter for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) Testing. Connect hourmeter to a 24 Vdc source and observe for proper operation. Replace hourmeter if it fails to operate correctly.

(4) Installation. Install hourmeter in reverse order of removal procedures.

e. Battery Charging Ammeter.

(1) Removal.

(a) Tag and disconnect electrical leads to battery charging ammeter.

(b) Remove self-locking nuts (16, figure 3-37, sheet 1 of 3) and screws (17).

(c) Remove battery charging ammeter (18) from panel.

(2) Cleaning and Inspection.

(a) Clean battery charging ammeter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect battery charging ammeter for corrosion, cracked casing, cracked or broken glass, evidence of shorting, stripped or otherwise damaged threads and other damage.

(c) Testing. If the battery charging ammeter is suspected of being faulty, temporarily substitute a known functional meter in its place. If the same readings are obtained with the substitute meter, the original is operational and need not be replaced.

(4) Installation. Install battery charging ammeter in reverse order of removal procedures.

f. Frequency Meter.

(1) Removal.

(a) Tag and disconnect electrical leads to frequency meter.

(b) Remove self-locking nuts (19, figure 3-37, sheet 1 of 3) and screws (20).

(c) Remove frequency meter (21) from panel.

(2) Cleaning and Inspection.

(a) Clean frequency meter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect frequency meter for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, evidence of shorting, and other damage.

(3) Installation. Install frequency meter in reverse order of removal procedures.

NOTE

The frequency meter and frequency transducer are matched components and shall be replaced as such.

g. Frequency Transducer.

(1) Removal.

(a) Tag and disconnect electrical leads to frequency transducer.

(b) Remove self-locking nuts (22, figure 3-37, sheet 1 of 3) and screws (23).

(c) Remove frequency transducer (24) from control cubicle.

(2) Cleaning and Inspection.

(a) Clean frequency transducer with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect frequency transducer for dents, cracks, corrosion, and other damage.

(3) Installation. Install frequency transducer in reverse order of removal.

h. Kilowatt Meter.

(1) Removal.

(a) Tag and disconnect electrical leads to kilowatt meter.

(b) Remove self-locking nuts (25, figure 3-37, sheet 1 of 3) and screws (26).

(c) Remove kilowatt meter (27) from panel.

(2) Cleaning and Inspection.

(a) Clean kilowatt meter with filtered

compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect kilowatt meter for corrosion, cracked casing, cracked or broken glass, stripped or damaged threads, and evidence of shorting or other damage.

(3) Installation. Install kilowatt meter in reverse order of removal procedures.

i. Thermal Watt Converter.

(1) Removal.

(a) Tag and disconnect electrical leads to thermal watt converter.

(b) Remove self-locking nuts (28, figure 3-37, sheet 1 of 3), screws (29) and washers (30) to remove thermal watt converter (31) from control cubicle assembly.

(2) Cleaning and Inspection.

(a) Clean thermal watt converter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect thermal watt converter for dents, cracks, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) Installation. Install thermal watt converter in reverse order of removal procedures.

j. AC Current Meter.

(1) Removal.

(a) Tag and disconnect electrical leads to AC current meter.

(b) Remove self-locking nuts (32, figure 3-37, sheet 1 of 3) and screws (33) to remove AC current meter (34) from panel.

(2) Cleaning and Inspection.

(a) Clean AC current meter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect AC current meter for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads and evidence of shorting or other damage.

(3) Installation. Install AC current meter in reverse order of removal procedures.

k. AC Voltmeter.

(1) Removal.

(a) Tag and disconnect electrical leads to AC voltmeter.

(b) Remove self-locking nuts (35, figure 3-37, sheet 1 of 3) and screws (36) to remove AC voltmeter (37).

(2) Cleaning and Inspection.

(a) Clean AC voltmeter with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect AC voltmeter for corrosion, cracked casing, cracked or broken glass, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) Testing. If an AC voltmeter is suspected of being faulty, test by temporarily replacing with another which is known to be serviceable. If the incorrect reading persists, the original meter is serviceable and should be reinstalled.

(4) Installation. Install AC voltmeter in reverse order of removal procedures.

l. Volts-Amps Transfer Switch.

(1) Removal.

(a) Tag and disconnect electrical leads to volts-amps transfer switch.

(b) Loosen setscrews in control knob (38, figure 3-37, sheet 1 of 3) and remove knob.

(c) Remove nut (39) to remove switch (40) from panel.

(2) Cleaning and Inspection.

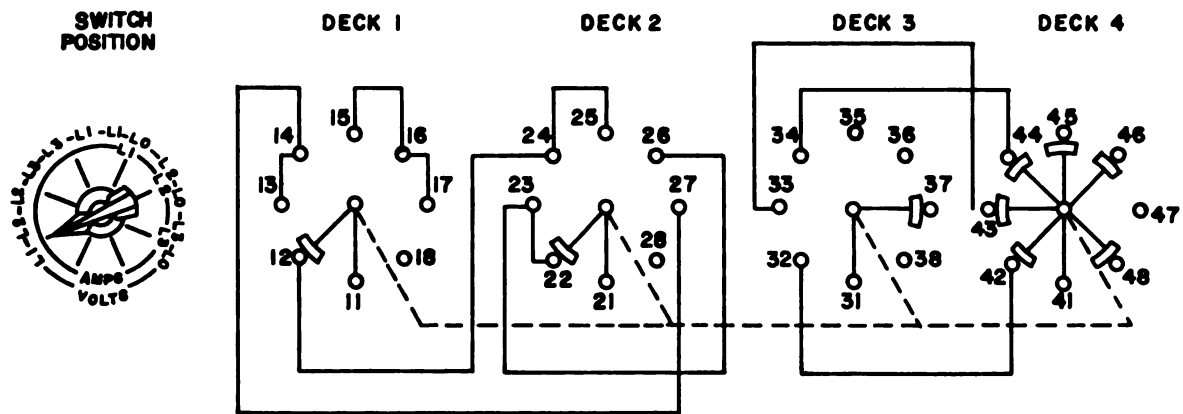
(a) Clean volts-amps transfer switch with filtered compressed air or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect volts-amps transfer switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) Testing.

(a) Rotate switch shaft counterclockwise as far as it will go. This places switch in L1-L2 volts position.

(b) Check switch for continuity with a multimeter using schematic of figure 3-38 as a guide.



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Figure 3-38. Volts-Amps Transfer Switch Schematic Diagram

(c) Rotate switch shaft clockwise to the next position and again check switch continuity.

**NOTE**

The wiper contacts shown in figure 3-38 rotate clockwise to the next set of stationary contacts when the switch shaft is rotated clockwise to the next position.

(d) Continue rotating switch shaft and checking continuity until all six positions have been checked.

(e) If a discontinuity is noted in any switch position, switch is unserviceable and shall be replaced.

(4) Installation. Install volts-amps transfer switch in reverse order of removal procedures.

**m. Panel Light Assemblies.**

**(1) Removal and Disassembly.**

(a) Tag and disconnect electrical leads to panel light assemblies.

(b) Remove nut (41, figure 3-37, sheet 1 of 3) to remove panel light assemblies (42).

(c) Remove covers (43) and unscrew lamps (44) from bases (45).

**(2) Cleaning and Inspection.**

(a) Clean panel light assemblies with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect base for corrosion, cracks, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(c) Visually inspect lamp for corrosion, burned out filament, and stripped or otherwise damaged threads.

(d) Visually inspect covers for cracks, corrosion, stripped or damaged threads and other damage.

(e) Replace any damaged or defective parts.

(3) **Assembly and Installation.** Assemble and install panel light assemblies in reverse order of removal and disassembly procedures.

n. **Control Cubicle Wiring Harness Assembly.**

(1) **Removal.**

(a) Tag and disconnect electrical leads to control cubicle assembly.

(b) Remove self-locking nut (46, figure 3-37, sheet 1 of 3) and screw (47) to remove clamp (48).

(c) Remove self-locking nut (49) to remove clamp (50). Do not remove self-locking nut (51) and screw (52) unless replacement is necessary.

(d) Remove self-locking nut (53) and screw (54) to remove clamp (55).

(e) Remove self-locking nut (56) and screw (57) to remove clamp (58).

(f) Remove self-locking nut (59) and screws (60) to remove wiring harness assembly (61).

(2) **Cleaning and Inspection.**

(a) Clean wiring harness assembly with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect wiring harness connector for cracks, corrosion, bent or broken pins, and stripped or damaged threads.

(c) Inspect insulation for burns, chafing, and deterioration.

(d) Check electrical leads for burned, bent, corroded, damaged or missing terminals.

(3) **Testing.** Check continuity of individual wires with a multimeter or continuity light using figures FO-1 and FO-2 as a guide.

**CAUTION**

Do not use acid core solder on electrical wiring. See appropriate manual in Appendix A for wiring installation practices.

(4) **Repair.** Replace damaged wires, terminals, and connector by unsoldering connections, installing replacement parts and soldering connections.

**NOTE**

If more than 30 percent of the wires are damaged or have been repaired, replace the wiring harness and forward it to high level maintenance for rebuilding.

(5) **Installation.** Install control cubicle wiring harness assembly in reverse order of removal procedures.

o. **Frequency Adjust Rheostat (Precise Sets Only).**

(1) **Removal.**

(a) Tag and disconnect electrical leads to frequency adjust rheostat.

(b) Loosen setscrew in control knob (62, figure 3-37, sheet 2 of 3), then remove knob from rheostat shaft.

(c) Remove nut (63), washer (64) and keyed washer (66) to remove rheostat from panel.

(2) **Cleaning and Inspection.**

(a) Clean rheostat with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect rheostat for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) **Testing.**

(a) Connect an ohmmeter across outer terminals of rheostat. Ohmmeter should indicate 500 ohms resistance.

(b) Rotate rheostat shaft counterclockwise as far as it will go.

(c) Connect ohmmeter between center terminal and either outer terminal. Ohmmeter should indicate 0 ohms resistance.

(d) Slowly, at an even rate, rotate the rheostat shaft clockwise as far as it will go. Ohmmeter should increase at an even rate from 0 to 500 ohms.

(e) If ohmmeter indication changes irrationally or is not 500 ohms when the rotation is completed, the rheostat is defective and shall be replaced.

(4) **Installation.** Install frequency adjust rheostat in reverse order of removal procedures.

**p. Voltage Adjust Rheostat.**

**(1) Removal.**

(a) Tag and disconnect electrical leads to voltage adjust rheostat.

(b) Loosen setscrew in control knob (67, figure 3-37, sheet 2 of 3) and remove knob from rheostat shaft.

(c) Remove nut (68) to remove rheostat (69).

**(2) Cleaning and Inspection.**

(a) Clean voltage adjust rheostat with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect rheostat for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

**(3) Testing.**

(a) Connect an ohmmeter across two outer terminals of rheostat. Indication shall be 250 ohms resistance.

(b) Rotate rheostat shaft counterclockwise as far as it will go.

(c) Connect ohmmeter between center terminal and either outer terminal.

(d) Slowly, at an even rate, rotate rheostat shaft clockwise as far as it will go while observing the ohmmeter.

(e) Ohmmeter indication shall increase, at an even rate, from 0 to 250 ohms resistance.

(f) If ohmmeter indication changes irrationally, or is not 250 ohms when rotation is complete, the rheostat is defective and shall be replaced.

(4) Installation. Install voltage adjust rheostat in reverse order of removal procedures.

**q. Battle Short Switch.**

**(1) Removal.**

(a) Tag and disconnect electrical leads to battle short switch.

(b) Remove nut (70, figure 3-37, sheet 2 of 3) and tooth lockwasher (71) to remove switch guard (72), battle short switch (73) and key washer (74).

(c) Do not remove nut (75) unless inspection reveals damage and replacement is necessary.

**(2) Cleaning and Inspection.**

(a) Clean switch and switch guard with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved cleaning solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or damage.

(c) Check switch guard for cracks, breaks, and other damage.

**(3) Testing.**

(a) Place switch in ON position (lever away from switch mounting bushing key way).

(b) Using an ohmmeter, check for continuity between each center terminal and the corresponding upper terminal.

(c) Place switch in OFF position.

(d) Check for continuity between each center terminal and corresponding lower terminal.

(e) Replace switch if any discontinuity is noted.

(4) Installation. Install battle short switch in reverse order of removal procedures.

**r. Operations Switch.**

**(1) Removal.**

(a) Tag and disconnect electrical leads to operations switch.

(b) Remove nut (76, figure 3-37, sheet 2 of 3) and tooth lockwasher (77), to remove operations switch (78) and key washer (79). Do not remove nut (80), unless inspection reveals damage and replacement is necessary.

**(2) Cleaning and Inspection.**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved cleaning solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped, or otherwise damaged threads, and evidence of shorting or other damage.

**(3) Testing.**

(a) Place switch in PARALLEL OPERATION position (lever away from mounting post key way).

(b) Using an ohmmeter, check for continuity between each center terminal and corresponding upper terminal.



(c) Place switch in **SINGLE UNIT OPERATION** position (lever toward mounting post key way).

(d) Check for continuity between each center terminal and corresponding lower terminal.

(e) Replace switch if any discontinuity is noted.

(4) **Installation.** Install operations switch in reverse order of removal procedures.

**s. Voltage Sensing Switch.**

(1) **Removal.**

(a) Tag and disconnect electrical leads to switch.

(b) Remove nut (81, figure 3-37, sheet 2 of 3) and tooth lockwasher (82) to remove switch (83) and key washer (84). Do not remove nut (85) from switch.

(2) **Cleaning and Inspection.**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) **Testing.**

(a) Place voltage sensing switch in **REMOTE** position (lever away from mounting post key way).

(b) Using an ohmmeter, check for continuity between center terminal and corresponding upper terminal.

(c) Place switch in **LOCAL** position (lever toward mounting post key way).

(d) Check for continuity between each center terminal and corresponding lower terminal.

(e) Replace switch if any discontinuity is noted.

(4) **Installation.** Install voltage sensing switch in reverse order of removal procedures.

**t. Panel Light Switch.**

(1) **Removal.**

(a) Tag and disconnect electrical leads to switch.

(b) Remove nut (86, figure 3-37, sheet 2 of 3) and tooth lockwasher (87) to remove switch (88) and key washer (89).

(c) Do not remove nut (90) from switch.

(2) **Cleaning and Inspection.**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

(3) **Testing.**

(a) Place switch in **OFF** position (lever toward mounting post key way).

(b) Using an ohmmeter, check for open circuit across switch terminals.

(c) Place switch in **ON** position (lever away from key way).

(d) Check for continuity across switch terminals.

(e) Replace switch if it fails to function properly.

(4) **Installation.** Install panel light switch in reverse order of removal procedures.

**u. Circuit Breaker Switch.**

(1) **Removal.**

(a) Tag and disconnect electrical leads to switch.

(b) Remove nut (91, figure 3-37, sheet 2 of 3) and tooth lockwasher (92) to remove switch (93) and key washer (94).

(c) Do not remove nut (95) unless inspection reveals damage and replacement is necessary.

(2) **Cleaning and Inspection**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads and evidence of shorting or other damage.

(3) **Testing.**

(a) Place switch in **OPEN** position (lever toward mounting post key way).

(b) Using an ohmmeter, check for continuity between terminals 1 and 2 and between terminals 4 and 5 (figures FO-1 and FO-2).

**NOTE**

Terminal markings are also on the switch.

(c) Place switch in the CLOSED position (lever away from mounting post key way).

(d) Using an ohmmeter check for continuity between terminals 2 and 3 and between terminals 5 and 6.

(e) Place switch in CENTER position.

(f) Using an ohmmeter, check for continuity between terminals 1 and 2 and between terminals 5 and 6.

(g) Replace switch if it fails any of the above tests.

(4) Installation. Install circuit breaker switch in reverse order of removal procedures.

**v. START-RUN-STOP switch.**

**(1) Removal.**

(a) Tag and disconnect electrical leads to switch.

(b) Remove nut (96, figure 3-37, sheet 2 of 3) and tooth lockwasher (97) to remove switch (98) and key washer (99).

(c) Do not remove nut (100) unless inspection reveals damage and replacement is necessary.

**(2) Cleaning and Inspection.**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

**(3) Testing.**

(a) Place switch in STOP position (lever toward mounting post key way).

(b) Using an ohmmeter, check for open circuit between terminals 2 and 3, 5 and 6, 8 and 9, and 11 and 12 (figures FO-1 and FO-2). All circuits shall be open.

(c) Place switch in RUN position.

(d) Check for continuity between terminals 2 and 3 and terminals 8 and 9. Both circuits shall have continuity.

(e) Check for open circuit between terminals 5 and 6.

(f) Place switch in START position (lever away from mounting post key way).

(g) Check for continuity between terminals 2 and 3, 5 and 6, 8 and 9 and 11 and 12. All circuits shall indicate continuity.

(h) Replace switch if it fails any of the above tests.

(4) Installation. Install START-RUN-STOP switch in reverse order of removal procedures.

**w. Engine Primer Switch.**

**(1) Removal.**

(a) Tag and disconnect electrical leads to ENGINE PRIMER switch.

(b) Remove nut (101, figure 3-37, sheet 2 of 3) and tooth lockwasher (102) to remove switch (103) and key washer (104).

(c) Do not remove nut (105) unless inspection reveals damage and replacement is necessary.

**(2) Cleaning and Inspection.**

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracked casing, corrosion, stripped or otherwise damaged threads, and evidence of shorting or other damage.

**(3) Testing.**

(a) Using an ohmmeter, check for open circuit across terminals. Ohmmeter shall indicate open circuit.

(b) Hold switch lever in ON position (toward mounting post key way) and check ohmmeter indication. Ohmmeter shall indicate continuity.

(c) Replace switch if it fails either of the above tests.

(4) Installation. Install switch in reverse order of removal procedures.

**x. Synchronizing Light Assemblies.**

**(1) Removal and Disassembly.**

(a) Tag and disconnect electrical leads to synchronizing light assemblies.

(b) Remove nuts (106, figure 3-37, sheet 2 of 3) and tooth lockwashers (107) to remove synchronizing light assemblies (108).

(c) Unscrew lens (109). Depress lamps (110) and rotate counterclockwise to remove from bases (111).

(2) **Cleaning and Inspection.**

(a) Clean synchronizing light assemblies with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect bases for cracks, corrosion, stripped or otherwise damaged threads, and evidence of shorting.

(c) Inspect lens for cracks, breaks, and stripped or otherwise damaged threads.

(d) Inspect lamps for corrosion, cracked or broken glass, and burned out filament.

(e) Replace any damaged or defective parts.

(3) **Assembly and Installation.** Assemble and install synchronizing light assemblies in reverse order of removal and disassembly procedures.

y. **Air Cleaner Condition, Circuit Breaker and Battle Short Indicator Light Assemblies.**

(1) **Removal.**

(a) Tag and disconnect electrical leads to indicator light assemblies.

(b) Remove lens (112, figure 3-37, sheet 2 of 3). Press in and rotate counterclockwise to remove lamps (113).

(c) Remove nuts (114) to remove bases (115), and tooth lockwashers (116) from control cubicle assembly panel (118).

(d) Do not remove nuts (117) unless inspection reveals damage and replacement is necessary.

(2) **Cleaning and Inspection.**

(a) Clean indicator light assembly with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect base for cracks, corrosion, stripped or otherwise damaged threads, and evidence of shorting.

(c) Inspect lamp for cracked or broken glass, corrosion, and burned out filament.

(d) Check lens for cracked or broken glass, cracks, and stripped or otherwise damaged threads.

(e) Replace any damaged or defective parts.

(3) **Installation.** Install indicator light assembly in reverse order of removal procedures.

**NOTE**

Air cleaner condition and battle short indicator lights have red lens. Circuit breaker indicator light has amber lens.

3-113. **FAULT LOCATING INDICATOR.**

a. **Inspection.** Inspect fault locating indicator for cracks, corrosion, cracked or broken indicator light lens, missing hardware and other damage.

b. **Testing.** Depress test or reset switch and check that all indicator lights are lit.

c. **Lamp Replacement.**

(1) Unscrew lens (figure 3-39) and remove lamp.

(2) Visually inspect lamp for corrosion, cracked or broken glass, and burned out filament.

(3) Replace lamp if defective.

(4) Install lamps and lens.

d. **Fuse Replacement.**

(1) Unscrew cap (figure 3-39) and remove fuse.

(2) Visually inspect fuse for corrosion, cracked or broken glass, and melted conductor.

(3) Replace fuse if defective.

(4) Install fuse and cap.

e. **Removal.**

(1) Disconnect wiring harness from back of fault locating indicator.

(2) Remove screws (1, figure 3-39.1) and lockwashers (2) to remove fault locating indicator from generator set.

f. **Disassembly.**

(1) Remove screw and captive washer assemblies (3) and cover plate (4).

(2) Remove screw and captive washer assemblies (5) and carefully pull indicator panel assembly (6) away from housing. Tag and disconnect electrical leads.

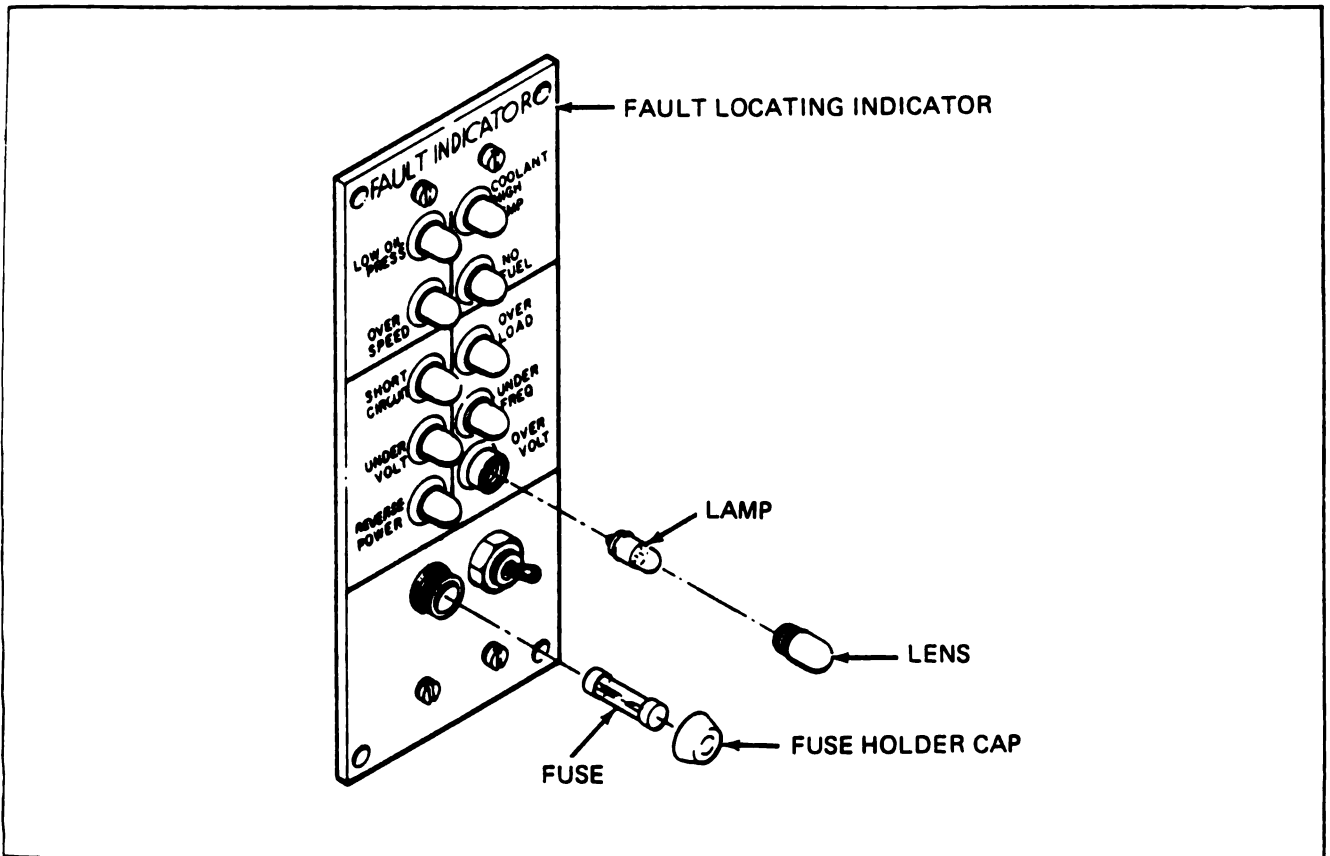


Figure 3-39. Fault Locating Indicator Lamp and Fuse Replacement

(3) Disassemble panel assembly (items 7 through 24) only as is necessary for replacement of damaged or defective components.

(4) Remove screw and captive washer assemblies (25) to remove cover plate assembly (26). Tag and disconnect electrical leads.

(5) Disassemble cover plate assembly (items 27 through 32) only as is necessary for testing and replacement of components.

(6) Remove screw and captive washer assemblies (33) to remove wiring harness (34) from housing (35).

g. Installation. Installation of the fault locating indicator is the reverse order of disassemble and removal.

### 3-114. MANUAL SPEED CONTROL

#### a. Inspection.

(1) Inspect manual speed control knob (figure 3-40) for cracks, breaks, and other damage and condition of boot.

(2) Inspect control cable assembly for corrosion, pinched, frayed, or otherwise damaged cable, pinched or damaged housing, insecure mounting, and stripped or otherwise damaged adjusting threads.

#### b. Testing.

(1) On precise models of the generator set, the manual speed control must be connected as follows.

(a) Push manual speed control all the way in.

(b) Insert manual speed control cable through sleeve of fuel injection pump manual throttle control arm (figure 3-40).

(c) Install and tighten adjustment screw.

(d) Install lockwire.

(2) Check manual speed control for unrestricted movement.

(3) Refer to paragraph 2-10 and start the generator set.

(4) Use the manual speed control to set generator output frequency.

(5) Rotate the control knob 90 degrees. Frequency change shall not exceed 1 percent for a 90 degree rotation (0.6 Hz for 50/60 Hz generator sets and 4 Hz for 400 Hz generator sets).

(6) Replace manual speed control if it fails any of the above tests or inspections.

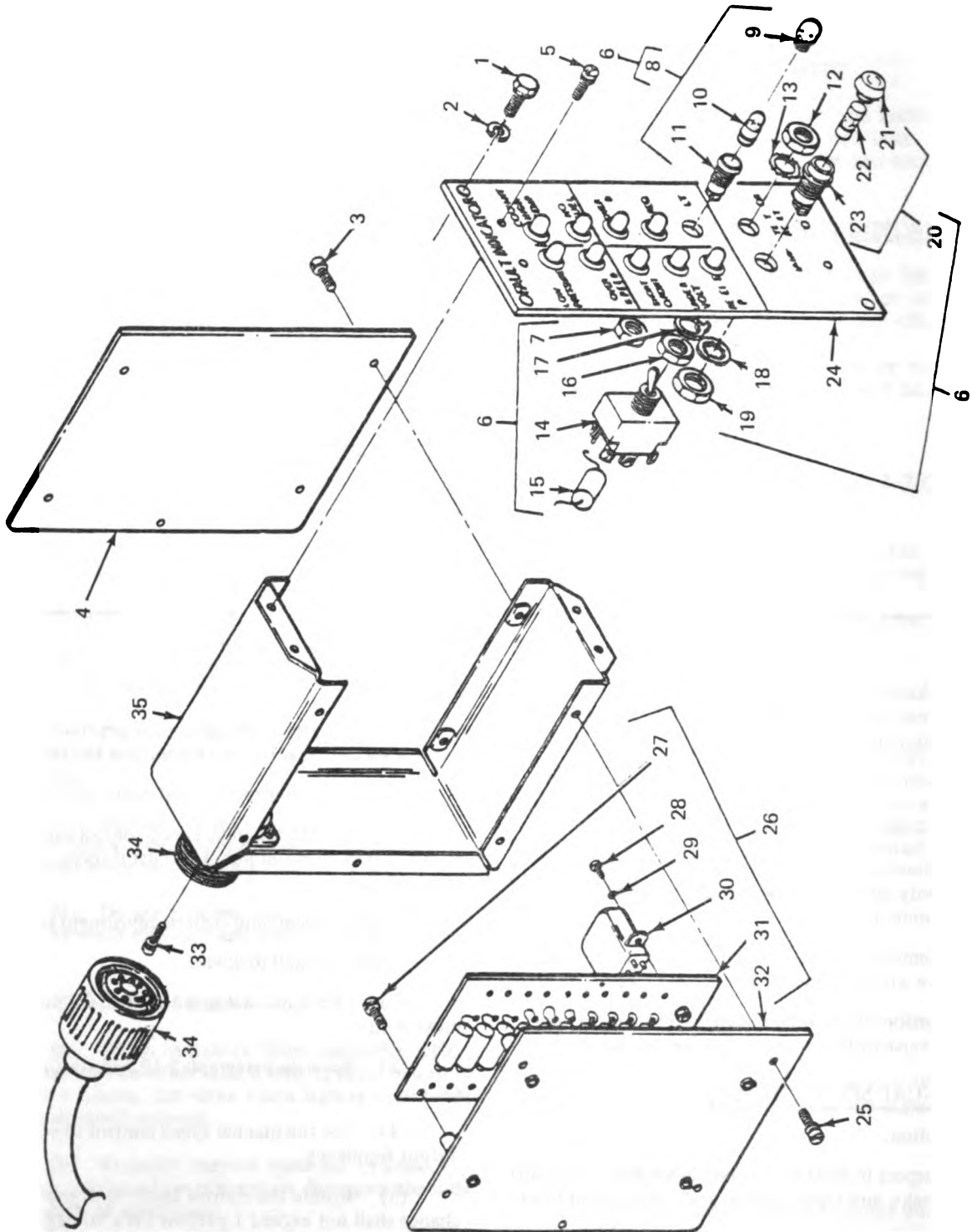


Figure 3-39.1 Fault Locating Indicator, Exploded View (Sheet 1 of 2)

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 1. Screw                         | 19. Tooth lockwasher              |
| 2. Lockwasher                    | 20. Fuse holder assembly          |
| 3. Screw and captive washer assy | 21. Cap                           |
| 4. Cover plate                   | 22. Fuse                          |
| 5. Screw and captive washer assy | 23. Fuse holder                   |
| 6. Indicator panel assembly      | 24. Panel                         |
| 7. Nut                           | 25. Screw and captive washer assy |
| 8. Indicator light assembly      | 26. Cover plate assy              |
| 9. Lens                          | 27. Screw and captive washer assy |
| 10. Lamp                         | 28. Screw                         |
| 11. Base                         | 29. Lockwasher                    |
| 12. Nut                          | 30. Relay                         |
| 13. Tooth lockwasher             | 31. Component board assembly      |
| 14. Test or reset switch         | 32. Cover plate                   |
| 15. Capacitor                    | 33. Screw and captive washer assy |
| 16. Nut                          | 34. Wiring harness                |
| 17. Positioning washer           | 35. Housing                       |
| 18. Nut                          |                                   |

Figure 3-39.1 Fault Locating Indicator, Exploded View (Sheet 2 of 2)

c. Replacement.

(1) Removal.

- (a) Loosen adjustment screw (figure 3-40) and remove cable from sleeve.
- (b) Remove nut and lockwasher, screw, and clip.
- (c) Remove nut and washer to remove manual speed control cable assembly and grommet.

- (d) Do not remove screws, lockwashers and mounting bracket unless inspection revealed damage.

NOTE

See paragraph 3-59 for emergency conversion from tactical precise to tactical utility and for reconfiguration back to tactical precise.

(2) Cleaning.

- (a) Clean all metal manual speed control parts in an approved solvent and dry thoroughly.

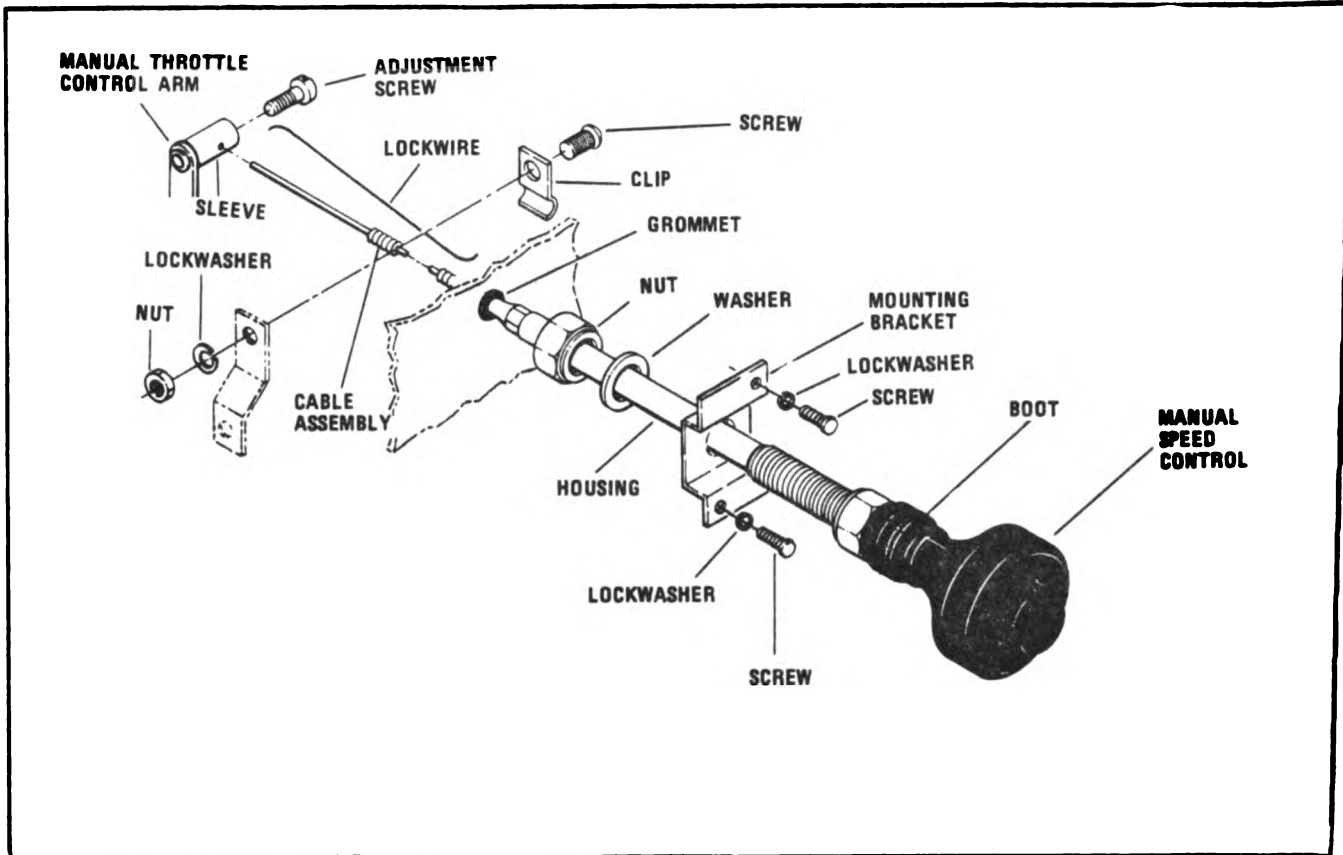


Figure 3-40. Manual Speed Control, Exploded View

(b) Clean boot on manual speed control knob with soap and water.

(3) Installation. Install manual speed control in reverse order of removal procedures.

### 3-115. DC CONTROL CIRCUIT BREAKER.

#### a. Removal.

(1) Tag and disconnect electrical leads to DC circuit breaker (figure 3-41).

(2) Remove mounting nut and tooth lockwasher to remove circuit breaker.

#### b. Cleaning and Inspection.

(1) Clean DC circuit breaker with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect circuit breaker for cracks, corrosion, stripped or damaged threads and evidence of shorting or other damage.

#### c. Testing.

(1) Using an ohmmeter, check for open circuit across circuit breaker terminals.

(2) Depress circuit breaker button and check ohmmeter indication. Ohmmeter shall indicate continuity.

(3) Replace circuit breaker if above test requirements are not met.

d. Installation. Install DC circuit breaker in reverse order of removal procedures.

