TM 5-6115-274-34

DEPARTMENT OF THE ARMY TECHNICAL MANUAL



# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

# GENERATOR SET, DIESEL ENGINE, 45 KW, AC, 120/208, 240/416 V, 3 PHASE, 400 HZ, SKID MOUNTED (STEWART AND STEVENSON MODEL 52300) NSN 6115-00-475-6573



This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY
MARCH 1979

## WARNING

**When the unit is operated in an enclosed area, exhaust gases must be piped to the outside. These gases contain carbon monoxide. Continued breathing of exhaust fumes is dangerous and may be fatal.**

**Do not operate the generator set without a suitable ground connection. Electrical defects in the unit can cause death by electrocution when contact is made with an ungrounded system.**

**Make sure that the fuel tank is completely filled with water before doing any brazing or welding on the fuel tank.**

**Failure to observe this warning may result in injury or death to personnel. Do not attempt to make or break load connections or perform maintenance on the generator set while it is in operation. Always make sure that it is not connected to an energized line before performing maintenance.**

**When malfunction of the selenium rectifier occurs, thoroughly ventilate the area to prevent inhalation of poisonous fumes. Do not handle the damaged selenium rectifier. Selenium oxide may be absorbed through the skin, especially when the rectifier is hot. Failure to observe this warning can result in severe illness or death.**

**Do not allow the spray from the fuel injectors to be directed upon any part of the body. The high pressure of the fuel being forced from the injector has sufficient power to penetrate the skin.**

**Drycleaning solvent, P-Dp680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

TM 5-6115-274-34
C 2

CHANGE NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 20 August 1984

Direct Support
and
General Support Maintenance
Manual

GENERATOR SET, DIESEL ENGINE,
45 KW, AC, 120/208, 240/416 V,
3 PHASE, 400 HZ, SKID MOUNTED
(STEWART AND STEVENSON MODEL 52300)
NSN 6115-00-475-6573

TM 5-6115-274-34, 30 March 1979, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

| Remove pages | Insert pages |
|---|---|
| 6-15 and 6-16 | 6-15 and 6-16 |
| 6-19 and 6-20 | 6-19 and 6-20 |
| 9-33 and 9-34 | 9-33 and 9-34 |
| 10-5 and 10-6 | 10-5 and 10-6 |

2. Retain this sheet in front of manual for reference purposes.

**By Order of the Secretary of the Army:**

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

**Official:**

**ROBERT M. JOYCE**
***Major General, United States Army***
***The Adjutant General***

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25D Direct and General Support Maintenance Requirements for Generator Sets, Engine Driven: 45 KW, 400 HZ.

TM 5-6115-274-34
C 1

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC., 15 January 1980

Direct Support
and
General Support Maintenance
Manual

GENERATOR SET, DIESEL ENGINE,
45 KW, AC, 120/208, 240/416 V,
3 PHASE, 400 HZ, SKID MOUNTED
(STEWART AND STEVENSON MODEL 52300)
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TM 5-6115-274-34, 30 March 1979, is changed as follows:

1. Remove and insert pages as indicated below.

| | Remove pages | Insert pages |
|---|---|---|
| Chapter 9 | 9-47 and 9-48 | 9-47 and 9-48 |
| Chapter 10 | 10-3 and 10-4 | 10-3 and 10-4 |

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3. Retain this sheet in front of manual for reference purposes.

**By Order of the Secretary of the Army:**

**E. C. MEYER**
***General, United States Army***
***Chief of Staff***

**Official:**

**J. C. PENNINGTON**
***Major General, United States Army***
***The Adjutant General***

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TECHNICAL MANUAL
NO. 5-6115-274-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *30 March 1979*

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

## GENERATOR SET, DIESEL ENGINE: 45 KW, AC, 120/208, 240/416 V, 3 PHASE, 400 HZ; SKID MOUNTED (STEWART AND STEVENSON MODEL 52300) NSN 6115-00-475-6573

### REPORTING OF ERRORS

You can help improve this manual by calling attention to errors and by recommending improvements. Your letter, DA Form 2028-2 (Recommended Changes to Publications and Blank Forms) and/or DA Form 2028-2 (Recommended Changes to Equipment Technical Manuals), may be used. Copies of DA Form 2028-2 are attached in the back of the manual for your use. Please mail your recommended changes directly to Commander, Headquarters, U.S. Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO. 63120. A reply will be furnished directly to you.

### TABLE OF CONTENTS



* This manual supersedes TM 5-6115-274-35, 18 January 1966, and all changes.

## LIST OF ILLUSTRATIONS

# CHAPTER 1
# INTRODUCTION

## Section I. GENERAL

### 1-1. Scope.

*a.* These instructions are published for the use of direct and general support maintenance personnel maintaining the Stewart and Stevenson Generator Set Model 52300. It provides information on the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to using organizations.

*b.* The appendix contains a list of publications applicable to this manual. The Maintenance Allocation Chart is located in TM 5-6115-274-12. Direct and general support maintenance repair parts are listed in TM 5-6115-274-34P.

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

*a.* DA Form 2404 (Equipment Inspection and Maintenance Worksheet).

*b.* DA Form 2407 (Maintenance Request Used for Requesting Support Maintenance).

*c.* DA Form 2407-1 (Continuation Sheet Used for Requesting Support Maintenance).

*d.* For further information, refer to TM 38-750 The Army Maintenance Management System (TAMMS).

### 1-3. Quality Assurance/Quality Control. (Not applicable)

### 1-4. Reporting of Equipment Improvement Recommendations.

EIR's will be prepared on DA Form 2407, Maintenance Request Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed directly to Commander, Headquarters, U.S. Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MEM, 4300 Goodfellow Blvd., St. Louis, MO. 63120. A reply will be furnished directly to you.

### 1-5. Destruction of Army Material to Prevent Enemy Use.

When capture or abandonment of the generator set to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all generator sets and all corresponding repair parts.

*a. Demolition To Render the Generator Set Inoperative.*

*(1) Mechanical means.* Use sledge hammers, crowbars, picks, axes, or any other heavy tools which may be available to destroy the following:

*(a)* Fuel injector pump and engine crankcase.

*(b)* All fuel and oil lines.

*(c)* Starter and starter solenoid.

*(d)* Battery-charging generator and generator regulator.

*NOTE*

*The above steps are minimum requirements for the above method.*

*(e)* Water pump.

*(f)* Governor assembly.

*(g)* Main generator assembly.

*(h)* All controls and instruments.

*(2) Demolition by misuse.* Perform the following steps to render the generator set inoperative:

*(a)* Drain the radiator and engine crankcase. Pour sand, gravel, nuts, bolts, screws, or broken glass into the radiator, oil filler pipe, fuel tank, and other openings.

*(b)* Remove the belts and block the emergency operation switch in the RUN position. Operate the engine at operating speed until failure occurs.

*b. Demolition by Explosive or Weapons Fire.*

*(1) Explosive.* Place as many of the following charges (fig. 1-1) as the situation permits and detonate them simultaneously with a detonating cord and a suitable detonator.

*Weapons fire.* Fire on the generator set with the heaviest practical weapons available.

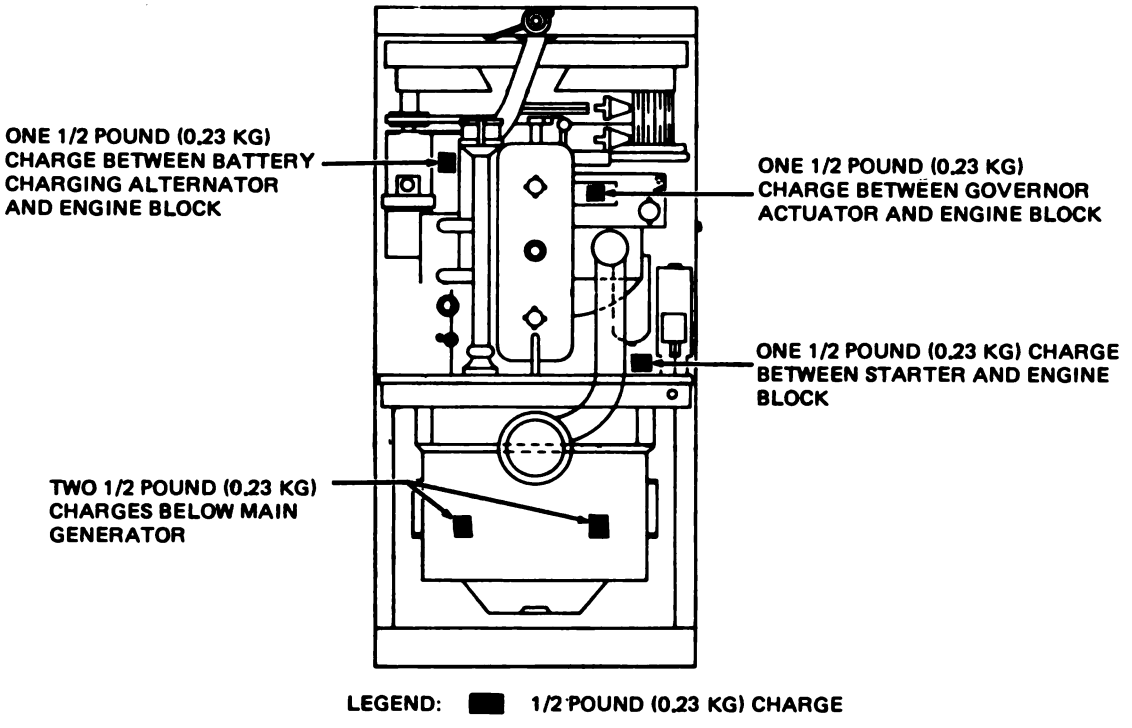



*Figure 1-1. Placement of Charges*

*c. Other Demolition Methods.*

*(1) Scattering and concealment.* Remove all easily accessible parts such as injector pump, fuel and oil lines, starter and solenoid, battery-charging generator, generator regulator, and instrument box and scatter them through dense foliage, bury them in dirt or sand, or throw them in a lake, stream, or other body of water.

*(2) Burning.* Pack rags, clothing, or canvas, under, around, and on top of the unit. Saturate this packing with gasoline, oil, or diesel fuel and ignite.

*(3) Submersion.* Totally submerge the generator set in a body of water to provide water damage and concealment. Salt water will do greater damage to metal parts than fresh water.

*d. Training.* All operators should receive thorough training in the destruction of the generator set. Simulated destruction using all of the methods listed above should be included in the operator training program. It must be emphasized in training that demolition operations are usually necessitated by critical situations when time available for carrying out destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction of equipment and be able to carry out demolition instructions without reference to this or any other manual.

## Section II. DESCRIPTION AND DATA

**1-6. Descroption.**

*a. General.* The Stewart and Stevenson Services, Inc. Generator Set, Model 52300 (figs. 1-2 and 1-3) is a self-contained, skid-mounted, enclosed unit and is completely winterized. The generator set is equipped with the necessary controls, instruments, and accessories for independent operation. The alternating current generator is driven by a 3-cylinder, 2-cycle, diesel engine. All accessories of the generator set are readily accessible through the hinged panels. The maintenance paragraphs of this manual contain detailed descriptions of all components.

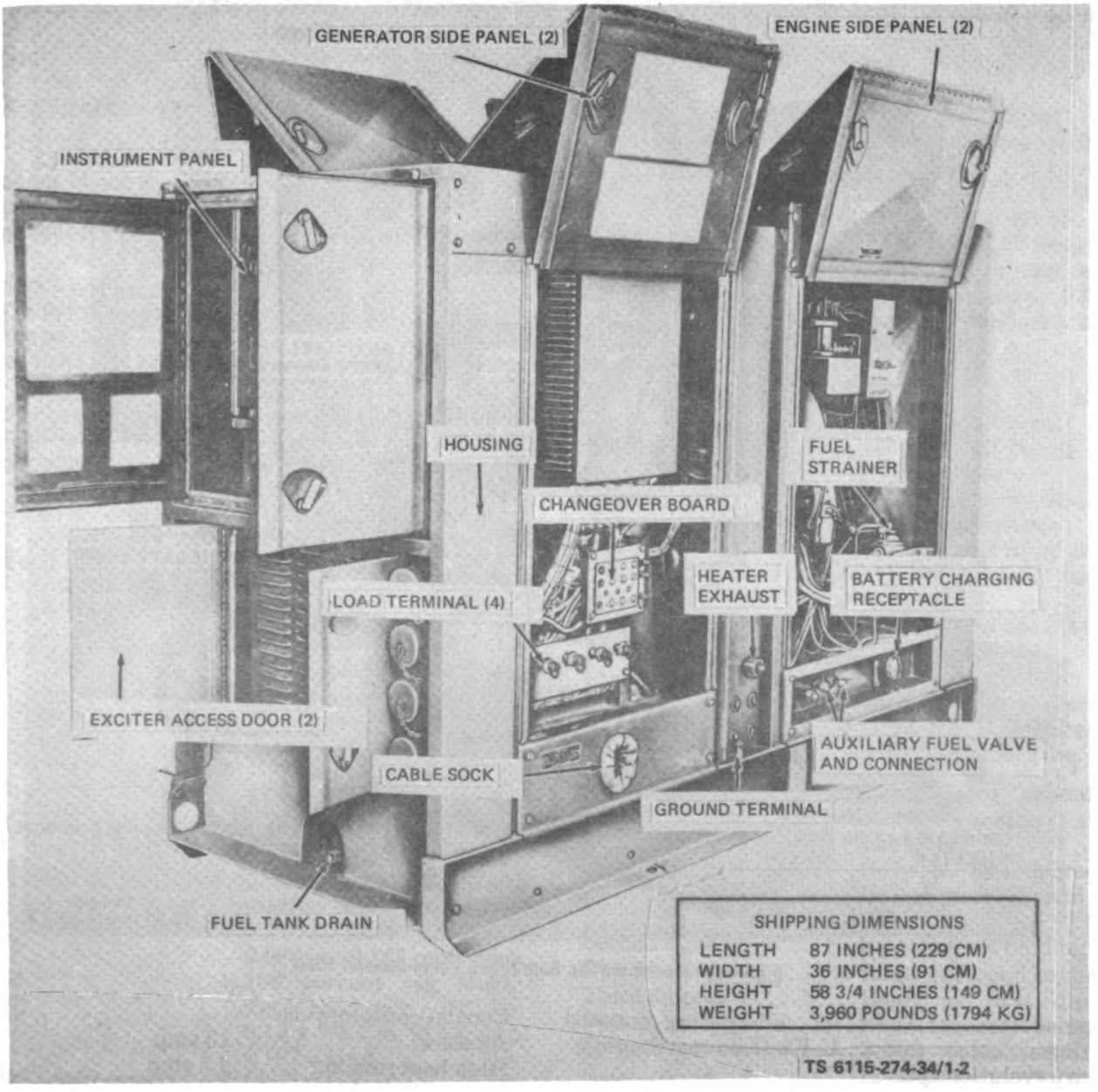



*Figure 1-2. Generator Set, Right Rear, Three-Quarter View*

*b. Engine.* The diesel engine is a 3-cylinder, 2-cycle, 67-horsepower, valve-in-head, liquid-cooled, diesel engine. The engine has full pressure lubrication, and is designed to operate at 1846 rpm (revolutions per minute) under full load. The direction of engine rotation is counterclockwise when viewed from the flywheel end of the engine.

*c.* The ac generator is driven directly from the engine flywheel. The generator is a 3-phase, 4-wire, 400 Hz unit. The generator is rated at 120/208 volts or 240/416 volts at 400 Hz, with a full load rating of 45 kilowatts at 0.8 power factor.

## 1-7. Tabulated Data.

*a. General.* This paragraph contains all the overhaul data pertinent to direct and general support maintenance personnel. A wiring diagram (see fig. FO-1) is also included.

Figure FO-1 is located in back of manual.

*b. Main Generator.*

| | |
|---|---|
| Manufacturer | Stewart and Stevenson Services, Inc. |
| Model | SSSI-52300 |

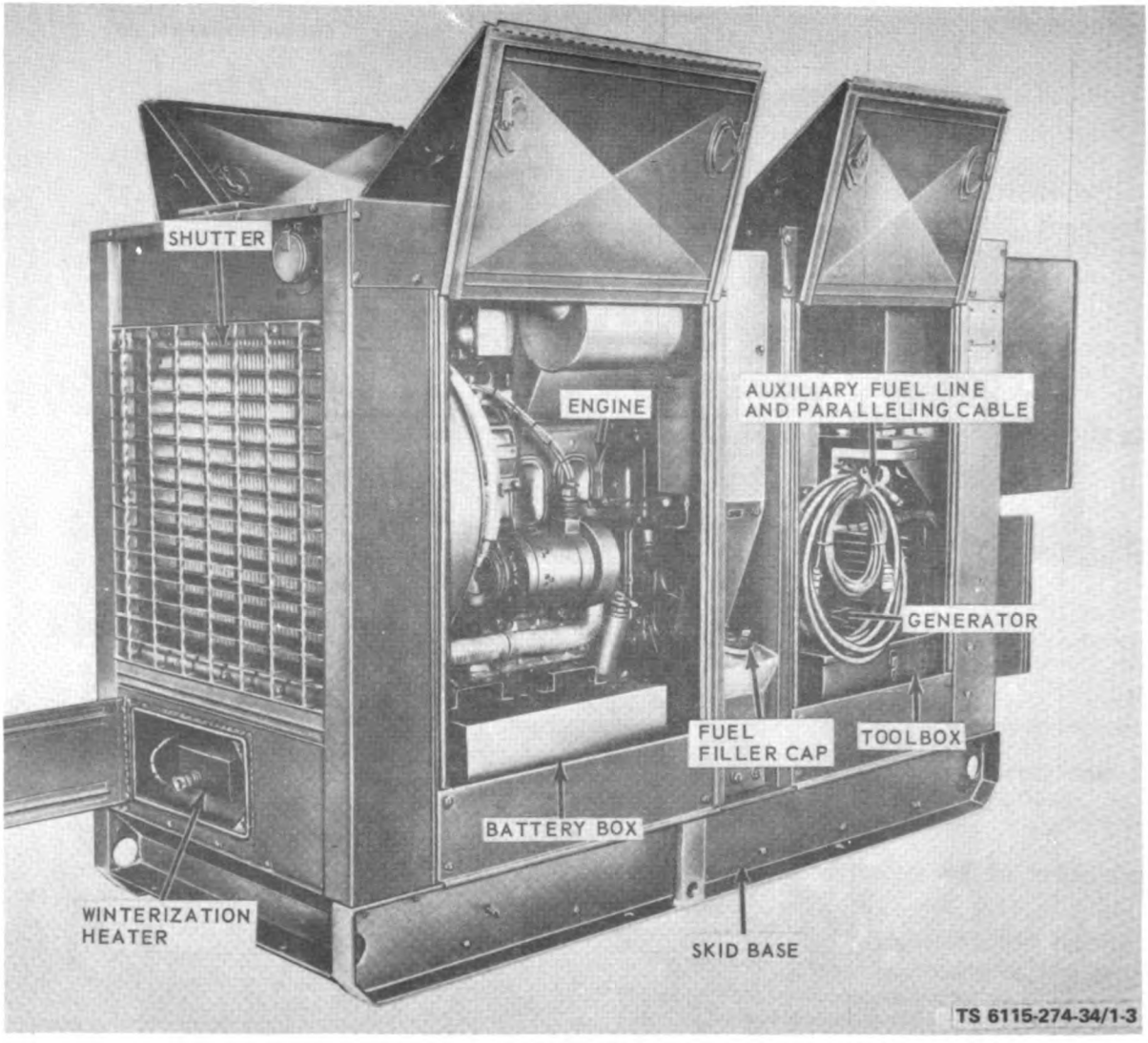



*Figure 1-3. Generator Set, Left Front, Three-Quarter View*

Type ..... AC (alternating current)
Rating ..... 45 Kw (Kilowatts)
Rpm (revolutions per minute) ..... 1.846
Volts ..... 120/208, 240/416
Amperes ..... 156 at 120/208v (volts) 78 at 240/416v
Frequency ..... 400 Hz (Hertz)
Power factor ..... 0.8
Phase ..... 3
Kva (Kilovolt-ampere) ... 56.25
Excitation ..... Static
Excitation amperes ..... 29
Excitation volts ..... 50

*c. Winterization Heater.*

Manufacturer ..... Benmar Company
Model ..... AP 2030
Type ..... Diesel fuel burning
Current consumption:
At start ..... 13 amp
High-heat running ..... 2.5 amp
Voltage ..... 24
Fuel pressure ..... 1-1/4 (pounds per square inch) 0.083
Kilograms per sq cm ..... kg/sq cm)
Fuel consumption ..... 1/3 gph (gallon per hour) 1.26 liters per hour
Heat output ..... 20,000 btu (British thermal units)
Air temperature rise
(High-heat 250 degrees F (Fahrenheit) 121 degrees C
No restriction ..... Celsius) (Fresh air)
Dimensions:
Length ..... 13-1/8 in. (inches) 33.34 cm (centimeters)