### 3-116. LOAD MEASURING UNIT.

#### a. Removal.

(1) Tag and disconnect electrical connector from load measuring unit (figure 3-42).

(2) Remove screws and tooth lockwashers to remove load measuring unit.

#### b. Cleaning and Inspection.

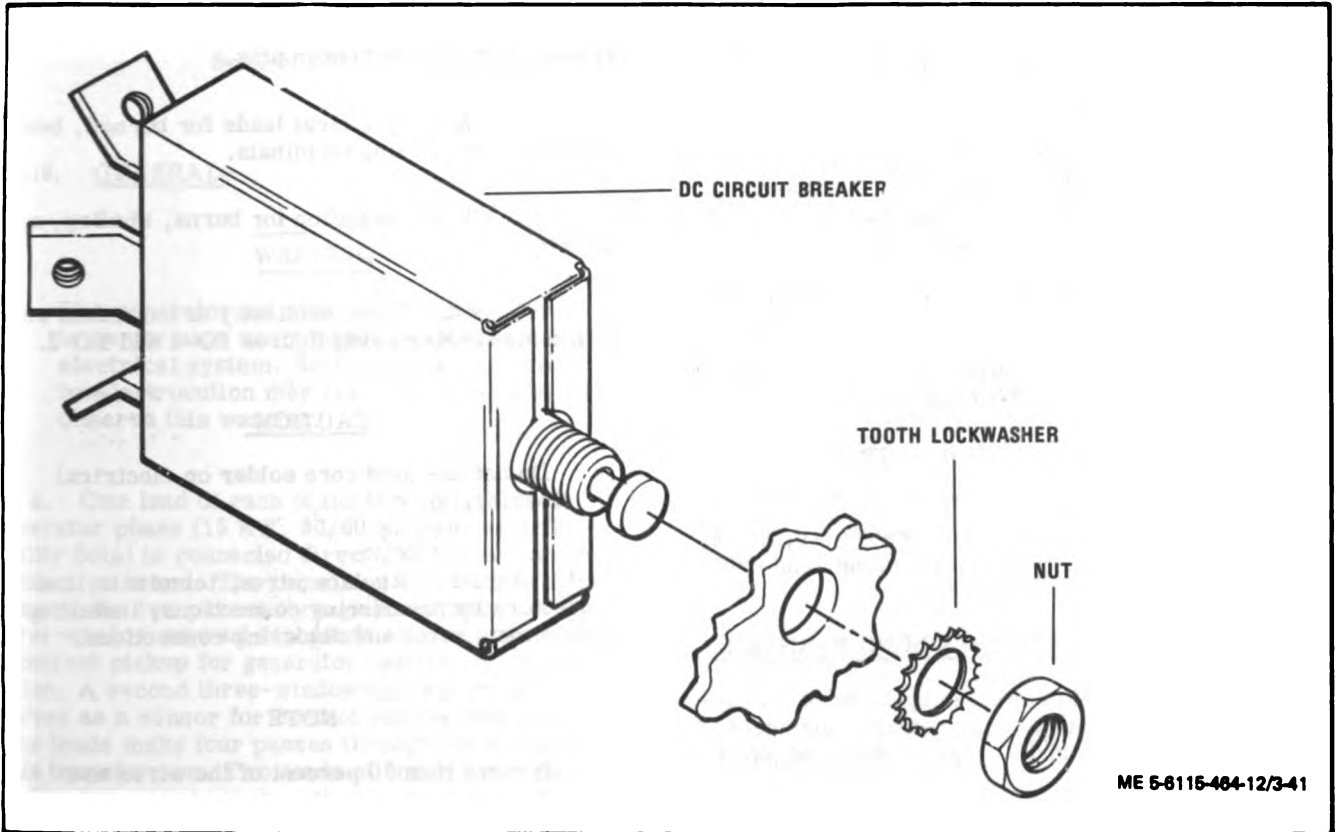


Figure 3-41. DC Circuit Breaker, Removal and Installation

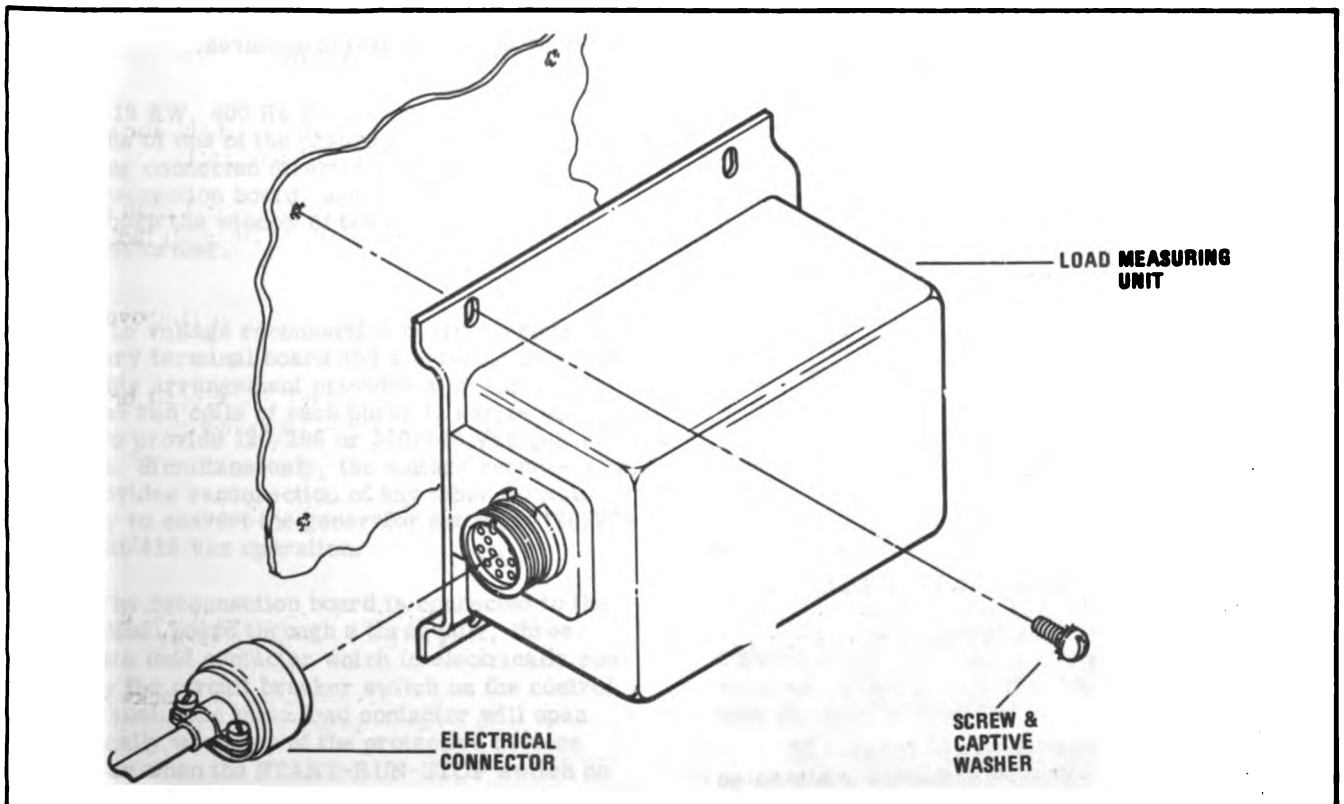


Figure 3-42. Load Measuring Unit, Removal and Installation

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(1) Clean load measuring unit with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect load measuring unit for cracks, dents, corrosion, stripped or damaged threads, bent or broken connector pins, and evidence of shorting or other damage.

(3) Replace load measuring unit if damaged or inoperable.

c. Installation. Install load measuring unit in reverse order of removal procedures.

3-117. GOVERNOR CONTROL UNIT (Precise Sets Only).

Inspect governor control unit for cracks, dents, insecure connectors, insecure mounting, and evidence of shorting or other damage.

3-118. INTERCONNECTING WIRING HARNSSES.

a. Removal. Remove wiring harness terminals, wires, and connectors as required for access to other components and to replace damaged parts.

b. Cleaning and Inspection.

(1) Clean wiring harness with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect connector for corrosion, cracks, and bent or broken pins.

(3) Check electrical leads for burned, bent, corroded, or missing terminals.

(4) Check insulation for burns, shafing, and deterioration.

c. Testing. Test continuity of individual wires with a multimeter using figures FO-1 and FO-2.

CAUTION

Do not use acid core solder on electrical wiring.

d. Repair. Replace wires, terminals, and connectors by unsoldering connections, installing replacement parts and soldering connections.

NOTE

If more than 30 percent of the wires are damaged, replace the wiring harness and forward it to higher level maintenance for rebuilding.

e. Installation. Install wiring harness in reverse order of removal procedures.

Section XVI. ORGANIZATIONAL MAINTENANCE OF THE GENERATOR  
ELECTRICAL SYSTEM

3-119. GENERAL.

WARNING

The generator set shall be shut down prior to performing maintenance on the generator electrical system. Serious injury or death by electrocution may result from failure to observe this warning.

a. One lead of each of the two coils of each generator phase (15 KW, 50/60 Hz Precise and Utility Sets) is connected directly to the voltage reconnection board. The remaining two leads of each phase make two passes through the windows of a three-window current transformer which serves as a current pickup for generator exciter voltage regulation. A second three-window current transformer serves as a sensor for control cubicle instruments. The leads make four passes through the windows of this transformer. Two leads of one of the phases makes two passes through a single-window cross-current transformer which senses current for reactive power measurement. Local voltage sensing and adjustment are accomplished across a single coil of the remaining phase. (See FO-1.)

NOTE

On 15 KW, 400 Hz Precise Sets, two leads of one of the phases, instead of being connected directly to the voltage reconnection board, are routed to pass through the window of the cross-current transformer.

b. The voltage reconnection board consists of a stationary terminal board and a movable link-type board. This arrangement provides a means of connecting the two coils of each phase in series or parallel to provide 120/208 or 240/416 Vac generator output. Simultaneously, the voltage reconnection board provides reconnection of any other circuits necessary to convert the generator set from 120/208 Vac to 240/416 Vac operation.

c. The reconnection board is connected to the load terminal board through a three pole, three phase main load contactor which is electrically controlled by the circuit breaker switch on the control cubicle panel. The main load contactor will open automatically when any of the protective devices actuates or when the START-RUN-STOP switch on the control cubicle panel is placed in the STOP position.

d. The generator electrical system also contains a 125 V, 15 amp duplex convenience receptacle which is equipped with a spring-loaded protective cover and protected by a 15-amp circuit breaker.

e. Generator output voltage is controlled by a solid state type regulator which is adjusted by the voltage adjust rheostat on the control cubicle panel. Voltage sensing may be local (at the generator set) or from a remote location. The voltage regulator permits parallel operation of generator sets by cross connection through the paralleling receptacles on the precise generator sets. Utility sets are not interconnected but the dummy plugs must be installed.

NOTE

If operating on 240/416 V and remote sensing is required, a 2:1 transformer must be supplied.

f. The tactical relay box, which is common to all three models, contains relays to shut down the generator set upon actuation of the over voltage, short circuit, overloaded, and reverse power protective devices. It also houses the current transformer load resistors.

g. The special relay box, which is found on all three models of the generator sets, contains the remainder of the protective devices and the voltage regulator paralleling controls.

h. The precise relay box, which is found only on precise models of the generator set, contains the paralleling controls for the electric governor and the fixed resistors of the frequency adjustment system. The precise relay box of the 50/60 Hz precise model is equipped with a frequency selector switch.

3-120. VOLTAGE RECONNECTION BOARD.

a. Removal.

(1) Remove screws and lockwashers to remove voltage reconnection board and spacers.

(2) Tag and disconnect electrical leads to voltage reconnection board assembly (figure 3-43).

b. Cleaning and Inspection.

(1) Clean reconnection board assembly with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect terminal board for burned or corroded terminals and links, cracked or broken insulation, links and terminals, and stripped or otherwise damaged threads.

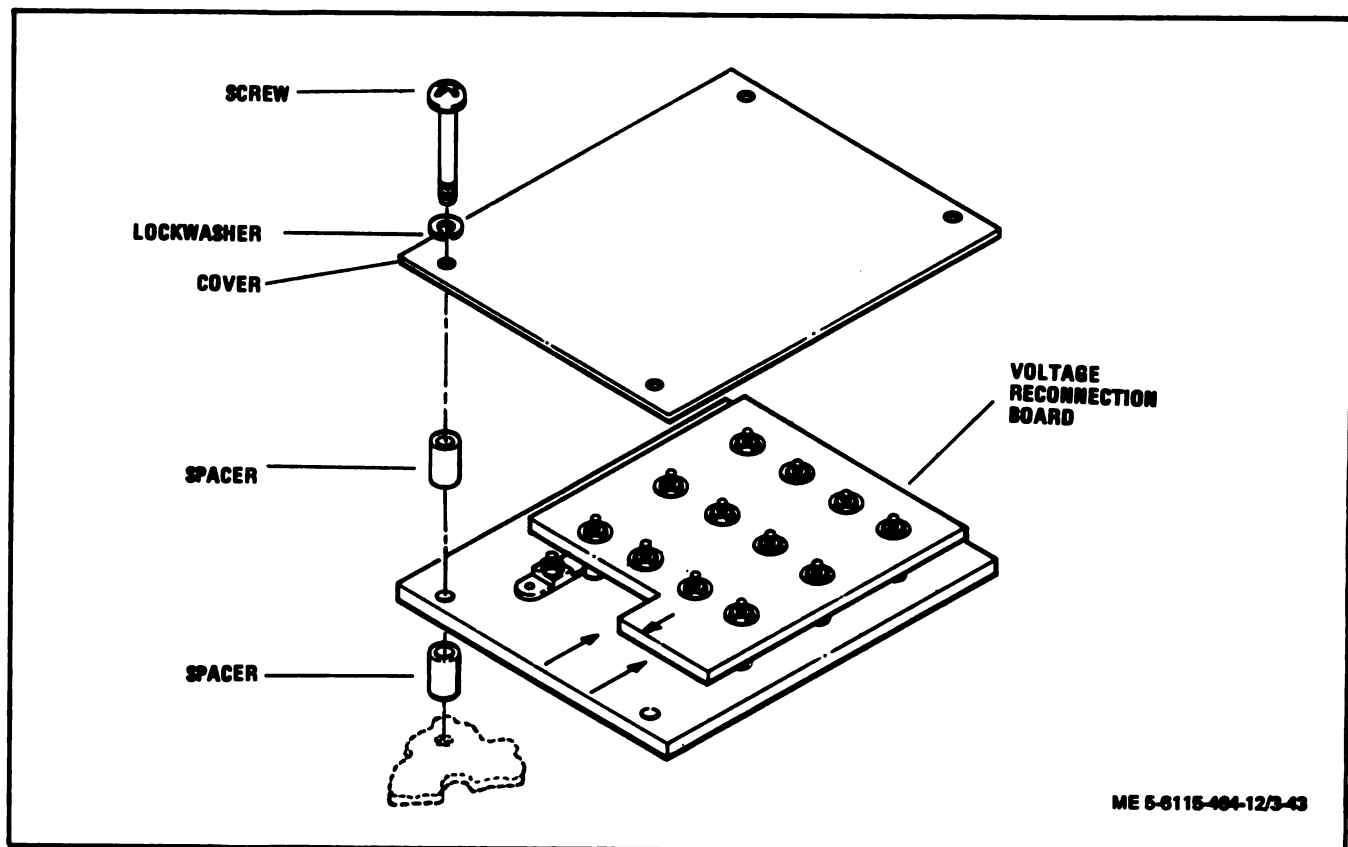


Figure 3-43. Voltage Reconnection Board, Removal and Installation

c. **Testing.** Test continuity of reconnection board links with a multimeter or similar device.

d. **Installation.** Install terminal board assembly in reverse order of removal procedures.

### 3-121. MAIN LOAD CONTACTOR.

a. **Inspection.** Visually inspect main load contactor (figure 1-2) for insecure mounting, loose electrical connections, cracks, corrosion, and evidence of shorting or other damage.

b. **Testing.**

(1) Using a multimeter or a continuity light, check for open circuit across terminal studs A1 and A2, B1 and B2, and C1 and C2 (figures FO-1 and FO-2).

(2) Check for open circuit across connector pins C and D, E and F, G and H, J and K, and R and T.

(3) Check for continuity between connector pins A and B, L and M, N and P, and R and S.

(4) Apply 24 Vdc across connector pins A and B while listening for audible indication of actuation.

(5) With the actuator coil energized, check for continuity between connector pins C and D, E and F, G and H, J and K, and R and T.

(6) Check for open circuit across connector pins L and M, N and P, and R and S.

(7) Check for continuity across terminal studs A1 and A2, B1 and B2, and C1 and C2.

(8) Disconnect 24 Vdc source from connector pins A and B.

c. **Removal.**

(1) Remove screws (1, figure 3-43A), lockwashers (2), and flat washers (3) to remove terminal covers (4).

(2) Tag and disconnect electrical leads to terminals.

(3) Disconnect wiring harness connector from main load contactor connector.

(4) Remove nuts (5) and screws (6) to remove main load contactor.

d. **Installation.** Install main load contactor in reverse order of removal procedures.

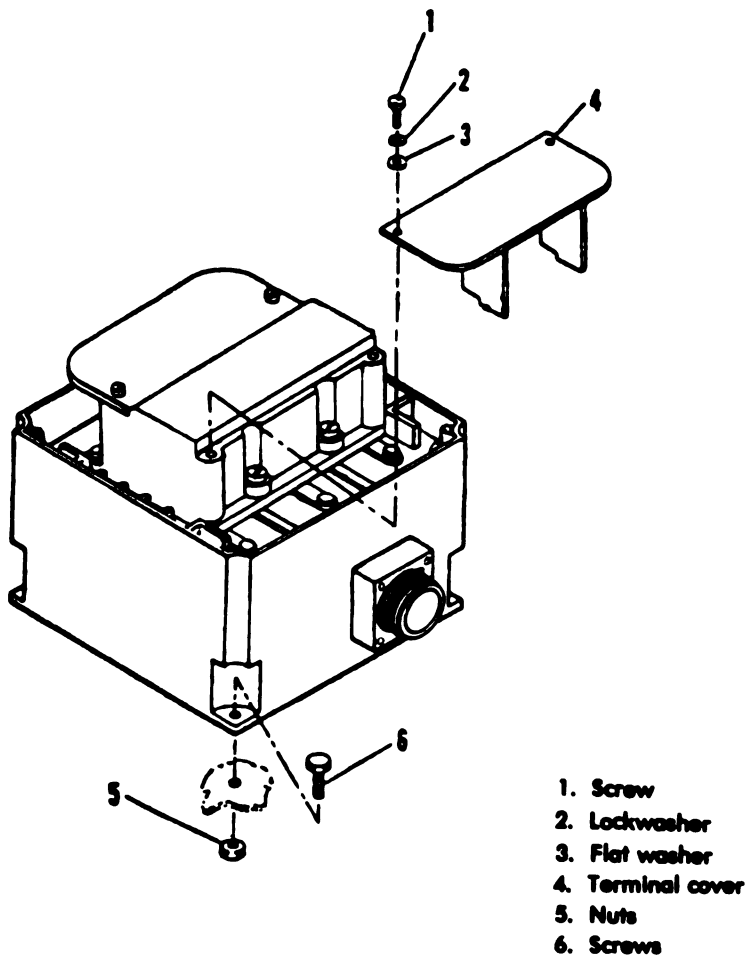


Figure 3-43A. Main Load Contactor, Removal

3-122. CURRENT TRANSFORMER ASSEMBLIES.

Inspect current transformer assemblies (figure 1-1) for cracks, breaks, corrosion, insecure mounting, loose electrical connections, and evidence of shorting or other damage.

3-123. LOAD TERMINAL BOARD ASSEMBLY.

a. Visually inspect load terminal board assembly (figure 1-2) for cracks, breaks, corrosion, burns, insecure mounting, loose electrical connections and other damage.

b. Replace lost or broken terminal clip (Retainer, Safety Clip). The terminal clip is a component of both the load terminal and the ground terminal. If the terminal clip is lost or broken, fabricate as follows.

(1) Requisition bulk wire NSN 9505-00-804-3814 (0.042 inch diameter) for the ground terminal (ground stud). Requisition bulk wire NSN 9505-01-049-0144 (0.050 inch diameter) for the load terminal.

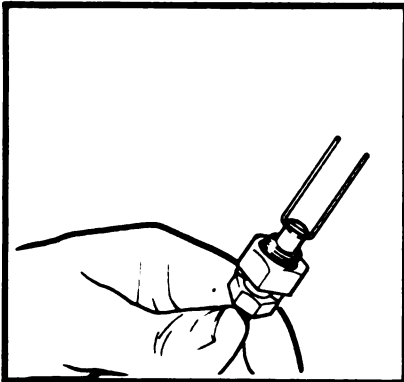
(2) Cut off about 3 inches of the wire; short enough to keep the clips from touching another terminal or the generator frame in the open or closed position.

(3) Slip the wire through the hole in the terminal.

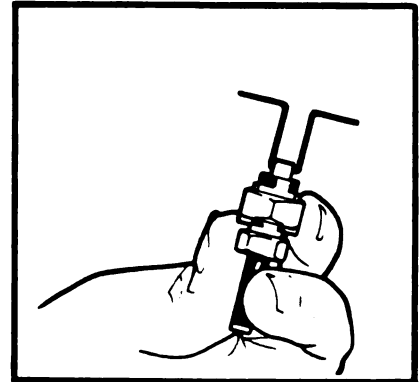
(4) Hold the terminal as shown (Detail A, figure 3-43B) and bend both ends of the wire straight up keeping the wire in as straight a line as you can with the terminal body.

(5) Bend the wire into back-to-back 90° angles (Detail B, figure 3-43B) so that the legs of both angles are about one-half inch long.

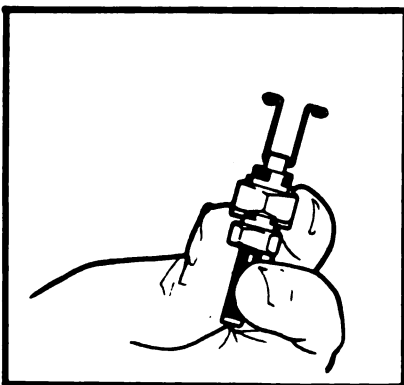
(6) Bend the ends of each 90° angle down around into a U-shape (Detail C, figure 3-43B) so that if done properly, the clip will hold the nut when it is unscrewed to install the cable (Detail D, figure 3-43B).



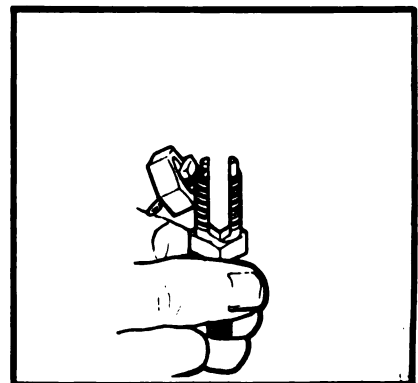
DETAIL A



DETAIL B



DETAIL C



DETAIL D

Figure 3-43B. Terminal Clip Replacement

### 3-124. CONVENIENCE RECEPTACLE AND CIRCUIT BREAKER.

#### a. Removal.

(1) Remove screws (1, figure 3-44) and carefully pull convenience receptacle box out from generator set.

(2) Remove screws (2) and carefully pull convenience receptacle and circuit breaker away from box (17).

(3) Tag and disconnect electrical leads from convenience receptacle and circuit breaker.

(4) Remove nuts (3) and screws (4 and 5) to remove cover (6) and gasket (7).

(5) Remove nuts (8) and screws (9) to remove receptacle (10).

(6) Remove nut (11) and tooth lockwasher (12) to remove circuit breaker (13) from bracket (14).

(7) Remove screw (16) to disconnect wire (15) from circuit breaker (13).

#### b. Cleaning and Inspection.

(1) Clean convenience receptacle with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect convenience receptacle for cracks, breaks, corrosion, bent terminals, burns or other indications of damage.

(3) Inspect cover for cracks, corrosion, damaged spring, and damaged or deteriorated gasket.

(4) Inspect circuit breaker for cracks, corrosion, and other damage.

(5) Using an ohmmeter or similar device, test circuit breaker as follows:

(a) Pull out circuit breaker button and check for open circuit across terminals. Ohmmeter shall indicate open circuit.

(b) Depress circuit breaker button and check for continuity across terminals. Ohmmeter shall indicate continuity.

(6) Check all threads for crossing, stripping and other damage.

(7) Replace any defective parts.

c. Installation. Install convenience receptacle and circuit breaker in reverse order of removal instructions.

### 3-125. PARALLELING RECEPTACLES.

#### a. Removal.

(1) Remove screws and lockwashers (figure 3-45).

(2) Unscrew protective caps and shorting plug from paralleling receptacles.

(3) Remove screws and pull paralleling receptacles away from generator set.

(4) Tag and unsolder electrical leads to receptacles.

#### b. Cleaning and Inspection.

(1) Clean paralleling receptacles with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect paralleling receptacles for cracks, corrosion, stripped or otherwise damaged threads and evidence of shorting or other damage.

(3) Visually inspect covers and shorting plug for cracks, corrosion, broken chains, stripped or otherwise damaged threads, and damaged or deteriorated gasket.

#### CAUTION

Do not use acid core solder on electrical components.

c. Installation. Install paralleling receptacles in reverse order of removal procedures, soldering electrical connections. Use figures FO-1 and FO-2 as a guide for proper connection.

### 3-126. TACTICAL RELAY ASSEMBLY.

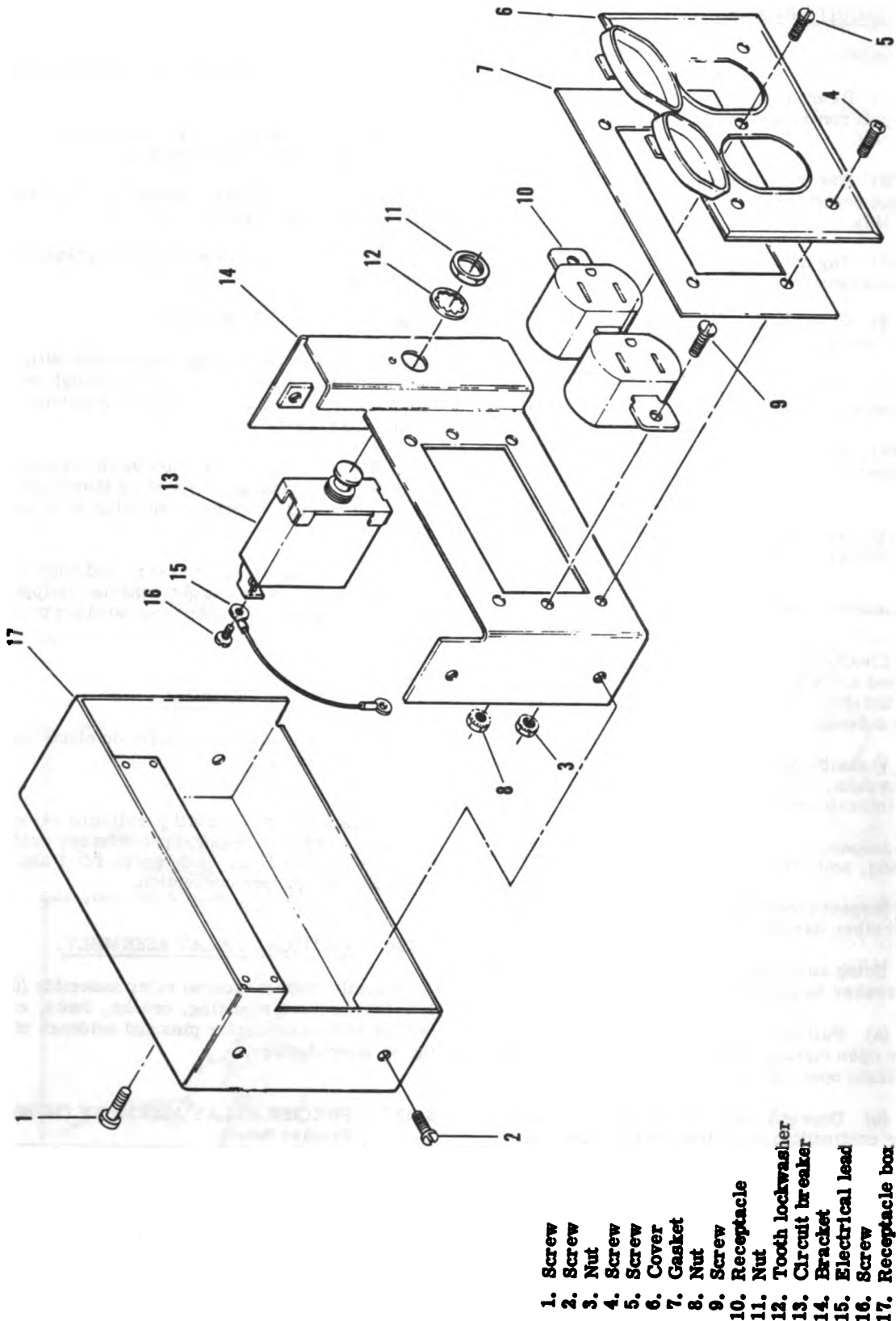
Visually inspect tactical relay assembly (figure 1-2) for insecure mounting, cracks, dents, corrosion, bent or broken connector pins and evidence of shorting or other damage.

### 3-127. PRECISE RELAY ASSEMBLY (50/60 Hz Precise Sets).

Visually inspect precise relay assembly (figure 1-1) for insecure mounting, cracks, dents, corrosion, bent or broken connector pins and evidence of shorting or other damage.

### 3-128. SPECIAL RELAY ASSEMBLY (50/60 Hz Precise and Utility Sets).

Visually inspect special relay assembly (figure 1-1) for insecure mounting, cracks, dents, corrosion,



- 1. Screw
- 2. Screw
- 3. Nut
- 4. Screw
- 5. Screw
- 6. Cover
- 7. Gasket
- 8. Nut
- 9. Screw
- 10. Receptacle
- 11. Nut
- 12. Tooth lockwasher
- 13. Circuit breaker
- 14. Bracket
- 15. Electrical lead
- 16. Screw
- 17. Receptacle box

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Figure 3-44. Convenience Receptacle and Circuit Breaker, Removal and Installation

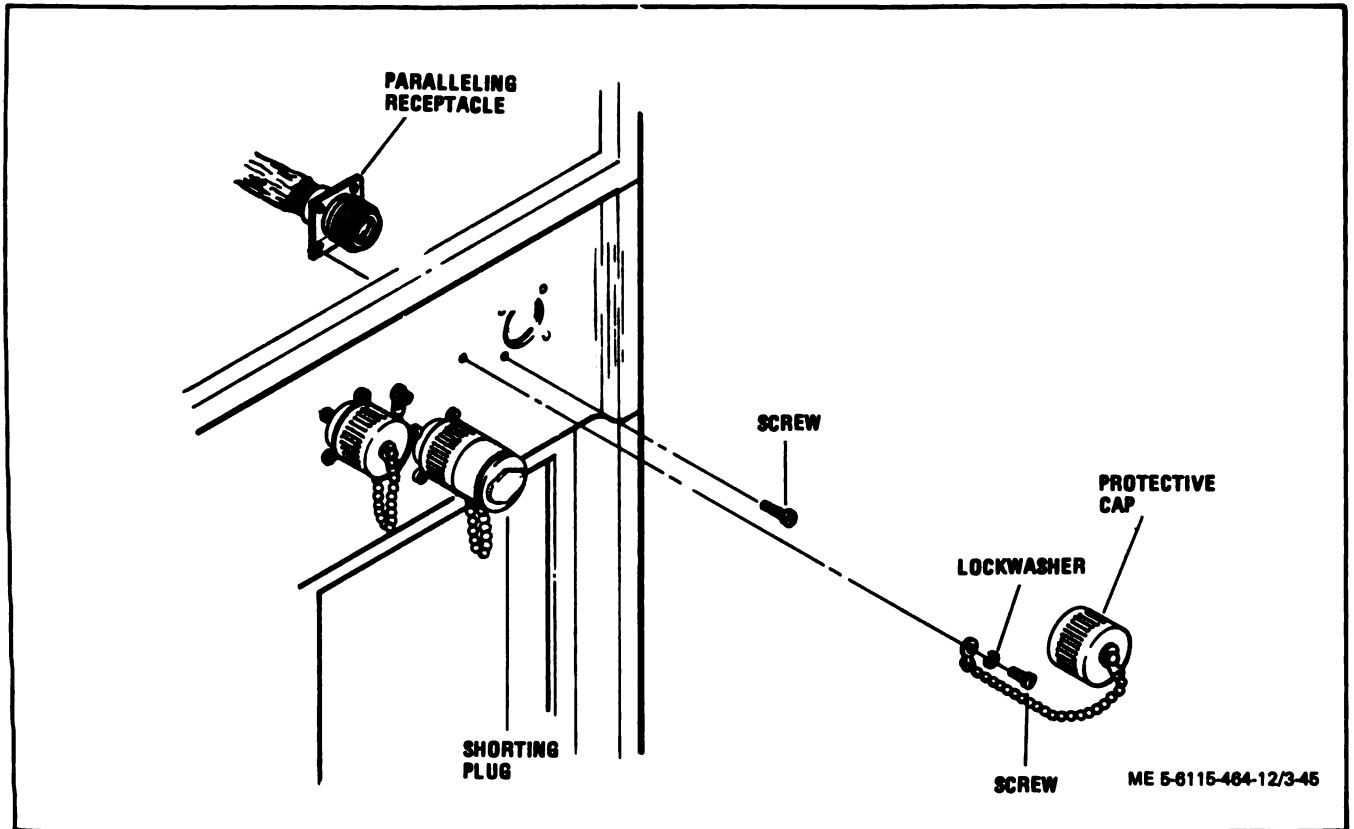


Figure 3-45. Paralleling Receptacles, Removal and Installation

bent or broken connector pins, and evidence of shorting or other damage.

**3-129. SPECIAL RELAY ASSEMBLY (400 Hz Precise Sets).**

Visually inspect special relay assembly (figure 1-1) for insecure mounting, cracks, dents, corrosion, bent or broken connector pins, and evidence of shorting or other damage.

**3-130. PRECISE RELAY ASSEMBLY (400 Hz Precise Sets).**

Visually inspect 400 Hz relay assembly (figure 1-1) for insecure mounting, cracks, dents, corrosion, bent or broken connector pins, and evidence of shorting or other damage.



## Section XVII. ORGANIZATIONAL MAINTENANCE OF THE GENERATOR ASSEMBLY

### 3-131. GENERAL.

Electrical power is generated by a single bearing, synchronous, brushless, self-ventilated generator assembly with an integral exciter assembly. Organizational maintenance of the generator assembly is limited to visual inspection of the generator and the generator bearing.

### 3-132. ORGANIZATIONAL MAINTENANCE INSPECTION OF GENERATOR ASSEMBLY.

- a. Visually inspect generator assembly for insecure mounting, cracks, corrosion, accumulation of foreign material in ventilator screens and other damage.
- b. Listen for unusual noises while operating.
- c. Notify higher level maintenance of any discrepancies found during inspection.

## Section XVIII. ORGANIZATIONAL MAINTENANCE OF THE HOUSING AND SKID BASE ASSEMBLIES

### 3-133. GENERAL.

The housing assembly fully encloses the top, sides and ends of the generator set. It consists of doors, covers, and panels. The cooling air intake openings which provide access to internal components are covered by doors which are equipped with seals to prevent the entry of foreign materials when the doors are closed. The cooling air exhaust opening is covered by the shutter and grille assemblies (paragraphs 3-86 and 3-87). The plate and sleeve assembly allows connection of load lines while excluding foreign materials. The lifting frame, located in the center of the housing assembly, is equipped with lifting clevises at the top of each side to which a hoisting sling may be attached. The housing assembly is supported on the skid base assembly which also provides support for the engine and generator assemblies. The skid base also provides the generator set grounding point and is drilled to accept attachment of the wheel mounting kit and M-200 trailer. A metal sheet near the bottom of the skid base prevents the entry of debris. Drain holes prevent the accumulation of spilled liquids on the sheet.

### 3-134. DOORS, COVERS, AND PANELS.

#### a. Removal.

- (1) Remove grille, radiator and shutter assembly (paragraphs 3-86 through 3-89).
- (2) Remove convenience receptacle and circuit breaker (paragraph 3-124).
- (3) Remove paralleling receptacles (paragraph 3-125).

- (4) Remove doors, covers and panels by following the ascending numerical sequence of index numbers (1 through 105) assigned to figure 3-46.

#### NOTE

It is not necessary to completely disassemble the housing assembly. Only those parts requiring replacement need be removed.

#### NOTE

A wiring harness support clamp on the underside of the top rear cover (87, figure 3-46) must be removed before attempting to remove the cover.

- b. Installation. Install housing assembly doors, covers, and panels in reverse order of removal procedures.

### 3-135. PLATE AND SLEEVE ASSEMBLY.

#### a. Removal and Disassembly.

- (1) Remove screws (1, figure 3-47) and lockwashers (2) to remove plate and sleeve assembly.
- (2) Remove ring (3) and bushing (4); then remove nuts (5), screws (6) and retainer (7) to remove sleeve (8) with draw string (9) from plate (10).

#### b. Cleaning and Inspection.

- (1) Clean plate and sleeve assembly with a clean, lint-free cloth lightly moistened with an approved solvent.

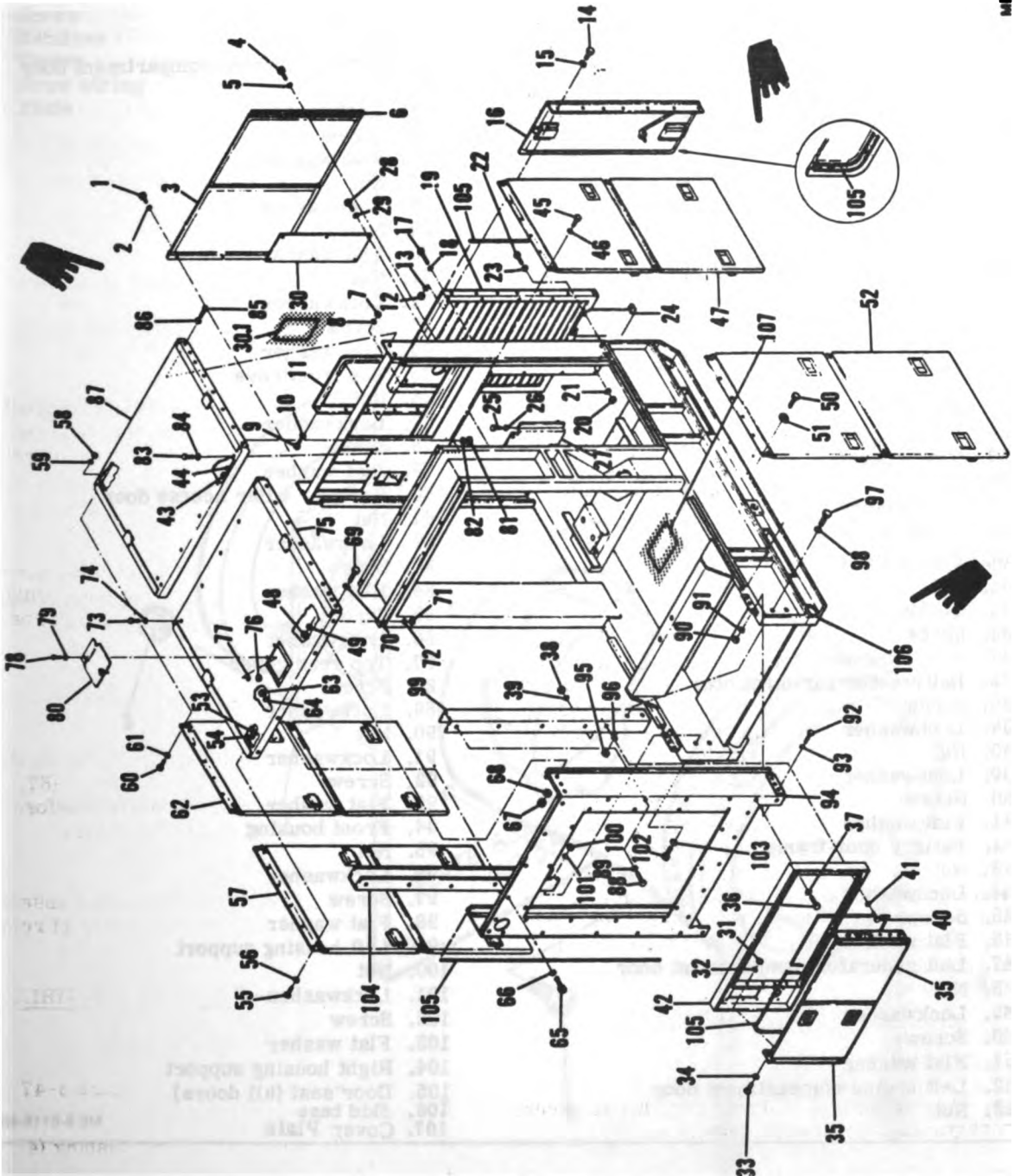
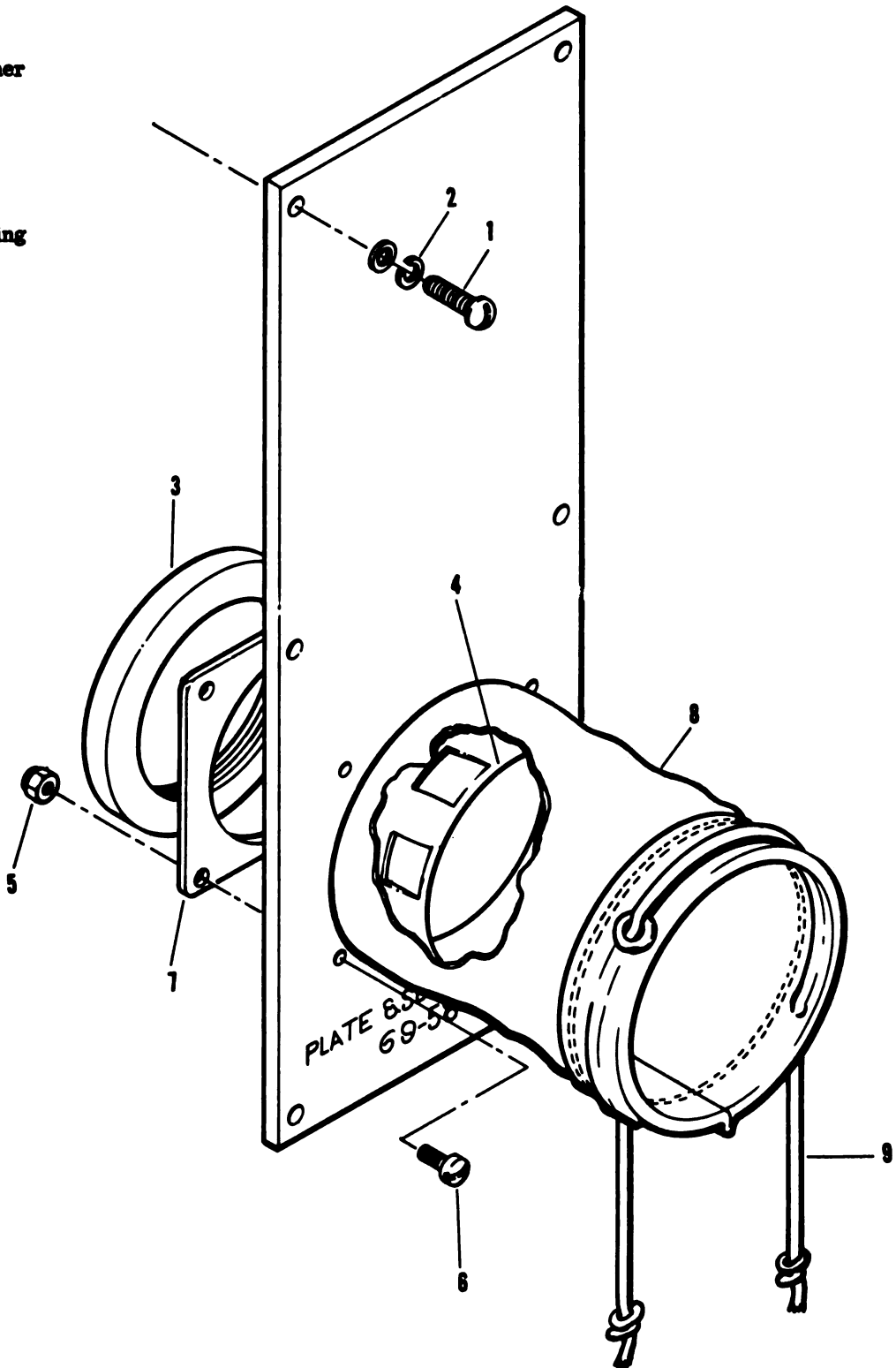


Figure 3-46. Housing Assembly, Exploded View (Sheet 1 of 2)

- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| 1. Screw                            | 54. Lockwasher                       |
| 2. Lockwasher                       | 55. Screw                            |
| 3. Right control cubicle door       | 56. Flat washer                      |
| 4. Screw                            | 57. Right engine compartment door    |
| 5. Lockwasher                       | 58. Nut                              |
| 6. Left control cubicle door        | 59. Lockwasher                       |
| 7. Nut                              | 60. Screw                            |
| 8. Flat washer                      | 61. Flat washer                      |
| 9. Screw                            | 62. Right generator compartment door |
| 10. Lockwasher                      | 63. Nut                              |
| 11. Right ventilation door          | 64. Lockwasher                       |
| 12. Nut                             | 65. Screw                            |
| 13. Flat washer                     | 66. Flat washer                      |
| 14. Screw                           | 67. Nut                              |
| 15. Lockwasher                      | 68. Lockwasher                       |
| 16. Left ventilation door           | 69. Screw                            |
| 17. Screw                           | 70. Flat washer                      |
| 18. Lockwasher                      | 71. Nut                              |
| 19. Ventilation louver panel        | 72. Lockwasher                       |
| 20. Nut                             | 73. Screw                            |
| 21. Flat washer                     | 74. Flat washer                      |
| 22. Screw                           | 75. Top front cover                  |
| 23. Lockwasher                      | 76. Nut                              |
| 24. Cover panel                     | 77. Lockwasher                       |
| 25. Screw                           | 78. Screw                            |
| 26. Lockwasher                      | 79. Flat washer                      |
| 27. Cover panel                     | 80. Radiator filler access door      |
| 28. Screw                           | 81. Nut                              |
| 29. Lockwasher                      | 82. Lockwasher                       |
| 30. Cover panel                     | 83. Screw                            |
| 30.1 Cover Plate                    | 84. Flat washer                      |
| 31. Nut                             | 85. Screw                            |
| 32. Lockwasher                      | 86. Lockwasher                       |
| 33. Screw                           | 87. Top rear cover                   |
| 34. Flat washer                     | 88. Screw                            |
| 35. Battery compartment door        | 89. Lockwasher                       |
| 36. Screw                           | 90. Nut                              |
| 37. Lockwasher                      | 91. Lockwasher                       |
| 38. Nut                             | 92. Screw                            |
| 39. Lockwasher                      | 93. Flat washer                      |
| 40. Screw                           | 94. Front housing                    |
| 41. Flat washer                     | 95. Nut                              |
| 42. Battery door frame              | 96. Lockwasher                       |
| 43. Nut                             | 97. Screw                            |
| 44. Lockwasher                      | 98. Flat washer                      |
| 45. Screw                           | 99. Left housing support             |
| 46. Flat washer                     | 100. Nut                             |
| 47. Left generator compartment door | 101. Lockwasher                      |
| 48. Nut                             | 102. Screw                           |
| 49. Lockwasher                      | 103. Flat washer                     |
| 50. Screw                           | 104. Right housing support           |
| 51. Flat washer                     | 105. Door seal (all doors)           |
| 52. Left engine compartment door    | 106. Skid base                       |
| 53. Nut                             | 107. Cover Plate                     |

Figure 3-46. Housing Assembly, Exploded View  
(Sheet 2 of 2)

1. Screw
2. Lockwasher
3. Ring
4. Bushing
5. Nut
6. Screw
7. Retainer
8. Sleeve
9. Draw string
10. Plate



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Figure 3-47. Plate and Sleeve Assembly, Exploded View

(2) Visually inspect plate for cracks, dents, illegible markings, defective paint, and other damage.

(3) Inspect weather sleeve for cracks, deterioration, broken or missing draw string, and other damage.

(4) Check threaded parts for stripped or damaged threads.

c. Installation. Install plate and sleeve assembly in reverse order of removal procedures.

### 3-136. LIFTING FRAME.

Visually inspect lifting frame (figure 1-1) for cracks, corrosion, damaged or missing lifting clevis, insecure mounting hardware, and other damage.

### 3-137. SKID BASE ASSEMBLY.

a. Visually inspect skid base assembly (figure 1-1) for cracks, corrosion, and other damage.

b. Check that bottom sheet drain holes are open.

c. Inspect ground stud for stripped or otherwise damaged threads, corrosion, and other damage. Replace lost or broken terminal clip (Retainer, Safety Clip). For fabrication procedure, see Chapter 3, Section XVI Organizational Maintenance of the Generator Electrical System, paragraph 3-123 Load Terminal Board Assembly.

d. Inspect fuel tank for insecure mounting, cracks, leaks, and other damage.

e. Check that fuel tank and engine crankcase drains are securely installed and not leaking.

f. Test fuel level sensor as follows:

(1) Drain fuel tank assembly (paragraph 3-49).

(2) Disconnect electrical connector from fuel level sensor.

(3) Connect an ohmmeter or similar device between fuel level sensor casing and connector pin. Ohmmeter shall indicate 0.0 to 1.0 ohms resistance.

(4) Fill fuel tank with proper grade of fuel (paragraph 3-49).

(5) Ohmmeter shall indicate  $27 \pm 2$  ohms resistance.

(6) Replace fuel level sensor if it fails to meet test requirements.

g. Replace fuel level sensor as follows:

(1) Drain fuel tank assembly (paragraph 3-49).

(2) Disconnect electrical connector from fuel level sensor.

(3) Remove 5 attaching screws to remove fuel level sensor and gasket from fuel tank.

(4) Install replacement fuel level sensor and gasket and secure with 5 attaching screws.

(5) Connect electrical connector to fuel level sensor.

(6) Service fuel tank with proper grade of fuel (paragraph 3-49).

Section XIX. TOOL STOWAGE BOX

3-138. **GENERAL.**

A tool stowage box is provided on the left side of the generator set (figure 1-2). The generator access door must be opened to gain access to the tool box. The dimensions of the tool box are 15.25" x 10.43" x 6.12". The tool box has a hinged cover that is held in the closed position by a single draw-pull fastener.

a. Removal.

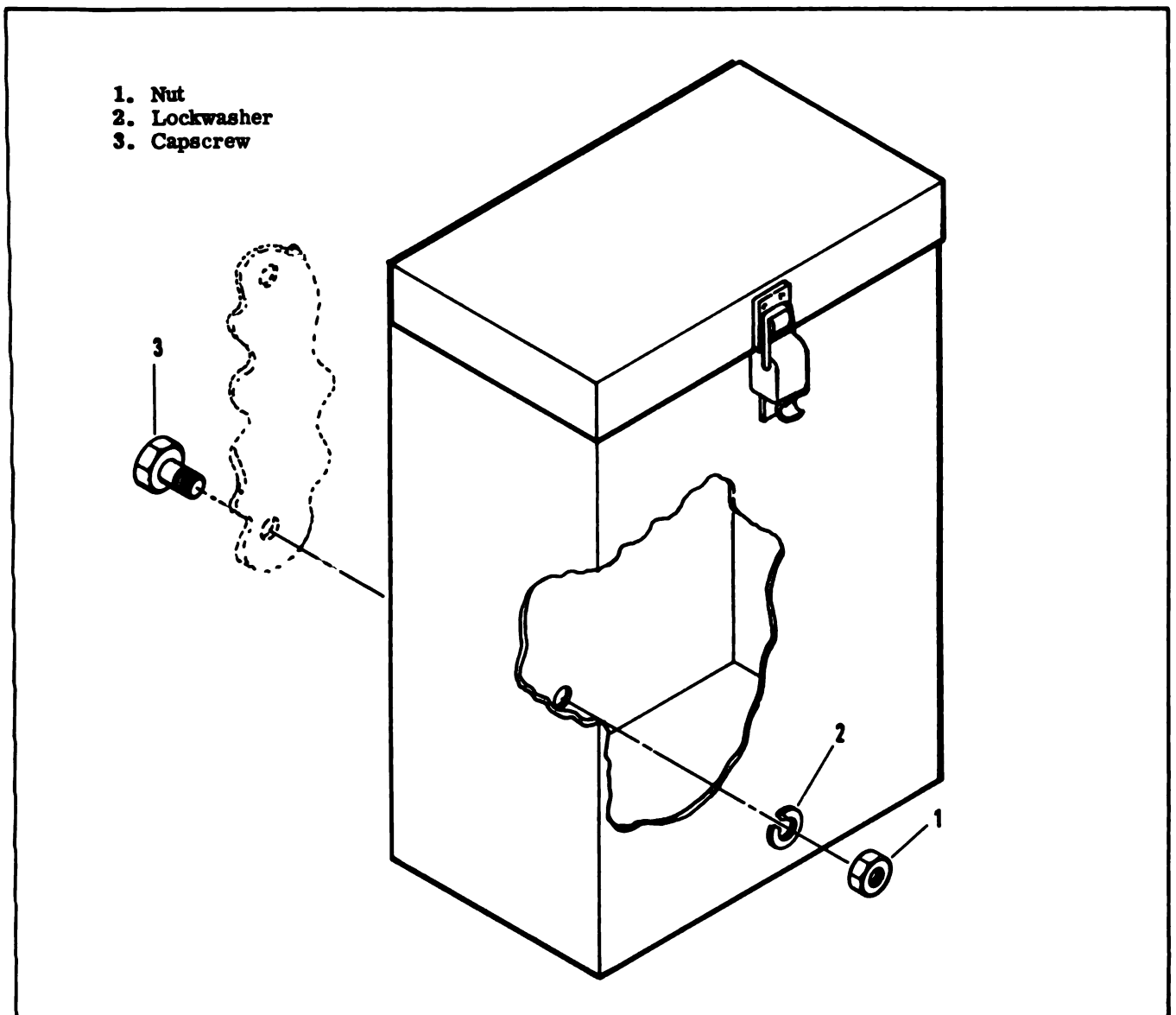
(1) Remove the hex nuts (1, figure 3-48), lockwashers (2) and capscrews (3) to remove the tool box.

b. Inspection and Cleaning.

(1) Inspect the tool box for damaged hinge or fastener, dents, corrosion, and deterioration of finish.

(2) Clean the tool box with an approved solvent and dry thoroughly.

c. Installation. Install the tool box by reversing removal procedures.



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Figure 3-48. Tool Stowage Box

Section XX. AUXILIARY FUEL LINE

3-139. GENERAL.

The auxiliary fuel line is a 25 foot, flexible, heat and oil resistant hose. It is used to connect the generator set to an auxiliary fuel supply. By connecting the auxiliary fuel line to the auxiliary fuel supply, the generator set may serve as a fuel source.

3-140. REPAIR OF AUXILIARY FUEL LINE.

a. Remove adapter, captive chain and fittings from hose (figure 3-49).

b. Clean all parts in an approved solvent and dry thoroughly.

c. Visually inspect hose for cuts, deterioration, and other damage.

d. Check all threaded parts for stripped or otherwise damaged threads.

e. Replace any parts found damaged.

f. Reinstall adapter, captive chain and fittings.

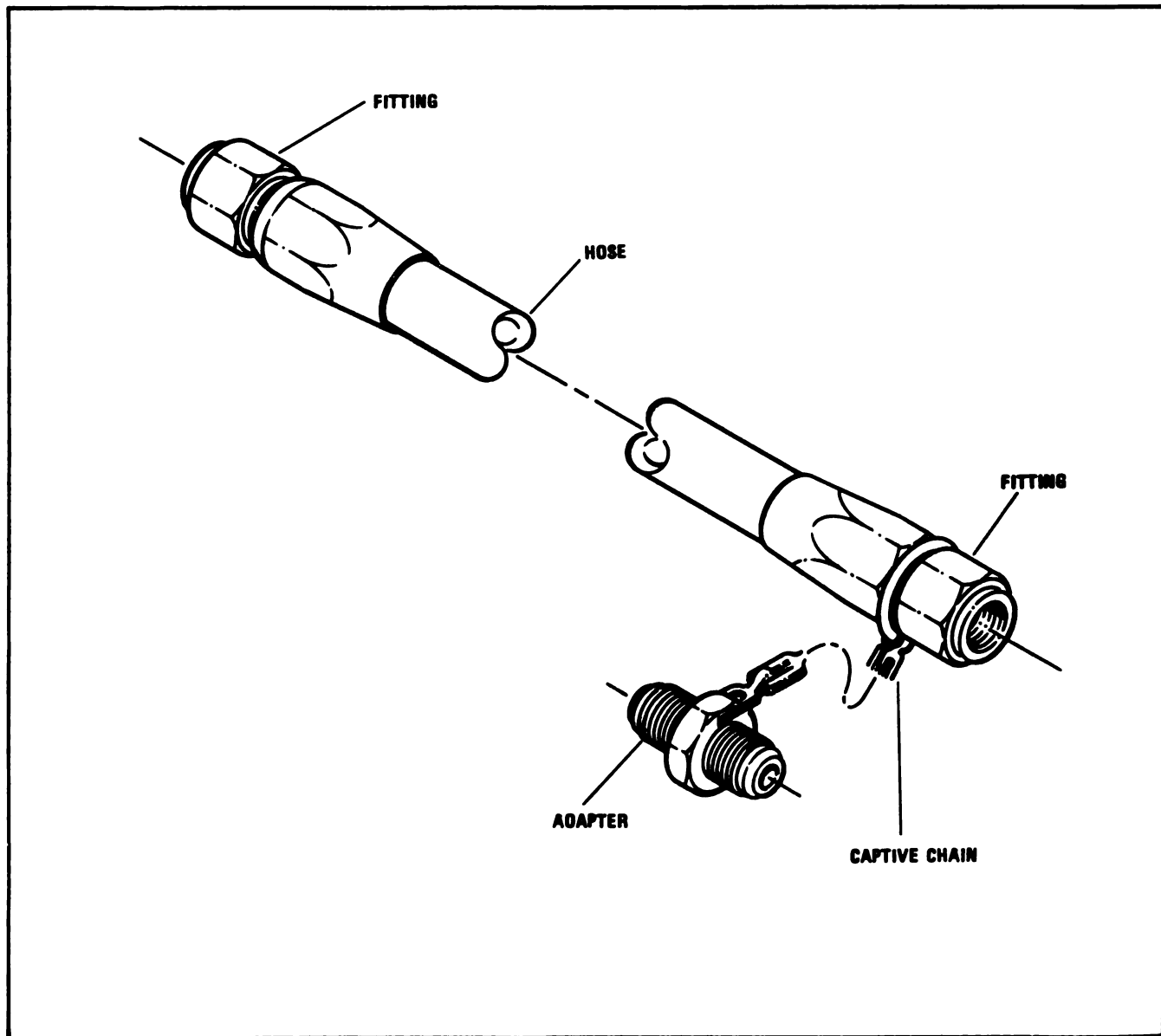


Figure 3-49. Repair of Auxiliary Fuel Line

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## Section XXI. PARALLELING CABLE

### 3-141. GENERAL.

The paralleling cable is a 25 foot, four conductor, flexible, heat and oil resistant cable. It is used to interconnect governor and voltage paralleling circuits of generator sets operating in parallel (precise sets only).

### 3-142. MAINTENANCE OF PARALLELING CABLE.

#### a. Cleaning and Inspection.

(1) Clean paralleling cable (figure 3-50) with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(2) Visually inspect paralleling cable for chafing, deterioration, and other damage.

(3) Check electrical connectors for bent or broken pins, stripped or damaged threads, cracks, corrosion and other damage.

#### b. Testing.

(1) Test individual wires for continuity with an ohmmeter or continuity light.

(2) Check between pins of each terminal for short circuits.

### CAUTION

Do not use acid core solder on electrical wiring.

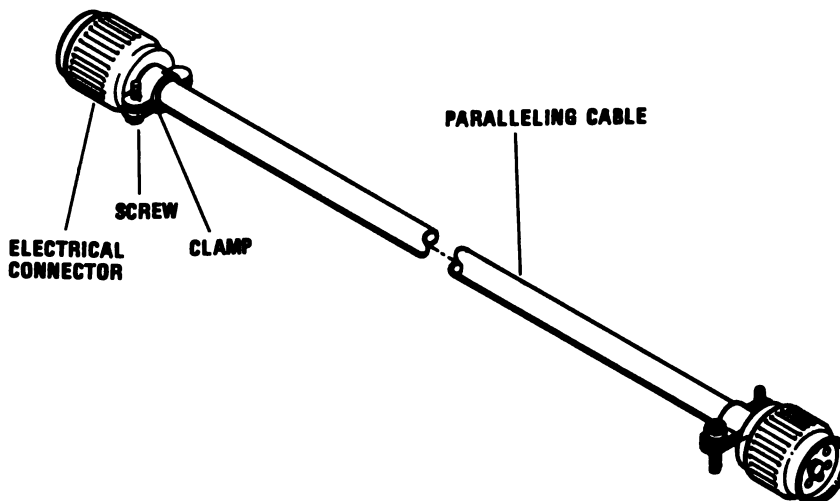
c. Repair. Replace damaged wires or connectors as follows:

(1) Loosen saddle clamp screws (figure 3-50).

(2) Tag wires and unsolder connections.

(3) Install replacement parts and solder connections.

(4) Tighten saddle clamp screws.



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Figure 3-50. Repair of Paralleling Cable





## CHAPTER 4

# MATERIAL USED IN CONJUNCTION WITH THE GENERATOR SET

### Section I. GENERAL

#### 4-1. Scope.

This chapter contains instructions for operator and organizational maintenance of material used in conjunction with the generator set.

#### 4-2. Service upon Receipt of Material.

The following services shall be performed upon receipt of material used in conjunction with the generator set.

- a. Remove the equipment from shipping container.
- b. Check to see that all components are present.
- c. Remove corrosion preventive compounds with an approved cleaning solvent.
- d. Visually inspect all components for damage which may have occurred during shipment and missing parts.
- e. Check all wiring for damage and loose connections.

### Section II. FUEL BURNING WINTERIZATION KIT

#### 4-3. General.

The fuel burning winterization kit is used to preheat the engine coolant and lubricating oil when ambient temperature is between  $-25^{\circ}\text{F}$  ( $-31.7^{\circ}\text{C}$ ) and  $-65^{\circ}\text{F}$  ( $-53.9^{\circ}\text{C}$ ). It consists of a heater coolant pump, coolant circulating lines, fuel line, electrical controls, wiring harness, and mounting hardware. The heater burns fuel from the generator set fuel tank to heat coolant from the engine block. The heated coolant is pumped through the heat exchanger in the engine oil pan, through the cylinder block, and returned to the engine block.

#### 4-4. Fuel Burning Winterization Kit Installation and Replacement.

##### a. Installation.

#### **CAUTION**

Disconnect battery negative cable before installing fuel burning winterization kit.

#### **NOTE**

If generator set is equipped with an electric winterization kit, refer to paragraph 4-10 for installation of components which must be provided to accommodate both kits.

(1) Refer to paragraph 4-7 and remove heater assembly protective cover (43, figure 4-1).

(2) Refer to paragraph 3-31 and drain the engine cooling system.

(3) Remove "WATER" plug (44, figure 4-1) from center, right-rear of engine cylinder block (use impact wrench if necessary).

(4) Remove plug (45) from right side of engine water pump assembly.

(5) Remove "WATER" plug (44) from center, left-rear of engine cylinder block.

(6) Remove plugs (46 and 47) from engine oil pan heat exchanger.

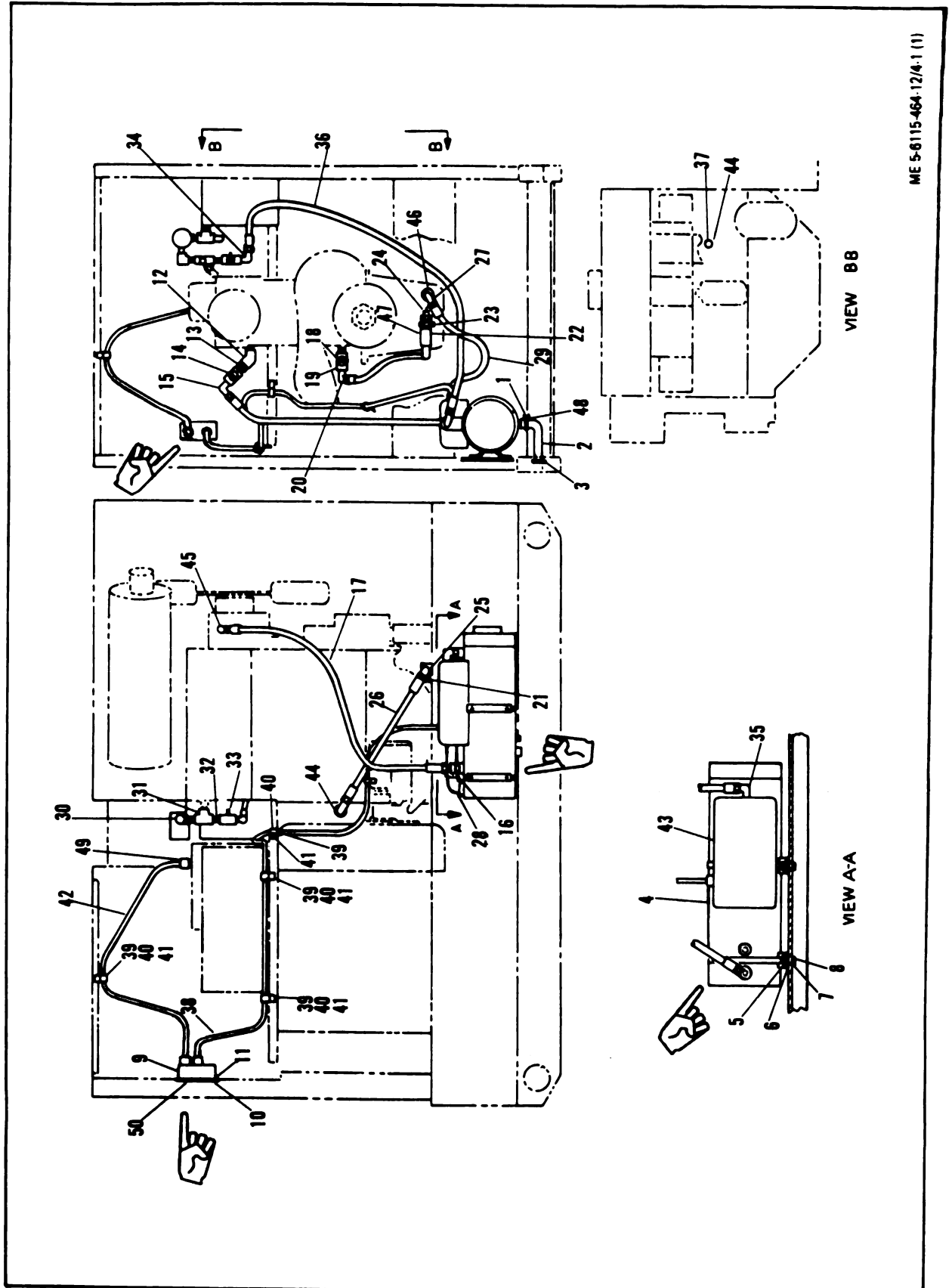
(7) Remove plate (48) located in skid base directly below heater mounting space.

(8) Remove protective cap (49) from special relay assembly connector J7 (figures FO-1 and FO-2).

(9) Remove cover (50) from heater control assembly mounting hole located to the right of the control cubicle assembly.

#### **NOTE**

Retain cover and attaching hardware. It is used to install heater control assembly.



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Figure 4-1. Fuel Burning Windmill

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| 1. Clamp                            | 26. Coolant hose assembly           |
| 2. Exhaust pipe                     | 27. Elbow                           |
| 3. Rain cap                         | 28. Elbow                           |
| 4. Heater assembly                  | 29. Coolant hose assembly           |
| 5. Screw                            | 30. Street elbow                    |
| 6. Flat washer                      | 31. Tee                             |
| 7. Lock washer                      | 32. Pipe nipple                     |
| 8. Nut                              | 33. Valve                           |
| 9. Heater control assembly          | 34. Elbow                           |
| 10. Screw & captive washer assembly | 35. Elbow                           |
| 11. Nut                             | 36. Fuel hose assembly              |
| 12. Elbow, 45 degree                | 37. Thermostat switch               |
| 13. Adapter                         | 38. Wiring harness                  |
| 14. Valve                           | 39. Clamp                           |
| 15. Elbow                           | 40. Screw & captive washer assembly |
| 16. Adapter                         | 41. Nut                             |
| 17. Coolant hose assembly           | 42. Wiring harness                  |
| 18. Pipe nipple                     | 43. Protective cover                |
| 19. Valve                           | 44. Plug "WATER"                    |
| 20. Elbow                           | 45. Plug                            |
| 21. Pipe nipple                     | 46. Plug                            |
| 22. Tee                             | 47. Plug                            |
| 23. Adapter                         | 48. Plate                           |
| 24. Pressure relief valve           | 49. Cap                             |
| 25. Elbow                           | 50. Cover                           |

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Figure 4-1. Fuel Burning Winterization Kit Installation (Sheet 2 of 2)

(10) Disconnect fuel line and remove elbow from fuel solenoid valve (paragraph 3-75).

(11) Install fuel burning winterization kit following the ascending sequence of index numbers (1 through 50) assigned to figure 4-1.

**NOTE**

Run wiring harnesses through existing clamps (39) as shown.

(12) Install elbow removed in step (10) above and connect fuel line.

(13) Fill cooling system with proper coolant (paragraph 3-31).

(14) Install heater assembly protective cover (paragraph 4-7).

(15) Loosen coolant hose(17, figure 4-1) at water pump assembly and open valve (19) to bleed air from heater assembly and coolant lines.

(16) Tighten coolant line and close valve.

(17) Add coolant to radiator as necessary.

b. Replacement.

(1) Removal.

(a) Refer to paragraph 3-31 and drain the engine cooling system.

(b) Remove fuel burning winterization kit in reverse order of steps (2) through (14) in paragraph 4-4a. above.

(c) Refer to paragraph 3-31 and service the engine cooling system with the proper coolant.

(2) Installation. Refer to paragraph 4-4a. above for installation procedures.

**4-5. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.**

a. General. To insure that the fuel burning winterization kit is ready for operation at all times, it must be systematically inspected in order that defects be discovered and corrected before serious damage or failure of the equipment results. Defects discovered during operation shall be noted for correction as soon as operation ceases. Operation shall be ceased immediately if a defect which may cause damage to the equipment is noted. All defects and short comings shall be recorded, together with the

corrective action taken on the applicable forms at the earliest opportunity. Army and Navy users shall accomplish the necessary preventive maintenance services listed and described in subparagraph b. below. Air Force users shall refer to the applicable inspection manual and work card sets in the T.O. 35C2-3 Series for periodic requirements and table 4-1 for detailed procedures. Marine Corps users should refer to the current issue of TM 11275/1.

b. Preventive Maintenance Checks and Services. (Army and Navy).

(1) Operator. Table 4-1 contains a tabulated listing of preventive maintenance checks and services which shall be performed before, during, and after operation and the weekly checks and services to be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-1 for checks and services.

(2) Organizational Maintenance. Table 4-1 also contains a tabulated listing of preventive maintenance checks and services which shall be performed by organizational maintenance personnel at monthly and semi-annual intervals. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-1 for checks and services.