Width..... 5-1/2 in. (13.9 cm)
Height..... 9-5/8 in. (24.45 cm)
Weight..... 10.5 lb (pounds) 4.76 kg (kilograms)

*d. Generator Overhaul Data.*

*(1) Stator.*

Number of poles ..... 26
Number of slots..... 120
Number of coils ..... 6 Skein-wound with 20 contours)
Coil pan ..... 1-4
Turns per coil..... 1
Wires per coil ..... 8
Wire size ..... No. 16 AWG (American Wire Gage)
Type of Wire..... Heavy Formvar
Insulation materials:
Top wedge..... Glass base polyester - 120 pieces, 0.205 x 1/32 x 7-3/8 in. (5.2 x 0.79 x 187.3 mm)
Slot cell ..... Laminated sheet - 120 pieces of 0.005 in. (0.127 mm) thick 100 percent rag stock, 0.003 in. (0.076 mm) thick Nylar, and 0.005 in. (0.127 mm) thick 100 percent rag stock, Total thickness - 0.013 x 1-7/8 x 7-3/8 in. (0.33 x 47.6 x 187.3 mm)
Coil spacer (top)..... Laminated sheet - 120 pieces of 0.005 in. (0.127 mm) thick 100 percent rag stock, 0.003 in. (0.076 mm) thick Nylar, and 0.005 in. (0.127 mm) thick 100 percent rag stock. Total thickness - 0.013 x 0.13 x 7-3/8 in. (0.33 x 3.3 x 187.3 mm)
Coil spacer (center) ..... Laminated sheet - 120 pieces of 0.005 in. (0.127 mm) thick 100 percent rag stock, 0.005 in. (0.076 mm) thick Nylar, and 0.005 in. (0.127 mm) thick 100 percent rag stock. Total thickness - 0.013 x 0.15 x 7-3/8 in. (0.33 x 3.8 x 187.3 mm)
Coil spacer (bottom) ..... Laminated sheet - 120 pieces of 0.005 in. (0.127 mm) thick 100 percent rag stock, 0.003 in. (0.076 mm) thick Nylar, and 0.005 in. (0.127 mm) thick 100 percent rag stock. Total thickness - 0.013 x 0.21 x 7-3/8 in. (0.33 x 5.3 x 187.3 mm)
Phase separators..... Laminated sheet - 174 pieces of 0.005 in. (0.127 mm) thick 100 percent rag stock, 0.003 in. (0.076 mm) thick Nylar, and 0.005 in. (0.127 mm) thick 100 percent rag stock. Total thickness - 0.013 x 1 x 2-1/2 in. (0.33 x 25.4 x 63.5 mm)
Sleeving:
Vinyl glass grade..... 36 pieces of "B" No. 2, 8-1/2 in. (21.59 cm)
Vinyl glass grade..... 36 pieces of No. 6, 8-1/2 in. (21.59 cm)
Tape..... 25 feet (7.62 m) of cotton 1 in. (2.54 cm) wide
Tie cord ..... 30 feet (9.14 m) of cotton cable braid armature twine
Dipping compound ..... Type AW, grade CB (MIL Spec/MIl-V-1137)
Dipping and baking:
First baking ..... Preheat stator to 300 degrees F (149 degrees C) to drive off moisture
First dipping ..... Keep stator submerged until varnish stops bubbling
Second baking ..... Bake at 300 degrees F (149 degrees C) until tack free
Second dipping ..... Same as first dipping
Third baking ..... Same as second baking
Third dipping..... Same as first dipping
Fourth baking ..... Same as second baking
Ground test ..... 2,000 volts, ac for 1 minute
Minimum insulation resistance ..... 1 megohm

*(2) Rotor.*

Number of coils ..... 13 top coils (8-1/2 in. (21.59 cm) inside length) 13 bottom coils (8-1/2 in. (21.59 cm) inside length)
Turns per coil..... 38
Wires per coil ..... 152
Coil winding..... Random
Wire size ..... No. 15 AWG
Type wire ..... Heavy Formvar
Coil span ..... 1
Coil connection ..... Series

| | |
|---|---|
| Insulation materials: | |
| Coil brace (large) | Glastic - 26 pieces 15/16 x 3/16 x 9-3/8 in. (23.8 x 4.8 x 238.1 mm) |
| Coil brace (small) | Glastic - 26 pieces 15/16 x 1/16 x 9-3/8 in. (23.8 x 1.6 x 238.1 mm) |
| Slot cell | Laminated sheet - 26 pieces of 0.009 in.(0.229 mm) thick 100 percent rag stock, 0.002 in. (0.051 mm) thick Nylar, and 0.009 in. (0.229 mm) thick 100 percent rag stock. Total thickness - 0.020 x 6-3/4 x 7-7/8 in. (0.508 x 171.5 x 200 mm) |
| Coil spacer (top) | Laminated sheet - 26 pieces of 0.009 in. (0.229 mm) thick 100 percent rag stock, 0.002 in. (0.051 mm) thick Nylar, and 0.009 in. (0.229 mm) thick 100 percent rag stock. Total thickness - 0.020 x 15/16 x 7-7/8 in. (0.508 x 23.8 x 200 mm) |
| Coil spacer (center) | Laminated sheet - 26 pieces of 0.009 in. (0.229 mm) thick 100 percent rag stock, 0.002 in. (0.051 mm) thick Nylar, and 0.009 in. (0.229 mm) thick 100 percent rag stock. Total thickness - 0.020 x 13/16 x 7-7/8 in. (0.508 x 20.6 x 200 mm) |
| Coil spacer (bottom) | Laminated sheet - 26 pieces of 0.009 in. (0.229 mm) thick 100 percent rag stock, 0.002 in. (0.051 mm) thick Nylar, and 0.009 in. (0.229 mm) thick 100 percent rag stock. Total thickness - 0.020 x 11/16 x 7-7/8 in. (0.508 x 17.5 x 200 mm) |
| Sleeving | 25 pieces of vinyl glass grade "B" No. 2, 2-7/8 in. (73 mm) long, 52 pieces of vinyl glass grade "B" 1/4 x 3 in. long (6.4 x 76.2 mm) |
| Banding tape | Thermo-setting, 43 feet long (13.1 m), 3.8 in. wide (9.5 mm), bursting strength of 600 lb (272.2 kg) per turn; use 5 turns per end |
| Dipping compound | Same as for stator |
| Dipping and baking: | |
| First baking | Same as for stator (1) above) |
| First dipping | Same as for stator (1) above) |
| Second baking | Same as for stator (1) above) |
| Second dipping | Same as for stator (1) above) |
| Third baking | Same as for stator (1) above) |
| Ground test | 1,500 volts, ac for 1 minute |
| Minimum insulation resistance | 1 megohm |

*e. Electric Governor Control.*

| | |
|---|---|
| Manufacturer | Electro Magnetics, Inc. |
| Model | 10024 |
| Volts | 120/208 |
| Hertz | 400 |

*f. Governor Actuator.*

| | |
|---|---|
| Manufacturer | Electro Magnetics, Inc. |
| Model | 10017 |
| PSI | 350 (24.6 kg/sq cm) |
| GPM (gallons per minute) | 2 (7.57 lpm (liters per minute) |

*g. Hydraulic Pump.*

| | |
|---|---|
| Manufacturer | John S. Barnes Corp. |
| Output pressure | 300 to 350 psi (21.0 to 24.6 kg/sq cm) |
| Capacity | 2 gpm (7.57 l pm) |

*h. Main Circuit Breaker.*

| | |
|---|---|
| Manufacturer | Westinghouse |
| Model | 32-E-6979 |
| Ampere rating | 78 amp (amperes) at 150 degrees F (66 degrees C) |
| Maximum volts | 600 |
| Hertz | 400 |
| Magnetic trip adjustment | 350-400 |
| Number of poles | 3 |

*(i) Adjustment Data.*

| | |
|---|---|
| Exhaust valves: | |
| Hot | 0.009 in. (0.2286 mm) |
| Cold | 0.012 in. (0.3048 mm) |
| Voltage regulator load relays: | |
| Hinge cap | 0.060 plus 0.002 or minus 0.002 in. &0.1524 plus 0.0508 or minus 0.0508 mm) |

| | |
|---|---|
| Main contact gap | 0.060 plus 0.002 or minus 0.002 in. (0.1524 plus 0.0508 or minus 0.0508 mm) |
| Auxiliary contact gap | 0.030 plus 0.002 or minus 0.002 in. (0.762 plus 0.0508 or minus 0.0508 mm) |
| Core gap | 0.028 plus 0.003 or minus 0.003 in. (0.7112 plus 0.0762 or minus 0.0762 mm) |

*j. Nut and Bolt Torque Data.*

| | |
|---|---|
| Cylinder head stud nut | 165-175 ft-lb (foot-pounds) (22.8-24.2 m-kg (meter-kilograms) |
| Cylinder head stud | 37-75 ft-lb (5.1-10.4 m-kg) |
| Injector camp nut | 20-25 ft-lb &2.8-3.5 m-kg) |
| Injector clamp stud | 10-25 ft-lb (1.4-3.5 m-kg) |
| Blower gear-to-rotor screw | 25-30 ft-lb (3.5-4.1 m-kg) |
| Blower-to-cylinder block screw | 55-60 ft-lb (7.6-8.3 m-kg) |
| Connecting rod nut | 65-75 ft-lb (9-10.4 m-kg) |
| Flywheel bolt | 150-160 ft-lb (20.7-22.1 m-kg) |
| Flywheel housing screws: | |
| 1/2 - 13 | 90-100 ft-lb (12.4-13.8 m-kg) |
| 3/8 - 16 | 25-30 ft-lb &3.5-4.1 m-kg) |
| 3/8 - 24 | 25-30 ft-lb (3.5-4.1 m-kg) |
| Main bearing screw (for line boring) | 165-175 ft-lb (22.8-24.2 m-kg) |
| Main bearing screw (for installation) | 180-190 ft-lb (24.9-26.3 m-kg) |
| Cylinder head screw | 180-190 ft-lb (24.9-26.3 m-kg) |
| Cylinder head nut | 165-175 ft-lb (22.8-24.2 m-kg) |
| Exhaust manifold nut | 30-35 ft-lb (4.1-4.8 m-kg) |
| Exhaust manifold stud | 15-30 ft-lb (2.1-4.1 m-kg) |
| Main bearing stud | 35-75 ft-lb (4.8-10.4 m-kg) |

*k. Diesel Engine Classification and Rating.*

| | |
|---|---|
| Manufacturer | Detroit Diesel Division of General Motors Corp. |
| Model | 1033-7100 (RC) |
| Maximum rpm - no load | 2000 rpm (revolutions per minute) |
| Low idle rpm | 350 rpm |
| Number of cylinders | 3 |
| Type | Diesel, 2 cycle, overhead valves |
| Compression ratio | 17 to 1 |
| Displacement | 213 cu in. (cubic inch) (es) (3490.5 cm) |
| Cylinder bore | 4-1/4 in. (inch) (es) (10.8 cm) |
| Piston stroke | 5 in. (12.7 cm) |
| Direction of rotation | Counterclockwise |
| Viewing flywheel end) | |
| Firing order | 1-3-2 |
| Number of main bearings | 4 |
| Minimum compression on any one cylinder: | |
| Zero altitude at sea level | 400 psi (28.1 kg/sq cm) |
| 2,500 feet (762 meters) altitude | 360 psi (25.3 kg/sq cm) |
| 5,000 feet (1524 meters) altitude | 324 psi (22.8 kg/sq cm) |
| 7.500 feet (2286 meters) altitude | 292 psi (20.5 kg/sq cm) |
| 10,000 feet (3048 meters) altitude | 263 psi (18.5 kg/sq cm) |

*(1) Engine Repair and Replacement Standards.* Table 1-1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearance.

*Table 1-1. Engine Repair and Replacement Standards*

NOTE

The manufacturer's dimensions and tolerances are given in U.S. inches and Metric measurements. (Millimeters are inclosed in parenthesis.)

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Cylinder Block | | | | | |
| Block bore | | | | | |
| Diameters | 4.6265 (117.513) | 4.6275 (117.538) | --- | --- | 0.002 (0.051) |
| Out-of-round | --- | 0.001 (0.025) | --- | --- | 0.003 (0.076) |
| Taper | --- | 0.001 (0.025) | --- | --- | 0.002 (0.051) |
| Cylinder Sleeve | | | | | |
| Counterbore | | | | | |
| Diameter | 5.0460 (128.165) | 5.0485 (128.232) | --- | --- | |
| Depth | 0.4785 (12.154) | 0.4795 (12.179) | --- | --- | |
| Main Bearing Bore | | | | | |
| Bore inside diameter | 3.812 (96.825) | 3.813 (96.850) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| **Cylinder Sleeves** | | | | | |
| Outside diameter | 4.6250 (117.475) | 4.6260 (117.500) | --- | --- | |
| Inside diameter | 4.2495 (107.937) | 4.2511 (107.978) | --- | --- | |
| Flange diameter | 4.7660 (121.056) | 4.7760 (121.310) | --- | --- | |
| Clearance, sleeve to block bore | 0.0005 (0.013) | 0.0025 (0.063) | --- | --- | 0.0030 (0.076) |
| Out-of-round, sleeve inside diameter | --- | 0.0020 (0.051) | --- | --- | 0.0030 (0.076) |
| Taper, sleeve inside diameter | --- | 0.0010 (0.025) | --- | --- | 0.0020 (0.051) |
| Depth of sleeve flange below block | 0.0465 (1.181) | 0.0500 (1.27) | --- | --- | |
| **Main Bearings** | | | | | |
| Bearing inside diameter | 3.5014 (88.935) | 3.5034 (88.986) | --- | --- | |
| Bearing-to-journal clearance | 0.0014 (0.035) | 0.0044 (0.112) | --- | --- | 0.0060 (0.152) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Bearing thickness, 90° from parting line | 0.1548 (3.932) | 0.1553 (3.945) | --- | --- | 0.153 (3.886) |
| Crankshaft | | | | | |
| Journal diameter, main bearing | 3.4990 (88.875) | 3.5000 (88.9) | --- | --- | |
| Journal diameter, connecting rod | 2.7490 (69.825) | 2.7500 (69.85) | --- | --- | |
| Journal out-of-round | --- | 0.00025 (0.006) | --- | --- | 0.0030 (0.076) |
| Journal taper | --- | 0.0005 (0.013) | --- | --- | 0.0030 (0.076) |
| Runout, total indicator reading (mounted on No. 1 and No. 4 journals at No. 2 and No. 3 journals). | --- | 0.0020* (0.051) | --- | --- | |

NOTE

*When runout of adjacent journals is in the opposite direction, the sum must not exceed 0.0030 total indicator reading. When runout of adjacent journals is in the same direction, the difference must not exceed 0.0030 total indicator reading.