#### 4-6. TROUBLE SHOOTING.

Table 4-2 contains a list of malfunctions which is useful in diagnosing and correcting unsatisfactory operation or failure of the fuel burning winterization kit. Each malfunction is followed by an alphabetical listing of probable causes of the malfunction. The corresponding alphabetical listing of corrective actions contains references to applicable maintenance paragraphs for correcting the malfunction. The table lists only those malfunctions, probable causes and corrective actions which are within the scope of organizational maintenance. Any malfunction whose corrective action is beyond the scope of organizational maintenance shall be reported to higher level maintenance.

#### 4-7. OPERATOR INSPECTION AND SERVICE OF FUEL BURNING WINTERIZATION KIT.

a. Inspection.

(1) Visually inspect heater assembly (4, figure 4-1) for insecure mounting, dents, cracks, corrosion, and other damage.

(2) Inspect fuel lines for cracks, breaks, loose connections and support clamps and other damage.

4-4

(3) Inspect electrical wiring for loose terminals or connectors, burned or frayed insulation, loose support clamps and other damage.

(4) Check coolant lines for loose connections, leaks, deterioration, and other damage.

b. Service.

(1) Loosen fasteners and remove protective cover (1, figure 4-2).

(2) Disconnect burner fuel line (2) and remove metering orifice assembly (3).

(3) Remove filter body (4) with gasket (5) and sintered filter (6) from heater assembly (7).

(4) Unscrew sintered filter (6) from filter body (4). Discard gasket (5).

(5) Clean metering orifice assembly, screen, and sintered filter in an approved solvent and dry with filtered compressed air.

(6) Hold orifice up to a light and check to make sure its pin hole is unobstructed.

(7) Screw sintered filter (6) into filter body (4) and install with new gasket (5) into heater assembly.

#### CAUTION

Use extreme care when installing the orifice assembly. Its pin hole can easily be clogged by any small particle of foreign matter.

(8) Install orifice assembly (3) and connect burner fuel line (2).

(9) Install protective cover (1) and tighten its fasteners.

#### 4-8. ORGANIZATIONAL MAINTENANCE OF FUEL BURNING WINTERIZATION KIT.

a. Heater Control Assembly.

(1) Removal.

(a) Remove screws (figure 4-3) and washers.

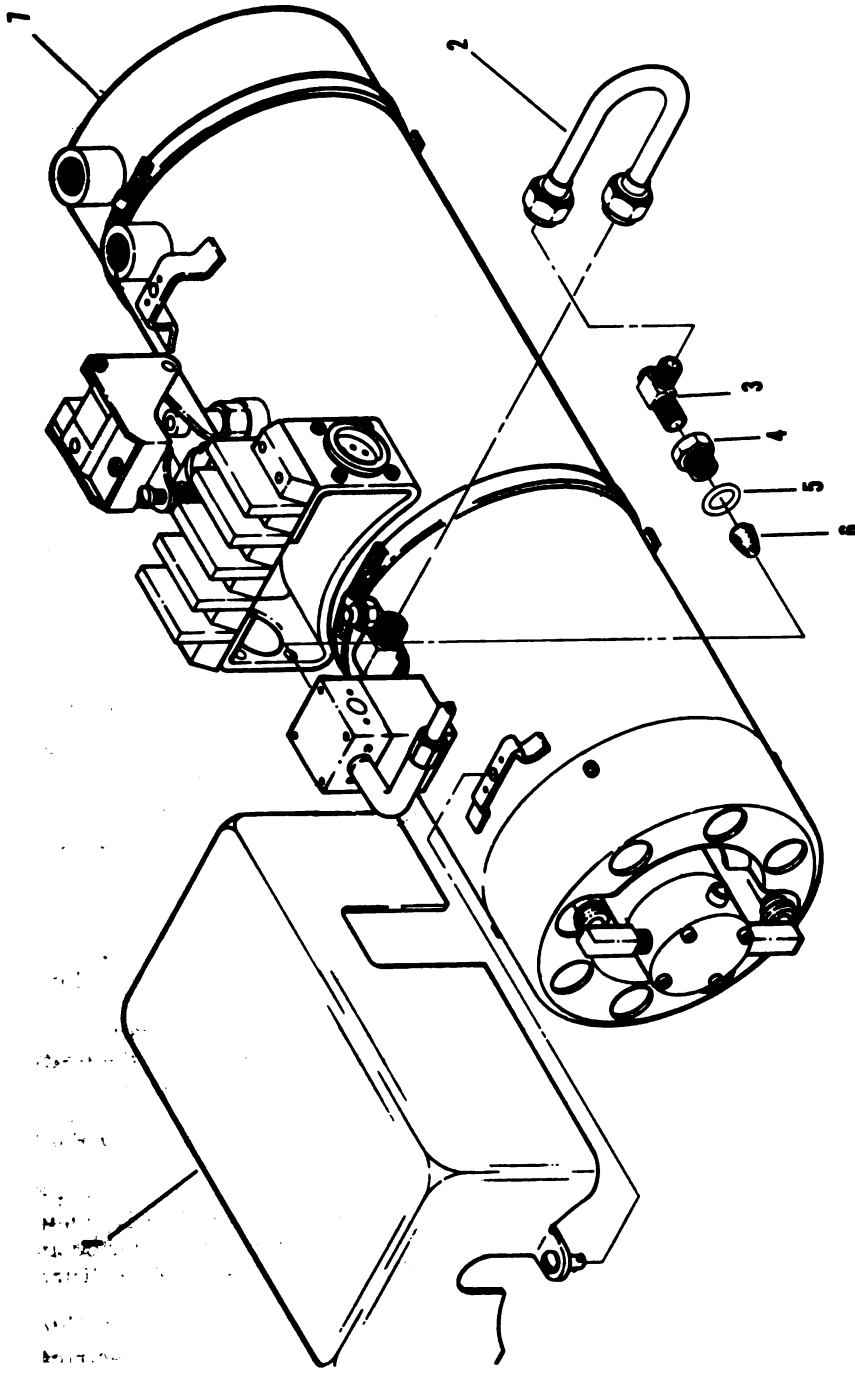
Table 4-1. FUEL BURNING WINTERIZATION KIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM NUMBER	INTERVAL							ITEM TO BE INSPECTED	PROCEDURE	REFERENCE
	OPERATOR			ORG						
	DAILY									
	B	D	A	W	M	S				
1	X					X	Heater assembly	Visually inspect for damage and check for proper operation quarterly. Check for leaks before and after operation. Inspect for damage and tighten connections and support clamps quarterly. Visually inspect for damage before operation weekly. Check for indicator light illumination during operation. Check for sufficient fuel supply. Check for proper coolant level. Service screen, metering orifice and sintered filter monthly. (More often under conditions of heavy usage.) Test output monthly. Service and adjust as necessary. Adjust flame switch quarterly. (More often under conditions of heavy usage.) Inspect and test limit switch quarterly. (More often under conditions of heavy usage.) Inspect and test igniter quarterly. (More often under normal conditions.) Replace if necessary. Inspect wiring for burned or frayed insulation and loose terminals or connectors. Test switch for proper operation. Replace if necessary. Check for loose or missing mounting hardware.	Figure 4-1	
2	X		X			X	Fuel and coolant lines		Figure 4-1	
3	X			X			Heater control panel		Para. 4-7	
4	X						Generator set fuel tank		Para. 2-10	
5	X		X				Generator set radiator		Para. 3-31	
6					X		Regulator valve assembly		Para. 4-7	
7						X	Flame switch		Para. 4-7	
8						X	Limit switch		Para. 4-8	
9						X	Igniter		Para. 4-8	
10						X	Wiring		Para. 4-7	
11						X	Thermostat switch		Para. 4-8	
12						X	Mounting hardware		Figure 4-1	

Table 4-2. Fuel Burning Winterization Kit Trouble Shooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Press-to-test indicator does not light when pressed	a. Discharged batteries. b. Circuit breaker open. c. Defective control assembly.	a. Recharge or replace batteries (para. 3-65). b. Reset circuit breaker (para. 2-22). c. Replace control assembly (para. 4-8).
Heater control switch placed in ON position but heater does not start	a. Circuit breaker open. b. Discharged batteries. c. Defective wiring harness. d. Defective control assembly.	a. Reset circuit breaker (para. 2-22). b. Replace or recharge batteries (para. 3-65). c. Replace damaged wiring harness (para. 4-4). d. Replace control assembly (para. 4-8).
Blower operates but heater does not ignite	a. Heater fuel shutoff valve closed. b. Generator set fuel supply exhausted. c. Restriction in fuel supply line. d. Defective thermostat switch. e. Defective igniter assembly. f. Regulator valve assembly screen, sintered filter or metering orifice clogged. g. Generator set fuel transfer pumps defective.	a. Open fuel shutoff valve (para. 2-22). b. Service generator set fuel supply (para. 3-49). c. Remove fuel line restriction. d. Test thermostat switch. Replace if necessary (para. 4-8). e. Inspect and test igniter assembly. Replace if necessary (para. 4-8). f. Service regulator valve assembly (para. 4-7). g. Replace fuel transfer pumps (para. 3-78).
Surging heater combustion	a. Restriction in fuel line. b. Defective generator set fuel transfer pumps. c. Defective igniter assembly.	a. Locate and remove restriction in fuel line. b. Replace fuel transfer pumps (para. 3-78). c. Inspect and test igniter assembly. Replace if necessary (para. 4-8).
Heater combustion continues after heater control switch placed in OFF position.	Flame switch out of adjustment.	Adjust flame switch (para. 4-8).
Heater does not complete purge cycle	Flame switch out of adjustment.	Adjust flame switch (para. 4-8).
Fan continues to operate after purge cycle	a. Flame switch out of adjustment. b. Incorrect wiring connections.	a. Adjust flame switch (para. 4-8). b. Check wiring for improper connections. Correct as necessary.

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- 1. Protective cover
- 2. Burner fuel line
- 3. Metering orifice assembly
- 4. Filter body
- 5. Sintered filter
- 6. Gasket
- 7. Heater assembly

Figure 4-2. Fuel Burning Winterization Kit Heater Assembly, Inspection and Service



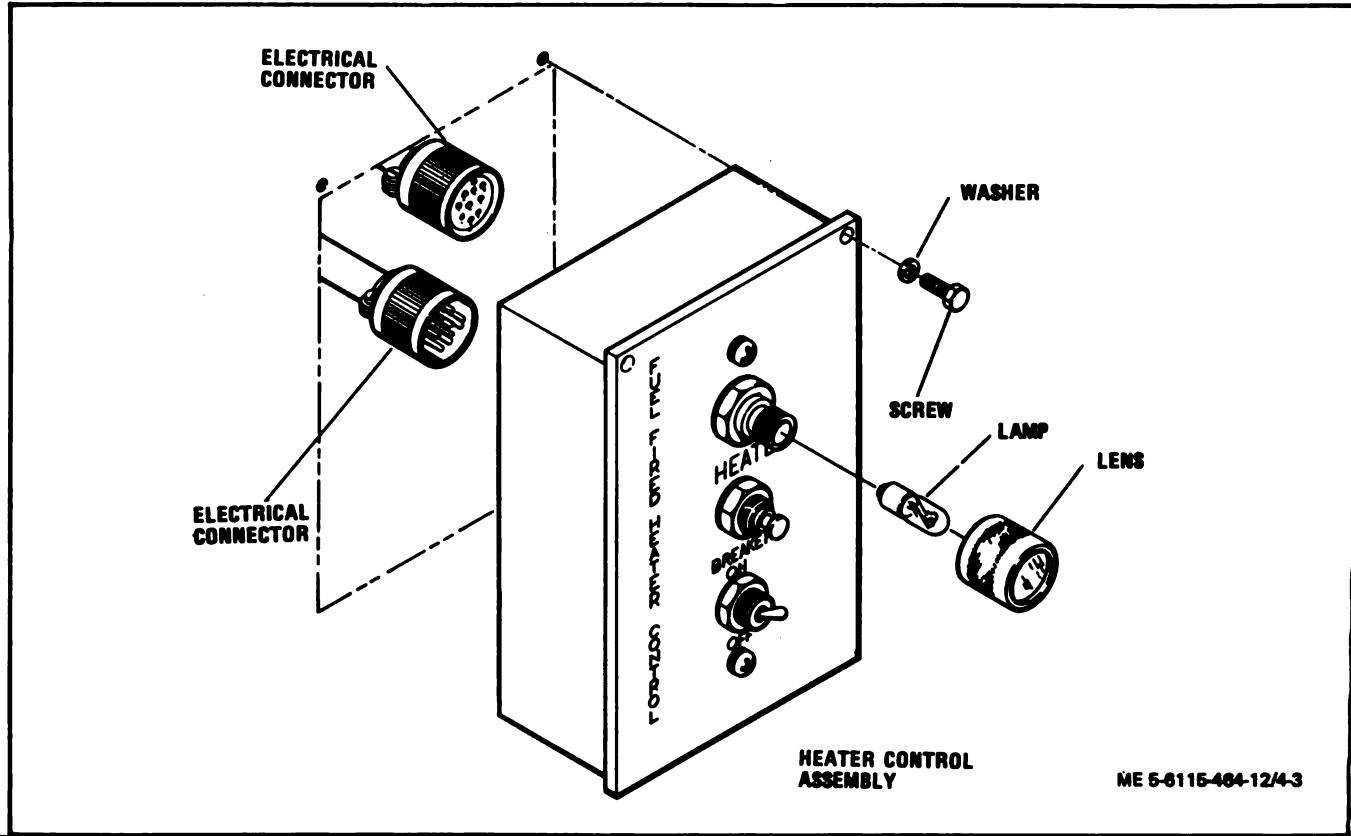


Figure 4-3. Fuel Burning Winterization Kit Heater Control Assembly Maintenance

(b) Pull control assembly out from generator set and disconnect electrical connectors.

**(2) Cleaning and Inspection.**

(a) Clean heater control assembly with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect heater control assembly for cracks, corrosion, bent or broken connector pins and other damage.

(c) Replace control assembly if damage is noted.

**(3) Lamp Replacement.**

(a) Unscrew lens (figure 4-3).

(b) Depress lamp and rotate counterclockwise to remove from indicator light base.

(c) Insert replacement lamp into base. Depress and rotate clockwise to lock in position.

(d) Install lens.

(4) Installation. Install heater control assembly in reverse order of removal procedures.

b. Heater Assembly Operational Testing. Refer to paragraph 2-22 and operate the heater assembly to determine if heater is operational.

c. Regulator Valve Assembly Fuel Flow Check and Adjustment.

(1) Service regulator valve assembly screen, sintered filter, and metering orifice assembly (paragraph 4-7b. above). Do not install burner fuel line or protective cover.

(2) Tag and disconnect electrical lead to igniter assembly (figure 4-4).

(3) Remove screws and cover plate to expose brass adjusting screw.

(4) Connect one end of burner fuel line onto metering orifice assembly and position the other end to drain into a graduated container.

(5) Install a jumper wire across terminals of thermostat switch (37, figure 4-1).

(6) With fuel inlet line connected and fuel at the valve, place heater assembly into operation (paragraph 2-22).

(7) Using a stop watch, time the fuel flow into graduated container. Flow should measure 1/2 pint in 10 to 12 minutes.

(8) If flow is not within specified limits, rotate adjusting screw (figure 4-4) to obtain proper flow rate.

#### NOTE

Rotating adjusting screw clockwise increases flow rate; rotating adjusting screw counterclockwise decreases flow rate.

(9) Stop heater assembly operation (paragraph 2-22).

(10) Install burner fuel line (figure 4-4).

(11) Install cover plate and secure with screws.

(12) Install igniter assembly electrical lead.

(13) Install heater assembly protective cover.

(14) Remove jumper wire from thermostat switch.

#### d. Flame Switch Adjustment.

(1) Remove protective cover (figure 4-4).

(2) Using a suitable screwdriver, rotate flame switch adjusting screw counterclockwise until heater motor starts.

(3) Rotate adjusting screw clockwise until motor stops.

(4) Give adjusting screw an additional 1/2 (180 degrees) turn.

(5) Reinstall protective cover.

#### e. Igniter Assembly.

(1) Removal.

(a) Remove protective cover (figure 4-4).

(b) Tag and disconnect electrical lead to igniter assembly.

(c) Remove assembly from heater assembly.

(2) Cleaning, Inspection, and Testing.

(a) Clean igniter assembly in an approved solvent and dry thoroughly.

(b) Visually inspect igniter assembly for shorted or broken coil, cracks, corrosion, stripped or damaged terminal threads or other damage.

(c) Using an ohmmeter, check resistance between igniter casing and terminal. Resistance shall be two ohms.

(d) Ground igniter assembly casing and apply 24 Vdc to terminal. Igniter coil should heat to bright red color in a few seconds.

(e) Replace igniter assembly if it fails either inspection or test.

(3) Installation. Install igniter assembly in reverse order of removal procedures.

#### f. Terminal Board Assembly.

(1) Remove protective cover (figure 4-4).

(2) Visually inspect terminal board assembly for insecure mounting, loose electrical connections, stripped or otherwise damaged threads, cracks, corrosion, and burns or other damage.

(3) Install protective cover.

#### g. Limit Switch.

(1) Remove protective cover (figure 4-4).

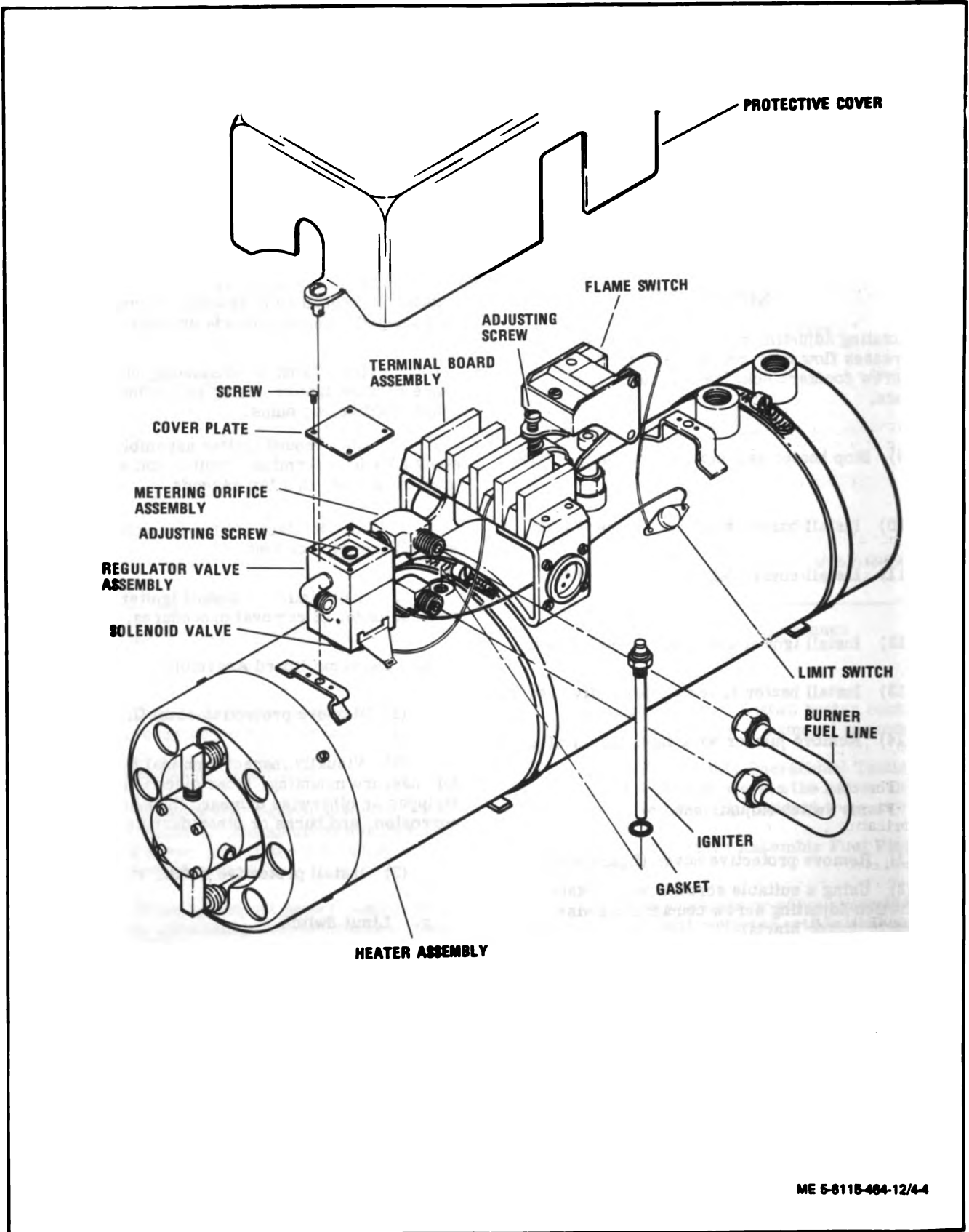
(2) Visually inspect limit switch for cracks, corrosion and evidence of shorting or other damage.

(3) Tag and disconnect electrical leads to switch.

(4) Using a multimeter or similar device, check switch for continuity.

(5) Reconnect electrical leads to switch.

(6) Install protective cover.



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Figure 4-4. Fuel Burning Winterization Kit Heater Assembly Maintenance

(7) If limit switch failed continuity test, report to higher level maintenance.

**h. Thermostat Switch.**

**(1) Removal.**

(a) Refer to paragraph 3-31 and drain the generator set radiator.

(b) Tag and disconnect electrical leads to thermostat (37, figure 4-1).

(c) Remove thermostat switch.

**(2) Cleaning and Inspection.**

(a) Clean thermostat switch with an approved solvent and dry thoroughly with filtered compressed air.

(b) Visually inspect switch for cracks, corrosion, stripped or damaged threads, and evidence of shorting or other damage.

**(3) Testing.**

(a) Suspend thermostat switch in a container of clean water so that its temperature sensor is completely immersed in water, but not touching the bottom or sides of the container.

(b) Suspend a reliable thermometer in the water so that its temperature sensing end is under water but not touching the sides or bottom of the container.

(c) Connect an ohmmeter across the terminals of the thermostat switch.

(d) Gradually heat the water stirring constantly to evenly distribute the heat.

(e) Observe both the ohmmeter and thermometer. The ohmmeter should indicate continuity up to a temperature of  $155 \pm 5^{\circ}\text{F}$  ( $68.4 \pm 2.8^{\circ}\text{C}$ ). Above this temperature, the ohmmeter should indicate an open circuit.

(f) Remove the heat and allow the water to cool.

(g) Ohmmeter should indicate continuity at a temperature of  $+135 \pm 5^{\circ}\text{F}$  ( $+56.2 \pm 2.8^{\circ}\text{C}$ ).

(h) Replace thermostat switch if it is damaged or fails to operate properly.

(4) Installation. Install thermostat switch in reverse order of removal procedures.

**Section III. ELECTRIC WINTERIZATION KIT**

**4-9. GENERAL.**

The electric winterization kit uses an external power source to maintain the engine coolant and lubricating oil at normal operating temperature in situations which require immediate starting of the generator set. The kit will function effectively down to an ambient temperature of  $-65^{\circ}\text{F}$  ( $-53.9^{\circ}\text{C}$ ). Coolant from the radiator is pumped into the heater assembly where it is heated by the heater elements. From the heater assembly, the heated coolant passes through the heat exchanger in the engine crankcase to heat the lubricating oil. After leaving the heat exchanger, the coolant is pumped through the cylinder block and returned to the radiator. The electric winterization kit may be installed on a generator set which is equipped with a fuel burning winterization kit. Power for operation of the kit may be obtained from any 205 to 240 volt, 50/60 Hz or 400 Hz, single phase source.

**4-10. ELECTRIC WINTERIZATION KIT  
INSTALLATION AND REPLACEMENT.**

**a. Installation.**

(1) Drain generator set cooling system (paragraph 3-31)

(2) Remove "WATER" plug (68, figure 4-5) from center, right-rear of engine cylinder block.

(3) Remove plug (69) from right side of engine water pump assembly.

(4) Remove plug (70) from engine oil pan heat exchanger.

(5) Remove cover plate (71) from heater control assembly mounting hole located to the right of the generator set control cubicle assembly.

**NOTE**

Retain cover plate attaching hardware. It is used to install heater control assembly.

(6) Install electric winterization kit by following the ascending sequence of index numbers (1 through 71) assigned to figure 4-5.

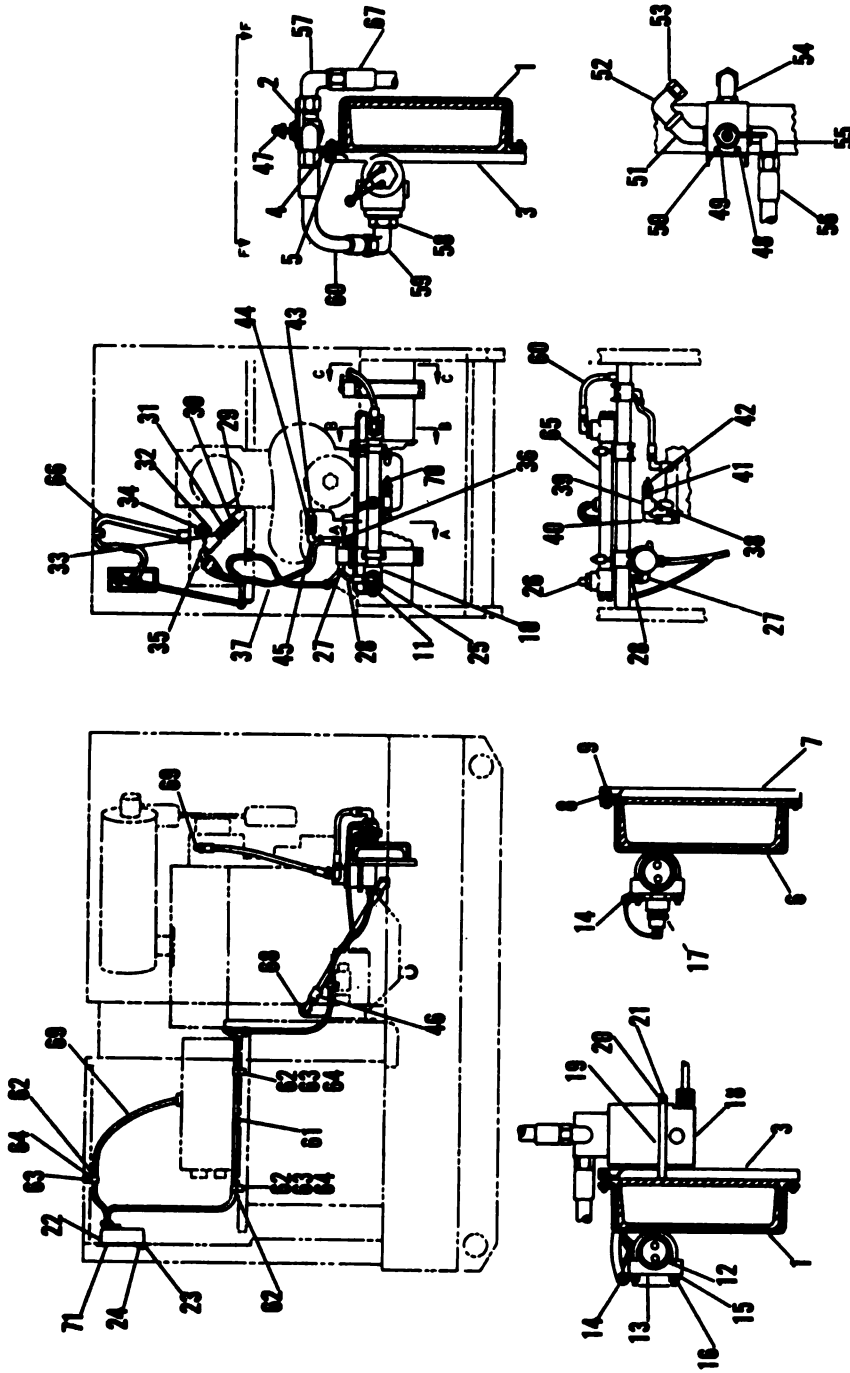


Figure 4-5. Electric Winterization Kit Installation (Sheet 1 of 2)

- |                             |                                     |
|-----------------------------|-------------------------------------|
| 1. Bracket                  | 37. Coolant hose assembly           |
| 2. Bracket                  | 38. Pipe adapter                    |
| 3. Bracket                  | 39. Tee                             |
| 4. Lockwasher               | 40. Elbow                           |
| 5. Screw                    | 41. Adapter                         |
| 6. Bracket                  | 42. Pressure relief valve           |
| 7. Bracket                  | 43. Pipe adapter                    |
| 8. Lockwasher               | 44. Valve                           |
| 9. Screw                    | 45. Elbow                           |
| 10. Pipe tee                | 46. Coolant hose assembly           |
| 11. Heating element         | 47. Three-way valve                 |
| 12. Pipe                    | 48. Screw                           |
| 13. Clamp                   | 49. Lockwasher                      |
| 14. Clamp                   | 50. Nut                             |
| 15. Lockwasher              | 51. Street elbow, 45 degree         |
| 16. Nut                     | 52. Elbow                           |
| 17. Thermostat switch       | 53. Tube cap                        |
| 18. Pump and motor assembly | 54. Elbow                           |
| 19. Clamp                   | 55. Elbow                           |
| 20. Lockwasher              | 56. Coolant hose assembly           |
| 21. Nut                     | 57. Elbow                           |
| 22. Heater control assembly | 58. Reducer                         |
| 23. Lockwasher              | 59. Elbow                           |
| 24. Screw                   | 60. Coolant hose assembly           |
| 25. Reducer                 | 61. Wiring harness                  |
| 26. Elbow                   | 62. Clamp                           |
| 27. Elbow                   | 63. Screw & captive washer assembly |
| 28. Coolant hose assembly   | 64. Nut                             |
| 29. Street elbow            | 65. Tubing                          |
| 30. Pipe coupling           | 66. Wiring harness                  |
| 31. Shutoff cock            | 67. Hose assembly                   |
| 32. Street tee              | 68. Plug                            |
| 33. Straight adapter        | 69. Plug                            |
| 34. Tube cap                | 70. Plug                            |
| 35. Elbow                   | 71. Cover plate                     |
| 36. Elbow                   |                                     |

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Figure 4-5. Electric Winterization Kit Installation (Sheet 2 of 2)

**NOTE**

Coat threads of all pipe fittings with sealing compound conforming to Military Specification MIL-S-22743, Grade HVV prior to installation.

**NOTE**

Tube caps (34 and 53) are to be removed and stored in the generator set tool box and tee (32) and straight adapter (33) installed if fuel burning winterization kit is to be installed.

(7) Run wiring harness through existing clamps (62) where indicated.

(8) Connect external power wiring harness to heater control assembly.

(9) Slide shrink tubing (65) over all screw terminals and shrink.

(10) Loosen coolant hose assembly (28) at elbow (26). Place three way valve (47) in open position and open valves (31) and (44).

(11) Service generator set cooling system (paragraph 3-31) and allow air to bleed from winterization kit.

(12) Tighten coolant hose assembly and close valves.

(13) Add coolant to generator set cooling system as necessary.

**b. Replacement.**

(1) Removal.

(a) Drain generator set cooling system (paragraph 3-31).

(b) Remove electric winterization kit in reverse order of steps a. (2) through a. (8) above.

(c) Service generator set cooling system.

(2) Installation. Refer to paragraph 4-10a. above for installation instructions.

#### 4-11. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

a. General. To insure that the electric winterization kit is ready for operation at all times, it must be systemically inspected in order that defects be discovered and corrected before serious damage or failure of the equipment results. Defects discovered during operation shall be noted for correction to be made as soon as operation ceases. Operation shall be ceased immediately if a defect which may cause damage to the equipment is noted. All defects and short comings shall be recorded together with the corrective action taken on the applicable forms at the earliest opportunity. Army and Navy users shall accomplish the preventive maintenance checks and services listed and described in subparagraph b. below. Air Force users shall refer to the applicable inspection manuals and work card sets in the T.O. 35C2-3 Series for periodic requirements and table 4-3 for detailed procedures. Marine Corps users should refer to the current issue of TM 11275/1.

b. Preventive Maintenance Checks and Services (Army and Navy).

(1) Operator. Table 4-3 contains a tabulated listing of preventive maintenance checks and services which shall be performed before, during and after operation and the weekly checks and services to be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-3 for checks and services.

(2) Organizational Maintenance. Table 4-3 also contains a tabulated listing of preventive maintenance checks and services which shall be performed by organizational maintenance personnel at monthly and semi-annual intervals. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-3 for checks and services.

#### 4-12. TROUBLE SHOOTING.

Table 4-4 contains a list of malfunctions which is useful in diagnosing and correcting unsatisfactory operation or failure of the electric winterization kit. Each malfunction is followed by an alphabetical listing

of probable causes of the malfunction. The corresponding listing of corrective actions contains references to the applicable maintenance paragraphs for correcting the malfunction. The table lists only those malfunctions, probable causes and corrective actions which are within the scope of organizational maintenance. Any malfunction whose causes and corrective actions are beyond the scope of organizational maintenance shall be reported to higher level maintenance.

#### 4-13. OPERATOR'S MAINTENANCE OF ELECTRIC WINTERIZATION KIT.

a. Coolant Pump Assembly.

(1) Inspect pump (18, figure 4-5) for cracks, breaks, corrosion and leaks.

(2) Check pump for discoloration or other signs of overheating.

b. Coolant Hoses and Fittings.

(1) Inspect coolant hoses (46, figure 4-5) for damage and deterioration.

(2) Check fittings and valves for loose connections and leaks.

c. Wiring Harnesses. Check wiring harness (61, 66, figure 4-5) for frayed, burned, or deteriorated insulation, insecure support clamps, and loose connections.

d. Indicator Lights.

(1) Inspection. Inspect indicator lights (figure 4-6) for cracked or broken lens, corrosion, and other damage.

(2) Testing.

(a) Close circuit breaker (figure 4-6) to apply power to control assembly.

(b) Depress indicator light lens. If lamp is operating, it will illuminate.

(c) Open circuit breaker.

(3) Lamp Replacement.

(a) Unscrew lens (figure 4-6).

(b) Depress and rotate lamp counterclockwise to remove.

Table 4-3. ELECTRIC WINTERIZATION KIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM NUMBER	INTERVAL					ITEM TO BE INSPECTED	PROCEDURE	REFERENCE	
	OPERATOR			ORG					
	DAILY			W	M				S
	B	D	A						
	B - BEFORE OPERATION D - DURING OPERATION A - AFTER OPERATION			DAILY - 8 HRS W - WEEKLY (40 HRS) M - MONTHLY (100 HRS) S - SEMI-ANNUAL (500 HRS)					
1	X		X			Power cable	Check that power cable is connected to power supply before operation. Disconnect after operation.	Para. 4-10	
2	X		X			Coolant line valves	Check that all coolant line valves are in the proper position for operation. Close all coolant line valves after operation.	Para. 4-10	
3	X		X			Generator set radiator	Check for proper coolant level.	Para. 3-31	
4	X	X	X		X	Coolant lines	Check coolant lines for leaks before, during, and after operation. Inspect condition and tighten connections quarterly.	Figure 4-5	
5				X	X	Wiring harnesses	Check for frayed insulation and loose connectors or terminals.	Figure 4-5	
6					X	Coolant pump	Check for proper operation.	Para. 4-14	
7	X			X	X	Control assembly	Check for damage and test indicator lights.	Para. 4-13	
8					X	Thermostat	Test for proper operation.	Para. 4-14	
9					X	Heater assembly	Inspect and test.	Para. 4-10	
10					X	Attaching hardware	Check for loose or missing attaching hardware. Tighten or replace as necessary.	Figure 4-5	



Table 4-4. Electric Winterization Kit Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
ON-OFF switch ON position but heaters and pump not operating	a. Power cable not connected to power supply. b. Circuit breaker not closed. c. Defective circuit breaker. d. Defective ON-OFF switch. e. Blown fuse. f. Defective wiring.	a. Connect power cable (figure 4-5). b. Close circuit breaker (para. 2-23). c. Replace circuit breaker (para. 4-14). d. Replace ON-OFF switch (para. 4-14). e. Replace fuse (para. 4-14). f. Check wiring. Repair or replace if necessary (para. 4-13).
Heaters inoperative	a. Defective ON-OFF switch. b. Defective thermostat switch. c. Defective wiring. d. Defective heater element.	a. Replace ON-OFF switch (para. 4-14). b. Replace ON-OFF switch (para. 4-14). c. Test wiring. Repair or replace if necessary (para. 4-14). d. Test heater elements. Replace if necessary (para. 4-14).
Pump inoperative.	a. Defective ON-OFF switch. b. Defective wiring.	a. Replace ON-OFF switch (para. 4-74). b. Inspect and test wiring. Repair or replace as necessary (para. 4-14).
Indicator light inoperative	a. Defective lamp. b. Defective wiring.	a. Replace lamp (para. 4-13). b. Inspect and test wires. Repair or replace if necessary (para. 4-14).