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Thrust washer thickness | 0.1205 (3.061) | 0.1220 (3.099) | --- | --- | |
| End thrust clearance | 0.0040 (0.102) | 0.0110 (0.279) | --- | --- | 0.0180 (0.457) |
| Cam Followers | | | | | |
| Diameter | 1.0600 (26.924) | 1.0610 (26.949) | --- | --- | |
| Clearance, follower-to-head | 0.0010 (0.025) | 0.0030 (0.076) | --- | --- | 0.0060 (0.152) |
| Width of roller slot | 0.5635 (14.313) | 0.5685 (14.440) | --- | --- | |
| Roller pin hole diameter | 0.4362 (11.079) | 0.4370 (11.100) | --- | --- | |
| Cam Follower Roller and Pins Roller outside diameter | 0.9020 (22.911) | 0.9070 (23.038) | --- | --- | |
| Roller bushing inside diameter | 0.4385 (11.138) | 0.4390 (11.151) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Roller pin outside dimensions | 0.4374 (11.110) | 0.4377 (11.117) | --- | --- | |
| Clearance, pin-to-bushing | 0.0008 (0.020) | 0.0016 (0.041) | --- | --- | |
| Bushing to roller (press fit) | 0.0025 (0.063) | 0.0040 (0.102) | --- | --- | |
| End play, roller-in-follower | 0.0150 (0.381) | 0.0230 (0.584) | --- | --- | |
| Pistons | | | | | |
| Diameter: | | | | | |
| At top | 4.2217 (107.231) | 4.2247 (107.307) | --- | --- | |
| At ring lands | 4.2350 (107.569) | 4.2380 (107.645) | --- | --- | |
| At skirt (below compression ring groove to bottom). | 4.2433 (107.780) | 4.2455 (107.835) | --- | --- | |
| Camshaft and Thrust | | | | | |
| Shaft Gears Backlash | 0.0030 (0.0762) | 0.0080 (0.203) | --- | --- | 0.0100 (0.254) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Gear inside diameter | 1.1865 (30.137) | 1.1875 (30.162) | --- | --- | |
| Gear-to-shaft | 0.0015 (0.038) | 0.0000 | --- | --- | 0.0015 (press) (0.038) |
| Camshaft | | | | | |
| Shaft diameter at bearings: | | | | | |
| Front and rear | 1.4970 (38.024) | 1.4975 (38.036) | --- | --- | |
| Center and intermediate | 1.4980 (38.049) | 1.4985 (38.062) | --- | --- | |
| Shaft diameter at gear | 1.1875 (30.162) | 1.1880 (30.175) | --- | --- | |
| Runout at center bearing (when mounted on end bearings) | --- | 0.0020 (0.051) | --- | --- | |
| Length-thrust bearing end: | | | | | |
| Journal | 2.8740 (72.999) | 2.8760 (73.050) | --- | --- | |
| End thrust | 0.0040 (0.102) | 0.0120 (0.305) | --- | --- | 0.0180 (0.458) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Thrust washer thickness | 0.120 (3.048) | 0.122 (3.099) | --- | --- | |
| Camshaft and Thrust Shaft Bearings Inside diameter: | | | | | |
| Front and rear | 1.5000 (38.1) | 1.5010 (38.125) | --- | --- | |
| Center and intermediate | 1.5010 (38.125) | 1.5030 (38.176) | --- | --- | |
| Clearance, bearing-to-shaft: | | | | | |
| Front and rear | 0.0025 (0.063) | 0.0040 (0.102) | --- | --- | 0.0060 (0.152) |
| Center and intermediate | 0.0025 (0.063) | 0.0050 (0.127) | --- | --- | 0.0090 (0.229) |
| Outside diameter of bearings: | | | | | |
| Front and rear | 2.1880 (55.575) | 2.1885 (55.588) | --- | --- | |
| Intermediate | 2.1840 (55.474) | 2.1860 (55.524) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Diameter of block bore | 2.1875 (55.562) | 2.1885 (55.588) | --- | --- | |
| Clearance, bearings-to-block: | | | | | |
| Front and rear | 0.0010 (tight) (0.025) | 0.0005 (loose) (0.013) | --- | --- | |
| Intermediate | 0.0015 (0.038) | 0.0045 (0.114) | --- | --- | |
| Thrust Shaft | | | | | |
| Shaft diameter at bearings | 1.4970 (38.024) | 1.4975 (38.036) | --- | --- | |
| Shaft diameter at gear | 1.1875 (30.162) | 1.1880 (30.175) | --- | --- | |
| Length-thrust bearing end journal | 2.8740 (73.000) | 2.8760 (73.050) | --- | --- | |
| End thrust | 0.0040 (0.102) | 0.0120 (0.305) | --- | --- | 0.0180 (0.457) |
| Thrust washer thickness | 0.1200 (3.048) | 0.0120 (0.305) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Cylinder Head | | | | | |
| Cam follower bore | 1.0620 (26.975) | 1.0630 (27.000) | --- | --- | 1.0650 (27.051) |
| Exhaust valve seat insert counterbore: | | | | | |
| Diameter | 1.6260 (41.300) | 1.6270 (41.326) | --- | --- | |
| Depth | 0.3705 (9.411) | 0.3845 (9.766) | --- | --- | |
| Valve Seat Inserts | | | | | |
| Exhaust valve seat angle | 30° | 30° | | | |
| Exhaust valve seat width | 0.0625 (1.587) | 0.09375 (2.381) | --- | --- | |
| Valve seat runout | --- | 0.0020 (0.051) | --- | --- | 0.0020 (0.051) |
| Outside diameter of seat insert | 1.6275 (41.339) | 1.6285 (41.364) | --- | --- | |
| Valve head to cylinder head | 0.0078 (0.198) | 0.0212 (0.538) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| **Exhaust Valves** | | | | | |
| Diameter of head | 1.5790 (40.107) | 1.5890 (40.361) | --- | --- | |
| Stem diameter | 0.3415 (8.674) | 0.3425 (8.699) | --- | --- | 0.3405 (8.649) |
| Valve clearance (hot) | 0.0090 (0.229) | 0.0090 (0.229) | --- | --- | |
| Valve clearance (cold) | 0.0120 (0.305 | 0.0120 (0.305) | --- | --- | |
| **Valve Guides** | | | | | |
| Height above cylinder head | 1.59375 (40.481) | 1.59375 (40.481) | --- | --- | |
| Diameter, inside | 0.3445 (8.750) | 0.3455 (8.776) | --- | --- | 0.3465 (8.801) |
| Clearance, stem-to-guide | 0.0020 (0.051) | 0.0040 (0.102) | --- | --- | 0.0060 (0.152) |
| **Rocker Arms and Shafts** | | | | | |
| Rocker shaft diameter | 0.8735 (22.187) | 0.8740 (22.200) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Rocket shaft bushing inside diameter | 0.8750 (22.225) | 0.8760 (22.250) | --- | --- | |
| Clearance, shaft-to-bushing | 0.0010 (0.025) | 0.0025 (0.063) | --- | --- | 0.0040 (0.102) |
| Rocker arm outer bushing: | | | | | |
| Inside diameter | 0.5640 (14.326) | 0.5650 (14.351) | --- | --- | |
| Rocker arm inner bushing: | | | | | |
| Outside diameter | 0.5620 (14.275) | 0.5625 (14.288) | --- | --- | |
| Clearance, outer-to-inner bushing | 0.0015 (0.038) | 0.0030 (0.076) | --- | --- | |
| Rocker arm inner bushing: | | | | | |
| Inside diameter | 0.4375 (11.112) | 0.4385 (11.138) | --- | --- | |
| Pushrod clevis pin outside diameter | 0.4380 (11.125) | 0.4385 (11.138) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Clearance, pin to bushing | 0.0010 (tight) (0.025) | 0.0005 (loose) (0.013) | --- | --- | |
| Piston Clearance | | | | | |
| Top of skirt | 0.0040 (0.102) | 0.0078 (0.198) | --- | --- | 0.0120 (0.305) |
| Bottom of skirt | 0.0040 (0.107) | 0.0078 (0.198) | --- | --- | 0.0120 (0.305) |
| Out-of-round | --- | 0.0005 (0.013) | --- | --- | |
| Taper | --- | 0.0005 (0.013) | --- | --- | |
| Ring Groove width | | | | | |
| Upper compression ring | 0.0880 (2.235) | 0.0900 (2.286) | --- | --- | 0.0940 (2.388) |
| 2nd compression ring | 0.1340 (3.404) | 0.1360 (3.454) | --- | --- | 0.1400 (3.556) |
| 3rd compression ring | 0.1320 (3.353) | 0.1340 (3.404) | --- | --- | 0.1380 (3.505) |
| 4th compression ring | 0.1300 (3.302) | 0.1320 (3.353) | --- | --- | 0.1360 (3.454) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Oil ring | 0.1875 (4.762) | 0.1895 (4.813) | --- | --- | |
| Piston Pin Bushing | | | | | |
| Diameter Inside | 1.5025 (38.163) | 1.5030 (38.176) | --- | --- | 1.5050 (38.227) |
| Outside | 1.7540 (44.551) | 1.7555 (44.590) | --- | --- | |
| Piston Pins | | | | | |
| Diameter | 1.4996 (38.090) | 1.5000 (38.1) | --- | --- | 1.4980 (38.049) |
| Pin-to-Piston bushing clearance | 0.0025 (0.063) | 0.0034 (0.086) | --- | --- | 0.0100 (0.254) |
| Pin-to-rod bushing clearance | 0.0015 (0.038) | 0.0024 (0.061) | --- | --- | 0.0100 (0.254) |
| Length | 3.6050 (91.567) | 3.6200 (91.948) | --- | --- | |
| Pin-to-retainer-end clearance | 0.0160 (0.406) | 0.0640 (1.626) | --- | --- | |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| **Piston Rings** | | | | | |
| **Compression rings:** | | | | | |
| Gap | 0.0180 (0.457) | 0.0430 (1.092) | --- | --- | 0.0600 (1.524) |
| Chrome rings | 0.0180 (0.457) | 0.0430 (1.092) | --- | --- | 0.0500 (1.27) |
| **Ring-to-groove clearance:** | | | | | |
| Top (No. 1) | 0.0100 (0.254) | 0.0120 (0.305) | --- | --- | 0.0220 (0.559) |
| No. 2 | 0.0080 (0.203) | 0.0105 (0.267) | --- | --- | 0.0150 (0.381) |
| No. 3 | 0.0060 (0.152) | 0.0085 (0.216) | --- | --- | 0.0130 (0.330) |
| No. 4 | 0.0060 (0.152) | 0.0085 (0.216) | --- | --- | 0.0130 (0.330) |
| **Oil rings:** | | | | | |
| Gap | 0.0080 (0.203) | 0.0230 (0.584) | --- | --- | 0.0430 (1.092) |
| Ring-to-groove clearance | 0.0015 (0.038) | 0.0055 (0.140) | --- | --- | 0.0080 (0.203) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| **Connecting Rods** | | | | | |
| Length, center-to-center | 10.1240 (257.150) | 10.1260 (257.200) | --- | --- | |
| Lower bore diameter | 3.0620 (77.775) | 3.0630 (77.800) | --- | --- | |
| Upper bushing diameter, inside | 1.5015 (38.138) | 1.5020 (38.151) | --- | --- | |
| Normal rod end thrust | 0.0060 (0.152) | 0.0120 (0.305) | --- | --- | |
| **Connecting Rod Bearings** | | | | | |
| Bearing inside diameter | 2.7514 (69.885) | 2.7534 (69.936) | --- | --- | |
| Bearing clearance | 0.0014 (0.035) | 0.0044 (0.112) | --- | --- | 0.0060 (0.152) |
| Bearing thickness, 90° from parting line | 0.1548 (3.932) | 0.1553 (3.945) | --- | --- | 0.1530 (3.886) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| **Blower Drive Gear** | | | | | |
| Backlash | 0.0030 (0.076) | 0.0080 (0.203) | --- | --- | 0.0100 (0.254) |
| Gear-to-hub fit | 0.0005 (0.013) | 0.0010 (0.025) | --- | --- | |
| **Blower Drive Gear Support** | | | | | |
| Support bearing inside diameter | 1.6260 (41.300) | 1.6265 (41.313) | --- | --- | |
| Bearing-to-hub clearance | 0.0010 (0.025) | 0.0025 (0.063) | --- | --- | |
| Support-to-end plate | 0.0005 (0.013) | 0.0025 (0.063) | --- | --- | |
| **Blower Drive Gear Hub** | | | | | |
| Diameter at bearing | 1.6240 (41.250) | 1.6250 (41.275) | --- | --- | |
| Hub-to-support clearance | 0.0010 (0.025) | 0.0025 (0.063) | --- | --- | 0.0050 (0.127) |

*Table 1-1. Engine Repair and Replacement Standards — Cont.*

| Component | Manufacturer's dimensions and tolerances | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Hub-to-cam clearance | 0.002 (0.051) | 0.007 (0.178) | --- | --- | |
| End thrust | 0.0050 (0.127) | 0.0080 (0.203) | --- | --- | 0.0100 (0.254) |
| Idler Gear | | | | | |
| Backlash | 0.0030 (0.076) | 0.0080 (0.203) | --- | --- | 0.0100 (0.254) |
| End play | 0.0030 (0.076) | 0.0060 (0.152) | --- | --- | 0.0080 (0.203) |
| Bearing-to-hub | 0.0020 (0.051) | 0.0035 (press) (0.089) | --- | --- | 0.0060 (0.152) |
| Pushrod clevis inside diameter | 0.4370 (11.100) | 0.4385 (11.138) | --- | --- | |
| Clearance, pin-to-clevis | 0.0015 (tight) (0.038) | 0.0005 (loose) (0.013) | --- | --- | |
| End play, clevis-to-rocker arm | 0.0080 (0.203) | 0.0170 (0.432) | --- | --- | |

*m. Time Standards.* Table 1-2 lists the number of man-hours required under normal conditions to perform the indicated maintenance and repair for the generator set. Components are listed under the appropriate functional index. The times listed are not intended to be rigid standards. Under adverse conditions, the operations will take longer; but under ideal conditions with highly skilled mechanics, most of the operations can be accomplished in considerably less time.

*Table 1-2. Time Standards*

| *Lubrication and Service* | *Hours* |
|---|---|
| 01 ENGINE | |
| 0100 ENGINE ASSEMBLY | |
| Engine | 0.8 |
| (Drain, flush, refill) | |
| 0106 ENGINE LUBRICATION SYSTEM | |
| Filter, fluid pressure | 0.3 |
| (Change element) | |
| Breather, rocker cover | 0.4 |
| (Clean breather) | |
| 03 FUEL SYSTEM | |
| 0301 FUEL INJECTOR | |
| Injector assembly, fuel (each) | 0.2 |
| (Clean strainer) | |
| 0302 FUEL PUMP | |
| Pump, fuel, transfer (each) | 0.2 |
| (Clean screen) | |
| 0304 AIR CLEANER | |
| Air cleaner intake | 0.6 |
| (Clean element) | |
| 0306 TANKS, LINES, FITTINGS | |
| Tank, fuel | 1.2 |
| (Clean screen) | |
| (Drain, flush, refill) | |
| Tank, fuel, engine day | 0.2 |
| (Drain, flush, refill) | |
| 0308 ENGINE SPEED GOVERNOR AND CONTROLS | |
| Tank, hydraulic, fluid | 0.3 |
| (Drain, flush, refill) | |
| 0309 FUEL FILTERS | |
| Strainer, fuel | 0.4 |
| (Drain body) | |
| Clean element | 0.6 |
| Filter, fuel | 0.6 |
| (Drain body) | |
| (Replace element) | |
| 0311 ENGINE STARTING AIDS | |
| Primer, starting | 0.1 |
| (Install capsule) | |
| 05 COOLING SYSTEM | |
| 0501 RADIATOR | |
| Radiator assembly | 0.5 |
| (Drain, flush, refill) | |
| 0603 STARTING MOTOR | |
| Motor, engine starter, electrical | 0.1 |
| (Lubricate with starter removed) | |
| 0612 BATTERIES, STORAGE | |
| (Battery, storage | 0.3 |
| (Add water, clean terminals) | |
| 22 BODY, CHASSIS OR HULL, AND ACCESSORY ITEMS | |
| 2207 WINTERIZATION EQUIPMENT | |
| Pump, reciprocating, power driven | 0.2 |
| (Clean screen) | |
| Adapter, hose to sump | 0.3 |
| (Clean screen) | |
| 40 ELECTRIC GENERATORS | |
| 4004 VENTILATING SYSTEM | |
| Cover, end | 0.1 |
| (Clean screen) | |
| Remove and Replace | |
| 01 ENGINE | |
| 0100 ENGINE ASSEMBLY | |
| Engine assembly w/accessories | 10.0 |
| (Hood and radiator removed) | |
| 0101 CRANKCASE, BLOCK, CYLINDER HEAD | |
| Block assembly, engine | 40.0 |
| (Engine removed) | |
| Head assembly, cylinder | 3.0 |
| (Radiator drained, engine hood removed) | |
| Sleeve, cylinder (all) | 7.0 |
| (Engine, removed, includes removal and installation of head, pan, piston and connecting rod assemblies). | |
| Cover, crankshaft, front | 0.3 |
| (Engine removed) | |
| Plate, end | 0.2 |
| (Engine removed) | |
| Cover, hand hole | 0.1 |
| 0102 CRANKSHAFT | |
| Bearing, sleeve (all) | 2.0 |
| (Engine removed, includes removal and installation of oil pan). | |
| Crankshaft | 3.6 |
| (Engine removed, includes removal and installation of oil pan and oil pump). | |

| *Lubrication and Service* | *Hours* |
|---|---|
| Pulley groove | 0.5 |
| (Engine in unit, radiator removed). | |
| Seal, plain, encased | 0.8 |
| (Engine in unit, pulley removed). | |
| 0103 FLYWHEEL ASSEMBLY | |
| Housing Assembly | 0.8 |
| (Flywheel removed) | |
| Flywheel assembly | 0.4 |
| (Engine removed) | |
| 0104 PISTONS, CONNECTING RODS | |
| Piston, internal combustion engine | 1.2 |
| (Engine removed, includes installing rings, cylinder head, oil pump and oil pan removed). | |
| Rod assembly, connecting (3) | 1.4 |
| (Engine removed, cylinder head, oil pan and oil pump removed) | |
| 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM | |
| Guide, valve, (each) | 0.3 |
| (Head and valve removed) | |
| Insert, valve seat (each) | 0.3 |
| (Head and valve removed) | |
| Valve, engine exhaust (all) | 2.5 |
| (Head removed, time includes refacing all valve seats). (Includes adjustment) | |
| Rocker arm assembly, valve | 0.4 |
| (Cover removed) | |
| Cover, valve | 0.1 |
| Follower assembly, cylinder (all) | 2.0 |
| (Includes remove and replace rocker arm assembly and adjust valve and injector clearance) | |
| Rods, push, valve, (all) | 2.1 |
| (Includes remove and replace rocker arm assembly and adjust valve and injector clearance) (Includes adjustment) | |
| Cover, balance weight | 1.0 |
| (Radiator removed) | |
| Shaft assembly, thrust | 6.0 |
| (Engine removed, includes remove and replace cylinder head, flywheel and housing timing gear and balance weight covers) | |
| Bearing, sleeve | 1.0 |
| (Balance cover and flywheel housing removed) | |
| Camshaft, engine | 6.0 |
| (Engine removed, includes remove and replace cylinder head, flywheel and housing timing gear and balance weight covers) | |
| Gears, helical | 0.3 |
| (Engine removed, flywheel housing removed) | |
| 0106 ENGINE LUBRICATING SYSTEM | |
| Pump, oil | 0.6 |
| (Oil pan removed) | |
| Regulator, oil | 0.5 |
| (Oil pan removed) | |
| Valve | 0.2 |
| Filter, fluid pressure | 0.5 |
| Adapter, oil cooling | 0.5 |
| (Housing and core removed) | |
| Core, oil cooler | 0.1 |
| (Housing removed) | |
| Housing, oil cooler | 0.5 |
| (Ammeter shunt, starter, and fuel solenoid removed) | |
| Valve, bypass | 0.2 |
| (Adapter removed) | |
| Breather, rocker cover | 0.2 |
| (Cover removed) | |
| Cap, oil fill | 0.2 |
| Pan, oil | 1.0 |
| Battery box and engine side panel removed) | |
| Pipe, outlet | 0.2 |
| (Oil pump removed) | |
| Gage, oil level bayonet | 0.1 |
| 03 FUEL SYSTEM | |
| 0301 FUEL INJECTOR | |
| Injector assembly, fuel (each) | 0.4 |
| (Rocker cover removed) | |
| 0302 FUEL PUMPS | |
| Pump, fuel, transfer | 0.7 |
| Pump, fuel, transfer | 0.4 |
| (Blower removed) | |
| 0304 AIR CLEANER | |
| Air cleaner intake | 0.4 |
| Hose, air duct | 0.2 |
| Blower assembly, air | 0.6 |
| (Water pump, fuel pump, and inlet housing removed) | |
| Coupling assembly, drive | 0.5 |
| (Blower removed) | |
| Housing, air inlet | 0.5 |
| (Solenoid and bracket removed) | |
| 0306 TANKS, LINES, FITTINGS | |
| Cap, fuel filler neck | 0.1 |
| Tank, fuel | 2.0 |
| (Rear skid panel removed) | |

| *Lubrication and Service* | *Hours* |
|---|---|
| Tank, fuel, engine, day | 0.6 |
| (Fuel drained) (Includes adjustment) | |
| Hose assembly | 0.5 |
| Tube assembly, fuel | 0.3 |
| Valve check | 0.3 |
| Valve, fuel control | 0.6 |
| 0308 ENGINE SPEED GOVERNOR AND CONTROLS | |
| Actuator assembly, hydraulic | 4.0 |
| (Rocker arm cover removed) (Includes adjustment) | |
| Tube assembly, metal | 0.1 |
| Pump assembly, hydraulic, governor | 4.5 |
| (Hydraulic tank drained) | |
| Strainer assembly | 0.5 |
| Tank, hydraulic fluid | 0.7 |
| (Fluid drained) | |
| 0309 FUEL FILTERS | |
| Strainer, fuel | 0.3 |
| Filter, fuel | 0.5 |
| (Fuel pressure switch removed) | |
| 0311 ENGINE STARTING AIDS | |
| Primer, starting | 0.3 |
| Primer pump, fuel | 0.3 |
| Tube assembly, metal | 0.1 |
| 0312 THROTTLE, OR CHOKE CONTROLS | |
| Control assembly, push pull | 0.4 |
| 04 EXHAUST SYSTEM | |
| 0401 MUFFLER AND PIPES | |
| Cap, exhaust pipe | 0.2 |
| Muffler and manifold assembly | 0.5 |
| (Radiator drained, rain cap and adapter and exhaust pipe removed) | |
| Pipe, exhaust | 0.1 |
| (Rain cap and adapter removed) | |
| 05 COOLING SYSTEM | |
| 0501 RADIATOR | |
| Cap, radiator | 0.1 |
| (Access door open) | |
| Radiator assembly | 0.4 |
| (Radiator drained, strainer and radiator cowl removed) | |
| Shutter assembly, radiator | 0.4 |
| (Radiator removed) | |
| Control assembly, radiator shutter | 0.4 |
| (Radiator drained) | |

| *Lubrication and Service* | *Hours* |
|---|---|
| 0503 WATER MANIFOLDS, THERMOSTAT AND HOUSING GASKET | |
| Manifold, water | 1.0 |
| (Radiator drained, bypass tube removed) | |
| Thermostat, Flow control | 0.5 |
| (Lower water level) | |
| Element Power | 0.6 |
| Hose, Radiator | 0.3 |
| Tubes, Radiator | 0.3 |
| Clamp, Hose (ea) | 0.1 |
| 0504 WATER PUMP | |
| Pump assembly, water | 0.6 |
| (Radiator drained) | |
| 0505 FAN ASSEMBLY | |
| Belts, V, Matched set | 0.4 |
| (Fan guard removed) (Includes adjustment) | |
| Support, fan | 0.3 |
| (Pulley and hub assembly removed) | |
| Fan, engine cooling | 0.4 |
| (Guard removed) | |
| Guard, engine, fan | 0.2 |
| Pulley and hub assembly | 0.5 |
| (Guard and fan removed) | |
| 06 ELECTRICAL SYSTEM | |
| 0601 GENERATOR | |
| Generator, engine ac | 0.5 |
| Belts, V, matched set | 0.4 |
| (Fan belts removed) (Includes adjustment) | |
| Pulley, groove | 0.3 |
| (Generator removed) | |
| 0602 GENERATOR REGULATOR | |
| Regulator, voltage | 0.7 |
| (Includes adjustment) | |
| Rectifier, metallic | 0.5 |
| 0603 STARTING MOTOR | |
| Motor, engine starting, electrical | 0.5 |
| (Radiator drained, cooler cover and core removed, solenoid and bracket removed) | |
| Relay, solenoid | 0.3 |
| Lead, electrical, copper | 0.2 |
| Brush, electrical contact | 0.5 |
| 0606 ENGINE SAFETY CONTROLS | |
| Governor, overspeed, diesel engine | 1.3 |
| (Air cleaner removed) (Includes adjustment) | |
| Switches, pressure | 0.3 |
| Switch, temperature | 0.3 |
| (Water level lowered) | |
| Solenoid, electrical, dc | 0.6 |
| (Includes adjustment) | |