(c) Insert replacement lamp. Depress and rotate clockwise to lock.

(d) Install lens.

e. Fuse.

(1) Remove fuse holder cap (figure 4-6).

(2) Withdraw fuse from fuse holder.

(3) Clean fuse with a clean, lint-free cloth lightly moistened with an approved solvent.

(4) Visually inspect fuse for cracks or broken glass, corrosion, and melted conductor.

(5) Use an ohmmeter, check fuse for continuity.

(6) Replace fuse if unserviceable.

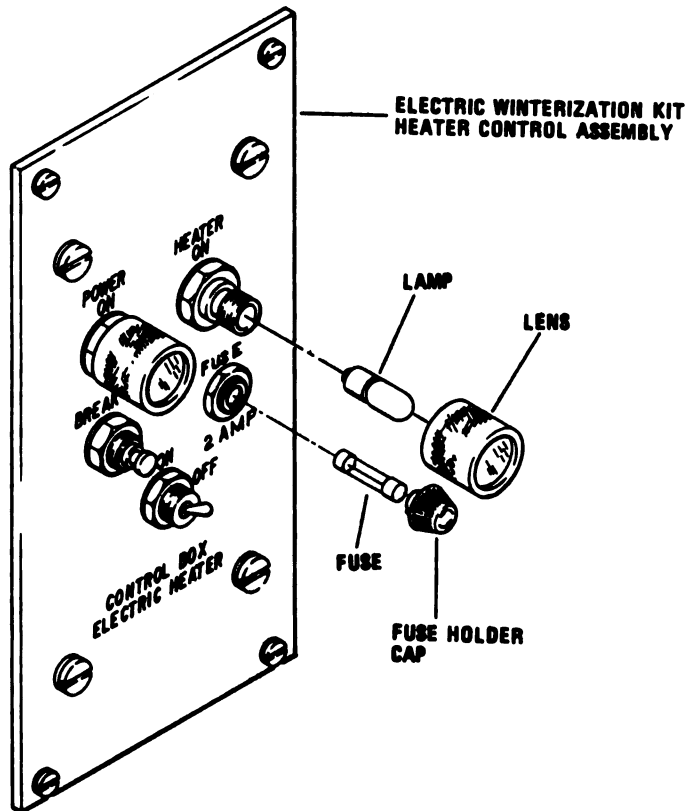
(7) Insert fuse into fuse holder and install fuse holder cap.

4-14. ORGANIZATIONAL MAINTENANCE OF ELECTRIC WINTERIZATION KIT.

a. Indicator Light Assembly.

(1) Removal.

(a) Remove screws (1, figure 4-7) and washers (2) and pull control box out from generator set.



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Figure 4-6. Electric Winterization Kit Control Assembly Indicator Lamp Fuse Replacement

(b) Tag and disconnect electrical connectors from control box.

(c) Remove screws (3) and carefully pull panel assembly (4) away from control box.

(d) Tag and disconnect electrical leads to indicator light assembly.

(e) Unscrew lens (5) and remove lamp (6).

(f) Remove nut (7) and tooth lockwasher (9) to remove nut (10) and base (8).

(g) Do not remove nut from base.

(2) Cleaning and Inspection.

(a) Clean indicator light assembly with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect indicator light assembly for cracks, corrosion, stripped or damaged threads and evidence of shorting or other damage.

(c) Replace indicator light assembly if damaged beyond simple repair.

(3) Installation. Install indicator light assembly in reverse order of removal procedures.

b. Circuit Breaker.

(1) Removal.

(a) Gain access to interior of control box (paragraph (a) through (c) above).

(b) Tag and disconnect electrical leads to circuit breaker.

(c) Remove nut (11, figure 4-7) and tooth lockwasher (12) to remove circuit breaker (13).

(2) Cleaning and Inspection.

(a) Clean circuit breaker with filtered compressed air and electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

- 1. Screw
- 2. Washer
- 3. Screw
- 4. Panel assembly
- 5. Lens
- 6. Lamp
- 7. Nut
- 8. Base
- 9. Tooth lockwasher
- 10. Nut
- 11. Nut
- 12. Tooth lockwasher
- 13. Circuit breaker
- 14. Fuse holder cap
- 15. Fuse
- 16. Nut
- 17. Tooth lockwasher
- 18. Fuse holder

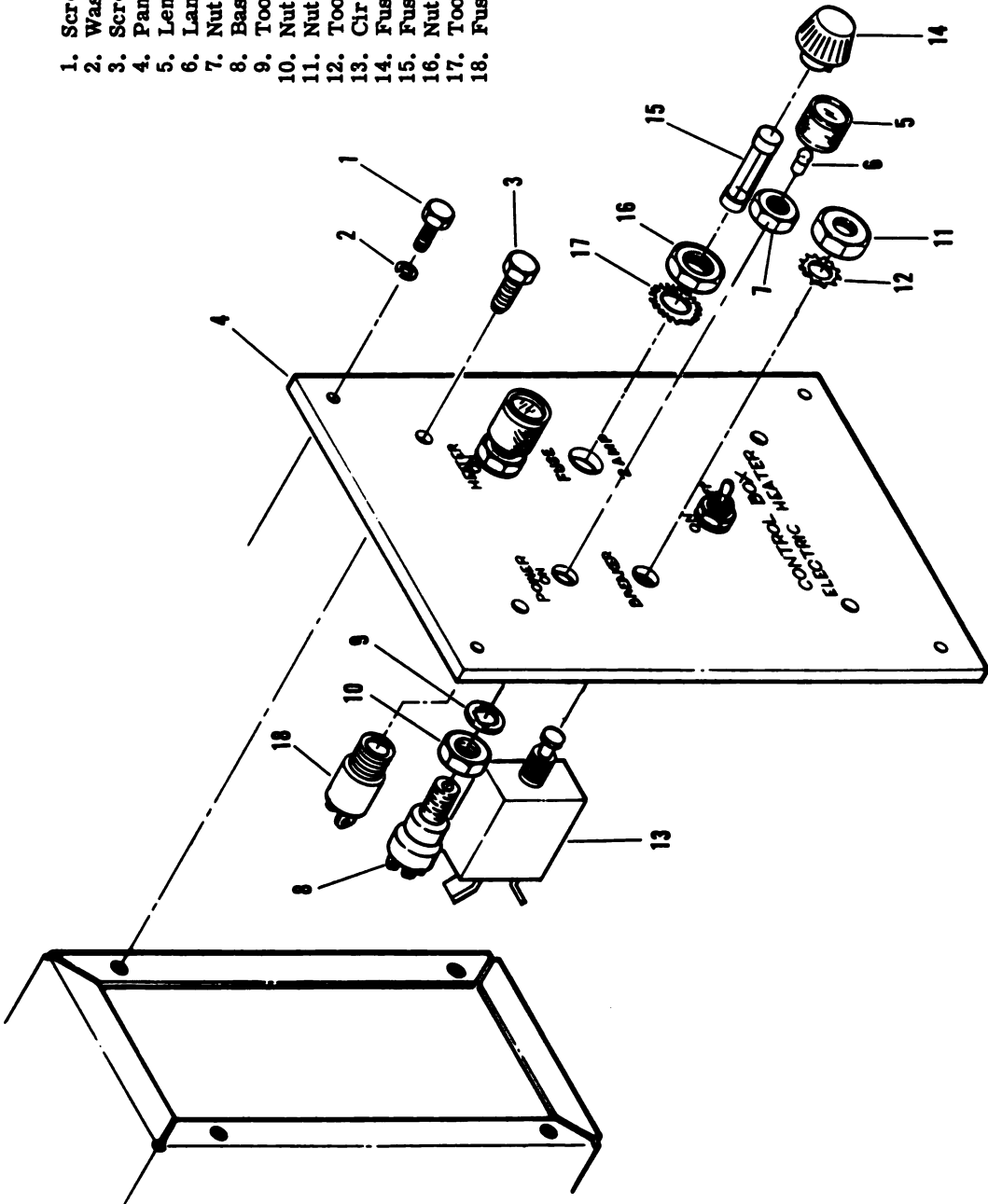


Figure 4-7. Electric Winterization Kit Control Assembly, Exploded View (Sheet 1 of 2)

(b) Visually inspect circuit breaker for cracks, corrosion, stripped or damaged threads and evidence of shorting or other damage.

(3) Testing.

(a) Connect an ohmmeter or similar device across circuit breaker terminals.

(b) Pull out circuit breaker button and check ohmmeter indication. Ohmmeter shall indicate open circuit.

(c) Depress circuit breaker button and check ohmmeter indication. Ohmmeter shall indicate continuity.

(d) Replace circuit breaker if the above continuity requirements are not met.

(4) Installation. Install circuit breaker in reverse order of removal procedures.

c. Fuse Holder Assembly.

(1) Removal.

(a) Tag and disconnect electrical leads to fuse holder assembly.

(b) Remove fuse holder cap (14, figure 4-7) and fuse (15).

(c) Remove nut (16) and tooth lock-washer (17) to remove fuse holder (18).

(2) Cleaning, Inspection, and Repair.

(a) Clean fuse holder assembly parts with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect fuse holder and fuse holder caps for cracks, corrosion, and stripped or otherwise damaged threads.

(c) Inspect fuse for cracked or broken glass, corrosion, and melted conductor.

(d) Use an ohmmeter to check fuse for continuity.

(e) Replace damaged or defective parts.

(3) Installation. Install fuse holder assembly in reverse order of removal instructions.

d. ON-OFF Switch. Visually inspect ON-OFF switch (figure 4-7) for insecure mounting, loose electrical connections, cracks, corrosion and other damage.

e. Coolant Pump and Motor Assembly.

(1) Motor Brushes Replacement.

NOTE

Note position of brushes as they are removed to facilitate installation

(a) Remove brush retainer caps, springs, and brushes from pump assembly motor.

(b) Measure brush length. Brushes shall be replaced if length is 3/16 inch or less.

(c) Install brushes, springs, and brush retainer caps.

(2) Cleaning and Inspection.

(a) Clean coolant pump and motor assembly with an approved solvent and dry with filtered compressed air.

(b) Visually inspect motor for cracks, corrosion, evidence of shorting and other damage.

(c) Visually inspect pump for cracks, corrosion, and other damage.

(3) Testing.

(a) Check that three-way valve (47, figure 4-5) is in the CLOSED position.

(b) Disconnect coolant hose assembly (67) from elbow (57) in three-way valve and position to drain into a three gallon container.

(c) Remove generator set radiator cap.

(d) Place ON-OFF switch (figure 4-7) in the ON position.

(e) Note time required to fill container. Time shall be approximately three minutes.

(f) Place ON-OFF switch in the OFF position and reconnect coolant hose assembly.

(g) Replace pump and motor assembly if it fails to function properly.

(h) Service generator set cooling system (paragraph 3-31).

(i) Install coolant hoses and service cooling system (paragraph 3-31) if pump functions properly.

f. Thermostat Switch.

(1) Removal.

(a) Refer to paragraph 3-31 and drain the radiator.

(b) Tag and disconnect electrical leads to thermostat switch (17, figure 4-5).

(c) Remove thermostat.

(2) Cleaning and Inspection.

(a) Clean thermostat switch with an approved solvent and dry thoroughly with filtered compressed air.

(b) Visually inspect thermostat switch for cracks, corrosion, evidence of shorting, stripped or damaged threads and other damage.

(3) Testing.

(a) Suspend thermostat switch in a container of clean water so that its temperature sensor is completely immersed but not touching the sides or bottom of the container.

(b) Suspend a reliable thermometer in the container so that its temperature sensing end is immersed but not touching the sides or bottom of the container.

(c) Connect an ohmmeter across the terminals of the thermostat switch. Check that ohmmeter indicates continuity.

(d) Gradually heat container, stirring constantly to evenly distribute heat.

(e) Observe both thermometer and ohmmeter. Ohmmeter should indicate continuity up to a temperature of  $150^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $65.6^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ). Above this temperature, ohmmeter should indicate open circuit.

(f) Remove heat and allow the container to cool while observing thermometer and ohmmeter.

(g) Ohmmeter should indicate continuity at a temperature of  $130^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $54.4^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ).

(h) Replace thermostat switch if it fails to operate properly.

(4) Installation. Install thermostat switch in reverse order of removal procedures.

#### g. Heating Elements.

(1) Removal.

(a) Drain engine cooling system (paragraph 3-31).

(b) Tag and disconnect electrical leads to heating elements (11, figure 4-5).

(c) Unscrew heating elements from pipe (12).

(2) Cleaning and Inspection.

(a) Clean heating elements with an approved solvent and dry thoroughly with filtered compressed air.

(b) Visually inspect heating elements for cracks, breaks, corrosion, stripped or damaged threads, evidence of shorting, or other damage.

(3) Testing.

(a) Using an ohmmeter, check for open circuit between heater element terminal and casing. Ohmmeter shall indicate open circuit.

(b) Check resistance across terminals. Resistance shall be  $30 \pm 3$  ohms.

(c) Replace heater element which does not test properly.

(4) Installation. Install heating element in reverse order of removal procedures.

#### h. Coolant Hoses and Fittings.

(1) Removal. Remove damaged coolant hoses and fittings by following the ascending numerical sequence of index numbers assigned to figure 4-5.

#### NOTE

Only those hoses and fittings requiring replacement need be removed.

(2) Installation. Install coolant hoses and fittings in reverse order of removal procedures.

#### i. Wiring Harnesses.

(1) Removal. Remove wiring harness assembly terminals and connectors as required for access to other components and testing or replacement of damaged parts.

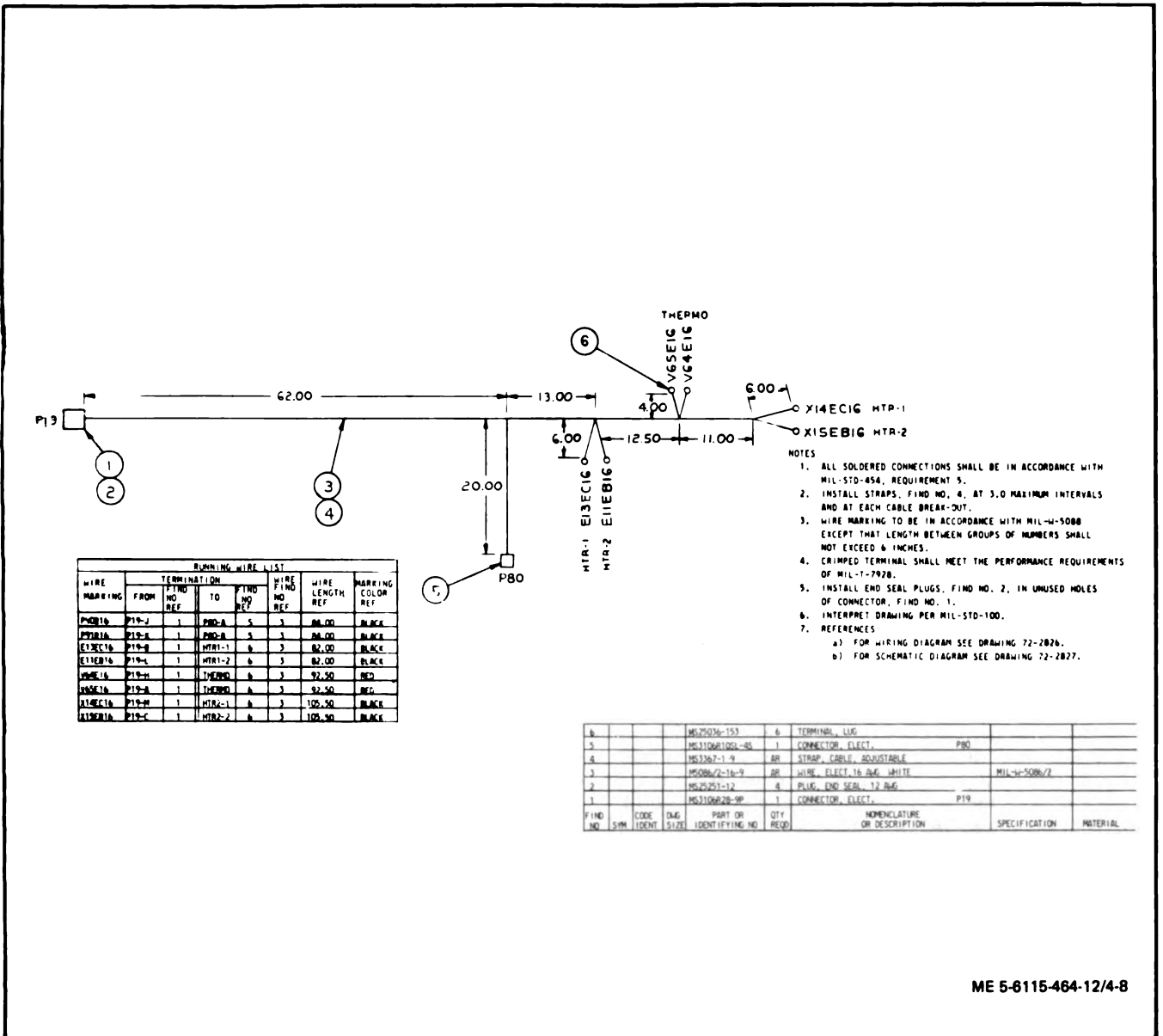
#### NOTE

Tag or otherwise identify electrical leads, terminals, and connectors and wiring harness support clamps before removal to facilitate installation.

(2) Cleaning and Inspection.

(a) Clean wiring harness with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect wiring harness for burned, bent, corroded or otherwise damaged terminals.



RUNNING WIRE LIST						
WIRE MARKING	FROM	TERMINATION	TO	WIRE	WIRE	MARKING
	NO	NO	NO	NO	LENGTH	COLOR
	REF	REF	REF	REF	REF	REF
PIB16	P19-J	1	P10-A	5	3	86.00 BLACK
PIB16	P19-K	1	P10-B	5	3	86.00 BLACK
E1EB16	P19-B	1	HTR-1	6	3	82.00 BLACK
E1EB16	P19-L	1	HTR-2	6	3	82.00 BLACK
W1E16	P19-H	1	THERMO	6	3	92.50 RED
W1E16	P19-A	1	THERMO	6	3	92.50 RED
W1E16	P19-M	1	HTR-1	6	3	102.50 BLACK
W1E16	P19-C	1	HTR-2	6	3	102.50 BLACK

- NOTES
1. ALL SOLDERED CONNECTIONS SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 5.
  2. INSTALL STRAPS, FIND NO. 4, AT 3.0 MAXIMUM INTERVALS AND AT EACH CABLE BREAK-OUT.
  3. WIRE MARKING TO BE IN ACCORDANCE WITH MIL-H-5088 EXCEPT THAT LENGTH BETWEEN GROUPS OF NUMBERS SHALL NOT EXCEED 6 INCHES.
  4. CRIMPED TERMINAL SHALL MEET THE PERFORMANCE REQUIREMENTS OF MIL-T-7928.
  5. INSTALL END SEAL PLUGS, FIND NO. 2, IN UNUSED HOLES OF CONNECTOR, FIND NO. 1.
  6. INTERPRET DRAWING PER MIL-STD-100.
  7. REFERENCES
    - a) FOR WIRING DIAGRAM SEE DRAWING 72-2826.
    - b) FOR SCHEMATIC DIAGRAM SEE DRAWING 72-2827.

FIND NO.	SIM	CODE IDENT	QTY REQD	DESCRIPTION	SPECIFICATION	MATERIAL
6		MS25036-153	6	TERMINAL LUG		
5		MS110621001-85	1	CONNECTOR, ELECT.	P80	
4		MS1367-1-9	AR	STRAP, CABLE, ADJUSTABLE		
3		MS086/2-16-9	AR	WIRE, ELECT. 16 AWG. WHITE	MIL-H-5088/2	
2		MS25251-12	4	PLUG, END SEAL, 12 AWG		
1		MS110628-9P	1	CONNECTOR, ELECT.	P19	

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Figure 4-8. Electric Winterization Kit Wiring Harness, Dwg. No. 72-2855

(c) Inspect connectors for cracks, corrosion, stripped or otherwise damaged threads, bent or broken pins and other damage.

(d) Check insulation for burns, deterioration and chafing.

(e) Replace any damaged parts.

(3) Testing. Test continuity of individual wires using a multimeter or continuity light, using figure 4-8 as a guide.

**CAUTION**

Do not use acid core solder on electrical components.

(4) Repair. Replace damaged wires, terminals, and connectors by unsoldering connections, installing replacement parts and soldering.

**NOTE**

If more than 30 percent of the wires are damaged, the wiring harness shall be replaced.

(5) Installation. Install wiring harness in reverse order of removal procedures.

## Section IV. WHEEL MOUNTING KIT

### 4-15. GENERAL.

The wheel mounting kit provides added mobility for the generator set. It consists of two wheel axle assemblies. The front axle is equipped with a towbar, pintle and safety chain for towing. The front wheels are free to pivot up to 40 degrees for steering. A mechanical parking brake locks the rear wheels against rotation and is actuated by a hand lever located at the right rear of the kit. The kit provides the generator set with 8 inches of ground clearance.

### 4-16. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

a. General. To insure that the wheel mounting kit is ready for use at all times, it must be systematically inspected in order that defects be discovered and corrected before serious damage or failure of the equipment results. Defects discovered during use shall be noted for correction to be made as soon as use is over. Use of the wheel mounting kit shall be terminated immediately if a defect which could cause damage to the equipment is noted. All defects and short comings shall be recorded, together with the corrective action taken on the applicable forms at the earliest opportunity. Army and Navy users shall accomplish the preventive maintenance checks and services listed and described in subparagraph b. below. Air Force users shall refer to the applicable inspection manuals and work card set in the T.O. 35C2-3 Series for periodic requirements and table 4-5 for detailed procedures. Marine Corps users should refer to the current issue of TM 11275/1.

#### b. Preventive Maintenance Checks and Services (Army and Navy).

(1) Operator. Table 4-5 contains a tabulated listing of preventive maintenance checks and services which shall be performed before, during, and after operation and the weekly checks and services to be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-5 for checks and services.

(2) Organizational Maintenance. Table 4-5 also contains a tabulated listing of preventive maintenance checks and services which shall be performed by organizational maintenance personnel at monthly and semi-annual intervals. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-5 for checks and services.

### 4-17. TROUBLE SHOOTING.

Table 4-6 contains a list of malfunctions which is useful in diagnosing and correcting unsatisfactory operation or failure of the wheel mounting kit. Each malfunction is followed by an alphabetical listing of probable causes. The corresponding alphabetical listing of corrective actions contains references to the applicable maintenance paragraph for correcting the malfunction. The table lists only those malfunctions, probable causes and corrective actions within the scope of organizational maintenance. Any malfunction whose causes and corrective actions are beyond the scope of organizational maintenance shall be reported to higher level maintenance.

### 4-18. OPERATOR'S MAINTENANCE OF WHEEL MOUNTING KIT.

#### a. Wheels and Tires.

(1) Visually inspect wheels for cracks, dents, corrosion, loose lug nuts, and other damage.

(2) Inspect tires for tread wear, cuts, breaks, blisters and imbedded material.

(3) Check tire pressure with standard tire pressure gauge. Tire pressure shall be 60 psig.

#### b. Front Axle and Tow Bar Assembly.

##### (1) Inspection and Repair.

(a) Visually inspect tow bar (28, figure 4-9) for cracks, corrosion, or other damage.

(b) Check tow bar locking mechanism for proper operation.

(c) Inspect safety chains (30) for security of attachment, cracked or broken links or hook, damaged or missing hook latch (25) and corrosion or damage.

(d) Check tie rod assemblies (31) for excessive play.

#### NOTE

Excessively worn tie rod ends (10 and 16) and king pins (14) may be indicated by excessive and uneven wear on the front tires.

Table 4-5. WHEEL MOUNTING KIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES

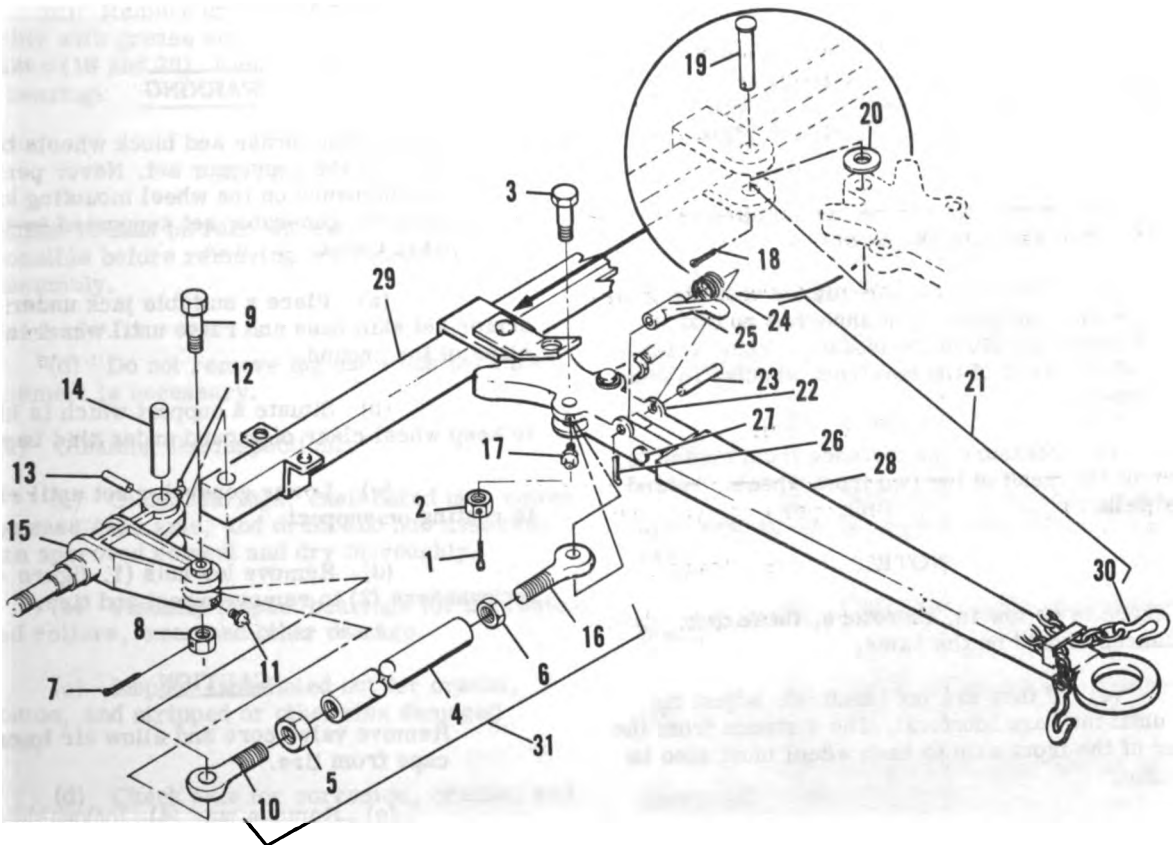
ITEM NUMBER	INTERVAL					ITEM TO BE INSPECTED	PROCEDURE	REFERENCE
	OPERATOR		ORG					
	DAILY							
	B	D	A	W	M			
1	X					Tires	Inspect tires. Service tires quarterly.	Para. 4-19
2	X			X		Safety chain	Inspect for secure attachment and condition.	Para. 4-19
3	X			X		Steering linkage	Inspect steering linkage before operation. Lubricate linkage and pivot points monthly.	Para. 4-18
4						Wheel bearings	Clean, inspect, and lubricate.	Para. 4-19
5						Attaching hardware	Inspect for loose or missing hardware. Tighten any found loose.	Para. 4-19
6				X		Parking brake linkage	Inspect parking brake linkage. Lubricate monthly.	Para. 4-19
7						Brakes	Inspect linings for wear. Adjust brakes.	Para. 4-19



Table 4-6. Wheel Mounting Kit Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Parking brake will not hold</p>	<p>a. Improperly adjusted or defective brake linkage.            b. Improperly adjusted brakes.            c. Worn brake linings.</p>	<p>a. Adjust or repair brake linkage (para. 4-19).            b. Adjust brakes (para. 4-18, 4-19).            c. Replace brake linings and adjust brakes (para. 4-19).</p>
<p>Parking brake will not release</p>	<p>a. Improperly adjusted brake linkage.            b. Improperly adjusted brakes.</p>	<p>a. Adjust brake linkage (para. 4-19).            b. Adjust brakes (para. 4-19).</p>
<p>Abnormal tire wear</p>	<p>a. Improper tire pressure.            b. Loose attaching hardware.            c. Wheel wobbles.            d. Worn or improperly adjusted tie rods.            e. Excessively worn king pins.</p>	<p>a. Correct tire pressure (para. 4-18).            b. Tighten attaching hardware.            c. See "Wheel wobbles" below.            d. Replace worn tie rod ends or adjust tie rods (para. 4-18b.).            e. Replace king pins (direct support maintenance).</p>
<p>Wheel wobbles</p>	<p>a. Loose lug nuts.            b. Defective wheel bearing or loose hub nut.            c. Bent wheel.</p>	<p>a. Tighten lug nuts.            b. Inspect wheel bearing. Replace if necessary. Tighten hub nut to obtain proper bearing pressure (para. 4-19).            c. Replace wheel (para. 4-18).</p>
<p>Kit pulls to one side or "wanders"</p>	<p>a. Improper tire pressure.            b. Wheel brake dragging.            c. Loose attaching hardware.</p>	<p>a. Correct tire pressure (para. 4-18).            b. Adjust brake (para. 4-19).            c. Tighten hardware.</p>

- |                    |                         |                      |
|--------------------|-------------------------|----------------------|
| 1. Cotter pin      | 12. Grease fitting      | 22. Center arm       |
| 2. Nut             | 13. Roll pin            | 23. Roll pin         |
| 3. Bolt            | 14. King pin            | 24. Spring           |
| 4. Tube            | 15. Spindle and knuckle | 25. Latch            |
| 5. Nut             | 16. Tie rod end         | 26. Cotter pin       |
| 6. Nut             | 17. Grease fitting      | 27. Hinge pin        |
| 7. Cotter pin      | 18. Cotter pin          | 28. Tow bar          |
| 8. Nut             | 19. Pin                 | 29. Front axle       |
| 9. Bolt            | 20. Spacer washer       | 30. Safety chain     |
| 10. Tie rod end    | 21. Tow bar assembly    | 31. Tie rod assembly |
| 11. Grease fitting |                         |                      |



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Figure 4-9. Wheel Mounting Kit, Front Axle and Tow Bar Assembly, Exploded View

(e) The generator's front end must be raised until the front wheels are clear of the ground in order to check excessive wearing of king pins. (See paragraph 4-19 for jacking procedures.)

**NOTE**

Care must be exercised when checking excessive wear on king pins to avoid mistaking wheel bearing play or loose wheel for excessively worn king pins.

(f) Replace excessively worn king pins and tie rod ends.

(2) Adjustment. If tie rod ends have been replaced, or adjustment is deemed necessary, adjust the tie rods using the following procedures:

(a) Adjust the tie rod assemblies to as near their original length as possible, with an equal number of threads showing on each tie rod end (10 and 16).

**NOTE**

With the tow bar aligned with the center line of the generator set, a preliminary check can be made to see if the tie rod assemblies are approximately the right length.

(b) Install the tie rod assemblies (31) with bolts (3 and 9) and nuts (2 and 8).

(c) With the tow bar aligned with the centerline of the generator, and anchored so that it will not move, measure the distance from center to center of the tread of the two front wheels, in front of the wheels.

(d) Measure the distance from center to center of the tread of the two front wheels, behind the wheels.

**NOTE**

There is no tow in, therefore, these distances should be the same.

(e) If they are not identical, adjust tie rods until they are identical. The distance from the center of the front axle to each wheel must also be the same.

(f) With the wheels on the ground, and tires evenly inflated, a taut string from front to rear of the wheel mounting kit should touch the sidewall of the aft and forward curvation of both front and rear tires simultaneously, as near the hubs as possible.

(3) Lubrication.

(a) Lubricate all grease fittings (11, 12, and 17) on both sides of the wheel mounting kit with grease (GAA).

(b) Lubricate tow bar mechanism and safety chain with an oil can.

c. Rear Axle Assembly.

(1) Visually inspect parking brake handle for insecure mounting, cracks, corrosion, and other damage.

(2) Inspect brake control rods for cracks, corrosion, bends and signs of wear at joints.

(3) Lubricate brake linkage with an oil can.

**4-19. ORGANIZATIONAL MAINTENANCE OF WHEEL MOUNTING KIT.**

a. Wheels and Tires.

(1) Removal.

**WARNING**

Set parking brake and block wheels before jacking the generator set. Never perform maintenance on the wheel mounting kit with the generator set supported by the jack alone.

(a) Place a suitable jack under the generator set skid base and raise until wheel is well clear of the ground.

(b) Situate a support which is high enough to keep wheel clear of ground under skid base.

(c) Lower generator set until skid base is resting on support.

(d) Remove lug nuts (1, figure 4-10) and lockwashers (2) to remove wheel and tire.

**CAUTION**

Remove valve core and allow air to escape from tire.

(e) Remove nuts (4), lockwashers (5) and screws (6) to separate wheel halves (7 and 8) and pneumatic tire (9).

(f) Inspect lug nut studs (3) for crossed, stripped, or peened threads or other damage.

(g) Refer to paragraph b. below and replace any defective studs.

(2) Repair. Refer to Appendix A for listing of applicable manual for pneumatic tire repair.

(3) Installation. Install wheel and tire in reverse order of removal procedures.

**b. Wheel Bearings.**

(1) Removal.

**NOTE**

Front wheels are not equipped with brakes.

(a) Remove wheel and tire as outlined in paragraph 4-19(a)(1) above.

(b) Remove grease cap (10, figure 4-9), cotter pin (11) and castellated nut (12) and key washer (13) to remove outer bearing (14).

(c) Remove drum (15) and hub (16) as an assembly with grease seal (17), inner bearing (18) and races (19 and 20). Remove grease seal and inner bearing.

**NOTE**

Adjust brakes on rear wheels as loose as possible before removing drum and hub assembly.

(d) Do not remove lug nut studs (3) unless replacement is necessary.

(2) Cleaning and Inspection.

(a) Clean bearings, castellated nut, cotter pin, grease cap, axle, and drum and hub assembly with an approved solvent and dry thoroughly.

(b) Visually inspect bearings for corrosion, scored rollers, wear and other damage.

(c) Inspect castellated nut for cracks, corrosion, and stripped or otherwise damaged threads.

(d) Check axle for corrosion, cracks, and stripped or otherwise damaged threads.

(e) Inspect drum and hub assembly for cracks, breaks, corroded or damaged bearing races and other damage.

**NOTE**

Check rear drum assemblies for deep scores or excessive wear on surface which mates with brake lining.

**CAUTION**

Do not drive bearing races from drum assembly. Use a puller instead.

(3) Repair. Replace any damaged parts.

**NOTE**

Bearings and races are matched sets and shall be replaced as such.

(4) Installation.

(a) If bearing races (19 and 20) were removed, press into drum assembly.

(b) Pack inner bearing (18) with grease Automotive and Artillery (GAA).

(c) Install grease seal (17).