| *Lubrication and Service* | *Hours* |
|---|---|
| 0607 INSTRUMENT OR ENGINE CONTROL PANEL | |
| Ammeter | 0.5 |
| Meter, time totalizing, electrical | 0.5 |
| Lamp, incandescent | 0.1 |
| Light panel | 0.5 |
| Switches, toggle | 0.3 |
| Wiring, electrical | 1.0 |
| 0608 MISCELLANEOUS ITEMS | |
| Connector, plug, electrical | 0.5 |
| Connector, receptacle, electrical | 0.4 |
| Shunt, ammeter | 0.4 |
| Cable assembly | 0.3 |
| 0612 BATTERIES | |
| Battery, storage (Cover removed) | 0.4 |
| Box, battery (Batteries removed) | 0.5 |
| Lead, electrical | 0.1 |
| 15 FRAME | |
| 1501 FRAME ASSEMBLY | |
| Base (Engine, generator, fuel tank removed) | 2.0 |
| Terminal, stud | 0.1 |
| 1801 BODY, CAB, HOOD | |
| Panels (Hood removed) | 0.2 |
| Cowl, center and rear (ea) (Engine and generator hood removed) | 1.5 |
| Cowl assembly, radiator, front (Engine hood removed) | 1.0 |
| Hood, engine and generator | 1.5 |
| Doors | 0.3 |
| 1808 STOWAGE RACKS, BOXES, STRAPS | |
| Strap, webbing | 0.4 |
| Box assembly, tool | 0.3 |
| Rack | 0.1 |
| 22 BODY, CHASSIS OR HULL AND ACCESSORY ITEMS | |
| 2202 ACCESSORY ITEMS | |
| Cable, paralleling | 0.4 |
| 2207 WINTERIZATION EQUIPMENT | |
| Pipe, flexible | 0.2 |
| Lamp, incandescent | 0.1 |
| Light, indicator | 0.5 |
| Pump, reciprocating, power driven | 0.7 |
| Hose, flexible | 0.2 |
| Switch, toggle | 0.3 |
| Switch, thermal (Batteries removed) | 0.2 |
| Valve assembly, not air | 0.3 |
| Adapter, hose to sump | 0.3 |
| Cable, air valve control | 0.3 |
| Heater assembly (Adapter removed) | 1.0 |
| Motor assembly, blower (Heater removed) | 1.0 |
| Igniter assembly (Heater removed) | 0.2 |
| Switch assembly, flame (Heater removed) (Includes adjustment) | 0.7 |
| Valve, regulator (Heater removed) | 1.0 |
| Coil, solenoid (Heater removed) | 1.0 |
| Terminal board (Heater removed) | 0.5 |
| Connector, receptacle, electrical (Heater removed) | 0.4 |
| Switch, limit (Heater removed) | 0.2 |
| Resistor assembly (Heater removed) | 0.2 |
| Casing, burner assembly (Heater removed) | 1.0 |
| Leads, electrical (Heater removed) | 0.2 |
| Tube, fuel (Heater removed) | 0.2 |
| Orifice assembly, metering (Heater removed) | 0.1 |
| Covers, protective and inlet (Heater removed) | 0.1 |
| 2210 DATA PLATES | |
| Plates, C.O.E. | 0.3 |
| Plates, instruction | 0.3 |
| Plates, identification | 0.3 |
| 40 ELECTRIC GENERATORS | |
| 4000 GENERATOR ASSEMBLY | |
| Generator (Includes remove and install rear cowl and separate from engine) | 8.0 |
| 4001 ROTOR ASSEMBLIES | |
| Rotor assembly (Generator removed) | 0.6 |
| 4002 STATOR ASSEMBLIES | |
| Stator assembly (Generator removed) | 0.6 |

| *Lubrication and Service* | *Hours* |
|---|---|
| 4003 BRUSH HOLDERS | |
| Brush, electrical contact | 0.5 |
| (End cover removed) | |
| Brush holder assembly | 0.9 |
| (End cover removed) (Includes adjustment) | |
| Spring tension (all 4) | |
| (End cover removed) | |
| (Includes adjustment) | |
| 4004 VENTILATING SYSTEM | |
| Cover, end | 0.1 |
| (Access doors removed) | |
| Cover, frame | 0.8 |
| 4005 FRAME SUPPORTS AND HOUSINGS | |
| Bracket, bearing | 1.0 |
| (Main generator removed) | |
| Bearing | 0.5 |
| (Rotor removed) | |
| 4007 DRIVE COMPONENTS | |
| Disk, drive | 0.5 |
| (Generator removed) | |
| 4009 CONTROL PANELS, HOUSINGS, CUBICLES | |
| Box, control | 6.0 |
| (Removed from rear cowl) | |
| Lamps, incandescent | 0.1 |
| Lights, panel | 0.3 |
| Meters, electrical | 0.3 |
| Panel, instrument | 4.0 |
| (Includes remove and replace all switches, meters and rheostats) | |
| Receptacle, electrical | 0.3 |
| Harness assembly | 4.0 |
| Wire, electrical | 0.2 |
| Sensing assembly | 0.3 |
| Converter, watt | 0.3 |
| Converter, frequency | 0.3 |
| 4010 MASTER OR AUXILIARY CONTROL ASSEMBLY | |
| Connector, receptacle | 0.2 |
| Master control assembly, governor | 1.2 |
| (Includes adjustment) | |
| (Engine air cleaner removed) | |
| 4011 CIRCUIT BREAKERS, CUTOUTS, FUSE AND FUSEHOLDERS | |
| (Includes disconnecting, wiring, labeling, wiring and reconnecting) | |
| Cable assemblies | 4.5 |
| Fuse, cartridge | 0.1 |
| Holder, fuse | 0.3 |

| *Lubrication and Service* | *Hours* |
|---|---|
| 4012 SWITCHES | |
| Switches | 0.5 |
| 4013 REGULATOR, VOLTAGE OR CURRENT | |
| Regulator, voltage | 0.5 |
| 4014 RESISTORS | |
| Resistors | 0.2 |
| Rheostat | 0.2 |
| 4015 RELAY OR ASSEMBLY | |
| Relay | 0.5 |
| (Includes adjustment) | |
| 4017 TRANSFORMERS, RECTIFIERS | |
| Transformer | 0.6 |
| Rectifier | 0.4 |
| 4018 TERMINAL BLOCKS JUNCTION BOXES | |
| Terminal board assembly | 1.0 |
| Bracket, terminal board | 0.2 |
| (Terminal board removed) | |
| Cable assembly, load | 1.0 |
| Receptacle | 0.3 |
| Connector board assembly | 1.0 |
| 4019 RADIO INTERFERENCE SUPPRESSION | |
| Capacitor, fixed, paper dielectric | 0.2 |
| (End cover removed) | |
| Lead electrical | 0.2 |
| 4020 STATIC EXCITER COMPONENTS | |
| Exciter assembly | 2.0 |
| Bracket, exciter mounting | 0.2 |
| Exciter removed | |
| Rectifier assembly | 0.5 |
| (End cover removed) | |
| Choke assembly | 0.5 |
| Transformers, current | 0.6 |
| Board, transformer mounting | 0.3 |
| (Transformer removed) | |
| 47 GAGES (NONELECTRICAL) WEIGHING AND MEASURING DEVICES | |
| 4702 GAGES | |
| Gages, oil pressure | 0.3 |
| Tube assembly, metal | 0.3 |
| 4702 FUEL GAGES (QUANTITY) | |
| Gage, liquid quantity | 0.4 |
| Indicator assembly, heat | 0.6 |
| (Lower water level) | |
| 76 FIGHTING EQUIPMENT | |
| 7603 FIRE EXTINGUISHER | |
| Extinguisher, fire | 0.1 |

**1-8. Lubrication Information.**

*a. Care of Lubricants.* Keep all lubricants in sealed containers and stored in a clean, dry place away from external heat. Allow no dirt, dust, or water to mix with the lubricants at any time. Keep all lubrication clean and ready to use.

*b. Points of Lubrication.* Follow the detailed lubrication instructions given on the current lubrication order. Always apply lubricant specified on the current lubrication order.

*c. Cleaning.* Keep all external parts not requiring lubrication free from lubricants. After every lubrication operation, remove any excess lubricants from the points of application and wipe away spilled lubricant.

*d. Operation Immediately After Lubrication.* Operate the unit for five minutes immediately after lubrication. Inspect the oil filter and oil lines for evidence of leakage. If the crankcase oil has been changed, it will be necessary to operate the engine for five minutes before checking the oil level.

**CAUTION**

**When OES oil is used, level should be checked more frequently.**

# CHAPTER 2

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

## Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

**2-1. Repair Parts.**

Direct and general support maintenance repair parts are listed and illustrated in TM 5-6115-274-34P.

**2-2. Special Tools and Equipment.**

The special tools required to perform the repair and overhaul operations on the engine and its accessories are listed in table 2-1 and TM 5-6115-274-34P, and shown on figure 2-1. No special equipment is required by direct and general support maintenance personnel for maintenance on the generator set.

**2-3. Specially Designed Tools and Equipment.**

No specially designed tools or equipment are required by direct and general support maintenance personnel to perform maintenance on the generator set.

*Table 2-1. Special Tools and Equipment*

| ITEM | NSN OR PART NO. | USE |
|---|---|---|
| Valve Spring and Injector Remover | J1227-01 | Remove valve springs and injectors |
| Injector timing gage | J1853 | Check fuel injector timing |
| Cam installer | J1471 | Blower drive gear |
| Handle for insert oil seals | J1508-8 | Install oil seal injectors |
| Adapter for oil seat insert | J1508-9 | Install oil seals |
| Puller set, blower gear and end plates | J1682-CB | Blower gear and end plates |

1. Valve spring and injector remover
2. Injector timing gage
3. Cam installer
4. Handle insert oil seals
5. Adapter for oil seal insert

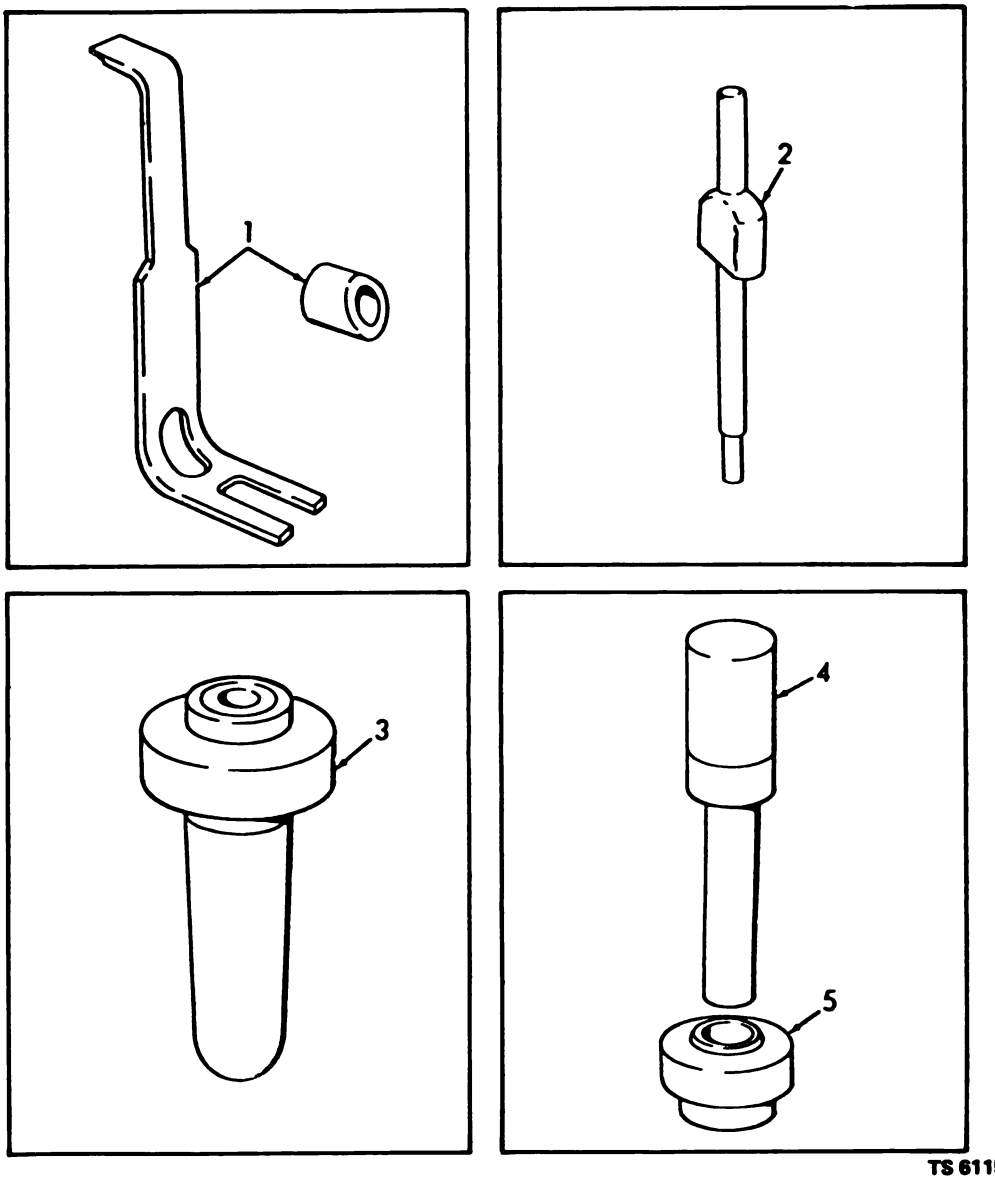



*Figure 2-1. Special Tools*

## Section II. TROUBLESHOOTING

**2-4. General.**

*a.* This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the generator set. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine corrective actions to take.

*b.* This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

**2-5. Direct and General Support Maintenance Troubleshooting.**

The following table 2-2 lists the common malfunctions which you may find during the operation or maintenance of the generator set or its components. You should perform the tests/inspections and corrective actions in the order listed.

*Table 2-2. Troubleshooting*

**MALFUNCTION**
**TEST OR INSPECTION**
**CORRECTIVE ACTION**

**ENGINE**

**1. ENGINE HARD TO START OR FAILS TO START**

*Step 1.* If the starting motor fails to crank the engine it could be a stripped flywheel spur gear or a defective starting motor.
- *a.* **Replace flywheel spur gear (fig. 9-2).**
- *b.* **Repair or replace starting motor (para 6-3).**

*Step 2.* If the engine fails to start it could be clogged or defective fuel injectors.
**Repair or replace fuel injectors (para 4-9).**

*Step 3.* If the engine fails to start it could be a defective cylinder head gasket.
**Replace cylinder head gasket (para 9-9).**

*Step 4.* If the engine fails to start it could be valves out of adjustment or defective valves.
**Adjust, repair or replace valves (para 9-9).**

*Step 5.* If the engine fails to start it could be defective piston rings.
**Replace piston rings (para 9-18).**

*Step 6.* If the engine fails to start it could be a defective blower.
**Repair or replace blower (para 7-15).**

**2. ENGINE MISSES OR RUNS ERRATICALLY**

*Step 1.* Check for clogged or defective fuel injector.
**Repair or replace injectors (para 4-9).**

*Step 2.* Check for worn or defective pistons, rings, or sleeves.
**Replace defective pistons, rings, or sleeves (para 9-18).**

*Step 3.* Check for stuck or burned valves.
**Repair or replace valves (para 9-9).**

*Step 4.* Check for defective cylinder head gasket.
**Replace gasket (para 9-9).**

*Step 5.* Check if electric governor control unit is defective or out of adjustment.
**Adjust, repair or replace governor control unit (para 5-9).**

**3. ENGINE LACKS POWER**

*Step 1.* Check for worn or sticking valves.
**Repair or replace valves (para 9-9).**

*Step 2.* Check if fuel injector control tube is defective or out of adjustment.
**Adjust or replace control tube (para 4-9).**

*Step 3.* Check if fuel injectors are clogged or defective.
**Repair or replace fuel injectors (para 4-9).**

*Table 2-2. Troubleshooting—Continued*

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|
| **4. ENGINE OVERHEATS** |
| *Step 1.* Check for clogged or defective radiator.<br>**Repair or replace radiator (para 7-21).** |
| *Step 2.* Check for cracked cylinder block or clogged oil gallery.<br>**Replace or repair cylinder block (para 9-24).** |
| **5. ENGINE KNOCKS OR DEVELOPS EXCESSIVE NOISE** |
| *Step 1.* Check for worn or defective piston pin or bushing.<br>**Replace worn or defective piston pin or bushing (para 9-18).** |
| *Step 2.* Check for worn or defective piston or cylinder sleeve.<br>**Replace worn or defective piston or cylinder sleeve (para 9-18).** |
| *Step 3.* Check for worn or loose connecting rod bearings.<br>**Replace or repair worn or loose connecting rod bearings (para 9-18).** |
| *Step 4.* Check for leaking injector spray tip valve.<br>**Repair or replace defective injector spray tip valve (para 4-9).** |
| *Step 5.* Check for worn blower.<br>**Repair or replace blower (para 7-15).** |
| *Step 6.* Check for defective gear train.<br>**Replace defective gears (para 9-12).** |
| *Step 7.* Check for worn crankshaft or main bearings.<br>**Replace worn crankshaft or main bearings (para 9-21).** |
| *Step 8.* Check for loose flywheel.<br>**Tighten flywheel (para 9-3).** |
| **6. ENGINE OIL PRESSURE LOW** |
| *Step 1.* Check for defective oil pump or pressure regulator.<br>**Repair or replace oil pump or pressure regulator (para 9-15).** |
| *Step 2.* Check for defective crankshaft, connecting rod bearings or main bearings.<br>**Replace defective crankshaft or bearings (para 9-21).** |
| **7. ENGINE OIL CONSUMPTION HIGH** |
| *Step 1.* Check for leaking oil pan gasket.<br>**Replace oil pan gasket (para 9-15).** |
| *Step 2.* Check for defective crankshaft oil seals.<br>**Replace oil seals (par 9-21).** |
| *Step 3.* Check for defective blower oil seal.<br>**Replace blower oil seal (para 7-15).** |
| *Step 4.* Check for defective piston or piston oil control rings.<br>**Replace defective piston or piston oil control rings (para 9-18).** |
| *Step 5.* Check for defective cylinder sleeve.<br>**Replace defective cylinder sleeve (para 9-24).** |
| **8. ENGINE EXHAUST SMOKE EXCESSIVE** |
| *Step 1.* Check if fuel injector control tube is defective or out of adjustment.<br>**Adjust or replace control tube (para 4-9).** |
| *Step 2.* Check if fuel injectors are clogged or defective.<br>**Repair or replace fuel injectors (para 4-9).** |
| *Step 3.* Check if valves are seating properly.<br>**Repair or replace valves or valve seats (para 9-9).** |
| **9. AMMETER SHOWS CHARGE WHEN BATTERIES ARE FULLY CHARGED** |
| *Step 1.* Check for grounded engine generator rotor.<br>**Replace rotor (para 6-9).** |
| *Step 2.* Check if engine generator voltage regulator is out of adjustment.<br>**Adjust regulator (para 6-12).** |

*Table 2-2. Troubleshooting—Continued*

**MALFUNCTION**
**TEST OR INSPECTION**
**CORRECTIVE ACTION**

**10. AMMETER SHOWS LOW OR NO CHARGE WHEN BATTERIES ARE DISCHARGED**

*Step 1.* Check for defective engine generator rotor.
**Replace rotor (para 6-9).**

*Step 2.* Check for grounded engine generator stator.
**Replace stator (para 6-9).**

*Step 3.* Check for defective engine generator brush holders or springs.
**Replace brush holders or springs (para 6-9).**

*Step 4.* Check if engine generator voltage regulator is defective or out of adjustment.
**Adjust or replace voltage regulator (para 6-12).**

**11. ENGINE GENERATOR OVERHEATS**

*Step 1.* Check for dirt in engine generator.
**Disassemble and clean generator (para 6-9).**

*Step 2.* Check for defective stator.
**Replace stator (para 6-9).**

*Step 3.* Check for defective rotor.
**Replace rotor (para 6-9).**

*Step 4.* Check for defective engine generator shaft bearing.
**Replace bearing (para 6-9).**

**12. MAIN GENERATOR FAILS TO BUILD UP RATED VOLTAGE**

*Step 1.* Check if voltage regulator is defective or out of adjustment.
**Adjust or replace regulator (para 10-4).**

*Step 2.* Check for defective static exciter.
**Replace or repair a defective static exciter (para 11-6).**

*Step 3.* Check for defective stator winding.
**Repair or replace stator (para 11-14).**

*Step 4.* Check for defective rotor.
**Repair or replace rotor (para 11-14).**

*Step 5.* Check for defective sliprings.
**Repair or replace sliprings (para 11-14).**

**13. MAIN GENERATOR OUTPUT VOLTAGE DROPS UPON LOAD INCREASE**

*Step 1.* Check if voltage regulator is defective or out of adjustment.
**Adjust or replace regulator (para 10-4).**

*Step 2.* Check for defective stator.
**Replace stator (para 11-14).**

*Step 3.* Check for defective rotor.
**Replace rotor (para 11-14).**

**14. MAIN GENERATOR VOLTAGE TOO HIGH**

*Step 1.* Check if voltage regulator is defective or out of adjustment.
**Adjust or replace regulator (para 10-4).**

*Step 2.* Check if linear reactor transformer is defective.
**Replace the transformer (para 10-4).**

**15. MAIN GENERATOR NOISE**

*Step 1.* Check for defective bearing.
**Replace bearing (para 11-14).**

*Step 2.* Check for loose or defective coupling.
**Tighten or replace coupling (para 11-14).**

**16. MAIN GENERATOR OVERHEATS**

*Step 1.* Check for dirt in main generator.
**Disassemble and clean generator (para 11-14).**

*Table 2-2. Troubleshooting—Continued*

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|
| *Step 2.* Check for defective bearing.<br>**Replace bearing (para 11-14).** |
| *Step 3.* Check if circuit breaker remains closed with generator overloaded.<br>**Replace circuit breaker (para 11-8).** |
| *Step 4.* Check for defective stator winding.<br>**Repair or replace stator (para 11-14).** |
| *Step 5.* Check for defective rotor.<br>**Repair or replace rotor (para 11-14).** |
| **17. MAIN GENERATOR VOLTAGE ERRATIC** |
| *Step 1.* Check for defective voltage regulator.<br>**Repair or replace regulator (para 10-4).** |
| *Step 2.* Check for defective rectifier or heat sink.<br>**Repair or replace rectifier or heat sink (para 11-12).** |
| *Step 3.* Check if engine speed fluctuates due to a defective electrohydraulic actuator.<br>**Repair or replace actuator (para 5-6).** |
| **18. CIRCUIT BREAKER CONTINUES TO TRIP** |
| *Step 1.* Check for defective circuit breaker.<br>**Replace circuit breaker (para 11-8).** |
| *Step 2.* Check for defective overvoltage-underfrequency relay.<br>**Replace relay (para 10-3).** |
| **19 MAIN GENERATOR FREQUENCY DRIFTS** |
| *Step 1.* Check for defective frequency control variable resistor.<br>**Replace resistor (para 10-3).** |
| *Step 2.* Check for misaligned or defective governor control unit.<br>**Align, repair or replace control unit (para 5-9).** |
| *Step 3.* Check if engine responds to electrohydraulic actuator.<br>**Adjust or repair actuator (para 5-6).**<br>**Adjust or repair fuel injector control tube (para 4-9).** |
| **20. BATTERY-CHARGING AMMETER FAILS TO REGISTER** |
| *Step 1.* Check for defective engine generator.<br>**Replace or repair generator (para 6-9).** |
| *Step 2.* Check if engine generator voltage regulator is defective or out of adjustment.<br>**Adjust or replace voltage regulator (para 6-12).** |
| **21. GENERATOR DOES NOT PARALLEL PROPERLY** |
| *Step 1.* Check for defective droop adjusting variable resistor.<br>**Replace resistor (para 10-3).** |
| *Step 2.* Check for misaligned or defective electric governor control unit.<br>**Align or replace control unit (para 5-9).** |
| **22. ELECTROHYDRAULIC ACTUATOR SLUGGISH** |
| *Step 1.* Check for binding of hydraulic pump drive shaft.<br>**Repair or replace pump (para 5-3).** |
| *Step 2.* Check for proper hydraulic pump output pressure.<br>**Repair or replace pump (para 5-3).** |
| *Step 3.* Check if actuator control rod is binding or out of adjustment.<br>**Adjust or replace control rod (para 5-6).** |
| **23. ENGINE HUNTS OR DOES NOT RESPOND TO ELECTROHYDRAULIC ACTUATOR** |
| *Step 1.* Check if electric governor control unit is misaligned or defective.<br>**Align or replace control unit (para 5-9).** |

*Table 2-2. Troubleshooting—Continued*

**MALFUNCTION**
**TEST OR INSPECTION**
**CORRECTIVE ACTION**

*Step 2.* Check for backlash between actuator rack and electrical potential indicator pinion.
**Replace rack and potential indicator or tension spring (para 5-6).**

**24. ENGINE SHUTS DOWN OR OVERSPEEDS WHEN GOVERNOR SWITCH IS TURNED ON**

*Step 1.* Check for defective frequency control variable resistor.
**Replace resistor (para 10-3).**

*Step 2.* Check for defective electrohydraulic actuator core and armature assembly.
**Test and, if necessary, replace core and armature assembly (para 5-6).**

**25. WINTERIZATION HEATER FAILS TO IGNITE**

**Check for defective solenoid fuel valve.**
**Replace valve (para 12-2).**

## Section III REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

### 2-6. Housing Group and Front Cowl.

*a. Removal.*

*(1)* Remove screws (1, fig. 2-2), washers (2), lockwashers (30), and nuts (12) in sequence necessary to remove doors (3, 4, 19, 26) and hoods (5, 6).

*(2)* Remove fuel control panel (22), canvas boot (23), side panel (24), and connector nut (25).

*(3)* Remove side panels (28, 29).

*(4)* Drain radiator liquid into suitable container and disconnect all hoses at radiator.

*(5)* Remove screws (1), washers (2), lockwashers (30), nuts (12), and remove muffler rain cap and retainer (14) and clip (38).

*(6)* Remove screws (1), lockwashers (40), fasteners (41), washers (2, 43), lockwashers (30), and nuts (12) and remove grill guard (39) and heater access door (42).

*(7)* Remove screws (1), lockwashers (30), and nuts (12) and remove doors (31, 32, 54, 57). Remove cotter pin (55) and door stop (56).

*(8)* Remove screw (1) and fire extinguisher bracket (27).

*(9)* Remove screws (1), washers (2), lockwashers (30), and nuts (12) and remove stowage rack (34).

*(10)* Remove bolts (33), lockwashers (36) and nuts (37) and remove toolbox (35).

*(11)* Remove radiator cap (10).

*(12)* Remove screws (8) and lockwashers (9) and remove radiator (11). Remove shutter assembly (46).

*(13)* Remove nuts (15), spacers (16), washers (17), latches (18), washers (20) and latch handles (21).

*(14)* Remove bolt (53), lockwasher (2), ground terminal identification strip (50) and ground terminal (51).

*(15)* Remove nuts (49), lockwashers (48), bevel washers (47), washers (44) and bolts (45) and remove front cowl (13).

*b.* Installation.

*(1)* Position front cowl (13, fig. 2-2) on frame and fasten with bolts (45).

*(2)* Install ground terminal (51) and identification strip (50) and attach with bolt (53) and lockwasher (52).

*(3)* Install latch handles (21), washers (20), latches (18), washers (17), spacers (16) and nuts (15).

*(4)* Install shutter assembly (46). Install radiator (11) and attach to cowl with lockwashers (9) and screws (8).

*(5)* Install radiator cap (10).

*(6)* Position toolbox (35) and fasten with bolts (33), and nuts (37).

*(7)* Install stowage rack (34) and fasten with screws (1), washers (2), lockwashers (30) and nuts (12).

*(8)* Install fire extinguisher bracket (27) with screw (1).

*(9)* Position doors (31, 32, 54, 57) and attach with screws (1), lockwashers (30), and nuts (12). Install door stop (56) and cotter pin (55).

*(10)* Install grill guard (39) and heater access door (42) with screws (1), lockwashers (40), fasteners (41), washers (2, 43), lockwashers (30), and nuts (12).

*(11)* Install clip (38) and muffler rain cap (14) with screws (1), washers (2), lockwashers (30), and nuts (12).

*(12)* Connect hoses to radiator and fill radiator with proper fluid.

*(13)* Install side panels (28, 29).

*(14)* Install connector nut (25), side panel (24), canvas boot (23), and fuel control panel (22).

*(15)* Install hoods (5, 6) and doors (3, 4, 19, 26), and fasten with screws (1), washers (2), lockwashers (30), and nuts (12).

---

1. Screw, cap, hex hd, 1/4-20 x 3/4 in. (77 reqd)
2. Washer, flat 1/4 in. (77 reqd)
3. Generator door, lh
4. Engine door, lh
5. Generator cover
6. Engine cover
7. Radiator cap access door
8. Screw, cap, hex hd, 5/16-18 x 3/4 in. (6 reqd)
9. Washer, lock, 5/16 in. (6 reqd)
10. Radiator cap
11. Radiator and air shroud
12. Nut, hex, 1/2-20 (56 reqd)
13. Front cowl
14. Muffler raincap and retainer
15. Nut (spec) (20 reqd)
16. Spacer (20 reqd)
17. Washer, flat, 3/8 in. (20 reqd)
18. Latch (20 reqd)
19. Engine door, rh
20. Flat washer (spec)
21. Latch handle
22. Fuel control panel
23. Canvas boot
24. Right rear side panel
25. Connector nut (spec)
26. Generator door, rh
27. Fire extinguisher bracket
28. Left rear side panel
29. Left front side panel
30. Washer, lock, 1/4 in. (56 reqd)
31. Instrument door, rh
32. Instrument door, lh
33. Bolt, machine, 5/16-18 x 3/4 in. (4 reqd)
34. Stowage rack
35. Toolbox
36. Washer, lock, 5/16 in. (4 reqd)
37. Nut, hex, 5/16-18 (4 reqd)
38. Clip
39. Grill guard
40. Washer, lock, IET, 1/4 in. (9 reqd)
41. Fastener (spec) (2 reqd)
42. Heater access door
43. Flat washer (spec)
44. Washer, flat, 1/2 in. (4 reqd)
45. Bolt, machine, 1/4-13 x 1 1/4 in. (4 reqd)
46. Shutter assembly
47. Bevel washer (spec)
48. Washer, lock, 1/2 in. (4 reqd)
49. Nut, hex, 1/2-13 (4 reqd)
50. Ground terminal identification strip
51. Ground terminal
52. Washer, lock, IET, 1/2 in.
53. Bolt, machine, 1/2-13 x 2 1/2 in.
54. Generator lower door, rh
55. Pin, cotter, 1/8-16 x 3/4 in.
56. Door stop
57. Generator lower door, lh

*Figure 2-2. Housing Group and Front Cowl, Removal and Installation*

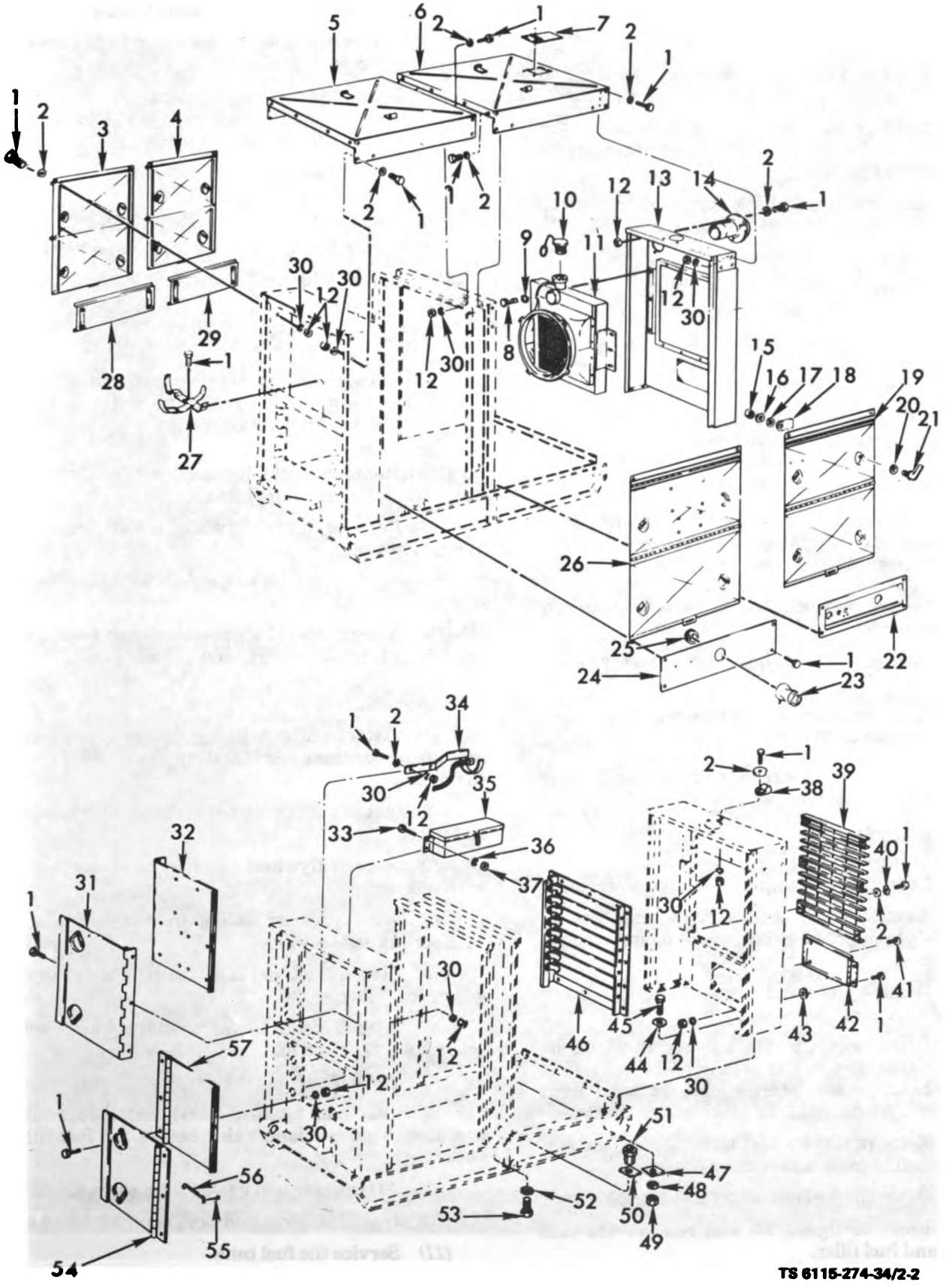



*Figure 2-2. Housing Group and Front Cowl, Removal and Installation (cont.)*

## 2-7. Engine.

*a. Removal.*

*(1)* Refer to figure 2-2 and following steps to remove housing group to gain access to the engine.

*(2)* Remove screws (1, fig. 2-2), washers (2), washers (17) and nuts (12) in sequence necessary to remove doors (3, 4, 19, 26) and hoods (5, 6).

*(3)* Remove fuel control panel (22), canvas boot (23), side panel (24) and connector nut (25).

*(4)* Remove side panels (28, 29).

*(5)* Drain radiator liquid into suitable container and disconnect all hoses at radiator.

*(6)* Remove front cowl (13) with radiator assembly attached by removing nuts (49), washers (48), bevel washers (47), washers (44) and bolts (45).

*(7)* Refer to figure 2-3 and loosen latches on battery box cover and remove cover.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first.*

*(8)* Loosen nuts, disconnect battery leads and remove jumper lead.

*(9)* Loosen battery holddowns and remove batteries.

*(10)* Refer to figure 2-4 and loosen clamps and remove heater-to-battery hose.

*(11)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(12)* Remove thermostat. Tag and disconnect electrical leads.

*(13)* Loosen hose clamp and remove drain hose.

*(14)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(15)* Remove nuts and screws holding battery box to frame and remove battery box.

*(16)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(17)* Remove screws and nuts holding generator stator frame cover and remove cover.

*(18)* Drain the fuel into a suitable container.

*(19)* Refer to figure 2-5 and remove the fuel tank cap and fuel filler.

*(20)* Remove fuel tank cap and strainer.

*(21)* Remove screws securing ring to filler neck and remove ring and gasket.

*(22)* Loosen the clamps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(23)* Remove the heater exhaust pipe at center cowl.

*(24)* Remove screws, washers and nuts holding center cowl to base frame and remove center cowl.

*(25)* Refer to figure 2-6 and following steps to remove the engine.

*NOTE*

*Position suitable blocking beneath rear of main generator before removing stator-to-flywheel housing screws.*

*(26)* Remove lockwire and screws holding stator frame to coupling plates.

*(27)* Remove screws holding stator frame to flywheel housing.

*(28)* Remove screws and nuts holding engine to skid base.

*(29)* Attach suitable lifting device to front and rear lifting brackets and remove engine.

*b. Installation.*

*(1)* Attach suitable lifting device to front and rear lifting brackets and install engine on base (refer to fig. 2-6).

*(2)* Attach engine to skid base with screws and nuts.

*(3)* Attach flywheel housing to stator frame with screws.

*(4)* Attach stator frame to coupling plates with screws and lockwire.

*(5)* Remove blocking from under main generator.

*(6)* Attach center cowl to base frame with screws, washers and nuts.

*(7)* Attach heater exhaust pipe to center cowl.

*(8)* Refer to figure 2-5 and install fuel filler and hose. Tighten clamps that secure the fuel filler hose.

*(9)* Attach ring and gasket with screws.

*(10)* Install strainer and tank cap.

*(11)* Service the fuel tank.