**CAUTION**

On rear wheel, make sure that brake lining and drum assembly are clean and free of grease before installing drum assembly.

(d) Apply light film of grease to axle and install drum and hub assembly (15 and 16).

(e) Pack outer bearing (14) with grease and install.

(f) Install key washer (13) and castellated nut (12).

(g) Tighten nut until snug, then back off until next cutout is aligned with cotter pin hole in axle.

(h) Check that drum assembly rotates freely.

(i) Install cotter pin (11) and grease cap (10).

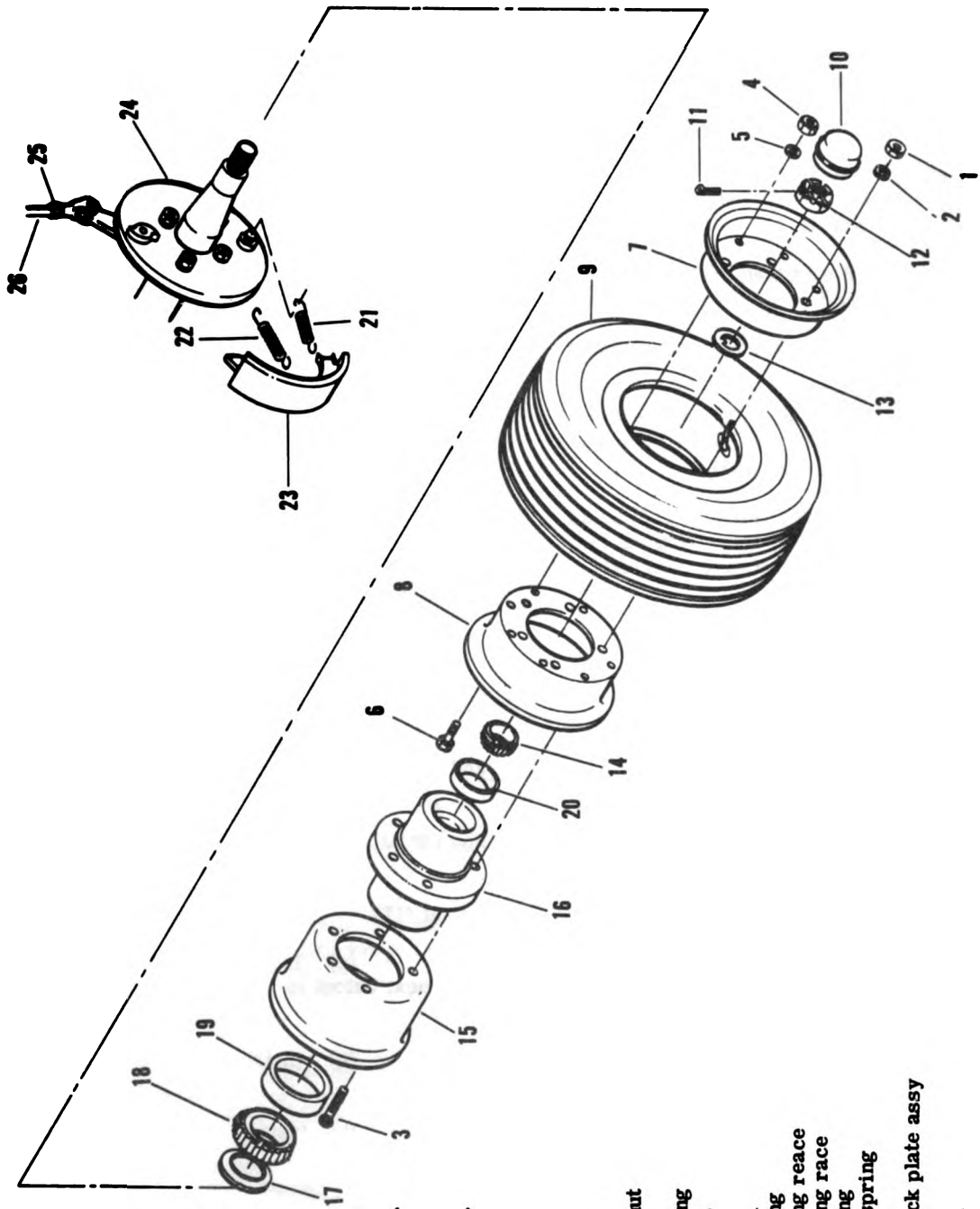
(j) Install wheel and tire as outlined in paragraph 4-19a.(3) above.

**NOTE**

Adjust brakes on rear wheels as outlined in paragraph 4-19 below before removing supports and jack.

**c. Brakes.**

(1) Removal.



1. Nut
2. Lockwasher
3. Stud
4. Nut
5. Lockwasher
6. Screw
7. Wheel half
8. Wheel half
9. Tire
10. Grease cap
11. Cotter pin
12. Catellated nut
13. Key washer
14. Outer bearing
15. Brake drum
16. Hub
17. Grease seal
18. Inner bearing race
19. Inner bearing reace
20. Outer bearing race
21. Return spring
22. Hold-down spring
23. Brake shoe
24. Axle and back plate assy
25. Lock nut
26. Linkage rod

Figure 4-10. Wheel Mounting Kit, Wheels and Brakes, Exploded View

(a) Remove wheel and tire with drum assembly as outlined in paragraph 4-19b. (1) above.

(b) Remove return springs (21, figure 4-10).

(c) Remove hold-down springs (22) and brake shoes (23) from axle and plate assembly (24).

(2) **Cleaning and Inspection.**

(a) Clean brake shoes with filtered compressed air.

(b) Clean remaining parts with dry cleaning solvent (Federal Specification P-D-680) and dry thoroughly.

(c) Inspect brake shoe linings for wear. If lining is 1/16 inch or less, brake shoes shall be replaced.

(d) Inspect return springs for cracks, corrosion and distortion.

(e) Check spring clip for cracks, corrosion, and other damage.

(f) Check adjustment bolts and abutment pins for cracks, corrosion, stripped or otherwise damaged threads and other damage.

(g) Check control lever and wedge for cracks, breaks, corrosion, and other damage.

(h) Inspect backing plate for cracks, corrosion, warping, missing or deteriorated dust covers and other damage.

(3) **Repair.** Replace any parts found defective.

(4) **Installation.**

(a) Install brake shoes in reverse order of removal procedures.

**CAUTION**

Make sure that drum assembly and brake shoe linings are clean and free of grease before installing drum assembly.

(b) Install drum assembly with wheel and tire attached as outlined in paragraph 4-19b. (4) above.

**NOTE**

Clean and inspect wheel bearings as outlined in paragraph 4-19b. (2) above before installing drum assembly.

(5) **Adjustment.**

(a) Rotate adjustment knob on brake control lever to provide minimum movement of brake linkage.

**NOTE**

Rotating adjustment knob clockwise increases brake linkage movement. Rotating adjustment knob counterclockwise decreases linkage movement.

(b) Loosen lock nuts (25, figure 4-10) on both wheels and rotate rod (26) until both brake shoes lightly rub drums. Tighten lock nuts (25).

(c) Actuate brake control lever to ascertain that brakes function properly. Additional adjustment is provided by adjustment knob on brake control lever.

**Section V. LOAD BANK KIT**

**4-20. GENERAL.**

The load bank is a balanced three phase, four wire, air cooled, resistive load which maintains the generator up to approximately 50 percent of its rated load to prevent excessive engine carbonizing due to light loads. It may be operated at 120/208 or 240/416 volts as determined by the voltage selector connectors. Generator load may be selected in 12.5 percent increments by use of the load selector switch.

**4-21. INSTALLATION, TESTING, AND REPLACEMENT OF LOAD BANK.**

**a. Installation.**

**WARNING**

Do not attempt to install load bank assembly while the generator set is operating. Serious electrical shock or death by electrocution may result from failure to observe this warning.

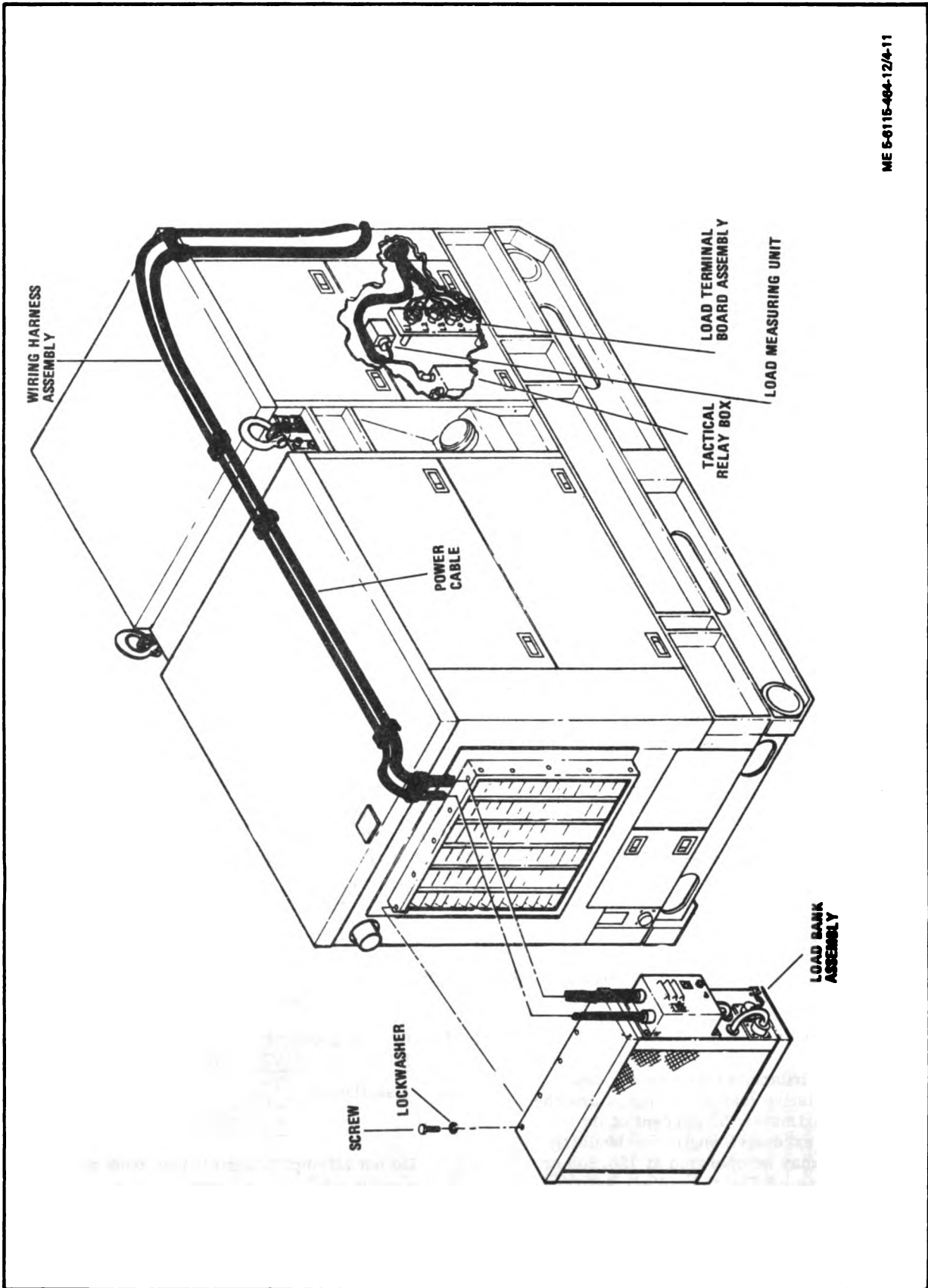


Figure 4-11. Load Bank Installation

(1) Install load bank assembly (figure 4-11) onto generator set radiator grille and secure with screws and lockwashers.

(2) Connect wiring harness leads to load terminal board assembly load measuring unit and tactical relay assembly (see figure 4-13).

b. Testing. Refer to paragraph 2-25 and operate the load bank to see if it is functional.

c. Replacement.

(1) Removal.

#### WARNING

Do not attempt to remove load bank while generator set is operating. Serious electrical shock or death by electrocution may result from failure to observe this warning.

(a) Disconnect load bank wiring harness from generator set load terminal board load measuring unit and tactical relay assembly.

(b) Remove screws (figure 4-11) and lockwashers to remove load bank assembly.

(2) Installation. Install load bank as outlined in paragraph 4-21a. above.

#### 4-22. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

a. General. To insure that the load bank is ready for operation at all times, it must be systematically inspected in order that defects be discovered and corrected before serious damage or failure of the equipment results. Defects discovered during operation shall be noted for correction to be made as soon as operation has ceased. Operation shall be terminated immediately if a defect which could cause damage to the equipment is noted. All defects and short comings shall be recorded, together with the corrective action taken, on the applicable forms at the earliest opportunity. Army and Navy users shall accomplish the preventive maintenance checks and services listed and described in subparagraph b. below. Air Force users shall refer to the applicable inspection manuals and work card set in the T. O. 35C2-3 Series for periodic requirements and table 4-7 for detailed procedures. Marine Corps users shall refer to the current issue of TM 11275/1.

b. Preventive Maintenance Checks and Services (Army and Navy).

(1) Operator. Table 4-7 contains a tabulated listing of preventive maintenance checks and services which shall be performed before, during, and after operation and the weekly checks and services to be performed by the operator. The item

numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-7 for checks and services.

(2) Organizational Maintenance. Table 4-7 also contains a tabulated listing of preventive maintenance checks and services which shall be performed by organizational maintenance personnel at monthly and semi-annual intervals. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-7 for checks and services.

#### 4-23. TROUBLE SHOOTING.

Table 4-8 contains a list of malfunctions which are useful in diagnosing and correcting unsatisfactory operation or failure of the load bank. Each malfunction is followed by an alphabetical listing of probable causes. The corresponding alphabetical listing of corrective actions contain references to the applicable maintenance paragraphs for correcting the malfunction. The table lists only those malfunctions whose causes and corrective actions are within the scope of organizational maintenance. Any malfunction whose corrective action is beyond the scope of organizational maintenance shall be reported to higher level maintenance.

#### 4-24. OPERATOR MAINTENANCE INSPECTION OF LOAD BANK.

a. Visually inspect wiring harness assembly (figure 4-11) for frayed or burned insulation, loose support clamps and connections or other damage.

b. Visually inspect voltage selector connectors (3, figure 4-12) and load selector switch (13, figure 4-12) for freedom of movement between positions, insecure mounting, loose connections, loose or broken control knobs and other damage.

#### 4-25. ORGANIZATIONAL MAINTENANCE OF LOAD BANK.

a. Transformers. Visually inspect transformers for corrosion, frayed wires, signs of overheating, discoloration, and other damage.

b. Voltage Selector Connectors.

(1) Removal.

(a) Refer to paragraph 4-21c. (1) above and remove load bank assembly from generator set.

(b) Remove nuts (1, figure 4-12) and screws (2) and pull voltage selector connectors (3) out from load bank.

(c) Tag electrical leads and unsolder connections to connector.

(d) Do not remove screw and captive washer assembly (4) and protective cap (5) unless inspection reveals damage.



Table 4-7. LOAD BANK PREVENTIVE MAINTENANCE CHECKS AND SERVICES

ITEM NUMBER	INTERVAL				ORG	ITEM TO BE INSPECTED	PROCEDURE	REFERENCE
	OPERATOR		W	M				
	DAILY	A						
			B	D				
1	X				Guard	Inspect for foreign materials.	Figure 4-8	
2			X		Mounting hardware	Inspect for loose mounting hardware.	Para. 4-24	
3	X		X		Control panel assembly	Inspect for damage.	Para. 4-24	
4				X	Wiring harness	Check for damage or evidence of shorting.	Para. 4-24	
5				X	Heater element	Visually inspect for damage and signs of overheating or shorting.	Para. 4-24	

Table 4-8. Load Bank Trouble Shooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Load bank does not apply load to generator	a. Defective load selector switch. b. Defective wiring.	a. Replace switch (para. 4-25). b. Repair or replace wiring (para. 4-25).
Indicator light does not illuminate when load bank is in operation.	a. Defective lamp. b. Defective wiring.	a. Replace lamp (para. 4-25). b. Replace or repair wiring (para. 4-25).

(2) Cleaning and Inspection.

(a) Clean voltage selector connectors with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect connectors for cracks, corrosion, stripped or damaged threads and other damage.

(3) Installation. Install voltage selector connectors in reverse order of removal procedures.

c. Load Selector Switch.

(1) Removal.

(a) Remove screws (6, figure 4-12) and lockwashers (7) and pull control box cover (8) away from load bank.

(b) Tag and disconnect electrical leads to load selector switch.

(c) Remove setscrew (9) and control knob (10).

(d) Remove screws (11) to remove load selector plate (12) and switch (13).

(2) Cleaning and Inspection.

(a) Clean switch with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect switch for cracks, corrosion, stripped, or damaged threads and other damage.

(3) Testing.

(a) Rotate switch to the OFF position.

(b) Using an ohmmeter or similar device, check for continuity using figure 4-13 as a guide.

(c) Replace switch if it fails to meet continuity requirements.

(4) Installation. Install load selector switch in reverse order of removal procedures.

d. Circuit Breaker.

(1) Removal.

(a) Remove control box cover as outlined in subparagraph c. (1)(a) above.

(b) Tag and disconnect electrical leads to circuit breaker.

(c) Remove screws (14, figure 4-12) to remove cover (15) and circuit breaker (16).

(2) Cleaning and Inspection.

(a) Clean circuit breakers with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect circuit breakers for cracks, corrosion, stripped, or damaged threads and evidence of shorting or other damage.

(3) Testing.

(a) Place circuit breaker in OPEN position.

(b) Using an ohmmeter or similar device, check for open circuit between terminals using figure 4-13 as a guide.

(c) Place circuit breaker in CLOSED position and check for continuity between terminals.

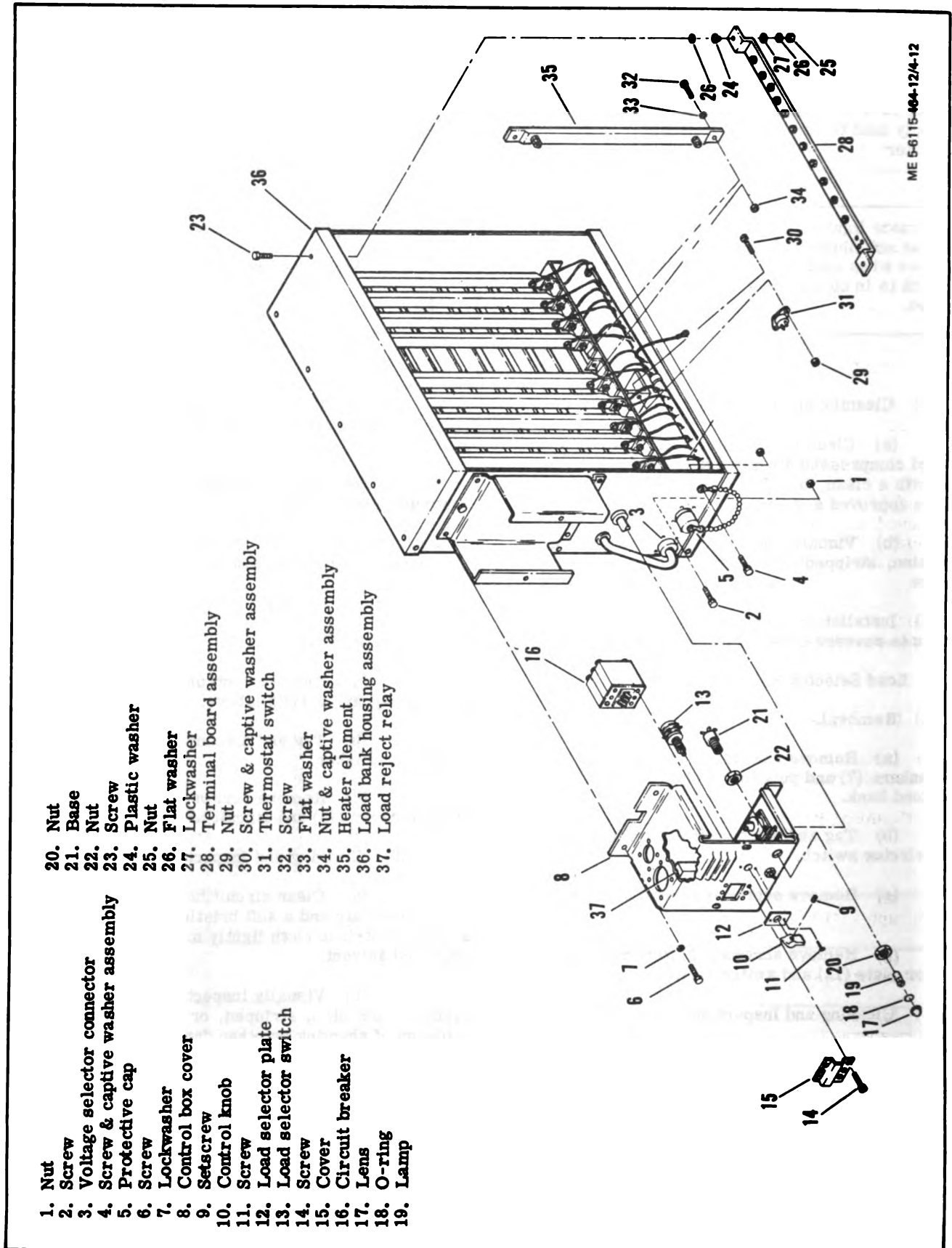


Figure 4-12. Load Bank Assembly, Exploded View

(d) Replace circuit breaker if it fails to meet the above continuity requirements.

(4) Installation. Install circuit breaker in reverse order of removal procedures.

**e. Indicator Light.**

(1) Removal.

(a) Remove control box cover as outlined in subparagraph c. (1)(a) above.

(b) Tag and disconnect electrical leads to indicator light.

(c) Unscrew lens (17) and remove o-ring (18) and lamp (19).

(d) Remove nut (20) to remove base (21) and nut (22).

(2) Cleaning and Inspection.

(a) Clean indicator light with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect light for cracks, corrosion, cracked or broken lens, stripped or damaged threads, burns and other damage.

(c) Check lamp for burned out filament.

(d) Replace only parts found damaged.

(3) Installation. Install indicator light in reverse order of removal procedures.

**f. Terminal Board Assembly.**

(1) Removal.

(a) Remove load bank assembly as outlined in paragraph 4-21c. (1) above.

(b) Tag and disconnect electrical leads to terminal board assembly.

(c) Remove screws (23, figure 4-12), plastic washers (24), nuts (25), flat washers (26) and washers (27) to remove terminal board assembly (28).

(2) Cleaning and Inspection.

(a) Clean terminal board with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect terminal board for cracks, corrosion, burns and stripped or damaged threads.

(c) Replace terminal board if damaged beyond simple repair.

(3) Installation. Install terminal board assembly in reverse order of removal procedures.

**g. Thermostat switch.**

(1) Removal.

(a) Remove load bank assembly as outlined in paragraph 4-21c. (1) above.

(b) Tag and disconnect electrical connections to thermostat switch.

(c) Remove nuts (29, figure 4-12) and screw and captive washer assemblies (30) to remove thermostat switch (31).

(2) Cleaning and Inspection.

(a) Clean thermostat by flushing with an approved solvent and drying thoroughly with filtered compressed air.

(b) Visually inspect thermostat for cracks, corrosion, stripped or damaged threads, and other obvious damage.

(c) Replace thermostat if damage is found.

(3) Installation. Install thermostat in reverse order of removal procedures.

**h. Heater Element.**

(1) Removal.

(a) Remove load bank assembly as outlined in paragraph 4-21c. (1) above.

(b) Tag and disconnect electrical leads to heater elements.

(c) Remove screws (32, figure 4-12), flat washers (33) and nut and captive washer assemblies (34) to remove heater elements (35) from housing (36).

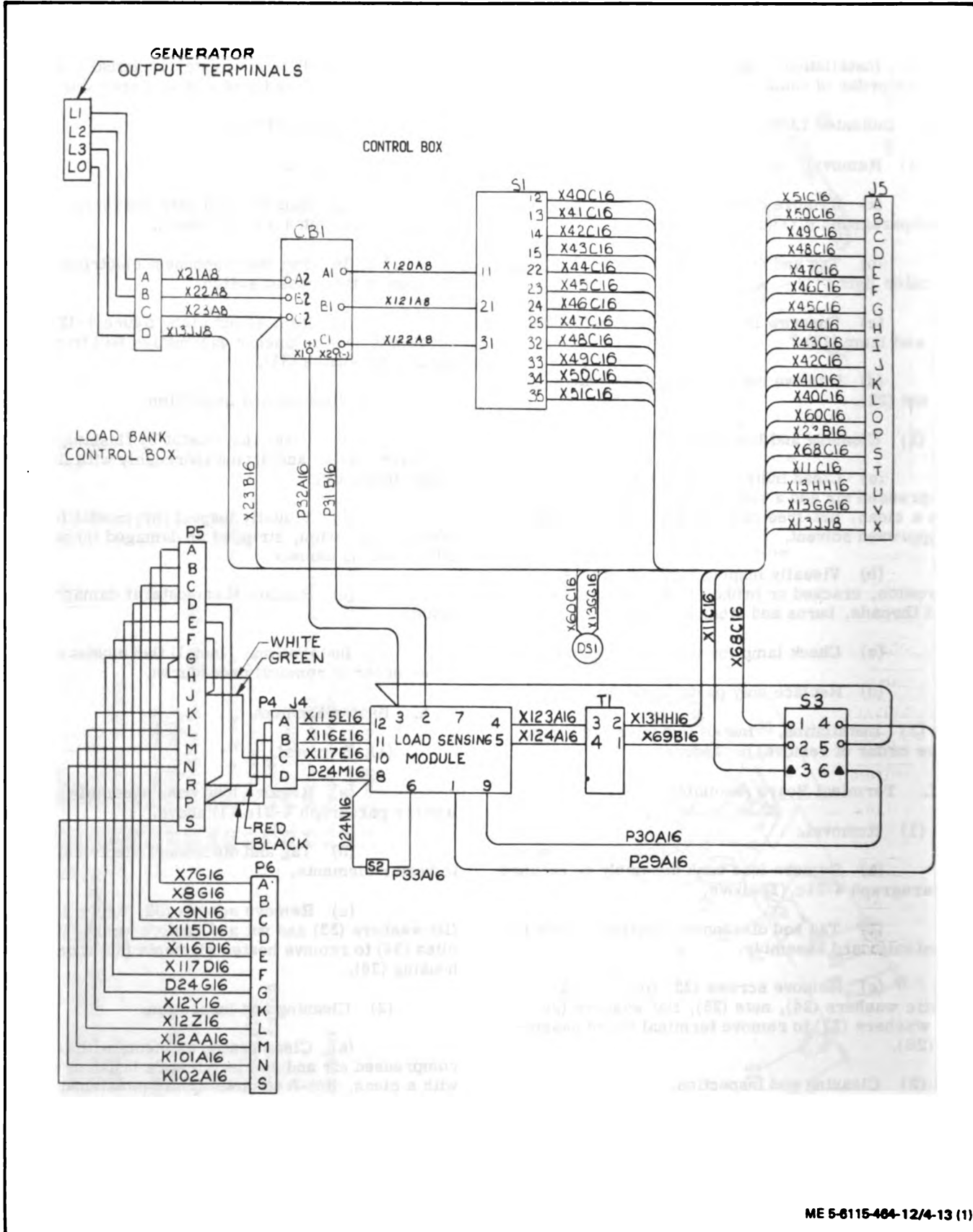
(2) Cleaning and Inspection.

(a) Clean heater elements with filtered compressed air and an electrician's brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect heater elements for cracks, breaks, corrosion, stripped or damaged threads and other damage.

(3) Testing.

(a) Using an ohmmeter, check resistance between terminals of heating elements. Resistance shall be approximately 37 ohms.



4-36 **Figure 4-13. Load Bank Wiring Diagram, Dwg. No. 72-2826 (Sheet 1 of 2)**

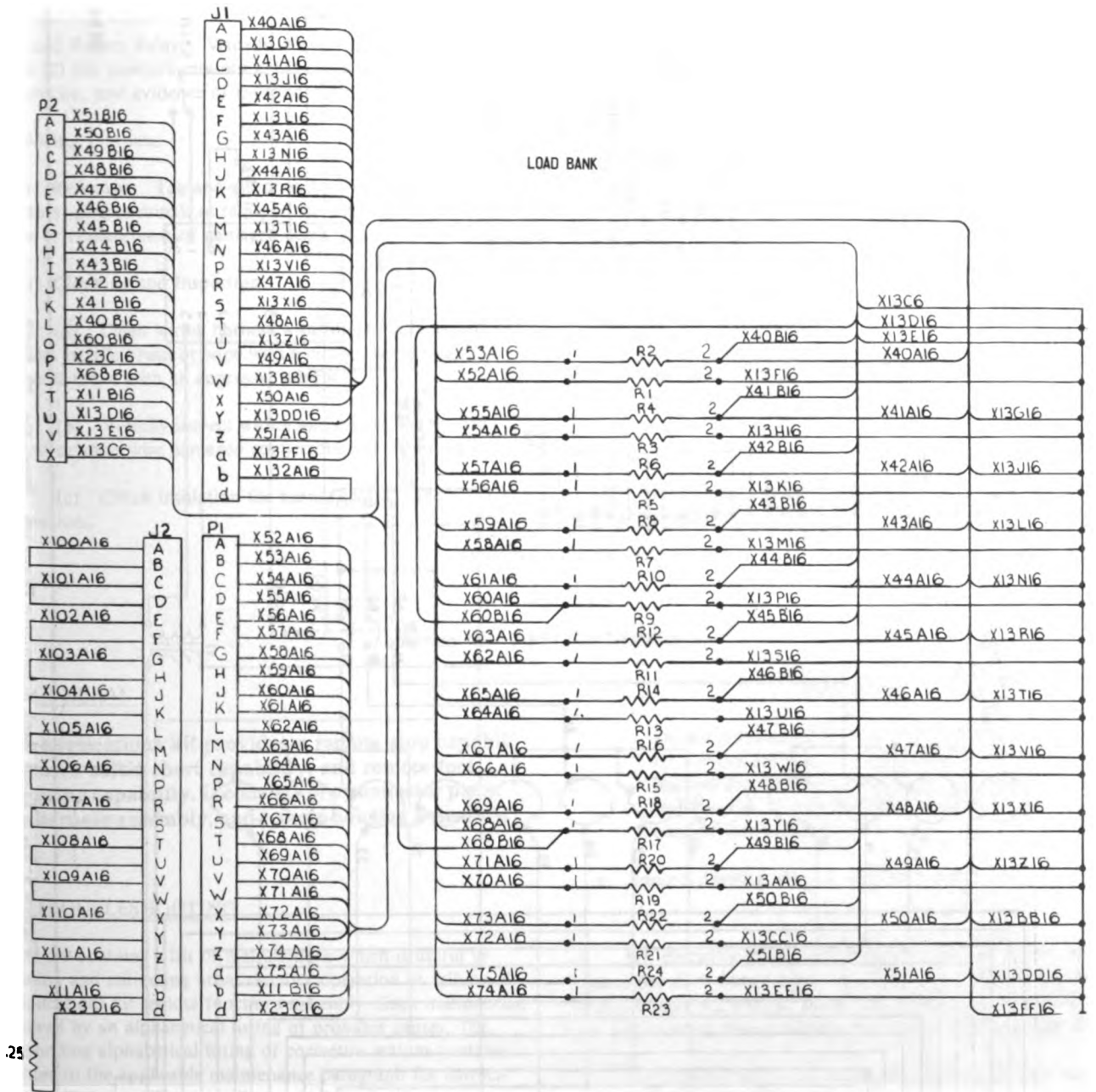
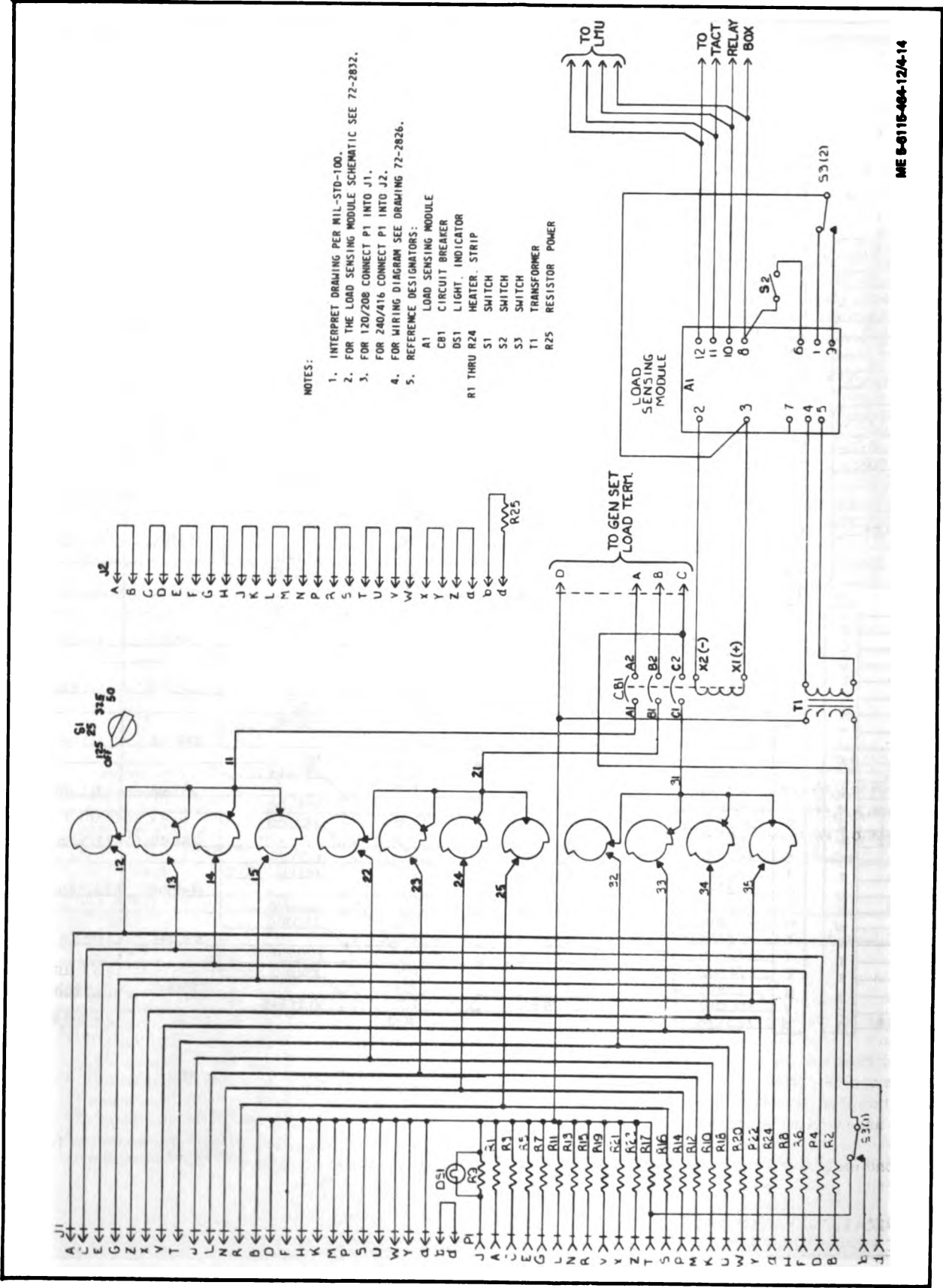


Figure 4-13. Load Bank Wiring Diagram, Dwg. No. 72-2826 (Sheet 2 of 2)



- NOTES:
1. INTERPRET DRAWING PER MIL-STD-100.
  2. FOR THE LOAD SENSING MODULE SCHEMATIC SEE 72-2832.
  3. FOR 120/208 CONNECT P1 INTO J1.
  4. FOR 240/416 CONNECT P1 INTO J2.
  5. FOR WIRING DIAGRAM SEE DRAWING 72-2826.
- REFERENCE DESIGNATORS:
- A1 LOAD SENSING MODULE
  - CB1 CIRCUIT BREAKER
  - DS1 LIGHT INDICATOR
  - R1 THRU R24 HEATER STRIP
  - S1 SWITCH
  - S2 SWITCH
  - S3 SWITCH
  - T1 TRANSFORMER
  - R25 RESISTOR POWER

ME 5-6115-464-12/4-14

Figure 4-14. Load Bank Schematic Diagram, Dwg. No. 72-2827

(b) Replace any heater element which does not test correctly.