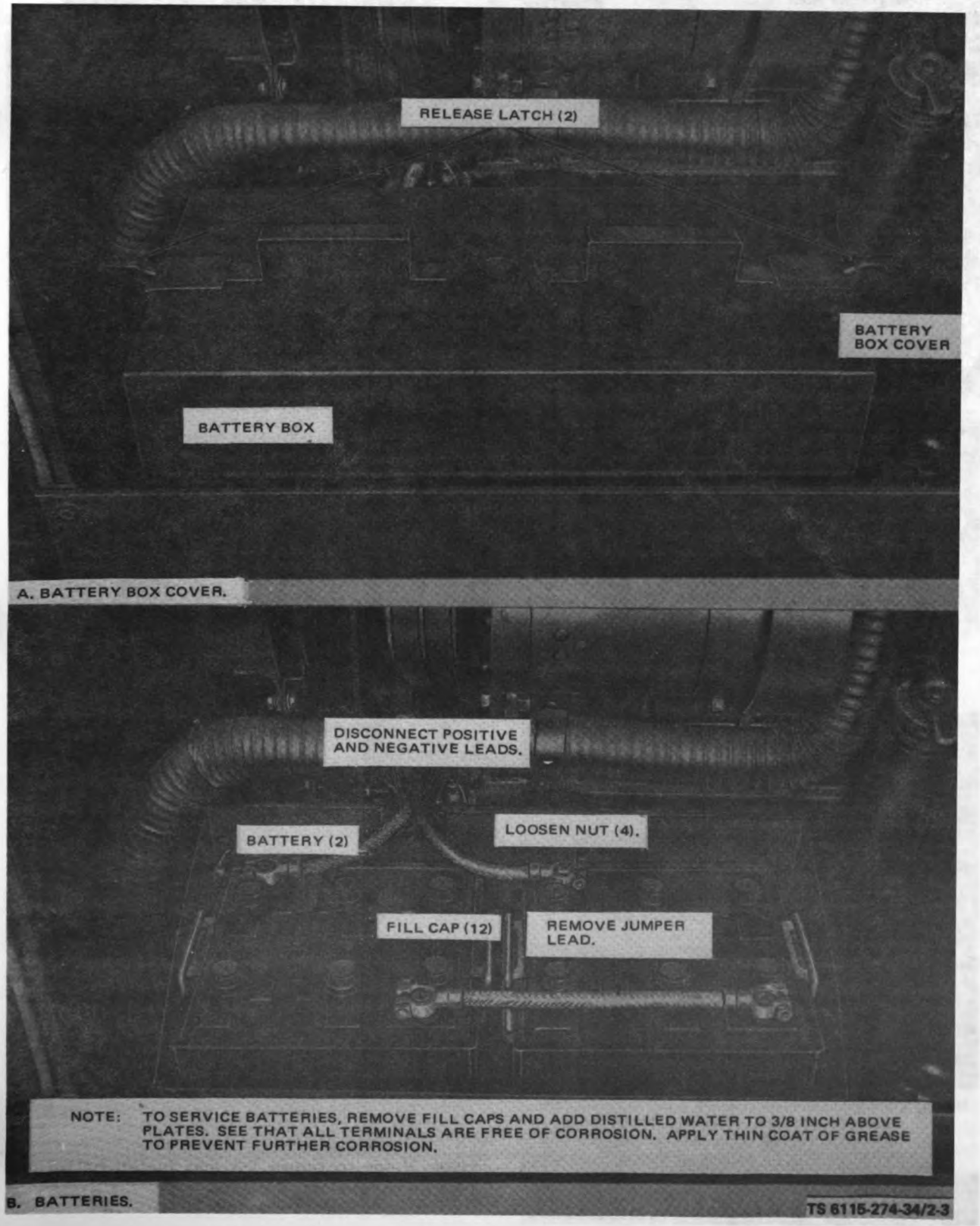



*Figure 2-3. Batteries, Removal and Installation*

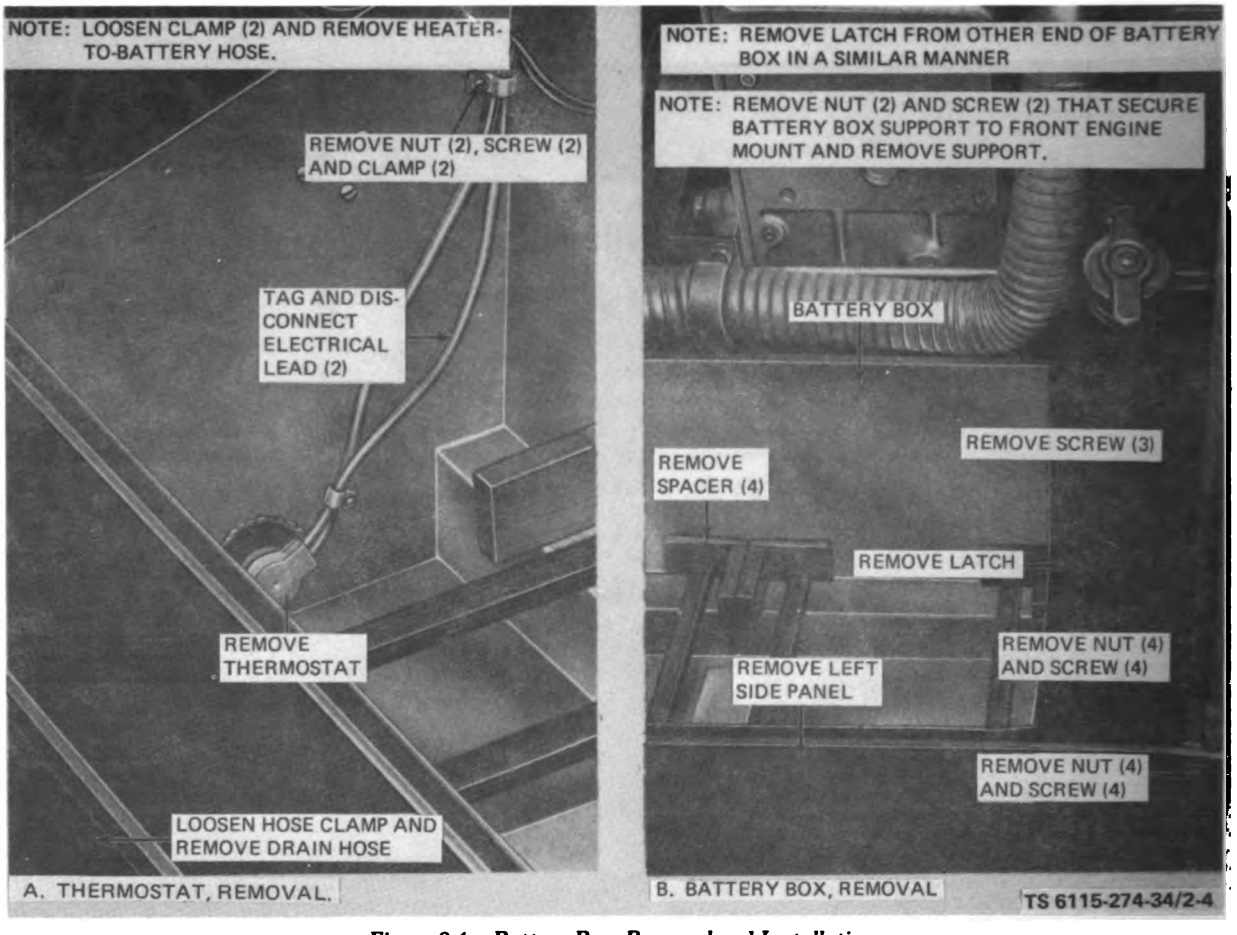



*Figure 2-4. Battery Box, Removal and Installation*

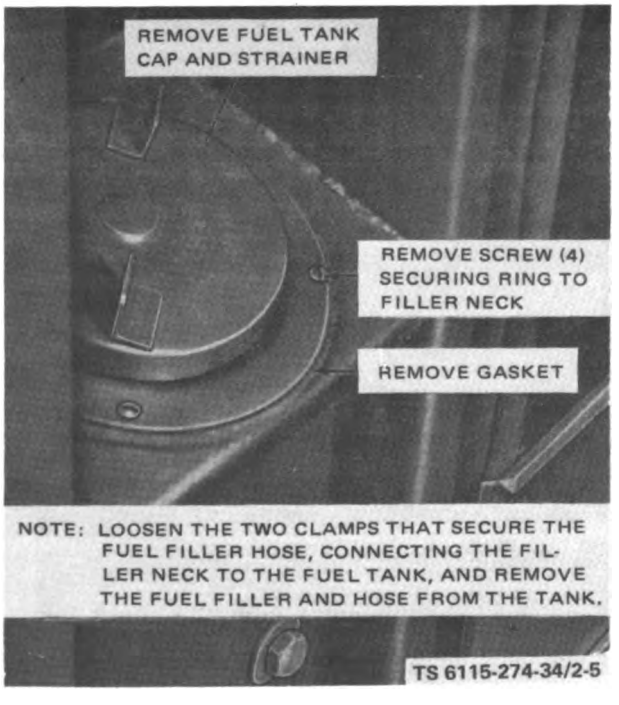



*Figure 2-5. Fuel Tank Cap and Fuel Filler, Removal and Installation*

*(12)* Install generator stator frame cover with screws and nuts.

*(13)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube to engine.

*(14)* Refer to figure 2-4 and install battery box and fasten to frame with nuts and screws.

*(15)* Install battery box support and attach to front engine mount.

*(16)* Attach drain hose and tighten clamp.

*(17)* Install electrical leads to battery box with clamps, nuts and screws.

*(18)* Reconnect electrical leads and install thermostat.

*(19)* Install heater-to-battery hose and tighten clamps.

*(20)* Refer to figure 2-3 and install batteries and fasten holddowns.

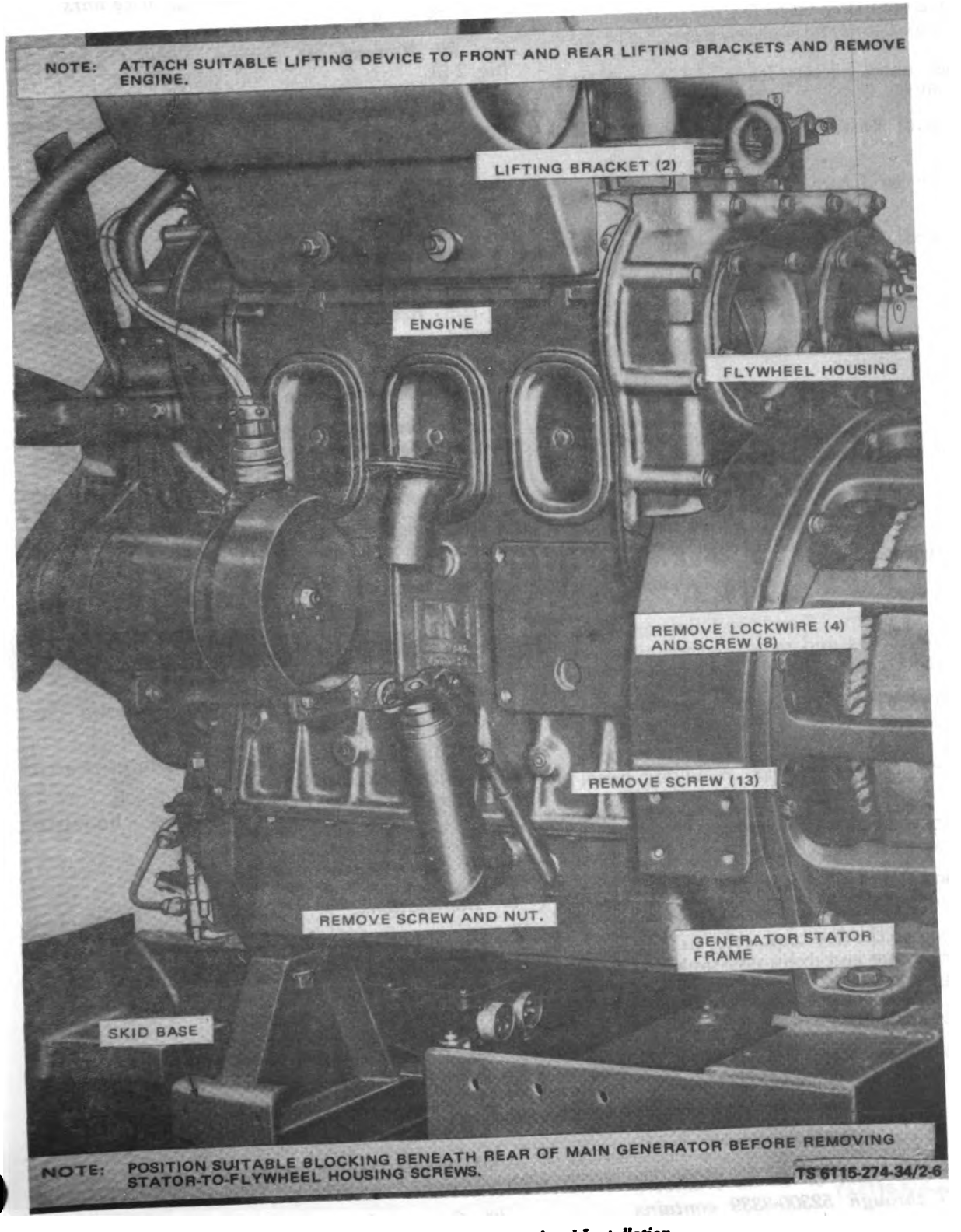



*Figure 2-6. Engine, Removal and Installation*

*NOTE*

*When reconnecting batteries, the positive lead (ground) must be connected last.*

*(21)* Reconnect battery leads and jumper lead and tighten nuts.

*(22)* Install battery box cover and engage latches.

*(23)* Refer to figure 2-2 and install housing and front cowl.

*(24)* Install front cowl (13) with radiator assembly attached and install nuts (49), washers (48), bevel washers (47), washers (44) and bolts (45).

*(25)* Connect all hoses at radiator and tighten clamps. Service radiator.

*(26)* Install side panels (28, 29).

*(27)* Attach fuel control panel (22), canvas boot (23), side panel (24) and connector nut (25).

*(28)* Install doors (3, 4, 19, 26) and hoods (5, 6) with screws (1), washers (2, 17) and nuts (12).

**2-8. Main Generator.**

*a. Removal.*

*(1)* Refer to figure 2-7 and the following steps to remove hood, doors and panels enclosing main generator compartment.

*(2)* Remove screws (1, fig. 2-7), washers (2), washers (16) and nuts (5) and remove hood (4), doors (3, 14) and panels (12, 15). Remove canvas boot (11) and connector nut (13) when removing panel (12).

*(3)* Remove screws (1), washers (2, 16) and nuts (5) and remove stowage rack (7).

*(4)* Remove bolts (6), washers (9) and nuts (10) and remove toolbox (8).

*(5)* To remove the day tank, refer to figure 2-8 and remove drainplug and drain day tank fuel into suitable container.

*(6)* Remove fuel lines from day tank.

*(7)* Remove screws and nuts holding tank to structure and remove day tank.

*NOTE*

*The fuel day tank or Serial Numbers 52300-593 through 52300-3339 contains two float valves and a microswitch and is mounted horizontally rather than vertically as in figure 2-8. This day tank is removed by disconnecting six lines, two electrical leads, and removing three nuts and screws.*

*(8)* Remove air cleaner, bracket and hose (fig. 2-9).

*(9)* Loosen clamps and remove air hose from top of air cleaner.

*(10)* Remove nuts and screws and remove straps.

*(11)* Remove air cleaner.

*(12)* Remove nuts and screws and remove saddle brackets.

*(13)* Remove screws and remove air cleaner bracket.

*(14)* Refer to figure 2-10 and the following steps to remove the main generator.

*(15)* Remove screws and nuts and remove fuel line. Remove primer cable.

*(16)* Remove screws and nuts and remove stator frame cover.

*(17)* Tag and disconnect electrical leads as necessary.

*(18)* Remove lockwire and screws holding stator frame to coupling plates.

*(19)* Position jacking bolts to support rear of engine.

*(20)* Remove screws and nuts securing the generator to frame base.

*(21)* Install two lifting eyes in main generator and attach suitable lifting device.

*(22)* Remove stator-to-flywheel housing screws.

*(23)* Remove generator.

*b. Installation.*

*(1)* Using suitable lifting device install generator in place behind engine (refer to fig. 2-10).

*(2)* Install screws connecting stator to flywheel housing.

*(3)* Attach generator to frame base with screws.

*(4)* Remove lifting eyes from generator and loosen jacking bolts from under rear of engine.

*(5)* Attach stator frame to coupling plates with screws and lockwire.

*(6)* Connect electrical leads.

*(7)* Attach stator frame cover.

*(8)* Attach primer cable and fuel line.

1. Screw, cap, hex hd
2. Washer, flat
3. Generator door, lh
4. Generator hood
5. Nut, hex
6. Bolt, machine
7. Stowage rack
8. Toolbox
9. Washer, lock
10. Nut, hex
11. Canvas boot
12. Right rear side panel
13. Connector nut (spec)
14. Generator door, rh
15. Left rear side panel
16. Washer, lock

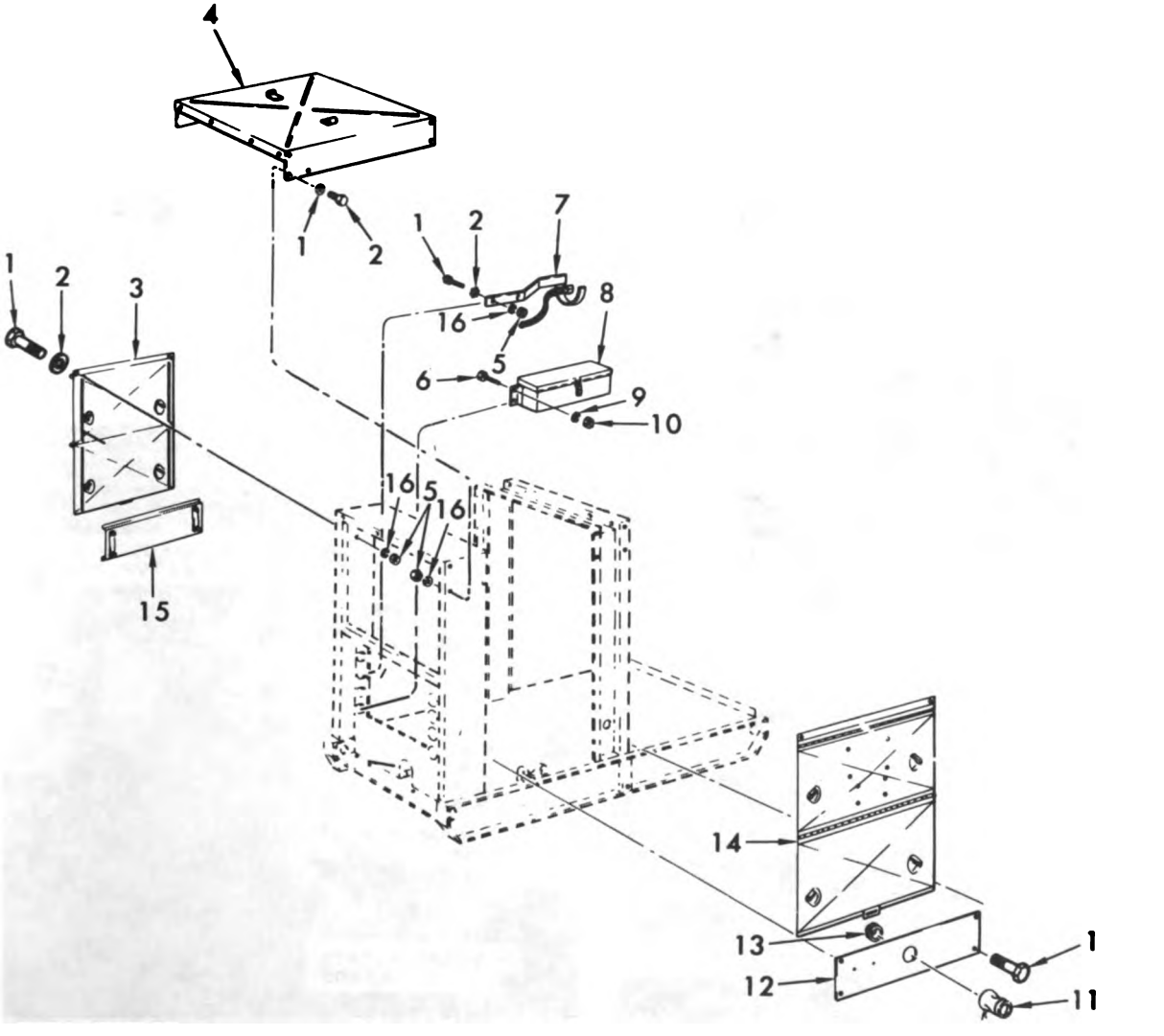



*Figure 2-7. Generator Hood, Doors and Panels, Removal and*

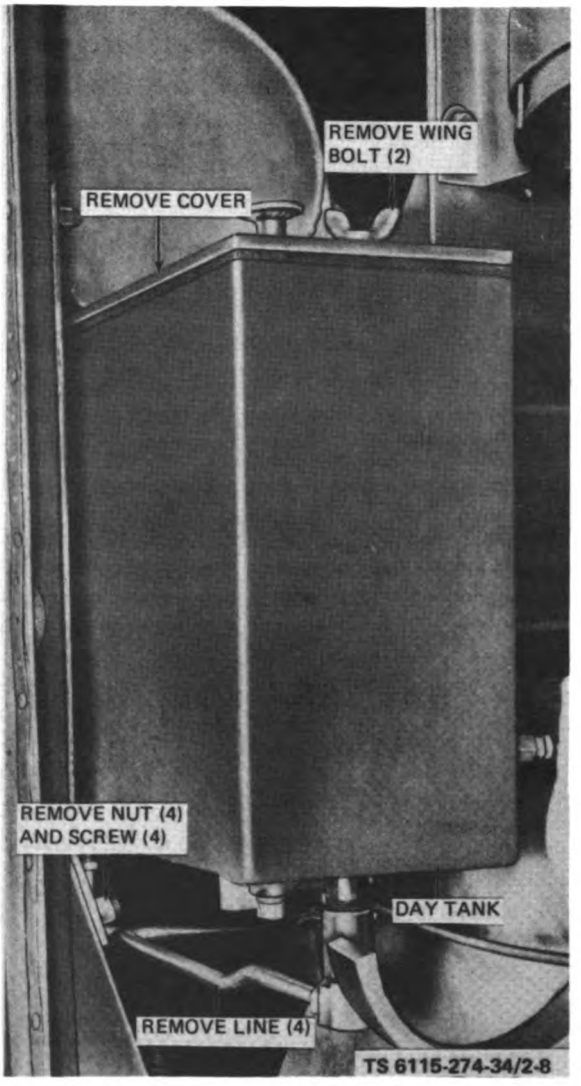



*Figure 2-8. Day Tank, Removal and Installation*

*(9)* Refer to figure 2-9 and install air cleaner bracket and saddle brackets and tighten screws.

*(10)* Install air cleaner and straps and tighten screws.

*(11)* Attach air hose to top of air cleaner and tighten clamps.

*(12)* Refer to figure 2-8 and attach day tank to structure and tighten screws.

*(13)* Attach fuel lines to day tank.

*(14)* Replace drainplug in tank.

*(15)* Refer to figure 2-7 and install toolbox (8) with bolts (6), washers (9) and nuts (10).

*(16)* Install stowage rack (7) with screws (1), washers (2, 16) and nuts (5).

*(17)* Install canvas boot (11) and connector nut (13) in panel (12). Install panels (12, 15), doors (3, 14) and hood (4) with screws (1), washers (2, 16) and nuts (5).

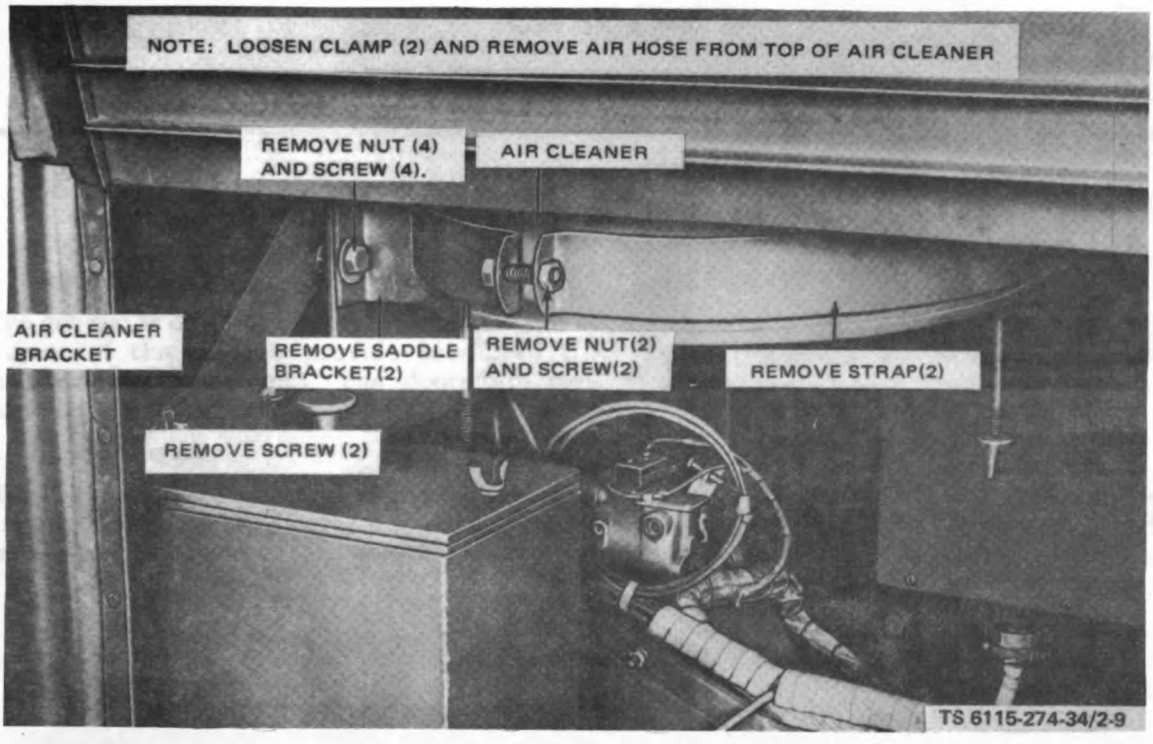



*Figure 2-9. Air Cleaner, Bracket, and Hose, Removal and Installation*

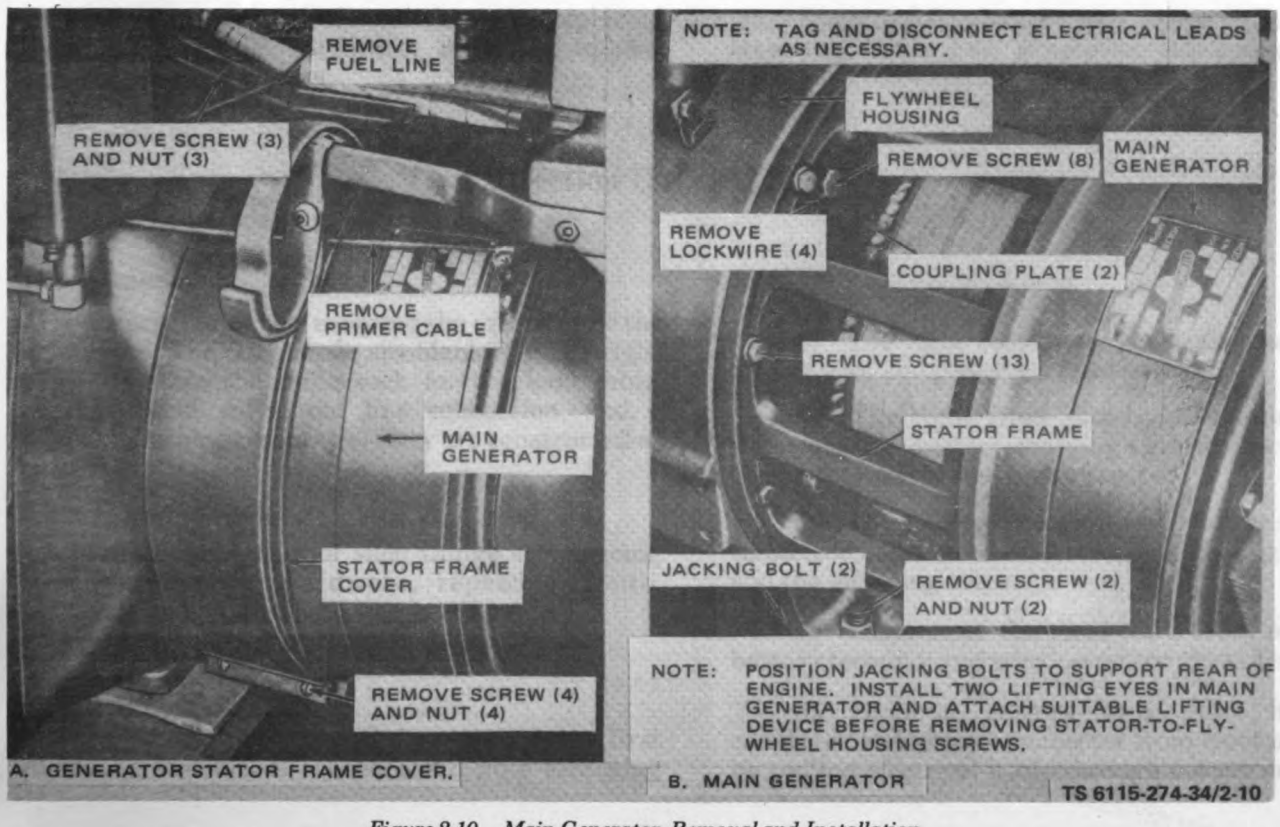



*Figure 2-10. Main Generator, Removal and Installation*

# CHAPTER 3
# REPAIR OF HOUSING GROUP

## Section I. DOORS

**3-1. General.**

The generator unit has doors at both sides and at the rear of the unit to provide access to the generator set components. The doors are constructed of sheet metal.

**3-2. Type of Repair.**

Repairs may consist of such things as replacing loose or missing hardware, repairing dents, scratches and repainting.

**3-3. Doors.**

*a. Removal.* A damaged door is removed by first removing the screws, washers and nuts attaching it to the generator set frame.

*b. Repair.* Repair damaged parts as necessay.

*c. Installation.* Install the repaired door by attaching it to the generator set frame with screws, washers and nuts.

## Section II. COVERS

**3-4. General.**

The top of the generator set is enclosed by two sheet metal covers or hoods.

**3-5. Type of Repair.**

Repairs may consist of such things as replacing loose or missing hardware, repairing dents, scratches and repainting.

**3-6. Covers.**

*a. Removal.* A damaged hood is removed by first removing the screws, washers and nuts attaching it to the generator set frame.

*b. Repair.* Repair damaged parts as necessary.

*c. Installation.* Install the repaired hood by attaching it to the generator set frame with screws, washers and nuts.

## Section III. PANELS

**3-7. General.**

There are four panels covering the areas below the side doors. The left panels are blank and the right panels contain the cable sock for the load cable, auxiliary fuel valve and line connection, and a battery charging receptacle. They are constructed of sheet metal.

**3-8. Type of Repair.**

Repairs may consist of such things as replacing loose or missing hardware, repairing dents, scratches and repaimting.

**3-9. Panels.**

*a. Removal.*

*(1)* A damaged panel is removed by first removing the screws, washers and nuts attaching it to the generator set frame.

*(2)* The right rear panel must also have the canvas boot and connector nut removed.

*(3)* The right front panel also requires the removal of the battery-charging electrical receptacle connector and the fuel control valve.

*(4)* The battery-charging electrical receptacle connector is removed in accordance with figure 3-1 and the following steps.

*(5)* Disconnect electrical leads from solenoid battery terminal and starting motor ground stud.

*(6)* Remove screws and nuts holding connector and remove connector from front of panel by pulling electrical leads through cutout in panel.

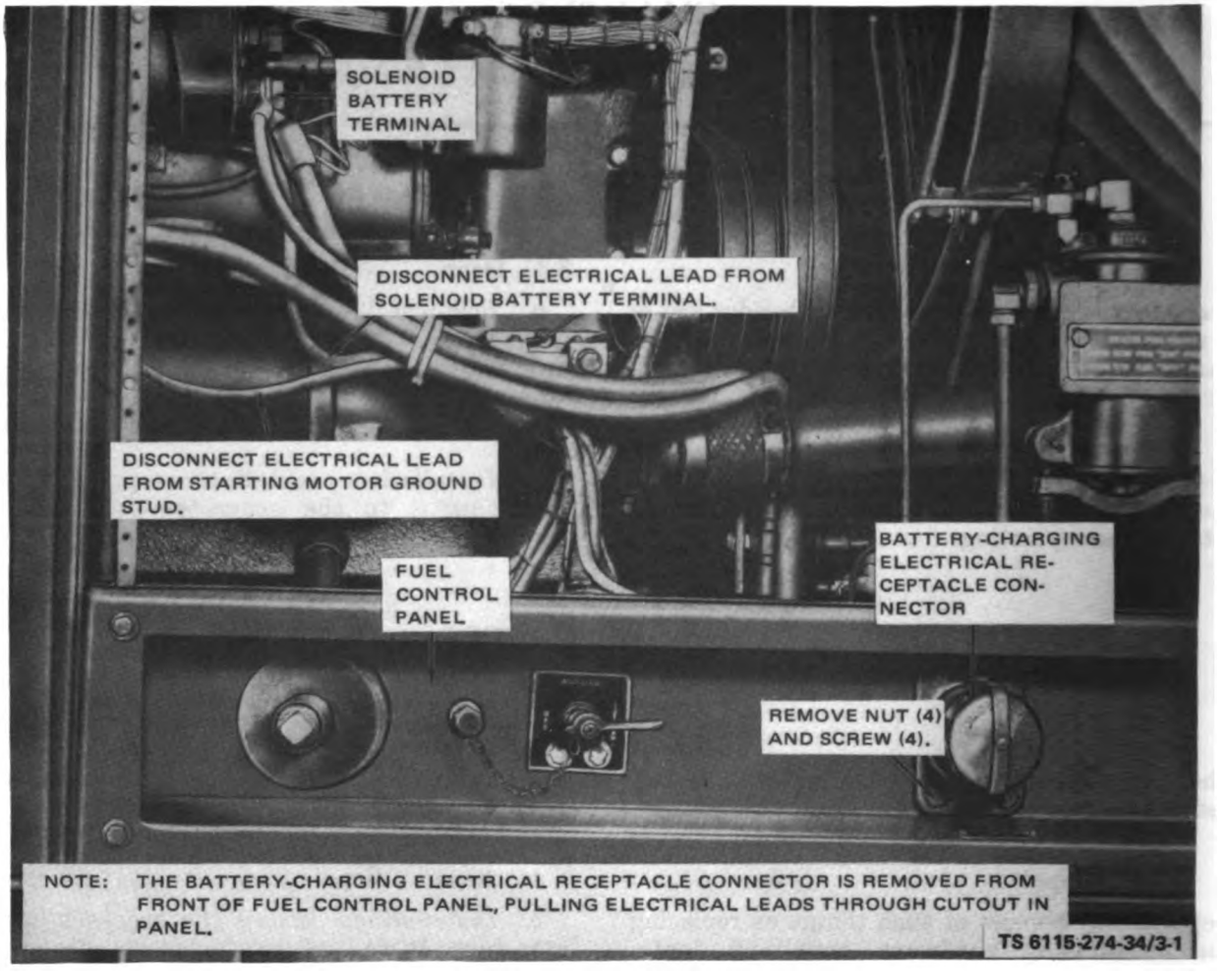



*Figure 3-1. Battery-Charging Electrical Connector, Removal and Installation Receptacle*

*(7)* The fuel control valve is removed in accordance with figure 3-2 and the following steps.

*(8)* Remove all necessary lines and fittings.

*(9)* Remove plug and chain.

*(10)* Remove screw and handle.

*(11)* Remove screws securing instruction plate and remove plate.

*b. Repair.* Repair damaged panels as necessary.

*c. Installation.*

*(1)* Refer to figure 3-2 and attach instruction plate with screws to fuel control panel.

*(2)* Install handle with screw.

*(3)* Install plug and chain.

*(4)* Connect lines and fittings.

*(5)* Refer to figure 3-1 and install connector by feeding electrical leads through cutout in panel and attach with screws and nuts.

*(6)* Connect electrical leads to solenoid battery terminal and starting motor ground stud.

*(7)* When installing the right rear panel the connector nut and canvas boot are installed on the load connector.

*(8)* Panels are attached to frames with screws, washers and nuts.

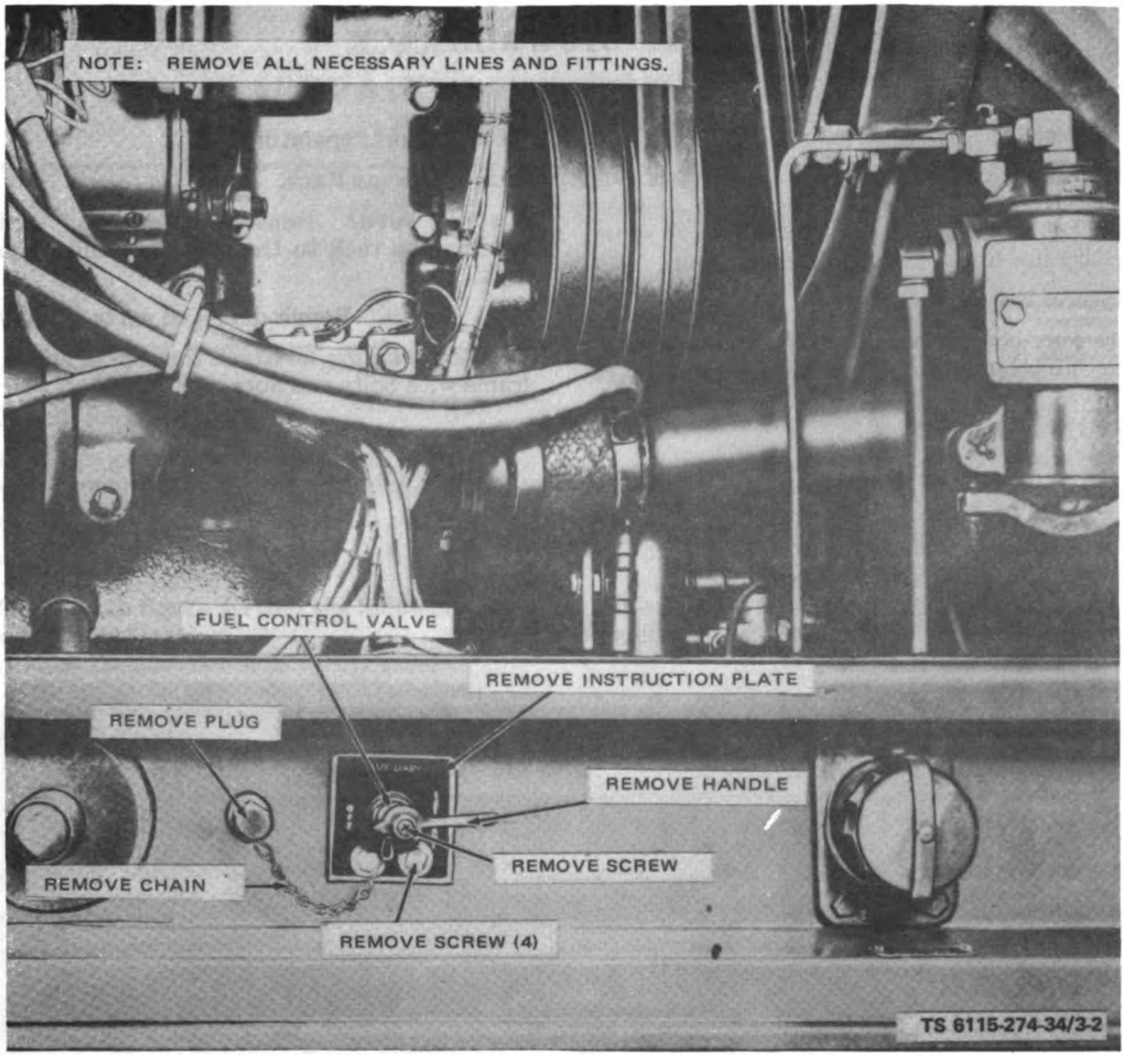



*Figure 3-2. Fuel Control Valve, Removal and Installation*

## Section IV. TOOLBOX

**3-10. General.**

A sheet metal toolbox is located at the left rear of the unit.

**3-11. Type of Repair.**

Repairs may consist of such things as replacing loose or missing hardware, repairing dents, scratches and repainting.

**3-12. Toolbox.**

*a. Removal.*

*(1)* The toolbox is bolted to the frame with four bolts and nuts.

*(2)* Remove the fasteners and lift the box from the unit.

*b. Repair.* Repair damaged parts as necessary.

*c. Installation.* Place toolbox in position and install bolts and nuts.

## Section V. STOWAGE RACK

### 3-13. General.

The stowage rack is located on the left side of the unit above the toolbox. It consists of a sheet metal bracket and a web strap and is used to stow the auxiliary fuel line and the paralleling cable.

### 3-14. Type of Repair.

Repairs may consist of such things as replacing loose or missing hardware, repairing dents, scratches and repainting.

### 3-15. Stowage Rack.

*a. Removal.* Remove two bolts and nuts holding the rack to the structure and remove the rack.

*b. Repair.* Repair damaged parts as necessary.

*c. Installation.* Attach the stowage rack to the frame with bolts and nuts.

# CHAPTER 4

# REPAIR OF DIESEL FUEL AND PRIMING SYSTEM

## Section I. FUEL STRAINER

**4-1. General.**

The fuel strainer traps any sediment which may be in the fuel.

**4-2. Type of Repair.**

Repair may involve replacing loose or missing hardware or repairing dents and scratches.

**4-3. Fuel Strainer.**

*a. Removal.*

*(1)* Refer to figure 4-1 and the following steps to remove the fuel strainer.

*(2)* Disconnect fuel lines.

*(3)* Remove heater fuel valve.

*(4)* Remove screws and nuts and remove instruction plate and fuel strainer.

*(5)* Remove screws and nuts and remove bracket.

*b. Disassembly.*

*(1)* Remove wingnut (9, fig. 4-2) and washer (8) and swing clamp (12) aside and remove cover (11), gasket (10) and screen (13). Remove cotter pin (14).

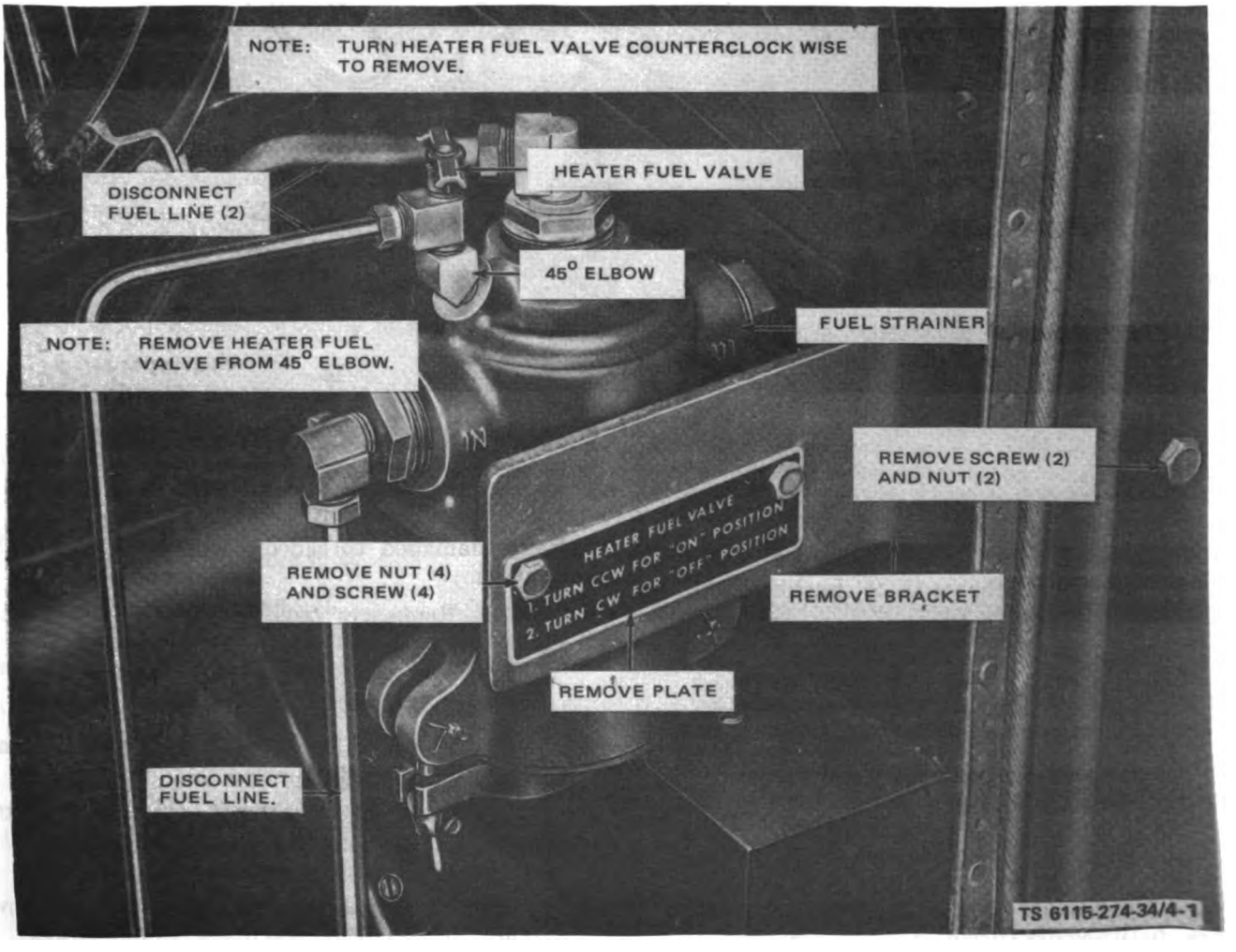



*Figure 4-1. Fuel Strainer, Removal and Installation*

1. Elbow, pipe-to-tube
2. Elbow, pipe-to-tube, 45 degrees
3. Plug, pipe
4. Pin
5. Draincock
6. Eyebolt, threaded
7. Pin, cotter
8. Washer, flat
9. Wingnut, plain
10. Fuel strainer cover gasket
11. Fuel strainer cover
12. Fuel strainer clamp
13. Sediment strainer screen
14. Pin, cotter
15. Nut, hex, castellated
16. Eyebolt, threaded
17. Bushing, pipe
18. Fuel strainer body
19. Bushing, reducing

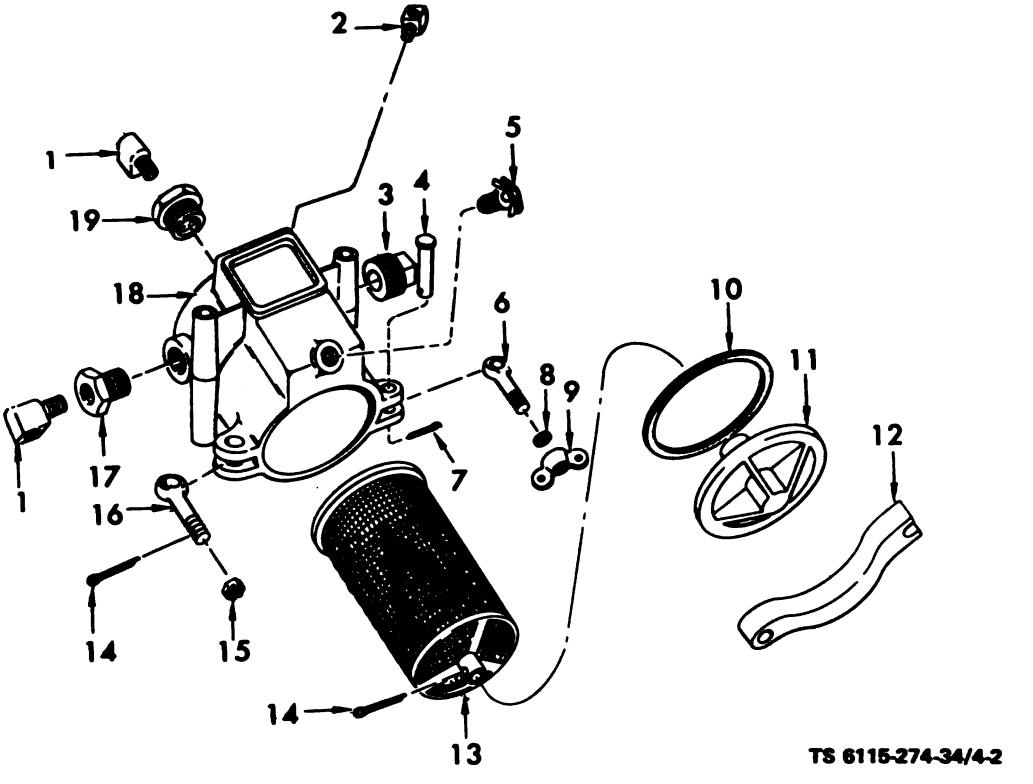



*Figure 4-2. Fuel Strainer, Disassembly and Reassembly*

*(2)* Remove cotter pin (14), nut (15), clamp (12), cotter pins (7), pins (4) and eyebolts (6, 16).