(4) Installation. Install heater element in reverse order of removal procedures.

i. Load Reject Relay. Visually inspect load reject relay (37, figure 4-12) for insecure mounting, loose electrical connections, dents, cracks, and evidence of shorting or other damage.

j. Wiring Harness.

(1) Removal. Tag and disconnect wiring harness wires, connectors, and terminals as required for access to other components or replacement of damaged parts.

(2) Cleaning and Inspection.

(a) Clean wiring harness with filtered compressed air and a soft bristle brush or wipe with a clean, lint-free cloth lightly moistened with an approved solvent.

(b) Visually inspect wiring harness for burns, bent, corroded or otherwise damaged connectors and terminals.

(c) Check insulation for burns, chafing, and deterioration.

(3) Testing. Check continuity of individual wires with a multimeter or continuity light using figure 4-13 as a guide.

#### CAUTION

Do not use acid core solder on electrical components.

(4) Repair. Replace damaged wires, terminals, and connectors by unsoldering connections, installing replacement parts and soldering connections.

#### NOTE

If more than 30 percent of the wires are damaged, replace the wiring harness and forward it to higher level for rebuilding.

(5) Installation. Install wiring harness in reverse order of removal procedures.

### Section VI. APPLICATIONS KIT

#### 4-26. GENERAL.

The applications kit provides a remote stop capability, remote battle short capability, and remote fuel monitoring capability. It consists of a connector plate, cable harness assembly, and remote housing assembly.

#### 4-27. TROUBLESHOOTING.

Table 4-9 contains a list of malfunctions which is useful in diagnosing and correcting unsatisfactory operation or failure of the applications kit remote functions assembly. Each malfunction is followed by an alphabetical listing of probable causes. The corresponding alphabetical listing of corrective actions contains references to the applicable maintenance paragraph for correcting the malfunction. The table lists only those malfunctions, probable causes and corrective actions within the scope of organizational maintenance. Any malfunction whose corrective actions are beyond the scope of organizational maintenance shall be reported to higher level maintenance.

#### 4-28. ORGANIZATIONAL MAINTENANCE OF APPLICATIONS KIT.

#### WARNING

Do not attempt to perform maintenance tasks on the applications kit while generator set is operating. Serious electrical shock or death by electrocution may result from failure to observe this warning.

a. Inspect Applications Kit. (Refer to figure 2-14.)

(1) Remove dust cap from connector J1 and inspect for dirt, loose pins, discoloration, and loose hardware. Make sure dust cover retaining chain is mounted on lower right hand mounting screw of connector J1.

(2) Inspect interior of generator set for dust, dirt, water, and excessive oil or grease.

(3) Inspect cables and wire harness connectors for loose connectors and plugs.



Table 4-9. Applications Kit Remote Functions Assembly Troubleshooting

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1. Low fuel monitor does not function.	a. Defective fuel level gauge, fuel level gauge wiring, or fuel level transmitter on generator set.  b. Defective cable assembly.	a. Refer to paragraph 3-112c.  b. Refer to paragraph 3-112c.
2. Generator set does not respond to remote emergency stop signal.	a. Defective speed switch.	a. Refer to paragraph 3-69.
3. Generator set does not respond to remote battle short signal.	a. Defective circuit breaker (CBI).	a. Refer to paragraph 3-112u.

(4) Inspect cables and wires for frayed insulation, burn marks, and loose wires and pins.

(8) Deleted.

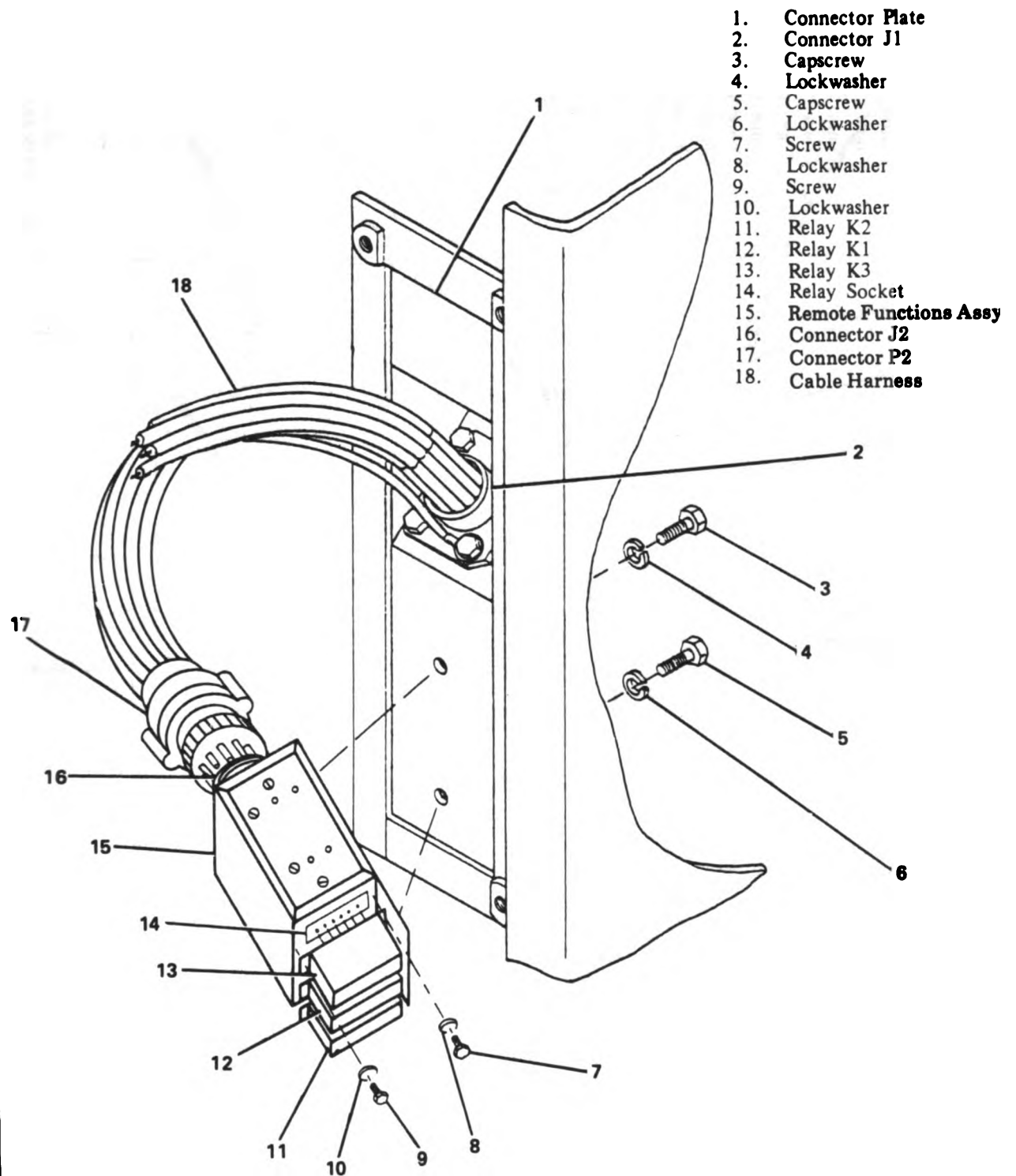
(5) Inspect cable connector strain relief screws for tightness.

(9) Inspect relays K1, K2, and K3 (figure 4-15) on remote functions housing for discoloration, bent pins, and loose fittings.

(6) Deleted.

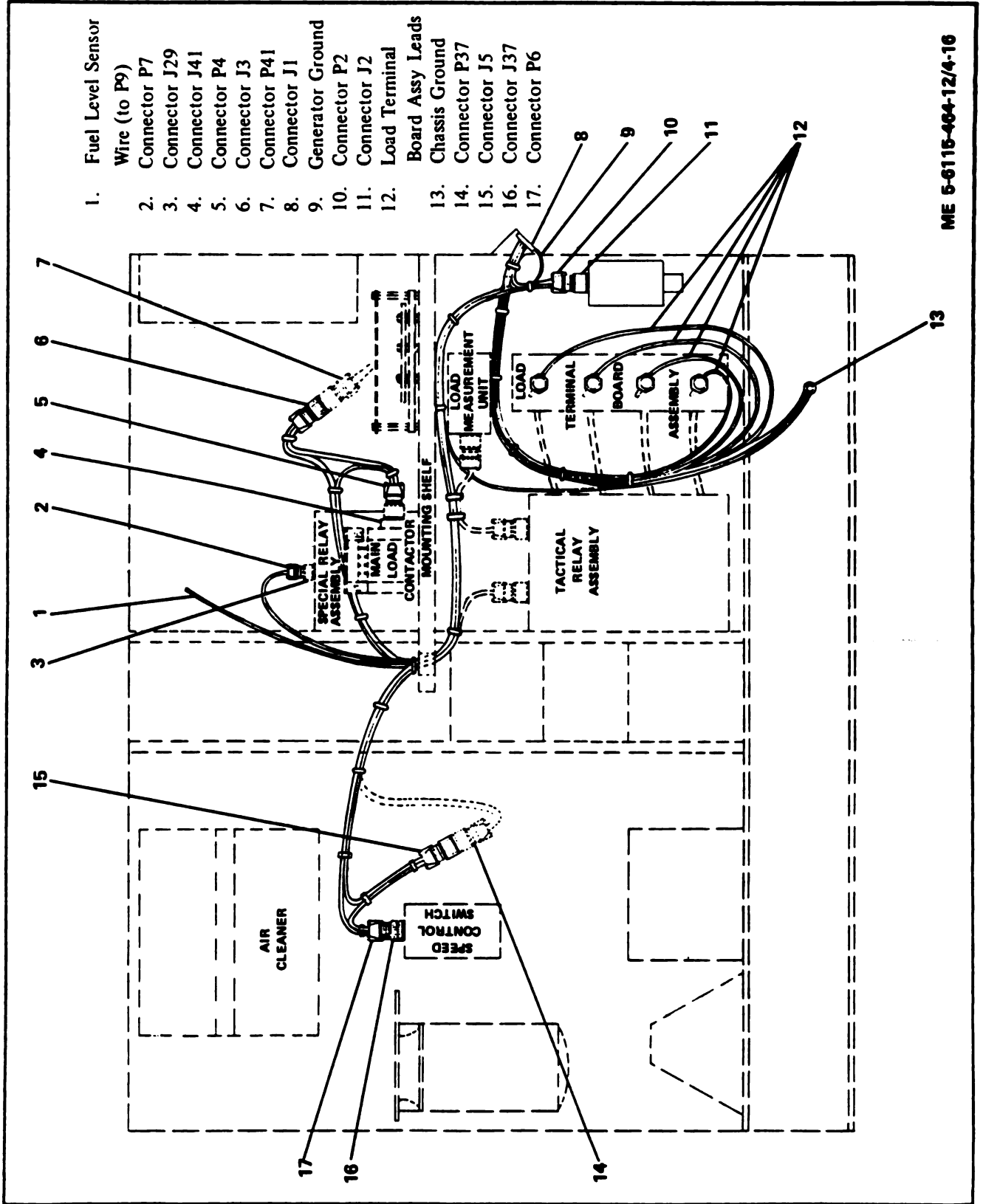
(7) Deleted.

b. Deleted.



ME 5-6115-464-12/4-15

Figure 4-15. Remote Functions Assembly



ME 5-6115-464-12/4-16

Figure 4-16. Applications Kit Cable Harness Assembly Installation (Right Side)

c. Deleted.

d. Deleted.

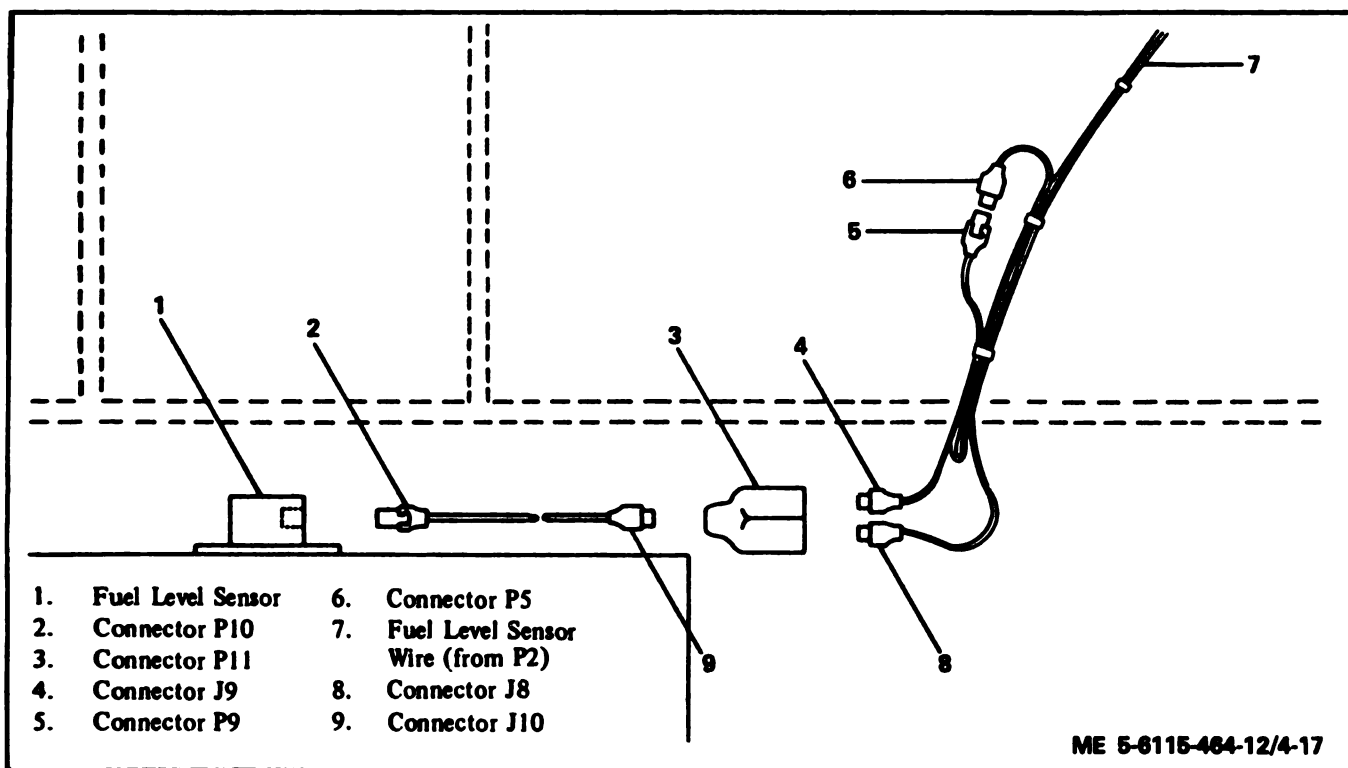


Figure 4-17. Applications Kit Cable Harness Assembly Installation (Left Side)



## APPENDIX A

### REFERENCES

This Appendix contains a list of reference manuals that may be used in conjunction with this TM in the operation and maintenance of the 15 KW DOD Generator Set. Those manuals not coded are

applicable for use by all services. The manuals are coded (A) for Army use, (F) Air Force use, (N) Navy use, and (M) Marine Corps use.

#### 1. FIRE PROTECTION

TB 5-4200-200-10 (A) Hand Portable Fire Extinguishers Approved for Army Use

#### 2. LUBRICATION

C9100-IL Petroleum, Petroleum Base Products and Related Materials

C6800-IL Chemicals and Chemical Products

LO 5-6115-464-12 (A) Lubrication Order

LO 07523A-12 (M)

#### 3. PAINTING

T.O. 35-1-3 (F) Painting and Marking of USAF Aerospace Ground Equipment

TM 9-213 (A) Painting Instructions for Field Use

#### 4. RADIO SUPPRESSION

TM 11-483 (A) Radio Interference Suppression

T.O. 31-1-141-13 (F) Basic Electronics Technology

#### 5. MAINTENANCE

TM 38-750 (A) The Army Maintenance Management System

TM 9-6140-200-14 (A) Maintenance of Storage Batteries; Lead Acid Type

T.O. 36Y-4-1-194 (F)

T.O. 00-25-225 (F) Repair of External Power Cables, Aerospace Ground Equipment

T.O. 00-25-234 (F) General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment

NAVWEPS 01-1A-505 (N) Installation Practices for Aircraft Electric and Electronic Wiring

T.O. 1-1A-14 (F)

TM 55-1500-323-25 (A)

T.O. 35-1-11 (F) Organizational, Intermediate and Depot Level Maintenance for FSC 6115 Non-Airborne Equipment

T.O. 35-1-12 (F) Compounds and Procedures for Cleaning Aerospace Ground Equipment

T.O. 35-1-26 (F) Repair/Replacement Criteria for FSC 6115 Aerospace Ground Equipment

T.O. 35-1-524 (F) USAF Equipment Registration Number System Applicable to FSC 6115 Equipment

5. MAINTENANCE (Continued)

T.O. 36-1-7

Operation in Cold Weather Areas

T.O. 36Y32-1-142 (F)  
TM 9-2610-200-20 (A)

Organizational Care, Maintenance and Repair of Pneumatic  
Tires and Inner Tubes

TM 5-6115-464-24P (A)  
T.O. 35C2-3-445-4 (F)  
NAVFAC P-8-624-24P (N)  
SL 4-07523A (M)

Organizational, Intermediate (Field) (Direct Support and  
General Support) and Depot Maintenance Repair Parts and  
Special Tools List

TM 5-6115-464-34 (A)  
T.O. 35C2-3-445-2 (F)  
NAVFAC -P-8-624-34 (N)  
TM 07523A-34 (M)

Intermediate (Field) (Direct and General Support) and Depot  
Level Maintenance Manual

TB 750-651 (A)

Use of Anti-freeze Solutions and Cleaning Compounds in  
Engine Cooling Systems

TM 5-6115-588-14 (A)  
T.O. 35CA-1-111 (F)  
NAVFAC P-8-601 (N)  
TM 6115-15/4 (M)

Maintenance Manual Including Repair Parts and Special Tools  
List for Auxiliary Equipment 15 through 200 KW, DOD  
Family Generator Sets

6. SHIPMENT AND STORAGE

TM 38-230 (A)

Preservation, Packaging and Packing of Military Supplies and  
Equipment

TB 740-97-2 (A)

Preservation of TROSCOM Mechanical Equipment for Shipment  
and Storage

TM 740-90-1 (A)

Administrative Storage of Equipment

T.O. 35-1-4 (F)

Processing and Inspection of Aerospace Ground Equipment  
for Storage and Shipment

T.O. 38-1-5 (F)

Processing and Inspection of Non-Mounted, Non-Aircraft  
Gasoline and Diesel Engines for Storage and Shipment

7. DESTRUCTION TO PREVENT ENEMY USE

TM 750-244-3 (A)

Procedures for Destruction of Equipment to Prevent Enemy Use

## APPENDIX B

### COMPONENTS OF END ITEMS LIST

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All data on pages B-1 thru B-4 deleted.





## APPENDIX C

### MAINTENANCE ALLOCATION CHART (ARMY ONLY)

#### Section I. INTRODUCTION

##### C-1. GENERAL.

- a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.
- b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.
- c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.
- d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

##### C-2. EXPLANATION OF COLUMNS IN SECTION II.

- a. Group Number, Column 1. The assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.
- b. Assembly Group, Column 2. This column contains a brief description of the components of each assembly group.
- c. Maintenance Functions, Column 3. This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

- C - Crew
- O - Organizational maintenance
- F - Direct support maintenance
- H - General support maintenance
- D - Depot maintenance

The maintenance functions are 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. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

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 the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of this 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 like items.

I - REPAIR. Those maintenance operations necessary to restore an item to serviceable condition through correction of material 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 material 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.

d. Tools and Equipment, Column 4. This column is provided for referencing by code the special tools and test equipment, (Section III), required to perform the maintenance functions (Section II).

e. Remarks, Column 5. This column is provided for referencing by code the remarks (Section IV) pertinent to the maintenance functions.

### **C-3. EXPLANATION OF COLUMNS IN SECTION III.**

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T&TE requirements column on the MAC. The letter represents the specific maintenance

function the item is to be used with. The letter is representative of columns A through K on the MAC.

b. Maintenance Category. This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal stock number of tools and test equipment.

### **C-4. EXPLANATION OF COLUMNS IN SECTION IV**

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and 400 Hz

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS			
		A	B	C	D	E	F	G	H	I	J			K		
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD		
01	Batteries and related items	C	O	C				O	O						1-B	A-A, B-B
	Slave receptacles	C							O							A-A
02	Exhaust and breather pipes	C							O						A-A	
03	Convenience receptacles 50/60 Hz	C							O							A-A
04	Convenience receptacles 400 Hz	C							O							A-A
05	Plate and sleeve assy	C							O							A-A
06	Paralleling receptacles	C							O							A-A
07	Generator set controls															
	Circuit breaker, dc		O						O							
	Manual speed control	O	O						O							A-A
	Fault indicator	O	O						O	F						A-A, C-B, D-I
	Wiring harness	F	F						F	F		F				
	Lamps		C						O							
	Fuse		O						O							
	Control box assembly	O	O						F	O						C-B
	Wiring harness	O							O	O		F				A-A, H-K
	Voltmeter, ac	C	O		C				O							E-D
	Wattmeter ac	C	F		C				O							C-B, E-D
	Wattmeter converter	O	F						O							C-B, E-D
	Ammeter, ac	C	F		C				O							C-B, E-D
	Rheostats/potentiometer	O	O						O					2-B		F-B
	Frequency meter	C	F		F				O							C-B
	Frequency transducer	O	F						O					2-B		F-B
	Switches	C	O						O					2-B		F-B
	Gauges	C	O						O							C-B
	Hourmeter	C	O						O							C-B
	Ammeter, dc	C	O						O							C-B
08	Housing group															
	Doors	C							O	F				3-I		G-I
	Covers	C							O	F				3-I		G-I
	Panels	C							O	F				3-I		G-I

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY. 50/60 and 400 Hz (Cont)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS				
		A	B	C	D	E	F	G	H	I	J			K			
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD			
09	Wiring harnesses																
	Engine	C	O						O	O			F	4-K		A-A, H-K	
	Generator	C	O						H	O			H	4-K		A-A, H-K	
	Interconnecting	C	O						O	O			F	4-K		A-A, H-K	
10	Load connection group																
	Main load contactor	O	O						O	F			D			A-A, C-B	
	Load terminal board assy	O							F	F	H					A-A	
	Current Xfmr assembly	O	F						F				2-B			A-A, I-B	
	Reconnection board	O	O						O								
11	Governor control unit																
		O	F		F				F	F	H		2-B, D, I			J-B, D-I	
		O	F		F				F								
		O	F						F	F							
		O	F						F	F							
12	Air cleaner assembly	C		C					O							A-A	
	Element	C		C					O								
13	Relay table group																
	Tactical relay assy	O	F						F	H	H		2-B			I-B	
	Special relay assy	O	F						F	H	H		2-B			I-B	
	Precise relay assy	O	F						F	H	H		2-B			I-B	
	Excitation assy																
	Exciter	F	F						F	F	H		2-B			F-B	
	Voltage regulator	F	F		F				F	F	H	D	2-B, 5-I, J			C-B	
	Load measuring unit	O	F						O	F						D-I	
14	Generator assembly	O	F						F	F	H	D	6, 7-H, 8-B, 9-I, J			C-B	
	Bearing	O							F				10-H			K-A	
	Rectifier rotating	F	F						F	F	H		2-B, 11-I			F-B	
	Fan generator	F							F								
	Rotor assembly	F	F						F	D		D	2-B			L-B, M-K	
	Stator exciter assy	F	F						F	D		D	2-B			L-B, M-K	
	Stator generator assy	F	F						F	D		D	2-B			L-B, M-K	
15	Day tank and fuel filter assy																
	Solenoid valve	O	O						O				2-B			F-B	
	Day tank	C		C					O	F						N-C	
	Float switch	O	O						O								
	Fuel filter assy	C		C					O							N-C	

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and 400 Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS			
		A	B	C	D	E	F	G	H	I	J			K		
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD		
16	Center support															
	Start aid assembly	C		C					O							
	Lifting frame	O							F	F						
	Fuel transfer pump	C	O	O					O							
17	Cooling group															
	Grille	C							O	O						
	Shutter thermostat	C	O						O					12-B		O-B
	Shutter assembly	C	O		O				O	F						C-B
	Radiator	C	F	C					O	F						
18	Hydraulic actuator	C	F	O	F				F	F	H	D	13-B, D			C-B, P-D
19	Hydraulic sump and filter	C		C					F	F						Q-C
20	Engine assembly	C	O	C					F	F	H	D	6-H, 7-H			C-B
	Belts, fan	C			O				O				14-D			R-D
	Alternator/battery charging	C	O		O				O	F	H	D	2-B 15-B, D			C-B, R-D
	Diodes	F	F						F				2-B, 11-H			F-B
	Rotors	F	F						F	H	H		2-B			F-B
	Field assembly	F	F						F	H	H		2-B			F-B
	Voltage regulator, dc	F	F						F	F			2-B, 15-B			C-B
	Hydraulic pump assy	C	F		F				F	F	H	D	16-B			S-B, T-D
	Speed switch and drive															
	Speed switch	C	O		F				O	F	H	D	2-B, 17, 18-D			F-B, U-D
	Adapter	C							F							
	Oil level gage and filler	C							C							
	Electric starter & adapter															
	Starter assembly	C	O						O	O	H	D	2-B, 19-I			C-B, D-I
	Brushes	O							O							V-A
	Starter, solenoid		O						O	F			2-B			C-B
	Starter, armature		F						F	F	H		21-B			W-B
	Drive starter	F							F	F						
	Field assembly	F	F						F	F						

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and 400 Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS				
		A	B	C	D	E	F	G	H	I	J			K			
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD			
20	Oil filters and sensors																
	Xmtr, pressure	C	O						O						2-B		F-B
	Switch pressure	O	O						O						2-B		F-B
	Filter assemblies																
	Oil, lube/hydraulic	C		O					O								X-C
	Secondary fuel filter	C		C					O								X-C
	Lube oil cooler	O							O	F	F						
	Injector nozzle, sleeve and lines																
	Injector nozzle	O	O		F				O	F	F			22-B, D-I			Y-D
	Nozzle sleeve	O	O						O								
	Lines	O							O								
	Pump, fuel injection	C	F		F				F	H	H	D					J-B, D-I
	Water pump and fan																
	Fan	C							F	F							
	Pump	C							O	F							
	Thermostat and housing																
	Thermostat		O						O					12-B			O-B
	Xmtr, temperature	C	O						O					2-B			F-B
	Sw, temperature	O	O						O					2-B			F-B
	Idler pulley	O							O								
	Intake manifold	O							O								
	Exhaust manifold	O							O								
	Engine front support	F							F								
	Oil pan assembly	C							F	F							
	Oil pump		H						H	H							
	Flywheel and housing																
	Flywheel assembly																
	Ring gear	H							H								
	Flywheel	H							H								
	Housing	H							H								
	Timing gear and cover																
	Cover, timing	F							H								
	Gears, timing	H							H								

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and 400 Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS				
		A	B	C	D	E	F	G	H	I	J			K			
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD			
20	Cylinder head and valve operating mechanism																
	Rocker arm assy	O		O			F	F	F								
	Rocker arm	O			O			F					21-D			R-D	
	Pushrod	F						F									
	Cylinder head assy	F						F	F	H	D		23-I, 24-H			Z-I	
	Valve int and exh	F	F					F	F				25-I			C-B	
	Spring valve		F					F					26-H			AA-B	
	Seat int and exh valves	F						H					27-H				
	Guide valve	F						H					28-H				
	Head cylinder	F						F	F	H	D						
	Lifters, valve	H						H									
	Camshaft	H						H									
	Piston and rings																
	Piston pin	H						H					29-A				
	Connecting rod	H						H					30-A, 31-H				
	Rod bearing	H						H					32-A				
	Piston rings	H						H					33-A, 34-H				
	Piston	H						H					35-H				
	Crankshaft and block																
	Cylinder sleeves	H						H					32, 36-A, 37-H				
	Main bearings	H						H					32, 36-A, 24-H				
	Crankshaft	H						H			D		38-A				
	Bearing, camshaft	H						H					29, 32-A				
	Cylinder block	H						H	H	H	D					AB-K	
21	Base group																
	Sensor, fuel		O					O					2-B			C-B	
	Tank, fuel	C		C				F	F								
	Skid base	O						F	F							C-I	
22	Accessory items																
	Paralleling cable	C	O					O	O	O							
	Fuel line, auxiliary	C						O	O	O							



MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and 400 Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS		
		A	B	C	D	E	F	G	H	I	J			K	
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD	
23	Parts Kits (Itemize)														
24	Fire Extinguisher							O							
25	Winterization kit														
	Fuel burning (regular)	C						O	O	F	H				
	Heater control box assy	O							O	O	F				
	Light assembly	O	O						F						
	Lamp		C						O						
	Circuit breaker	O	F						F						
	Power switch		F						F						
	Heater assembly	C	O	C	O				F	F	H				
	Valve	F							F						
	Nozzle	F							F						
	Terminal board	O							F						
	Switch	O	O						F				2-B		F-B
	Burner assembly	O							F	F					
	Igniter assembly	O							O						
	Head assembly	F							F						
	Switch, flame	F							F				2-B		F-B, R-D
	Wiring harness	O							O	O		F			A-A, H-K
	Blower assembly	F							F	F					
	Coolant pump & motor assembly														
	Pump	F	F						F	F					
	Relief valve		F						F						
	Fan motor assy	F							F	F					
	Fan	F							F						
	Motor	F							F						
	Thermostat switch	O	O						O				2-B		C-B
26	Heater kit, winterization electric							O	O	O	H	D			
	Coolant pump and motor assembly	O						O	O	F					C-B
	Pump	O	O							F	F				
	Relief valve		F							F					
	Motor	O	F							F	O				
	Heating elements	O	O							O					C-B

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 30/60 and 400 Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS	
		A	B	C	D	E	F	G	H	I	J			K
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD
26	Thermostat switch	O	O						O				2-B	C-B
	Hose lines fitting	C							O	O				
	Electric wiring cables and harness	C	O						O	O		F	2-B	
	Electric winterization control box	O	O					O	O	F			2-B	
	Transformers	F	F						F					
	Relay	F	F						F				2-B	F-B
	Semi-conductors	F	F						F					
	Circuit breaker	O	O						O				2-B	F-B
	Switch toggle	O	F						F					
	Fuse holder	O							F					
	Fuse		O						O					
	Light assembly	C	O						O				2-B	F-B
Indicating lamps	C	C						C						
27	Kit-wheel mounting	C	C	C				F	F	O				
	Wheels and tires	C	C	C					O	O			39-B	AC-B
	Bearings wheel	O		O					O					
	Brakes	O		O	O				O	O				
28	Load bank	O	O					O	O	F	H			C-B
	Wiring harness	C	O						O	O		F	2-B	F-B
	Control panel assembly													
	Switch rotary	C	O							O			2-B	F-B
	Semi-conductors	F	F						F				2-B	F-B
	Transformers	O	F						F				2-B	I-B
	Terminal board	O							O					
	Diodes		F						F					
	Breakers, circuit	O	O						O				2-B	F-B
	Fan and motor assy	O	O						O	O				
	Brushes	O							O					
	Fan	O							O					
	Indicating light	O	O						O					
	Lamp		O						O					
	Load reject relay	O	F						F				2-B	F-B
Thermostat		O						O						
Heater elements	O	O						O				2-B	F-B	

MAINTENANCE ALLOCATION CHART FOR 15 KW, TACTICAL, PRECISE  
 AND UTILITY, 50/60 and Hz (CONT)

(1) GROUP NO.	(2) FUNCTIONAL GROUP	(3) MAINTENANCE FUNCTIONS										(4) TOOLS AND EQUIPMENT	(5) REMARKS	
		A	B	C	D	E	F	G	H	I	J			K
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL			REBUILD
29	Applications Kit	O						F		F			40-G, 42-G, I, 43-G, I, 44-G, I, 45-G, I	A-A, J-B, D & I
	Remote Functions Assy.		F							F			46-B	C-B
	Cable Assembly	O	F							F	F		4-K, 46-B, 42-G, I, 49, 50-H	A-A, F-B

Section III. MAINTENANCE ALLOCATION CHART

FOR: 15 KW, 50/60 and 400 Hz, DOD Generator Sets

DATE: 18 August 1972

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SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	TOOL NUMBER
1-B	O	Tester, Battery Elect-Rolyte Solution (Component of Tool Set L/I TI3152)	6630-171-5126 or Equal
2-B	O	Multimeter	6625-581-2036 or Equal
3-I	F	Torch Outfit, Cutting and Welding (Tool Set L/I W67706)	3433-357-6311 or Equal
4-K	O	Tool Kit, Electrical Connector Repair	5180-876-9336 or Equal
5-D, I, J	F	Oscilloscope	6625-643-1740 or Equal
6-H	F	Hoist, Chain, 3 Ton	3950-292-9879 or Equal
7-H	F	Trestle, Hoist, Portable 5 Ton	3950-449-7005 or Equal
8-B	F	Multimeter, Split Core	6625-892-1497 or Equal
9-I, J	F	Ohmmeter	6625-581-2466 or Equal
10-H	F	Puller Attachment (Component of Puller Kit 5180-701-8046)	5180-711-6753 or Equal
11-I	F	Soldering Outfit, Electric	3439-853-8760 or Equal
12-B	O	Thermometer, Self-Indicating 50-400 Degree F. Range	6685-527-7867 or Equal
13-B, D	F	Test Stand, Actuator	4940-152-2107 or Equal
14-D	O	Scale, Dial Indicating, 0-50 lb	6670-254-4634 or Equal
15-B, D	O	Test Set, Generator and Voltage Regulator	4910-270-3780 or Equal
16-B	F	Test Gage and Hose Assembly	4910-774-9343 or Equal
17-D	F	Tachometer, Stroboscopic	6680-892-1510 or Equal
18-D	F	Test Stand, Ignition Magneto	4910-912-3960 or Equal
19-I	O	Tester Spring Resiliency	6635-449-3750 or Equal
20-D	F	Gage, Thickness	5120-221-1999 or Equal
21-B	F	Test Set, Armature	6625-233-1459 or Equal
22-B, D, I	F	Tool Kit, Diesel Injector Repair	4910-317-8265 or Equal
23-I	F	Grinding Kit, Valve Seat	4910-473-6437 or Equal
24-H	F	Wrench, Torque	5120-542-5577 or Equal
25-I	F	Grinding Machine, Valve Face	4910-540-4679 or Equal
26-H	F	Lifter, Valve Spring	5120-239-8686 or Equal
27-H	H	Remover and Replacer, Insert Valve Seat	5120-473-7393 or Equal
28-H	H	Remover and Replacer, Valve Guide	5120-219-8404 or Equal
29-A	H	Caliper Micrometer, Outside 1" thru 2"	5210-243-2933 or Equal

SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS (CONT.)

REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	TOOL NUMBER
30-A	H	Indicator, Connecting Rod Alignment	4910-733-2487 or Equal
31-H	H	Wrench, Torque	5120-640-6364-or Equal
32-A	H	Gage Set, Telescoping	5120-473-9350 or Equal
33-A	H	Gage, Thickness	5210-517-8097 or Equal
34-H	H	Compressor, Piston Ring	5120-894-0753 or Equal
35-H	H	Expander, Piston Ring	5120-393-0549 or Equal
36-A	H	Caliper, Micrometer	5120-255-7564 or Equal
37-H	H	Puller, Mechanical, Cylinder, Sleeve	5120-417-2952 or Equal
38-A	H	Caliper, Micrometer	5210-221-1934 or Equal
39-B	C	Gage, Tire Pressure	4910-204-3170 or Equal
40-G	F	Shears, Metal Cutting	5110-00-221-1085 or Equal
41-G, I	F	C-Clamp	5120-00-180-0907 or Equal
42-G, I	F	Ty-Wrap Tool	5120-00-781-7891 or Equal
43-G, I	F	Rivet Gun, Hand	5120-00-970-6423 or Equal
44-G, I	F	Drill, Electric	5130-00-889-8996 or Equal
45-G, I	F	Drill Set, Twist	5133-00-227-9654 or Equal
46-B	F	Multimeter	6625-00-553-0142 or Equal
47-B	F	Power Supply, Adjustable	6130-01-0222-7532 or Equal
48-B	F	Circuit Card Holder	BA177B003 or Equal
49-H	F	Solder/Desolder Set	3439-00-460-7198 or Equal
50-H	F	Heat Gun	37N1447 or Equal

Section IV. MAINTENANCE ALLOCATION CHART

FOR: 15 KW, 50/60 and 400 Hz DOD Generator Set

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REFERENCE CODE	REMARKS
A-A	Visual Inspection
B-B	Hydrometer Test
C-B	Operational Test
D-I	Repair by Replacement of Components
E-D	Zero Adjust
F-B	Continuity Test
G-I	Weld and Straighten
H-K	Fabricate New Harness
I-B	Test for Known Voltage at Terminals
J-B, D & I	In Accordance with Procedures in Applicable TM
K-A	Visual, Audible and Physical Heat Detection
L-B	Insulation Breakdown and Continuity Tests
M-K	Rewind
N-C	Drain Condensation
O-B	Thermometer Test
P-D	Adjust After Replacement or Repair
Q-C	Check Fluid Level
R-D	Adjust to Specifications in Applicable TM
S-B	Test Pressure Output
T-D	Adjust Pressure Output
U-D	Overspeed Only
V-A	Inspect for Minimum Length
W-B	Growler Test
X-C	Replace Element
Y-D	Adjust Injector Pressure Setting
Z-I	Includes Replacing Valves and Springs
AA-B	Spring Tension and Length
AB-K	Include Replacement of Sleeves
AC-B	Pressure Test



## APPENDIX D

### MAINTENANCE AND OPERATING SUPPLIES

#### Section I. INTRODUCTION

##### D-1. SCOPE.

This appendix lists maintenance and operating supplies which are required for operation of the generator set.

##### D-2. EXPLANATION OF COLUMNS.

a. Component Application, Column (1). This column identifies the component application of each maintenance and operating supply item.

b. Federal Stock Number, Column (2). This column indicates the Federal stock number for each item and will be used for requisitioning purposes. The number in parentheses following each stock number refers to the corresponding number of a note in column (6).

c. Description, Column (3). This column gives the name and a brief description of each item.

d. Quantity Required for Initial Operation, Column (4). This column indicates the quantity of each item required for initial operation of the generator set.

e. Quantity Required for 8 Hours of Operation, Column (5). This column indicates the estimated quantity of each item required for a normal 8 hour operating period.

f. Notes, Column (6). This column lists explanatory notes which are keyed to the numbers in parentheses appearing in columns (2), (4) and (5).



Section II. MAINTENANCE AND OPERATING SUPPLIES

(1) COMPONENT APPLICATION	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION	(4) QTY REQ'D FOR INITIAL OPERATION	(5) QTY REQ'D FOR INITIAL OPERATION	(6) NOTES		
Tank, fuel	9130-00-266-8613 (1)	<u>FUEL</u> JP-4, MIL-J-5624, Bulk	(3)	(4)	(1) See Federal Supply Catalog 9100-IL for additional requisitioning data		
	9140-00-266-5394 (1)	<u>FUEL OIL, DIESEL</u> Regular Grade, DF2, Bulk VV-F-800	(3)	(4)	(2) See Federal Supply Catalog 6800-IL for additional requisitioning data		
	9140-00-298-5286 (1)	Winter Grade, DF1, Bulk VV-F-800	(3)	(4)	(3) Tank Capacity 15 Gal.		
	9140-00-266-5283 (1)	Arctic Grade, DFA, Bulk VV-F-800	(3)	(3)	(4) Average Fuel Consumption is 1 Gal/10 KW hrs		
	Crankcase	9150-00-265-9435 (1)	<u>OIL, LUBRICATING</u> (5 gal. pail) Grade OE/HDO 30 MIL-L-2104	(5)	(10)	(5) Crankcase Capacity 8.0 qts.	
		9150-00-265-9428 (1)	Grade OE/HDO 10 MIL-L-2104	(5)	(10)	(6) Cooling System Capacity 50-50 Solution 18.6 qts.	
		9150-00-242-7603 (1)	Grade OES MIL-L-10295 (55 gal. drum)	(5)	(5)	(10)	(7) One Hour Consumption 1.5 gal.
		9150-00-265-9436 (1)	Grade OE/HDO 30 MIL-L-2104	(5)	(5)	(10)	
		9130-00-191-3773 (1)	Grade OE/HDO 10 MIL-L-2104	(5)	(5)	(10)	
		9130-00-242-7604 (1)	Grade OES MIL-L-10295	(5)	(5)	(10)	

(1) COMPONENT APPLICATION	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION	(4) QUANTITY REQUIRED F/INITIAL OPERATION	(5) QUANTITY REQUIRED F/8 HRS OPERATION	(6) NOTES
Wheel mounting kit	9150-00-190-0906 (1)	GREASE, AUTOMOTIVE <i>ARTILLERY (5 lb. can)</i> MIL-G-10924			
Parts, cleaning	6850-00-281-1985 (2)	<i>SOLVENT (1 gal. can)</i> FED-P-D-690 (9) STARTING AID			
Engine	2910-00-646-9727	Tank, Ether	(11)		(11) For use at 40°F. and below.
Batteries	6810-00-249-9354	<i>ELECTROLYTE</i> Electrolyte	(12)		(12) Requires 4 gallons to fill batteries.
Governor	9150-00-223-4134 (1)	<i>OIL, HYDRAULIC (1 gal. can)</i> OHA-MIL-H-5606			(8) See para 4-19 for lube points.
Radiator	6850-00-243-1992 (2)	<i>COOLANT</i> Anti-freeze, inhibited glycol, 1 gal. can	(6)		(10) See LO for grade appli- cation and replenish- ment intervals.
	6850-00-174-1806 (2)	Anti-freeze, compound Arctic, 55 gal. drum	(6)		
Heater	9130-00-256-9613 (1)	<i>FUEL</i> JP-4, MIL-J-5624, Bulk Fuel Oil, Diesel	(7)		
	9140-00-286-5294 (1)	Regular Grade, DF2, Bulk	(7)		
	9140-00-286-5294 (1)	Winter Grade, DF1, Bulk	(7)		
	9140-00-286-5283 (1)	Arctic Grade, DFA, Bulk	(7)		
Tape	8080-00-889-3534	Anti Seizing U/I roll, Amt. 1 ea			



## APPENDIX E

# ADDITIONAL AUTHORIZATION LIST

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### Section I. INTRODUCTION

**E-1. SCOPE:** This appendix lists additional items you are authorized for the support of the generator set.

**E-2. GENERAL:** This list identifies items that do not have to accompany the generator set and that do not have to be turned in with it. These items are authorized to you by CTA, MTOE, TDA or JTA.

**E-3. EXPLANATION OF LISTING:** National stock number, descriptions and quantities are provided to help you identify and request the additional items you require to support this equipment. "USABLE ON" codes are identified as follows:

CODE	USED ON
A	MEP-004A
B	MEP-103A
C	MEP-113A

Section II. ADDITIONAL AUTHORIZATION LIST

(1) NATIONAL STOCK NUMBER	PART NUMBER & FSCM	(2) DESCRIPTION	USABLE ON CODE	(3) U/M	(4) QTY AUTH
5935-00-322-8959		ADAPTER CONNECTOR		EA	1
4910-00-204-3170	800648 (34623)	GAGE: Tire, Pressure 10 to 60 lbs range	A,B,C	EA	1
4930-00-253-2478	41G1330-72 (10001)	GREASE GUN: Hand lever operated, 1603	A,B,C	EA	1
4930-00-141-8311	1083LII (39428)	HOSE ASSEMBLY Grease	A,B,C	EA	1
6150-00-463-9088	MEP005ALM (30554)	LOAD BANK KIT	A,B,C A,B,C	EA EA	1 1
4120-00-708-0031	MILE52031 (99539)	REPLACEMENT CYLINDER KIT For 4210-00-555-8837			
6115-00-463-9094	MEP005AWM (30554)	WHEEL MOUNTING KIT	A,B,C	EA	1
6115-00-463-9085	MEP005AWE (30554)	WINTERIZING KIT, Electric	A,B,C	EA	1
6115-00-463-9083	MEP005AWF (30554)	WINTERIZING KIT, Fuel burning	A,B,C	EA	1
6115-01-096-9015	13220E8189 (97403)	APPLICATIONS KIT	C	EA	1
5975-00-878-3791	FS0216B122-1 (15277)	Rod, Ground,	A,B,C	EA	1
6150-00-123-0108	13208E4816 (97403)	Cable, Power, Electrical	A,B,C	EA	1
5120-01-013-1676	P74-144 (45225)	Puller, Ground Rod	A,B,C	EA	1
4120-00-555-8837	10596569-1 (18876)	Extinguisher, Fire Monobromotrifluorimethane, with bracket. Operating range minus 50°F (-46°C) to plus 120°F (49°C)	A,B,C	EA	1
		TM 5-6115-464-12 NAVFAC P-8-624-12 TO 35C2-3-445-1 TM-07523A-12	A,B,C	EA	1
		Operator and Organizational Main- tenance Manual from Generator Set, Diesel Engine Driven, Tactical Skid Mtd., 15 KW, 3 Phase, 4 Wire 120/208 and 140/416 volts.			

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WITCHES

ATURE

E

TERMINAL BOARDS

D  
ONNECTION  
LD

:

**NOTES:**

1. INTERPRET DRAWING PER MIL-STD-100.
2. FOR UTILITY CONFIGURATION, OMIT THE FOLLOWING FROM THE LIST: A23, A24, A25, E2, K11, K12, R28, K16, S10, C1, R5.
3. FOR 400 Hz CONFIGURATION OMIT SWITCH S10 FROM THE LIST.
4. FOR 50/60 Hz SET, T5 AND T11 CONNECT DIRECTLY TO T86 AND DO NOT PASS THROUGH CT7.

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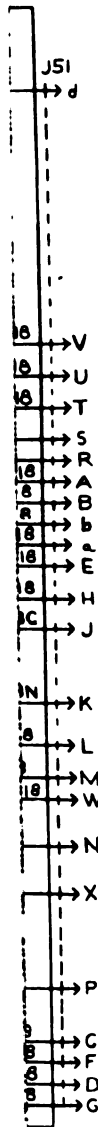
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ME 5-6115-464-12/FO-1 (1)

and 30 KW, 50/60 and 400 Hz, Precise and Utility,  
am, Dwg. No. 72-2205 (Sheet 1 of 4)



TM 5-6115-464-12  
NAVFAC P-8-624-12  
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TM 07523A-12



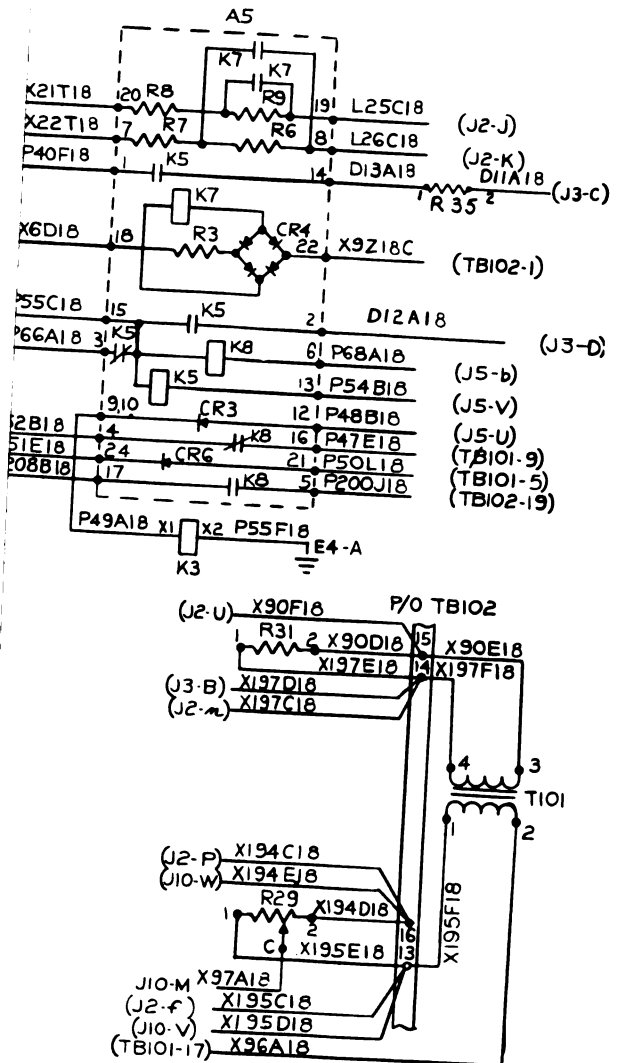
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and 30 KW, 50/60 and 400 Hz, Precise and Utility,  
m, Dwg. No. 72-2205 (Sheet 2 of 4)

Change 9 FO-1 (Sheet 2)







SHEET

ME 5-6115-464-12/FO-1 (3)

-2

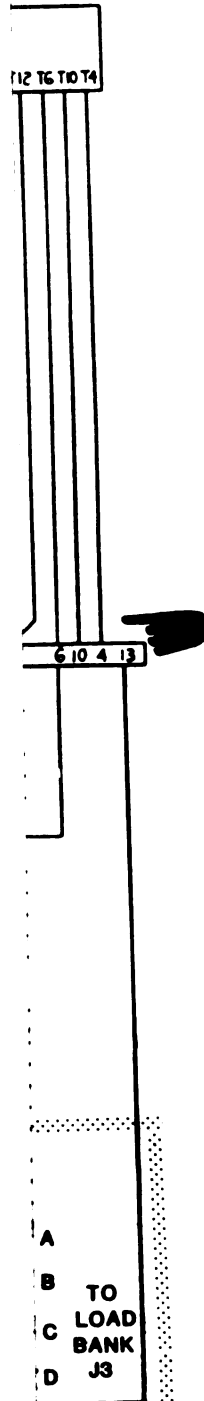
50 and 400 Hz, Precise and Utility,  
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FO-1 (Sheet 3)



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TM 07523A-12

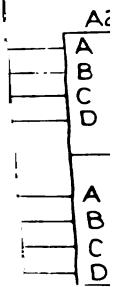
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ME 5-6115-464-12/FO-1 (4)

0 and 400 Hz, Precise and Utility,  
2-2205 (Sheet 4 of 4)

Change 9 FO-1 (Sheet 4)



**ASSEMBLIES**

- A1 CONVERTOR, THERMAL WATT
- A2 CONVERTOR, FREQUENCY
- A4 CONTROL PANEL RELAY ASSY
- A5 DC RELAY ASSY
- A6 RESISTOR ASSY, GOV.
- A7 RESISTOR ASSY, CURRENT TRANSFORMER LOAD
- A8 GOVERNOR LMU
- A11 STATIC EXCITER
- A15 LOAD TERMINALS
- A22 CONVENIENCE RECEPTACLE BOX
- A23 GOVERNOR CONTROL UNIT
- A24 GOVERNOR ACTUATOR

**CAPACITOR**

- C1 GOVERNOR

**CIRCUIT BREAKERS**

- CB2 CONTACTOR, MAIN AC OUTPUT
- CB3 CONVENIENCE RECEPTACLE

**DIODES**

- CR1 DIODE, FULL WAVE BRIDGE, REMOTE SENSING CIRCUIT
- CR4 DIODE, FULL WAVE BRIDGE, K7 CIRCUIT

**TRANSFORMERS**

- CT1 INSTRUMENTS
- CT2 INSTRUMENTS
- CT3 INSTRUMENTS
- CT4 EXCITER
- CT5 EXCITER
- CT6 EXCITER
- CT7 CROSS CURRENT

**LIGHTS**

- DS4 SYNCHRONIZING
- DS5 SYNCHRONIZING
- G1 MAIN ALTERNATOR

**RELAYS**

- K2 OVERVOLTAGE
- K6 REMOTE VOLTAGE SENSING
- K7 PARALLEL LIGHTS VOLTAGE SENSOR
- K11 UNDERVOLTAGE
- K12 UNDERFREQUENCY
- K13 SHORT CIRCUIT
- K14 OVERLOAD
- K15 REVERSE POWER
- K16 PERMISSIVE PARALLELING

**METERS**

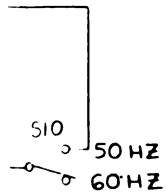
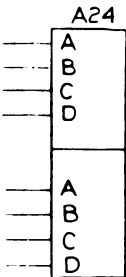
- M6 FREQUENCY
- M7 KILOWATT
- M8 AMMETER
- M9 VOLTMETER

**RESISTORS**

- R1 RHEOSTAT, FREQ. ADJUST
- R2 RHEOSTAT, VOLTAGE ADJUST
- R3 DROPPING FOR CR4 (K7)
- R4 FREQ. ADJUST CIRCUIT
- R5 FREQ. ADJUST CIRCUIT
- R6 PARALLELING LIGHT
- R7 PARALLELING LIGHT
- R8 PARALLELING LIGHT
- R9 PARALLELING LIGHT
- R10 DROPPING FOR CR1 (K6)
- R23 GOVERNOR
- R24 GOVERNOR
- R25 GOVERNOR
- R28 RHEOSTAT, LOAD SHARING
- R29 RHEOSTAT, REACTIVE CURRENT SHARING
- R31 RHEOSTAT, RATE ADJUST, VOLTAGE REGULATOR

**SWITCHES**

- S5 LOCAL-REMOTE VOLTAGE UNIT-PARALLEL
- S6 UNIT-PARALLEL
- S8 VOLT-AMP SELECTOR
- S10 50/60 HERTZ
- TB6 RECONNECTION BOARD
- T4 TRANSFORMER



TB6		
TERMINALS CONNECTED TOGETHER		
120/208 VOLT CONNECTION		240/416 VOLT CONNECTION
1-7	4-10	4-7
2-8	5-11	5-8
3-9	6-12	6-9

**ME 5-6115-464-12/FO-2**

**NOTES:**

1. INTERPRET DRAWING PER MIL-STD-100.
2. S10 NOT REQUIRED FOR 400 Hz SETS.
3. FOR 50/60 Hz SET, T5 AND T11 CONNECT DIRECTLY TO TB6 AND DO NOT PASS THROUGH CT7.

**FO-2. AC Schematic Diagram, 15 and 30 KW, Precise Generator Sets, Dwg. No. 72-2200**

**Change 6**

**FO-2**



SOLENOIDS

L1 ENGINE FUEL  
L2 DAY TANK FUEL  
L3 ETHER  
L4 STARTER

METERS

M1 OIL PRESSURE  
M2 COOLANT TEMPERATURE  
M3 FUEL LEVEL  
M4 BATTERY CHARGING  
M5 TOTAL TIME  
MT1 TRANSDUCER, OIL PRESSURE  
MT2 TRANSDUCER, COOLANT TEMP  
MT3 TRANSDUCER, FUEL LEVEL

RESISTORS

R13 SHUNT, INSTRUMENT  
R35 FIELD FLASH CURRENT LIMITING

SWITCHES

FL1 FUEL LEVEL  
FL2 FUEL LEVEL  
OP LOW OIL PRESSURE  
WT HIGH COOLANT TEMPERATURE  
S1 ENGINE PRIMER  
S2 START-RUN-STOP  
S3 CONTACTOR  
S4 PANEL LIGHTS  
S7 BATTLE SHORT  
S9 ENGINE SPEED  
SR1 SLAVE RECEPTACLE

ION

STD-100.

ME 6115-464-12/FO-3/C2

ME 6115-465-12/FO-3/C2

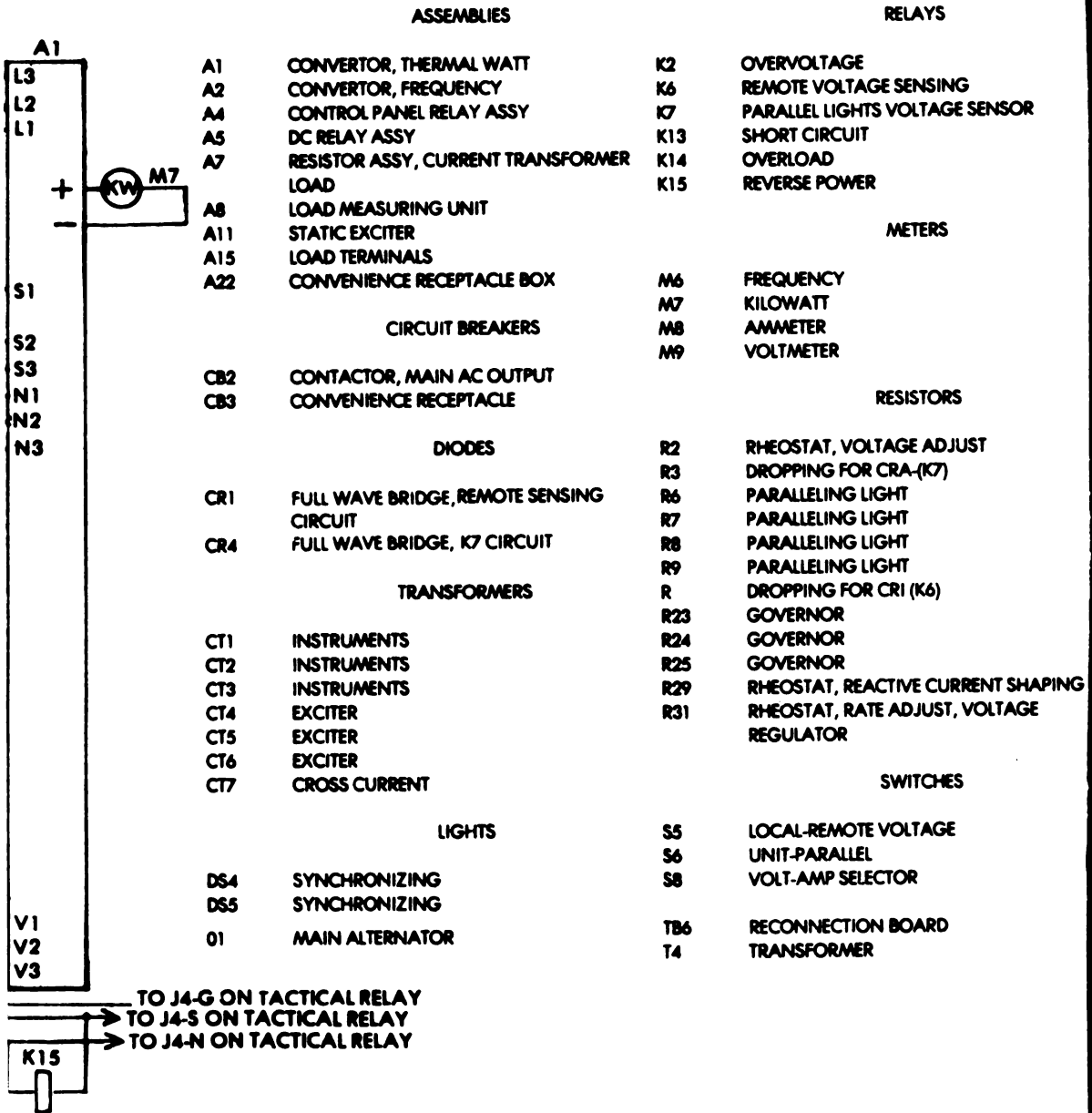
30 KW, Precise Generator Sets, Dwg. No. 72-2269

Change 6

FO-3







ASSEMBLIES

RELAYS

- A1 CONVERTOR, THERMAL WATT
- A2 CONVERTOR, FREQUENCY
- A4 CONTROL PANEL RELAY ASSY
- A5 DC RELAY ASSY
- A7 RESISTOR ASSY, CURRENT TRANSFORMER LOAD
- A8 LOAD MEASURING UNIT
- A11 STATIC EXCITER
- A15 LOAD TERMINALS
- A22 CONVENIENCE RECEPTACLE BOX

- K2 OVERVOLTAGE
- K6 REMOTE VOLTAGE SENSING
- K7 PARALLEL LIGHTS VOLTAGE SENSOR
- K13 SHORT CIRCUIT
- K14 OVERLOAD
- K15 REVERSE POWER

METERS

- M6 FREQUENCY
- M7 KILOWATT
- M8 AMMETER
- M9 VOLTMETER

CIRCUIT BREAKERS

- CB2 CONTACTOR, MAIN AC OUTPUT
- CB3 CONVENIENCE RECEPTACLE

RESISTORS

- R2 RHEOSTAT, VOLTAGE ADJUST
- R3 DROPPING FOR CRA-(K7)
- R6 PARALLELING LIGHT
- R7 PARALLELING LIGHT
- R8 PARALLELING LIGHT
- R9 PARALLELING LIGHT
- R DROPPING FOR CR1 (K6)
- R23 GOVERNOR
- R24 GOVERNOR
- R25 GOVERNOR
- R29 RHEOSTAT, REACTIVE CURRENT SHAPING
- R31 RHEOSTAT, RATE ADJUST, VOLTAGE REGULATOR

DIODES

- CR1 FULL WAVE BRIDGE, REMOTE SENSING CIRCUIT
- CR4 FULL WAVE BRIDGE, K7 CIRCUIT

TRANSFORMERS

- CT1 INSTRUMENTS
- CT2 INSTRUMENTS
- CT3 INSTRUMENTS
- CT4 EXCITER
- CT5 EXCITER
- CT6 EXCITER
- CT7 CROSS CURRENT

SWITCHES

- S5 LOCAL-REMOTE VOLTAGE UNIT-PARALLEL
- S6 VOLT-AMP SELECTOR
- S8
- TB6 RECONNECTION BOARD
- T4 TRANSFORMER

LIGHTS

- DS4 SYNCHRONIZING
- DS5 SYNCHRONIZING
- O1 MAIN ALTERNATOR

NOTES:

1. INTERPRET DRAWING PER MIL-STD-100.

→ TO S2-2  
 → TO A23, J17-J

TB6		
TERMINALS CONNECTED TOGETHER		
120/208 VOLT CONNECTION		240/416 VOLT CONNECTION
1-7	4-10	4-7
2-8	5-11	5-8
3-9	6-12	6-9



SOLENOIDS

L1 ENGINE FUEL  
L2 DAY TANK FUEL  
L3 ETHER  
L4 STARTER

METERS

M1 OIL PRESSURE  
M2 COOLANT TEMPERATURE  
M3 FUEL LEVEL  
M4 BATTERY CHARGING  
M5 TOTAL TIME  
MT1 TRANSDUCER, OIL PRESSURE  
MT2 TRANSDUCER, COOLANT TEMP  
MT3 TRANSDUCER, FUEL LEVEL

RESISTORS

R13 SHUNT, INSTRUMENT  
R35 FLASH FIELD CURRENT LIMITING

SWITCHES

FL1 FUEL LEVEL  
FL2 FUEL LEVEL  
OP LOW OIL PRESSURE  
WT HIGH COOLANT TEMPERATURE  
S1 ENGINE PRIMER  
S2 START-RUN-STOP  
S3 CONTACTOR  
S4 PANEL LIGHTS  
S7 BATTLE SHORT  
S9 ENGINE SPEED  
SR1 SLAVE RECEPTACLE

D.  
W GENERATOR SETS MODEL NUMBERS  
LY.

ME 6115-464-12/FO-5/C2

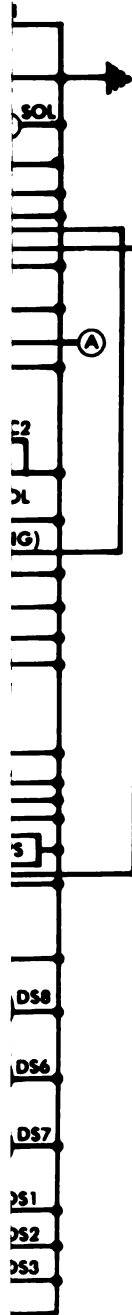
ME 6115-465-12/FO-5/C2

0 KW, utility generator sets, Dwg. No. 72-2277.

**Change 6** FO-5



TM 5-6115-464-12  
NAVFAC P-8-624-12  
TO 35C2-3-445-1  
TM 07523A-12











T  
V  
A  
S  
C  
H

- M6 METER, FREQUENCY
- M7 METER, KILOWATT
- M8 AMMETER, AC
- M9 VOLTMETER
  
- R1 RHEOSTAT, FREQUENCY ADJUSTING
- R2 RHEOSTAT, VOLTAGE ADJUSTING
- R3 RESISTOR
- R4 RESISTOR
- R5 RESISTOR
- R6 RESISTOR
- R7 RESISTOR
- R8 RESISTOR
- R9 RESISTOR
- R10 RESISTOR
- R23 RESISTOR, GOVERNOR
- R24 RESISTOR, GOVERNOR
- R25 RESISTOR, GOVERNOR
- R28 RHEOSTAT, LOAD SHARING
- R29 RHEOSTAT, REACTIVE CURRENT
- R31 RHEOSTAT, RATE ADJUST, VOLTAGE REGULATOR
  
- S5 SWITCH, LOCAL-REMOTE VOLTAGE
- S6 SWITCH, UNIT-PARALLEL
- S8 SWITCH, AMMETER, VOLTMETER TRANSFER
- S10 SWITCH, 50/60 HERTZ
  
- T101 TRANSFORMER, CURRENT, SPECIAL
  
- TB101 TERMINAL BOARD
- TB102 TERMINAL BOARD
- TB5 TERMINAL BOARD, LOAD
- TB6 TERMINAL BOARD, RECONNECTION
  
- C3 CAPACITOR, EMI SUPPRESSION
- C4 CAPACITOR, EMI SUPPRESSION
- C5 CAPACITOR, EMI SUPPRESSION
- C6 CAPACITOR, EMI SUPPRESSION

CH TRANSFORMER		
CT5	CT6	CT7
0	0	1
1	0	0
0	1	0
0	0	1
0	0	0
0	0	2
1	0	0
0	1	0
0	0	0
0	0	0

## TROUBLESHOOTING DIAGRAM, AC, 50/60 HZ AND 400 HZ, 15 KW AND 30 KW, PRECISE AND UTILITY, DOD GENERATOR SETS

FO-8. Troubleshooting Diagram

TM 5-6115-464-12  
 NAVFAC P-8-624-12  
 TO 35C2-3-445-1  
 TM 07523A-12

A1	CONVERTOR, THERMAL WATT
A2	CONVERTOR, FREQUENCY
A4	CONTROL PANEL RELAY ASSEMBLY
A5	D. C. RELAY ASSEMBLY
A6	RESISTOR ASSEMBLY, GOVERNOR
A7	RESISTOR ASSEMBLY, C.T. LOAD, R23, R24, R25
A8	GOVERNOR, LOAD MEASURING UNIT
A11	REGULATOR-EXCITER
A12	REMOTE CONTROL BOX
A22	CONVENIENCE RECEPTACLE BOX
A23	GOVERNOR CONTROL UNIT
A24	GOVERNOR ACTUATOR
C1	CAPACITOR, GOVERNOR
CR1	DIODE, FULL WAVE BRIDGE
CR4	DIODE, FULL WAVE BRIDGE
CT1	TRANSFORMER, CURRENT, INSTRUMENT
CT2	TRANSFORMER, CURRENT, INSTRUMENT
CT3	TRANSFORMER, CURRENT, INSTRUMENT
CT4	TRANSFORMER, CURRENT, EXCITER
CT5	TRANSFORMER, CURRENT, EXCITER
CT6	TRANSFORMER, CURRENT, EXCITER
CT7	TRANSFORMER, CURRENT, CROSS
G1	GENERATOR
K2	RELAY, OVER VOLTAGE
K6	RELAY, REMOTE VOLTAGE SENSING
K7	RELAY, PARALLEL LIGHTS VOLTAGE SENSOR
K11	RELAY, UNDER VOLTAGE
K12	RELAY, UNDER FREQUENCY
K13	RELAY, SHORT CIRCUIT
K14	RELAY, OVERLOAD
K15	RELAY, REVERSE POWER
K16	RELAY, PERMISSIVE PARALLELING

A1 CONVERTOR, WATT  
 A2 CONVERTOR, FREQUENCY  
 A4 CONTROL PANEL RELAY ASSEMBLY  
 A8 DC RELAY ASSEMBLY  
 A8 RESISTOR ASSEMBLY, GOVERNOR  
 A7 RESISTOR ASSEMBLY, C.T. LOAD, R23, R24, R25  
 A8 GOVERNOR, LOAD MEASURING UNIT  
 A11 REGULATOR - EXCITER  
 A12 REMOTE CONTROL BOX  
 A22 CONVENIENCE RECEPTACLE BOX  
 A23 GOVERNOR CONTROL UNIT  
 A24 GOVERNOR ACTUATOR  
 A31 LOAD SHARING  
 C1 CAPACITOR GOVERNOR  
 CR1 DIODE, FULL WAVE BRIDGE  
 CR4 DIODE, FULL WAVE BRIDGE  
 CT1 TRANSFORMER, CURRENT, INSTRUMENT  
 CT2 TRANSFORMER, CURRENT, INSTRUMENT  
 CT3 TRANSFORMER, CURRENT, INSTRUMENT  
 CT4 TRANSFORMER, CURRENT, INSTRUMENT  
 CT5 TRANSFORMER, CURRENT, EXCITER  
 CT6 TRANSFORMER, CURRENT, EXCITER  
 CT8 TRANSFORMER, CURRENT, EXCITER  
 CT7 TRANSFORMER, CURRENT, CROSS  
 G1 GENERATOR  
 K2 RELAY, OVER VOLTAGE  
 K6 RELAY, REMOTE VOLTAGE SENSING  
 K7 RELAY, PARALLEL LIGHTS VOLTAGE SENSOR  
 K11 RELAY, UNDER VOLTAGE  
 K12 RELAY, UNDER FREQUENCY  
 K13 RELAY, SHORT CIRCUIT  
 K14 RELAY, OVERLOAD  
 K15 RELAY, REVERSE POWER  
 Y16 RELAY, PERMISSIVE PARALLELING  
 M6 METER, FREQUENCY  
 M7 METER, KILOWATT  
 M8 AMMETER, AC  
 M9 VOLTMETER  
 R1 RHEOSTAT, FREQUENCY ADJUSTING  
 R2 RHEOSTAT, VOLTAGE ADJUSTING  
 R3 RESISTOR  
 R4 RESISTOR  
 R5 RESISTOR  
 R6 RESISTOR  
 R7 RESISTOR  
 R8 RESISTOR  
 R9 RESISTOR  
 R10 RESISTOR  
 R23 RESISTOR, GOVERNOR  
 R24 RESISTOR, GOVERNOR  
 R25 RESISTOR, GOVERNOR  
 R26 RHEOSTAT, LOAD SHARING  
 R29 RHEOSTAT, REACTIVE CURRENT  
 R31 RESISTOR, VOLTAGE REGULATOR  
 R38-39 RESISTOR, LOAD SHARING  
 S8 SWITCH, LOCAL-REMOTE VOLTAGE  
 S9 SWITCH-UNIT PARALLEL  
 S9 SWITCH, AMMETER, VOLTMETER TRANSFER  
 T101 TRANSFORMER, CURRENT, SPECIAL  
 TB101 TERMINAL BOARD  
 TB02 TERMINAL BOARD  
 TB5 TERMINAL BOARD, LOAD  
 TB6 TERMINAL BOARD, RECONNECTION  
 C3 CAPACITOR, EMI SUPPRESSION  
 C4 CAPACITOR, EMI SUPPRESSION  
 CE CAPACITOR, EMI SUPPRESSION  
 C6 CAPACITOR, EMI SUPPRESSION  
 CB2 CONTACTOR, AC  
 CB3 CIRCUIT BREAKER, CONVENIENCE RECEPTACLE

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