*(3)* Remove elbows (1, 2), bushings (17, 19), plug (3) and draincock (5).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect all parts for cracks, breaks, leaks, damaged threaded parts, wear, and other damage.

*(3)* Replace or repair a damaged or defective part.

*d. Assembly.*

*(1)* Install elbows (1, 2, fig. 4-2), bushings (17, 19), plug (3) and draincock (5).

*(2)* Assemble eyebolts (6, 16), pins (4), cotter pins (7), nut (15), clamp (12) and cotter pin (14) to fuel strainer body (18).

*(3)* Assemble screen (13), gasket (10), cover (11) and cotter pin (14) and install in fuel strainer.

*(4)* Swing clamp (12) into place under cover (11) and install washer (8) and wingnut (9) and tighten.

*e. Installation.*

*(1)* Refer to figure 4-1 and attach bracket to frame with screws and nuts.

*(2)* Install instruction plate and fuel strainer to bracket with screws and nuts.

*(3)* Install heater fuel valve.

*(4)* Connect fuel lines.

## Section II. FUEL FILTER

**4-4. General.**

The fuel filter removes impurities from the line between the fuel pump and the fuel intake line, which supplies the injectors.

**4-5. Type of Repair.**

Repair may involve replacement of loose or missing hardware or repair of dents and scratches.

**4-6. Fuel Filter.**

*a. Removal.*

*(1)* Refer to figure 4-3 and the following steps to remove the fuel filter.

*(2)* Tag and disconnect electrical leads to the fuel oil pressure switch and turn it counterclockwise to remove. The pressure switch is removed to allow working space for removal of the fuel filter.

*(3)* Open fuel filter draincock and drain fuel sediment into suitable container and discard.

*(4)* Disconnect fuel lines from fuel filter.

*(5)* Remove screws securing filter and remove filter.

*b. Disassembly.*

*(1)* Remove screw (1, fig. 4-4), washers (2 and 3), packing (4) and filter shell (5).

*(2)* Disassemble seal (6), element (7), seal (8), retaining ring (9), retainer (10), seat (11), spring seal (12), and spring (13) from filter shell.

*(3) Remove draincock (14).*

*(4)* Remove elbows (15, 16, 17), bushing (18) from filter shell cover (19).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-Dp680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

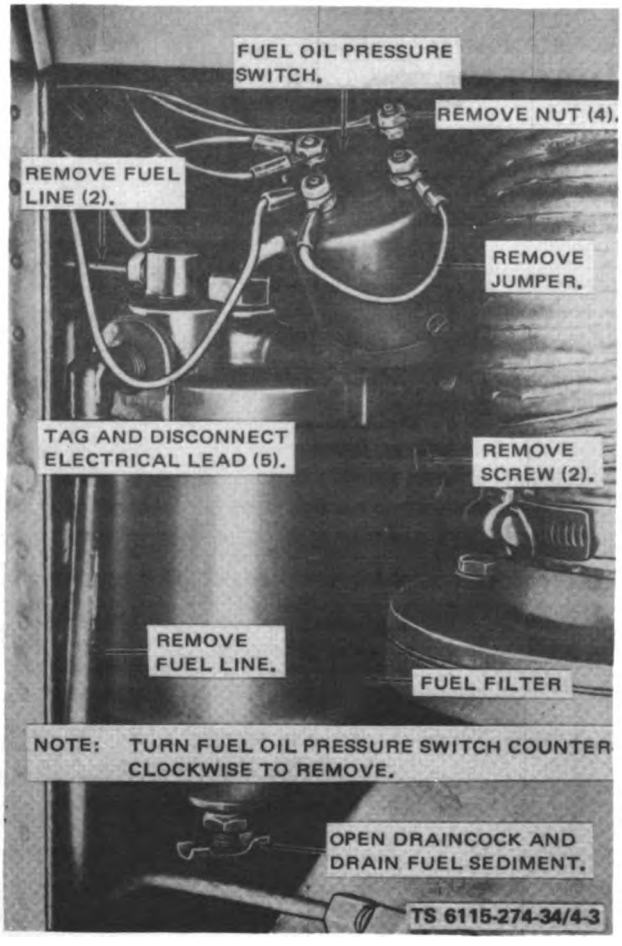



*Figure 4-3. Fuel Filter and Fuel Oil Pressure Switch, Removal and Installation*

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect for cracks, breaks, wear, leaks, and other damage.

*(3)* Replace or repair a damaged or defective part.

*(4)* Replace element if unable to get it clean.

1. Screw (spec)
2. Washer (spec)
3. Washer (spec)
4. Preformed packing
5. Filter shell
6. Seal
7. Element
8. Seal
9. Retaining ring
10. Retainer
11. Seat
12. Spring seat
13. Spring
14. Draincock
15. Elbow
16. Elbow
17. Elbow
18. Bushing
19. Filter shell cover

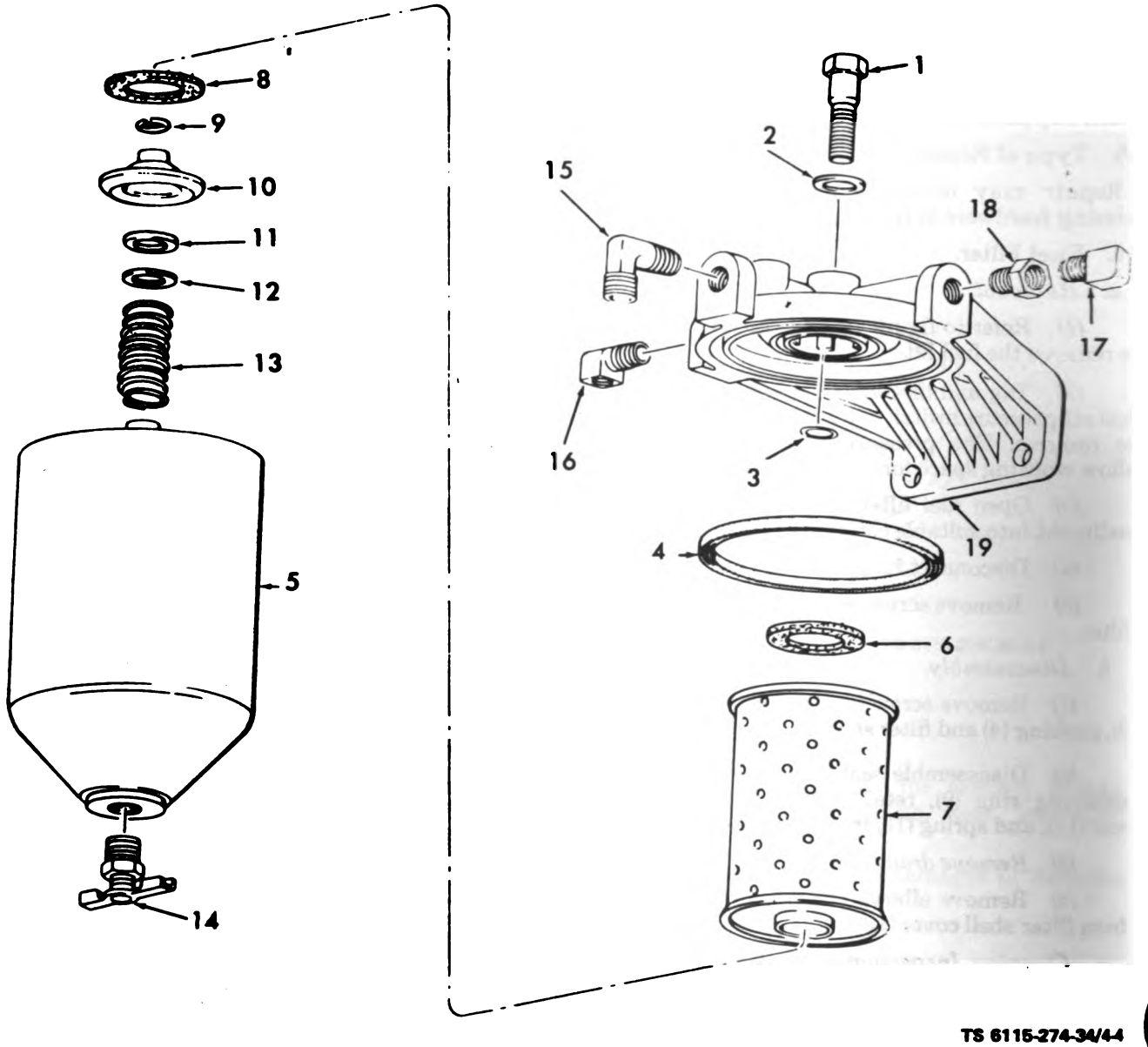



*Figure 4-4. Fuel Filter, Disassembly and Assembly*

*d. Assembly.*

*(1)* Install elbows (15, 16, 17, fig. 4-4) and bushing (18) onto filter shell cover (19).

*(2)* Install draincock (14).

*(3)* Assemble spring (13), spring seat (12), set (11), retainer (10), retaining ring (9), seal (8), element (7) and seal (6) into filter shell (5).

*(4)* Attach filter shell (5) to filter shell cover (19) with packing (4), washer (3), washer (2) and screw (1).

*e. Installation.*

*(1)* Refer to figure 4-3 and install filter with screws.

*(2)* Connect fuel lines to fuel filter.

*(3)* Install fuel oil pressure switch on the fuel filter turning clockwise to tighten.

*(4)* Connect electrical leads to the fuel oil pressure switch.

## Section III. FUEL INJECTORS

### 4-7. General.

The fuel injectors are located on top of the cylinder head and introduce fuel into the cylinders, which are ignited by compression of the pistons.

### 4-8. Type of Repair.

Repair may involve replacing loose or missing parts, dents and scratches.

### 4-9. Fuel Injectors.

*a. Removal.*

*(1)* Remove mounting hardware necessary to remove the engine hood and engine doors.

*(2)* Loosen thumbscrews and remove rocker arm cover.

*(3)* Remove pins and detach control tube arm from control rod.

*(4)* Remove four screws and remove fuel injector control tube (fig. 4-5).

*(5)* Loosen four nuts and remove fuel injector tubes (fig. 4-6, View A).

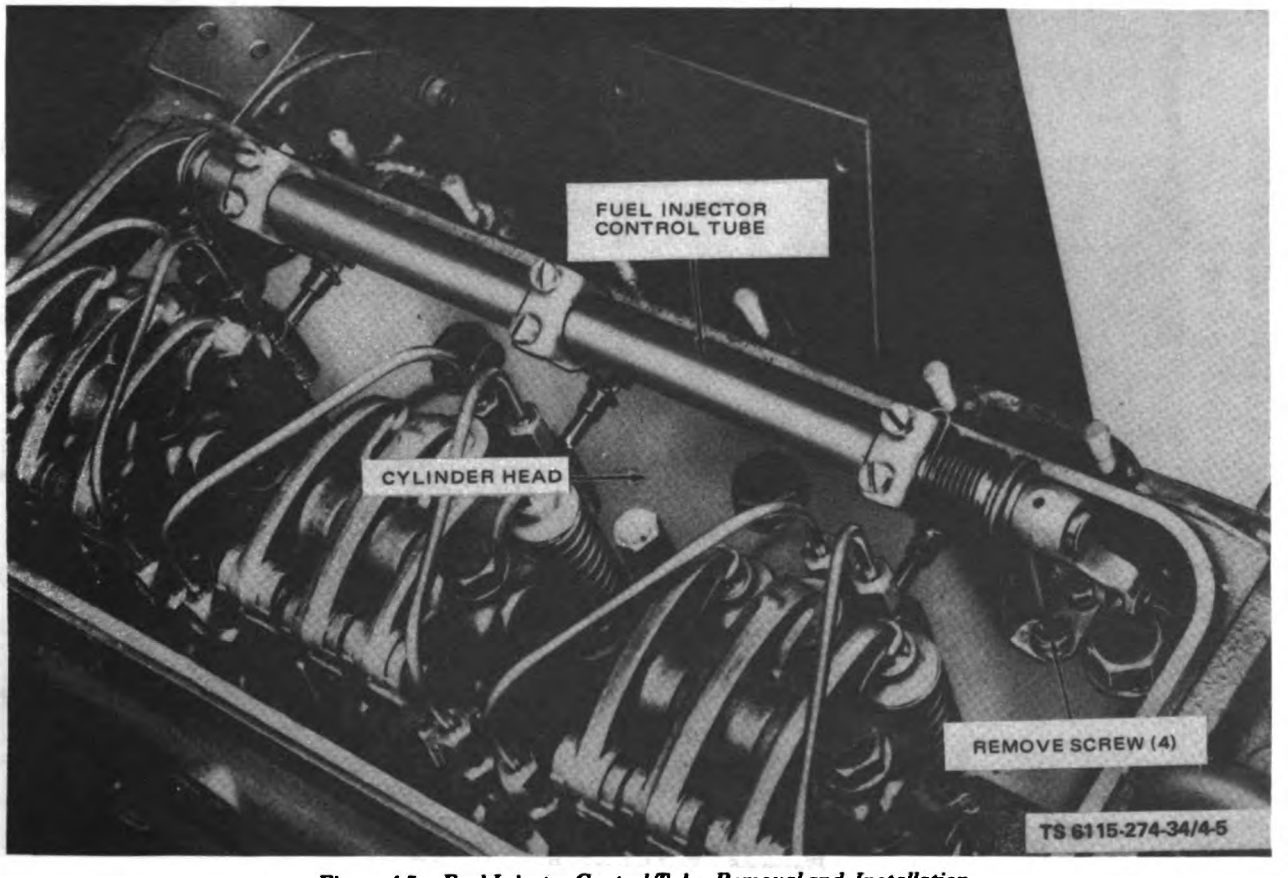



*Figure 4-5. Fuel Injector Control Tube, Removal and Installation*

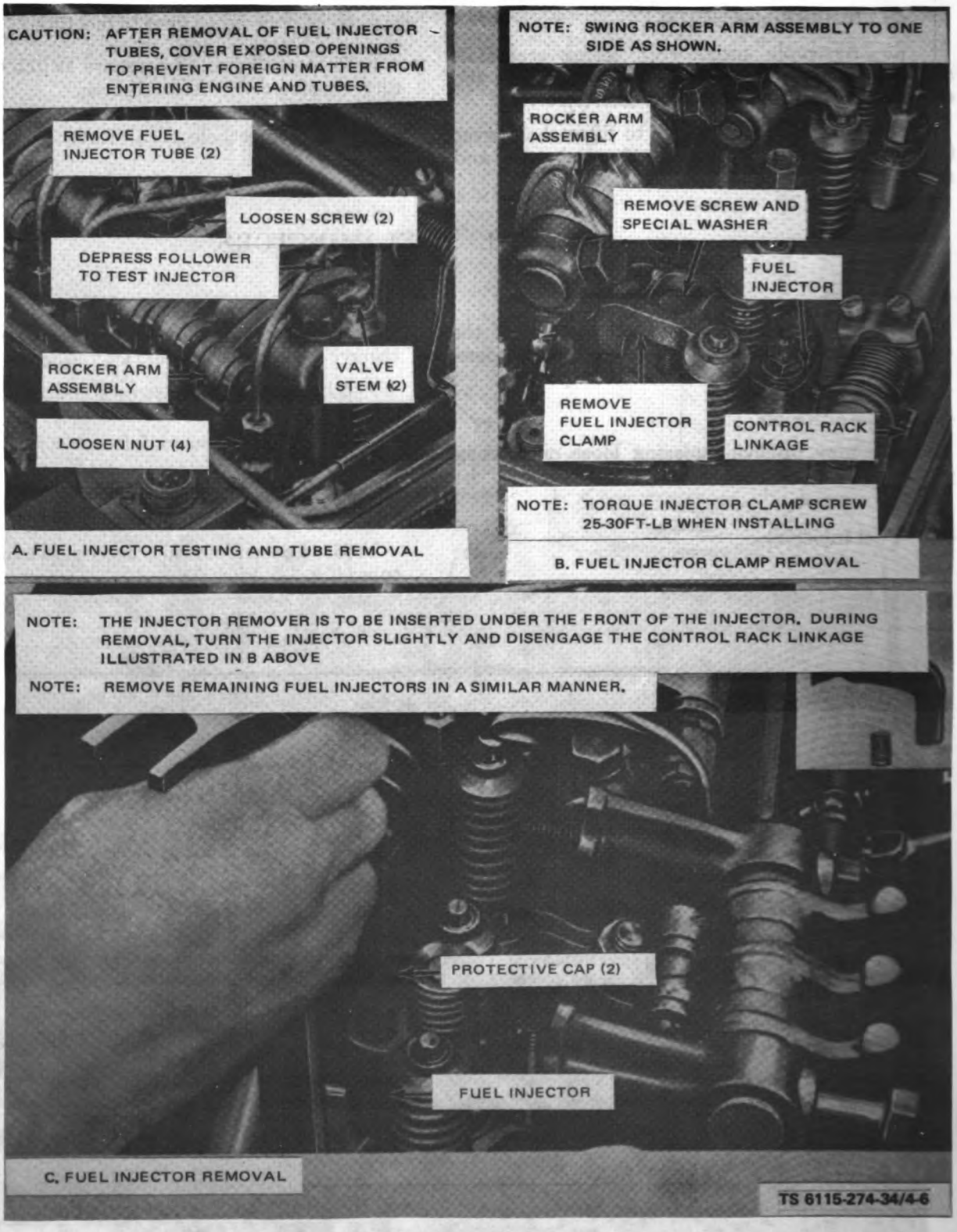



*Figure 4-6. Fuel Injector, Removal and Installation*

*(6)* Remove screw and special washer and remove fuel injector clamp (fig. 4-6, View B).

*(7)* Using the injector remover (fig. 4-7), remove the fuel injector (fig. 4-6, View C).

*b. Disassembly.*

*(1)* Remove filter caps (2, fig. 4-8), gaskets (3), springs (4) and filter elements (5) from body (7).

*(2)* Remove follower (1), plunger (25), spring (24), and stop pin (23).

*(3)* Remove pin (8) and control rack (6).

*(4)* Disassemble valve nut (13), seal (12), deflector (11), spray tip (16), check valve (17), check valve cage (18), valve stop (19), spring (20), injector valve (21), valve seat spacer (22), bushing (15), pin (14), gear retainer (10), and spur gear (9).

*(5)* Remove pin (7, fig. 4-9), arm (6), brackets (1), spring (8), and shoulder pin (2).

*(6)* Loosen screws (4) and remove control levers

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Discard the filter element. Wash all injector parts in cleaning solvent (Item 4, App. B) and dry thoroughly with moisture-proof compressed air.

*(2)* Inspect the injector body for nicks, burrs, cracks, breaks, and other damage.

*(3)* Inspect the spray tip, disk, injector valve cage, spray tip valve, injector valve seat, plunger bushing, and bushing surface with a magnifying glass for scoring and other damage. These parts have a lapped finish. Damaged parts must be replaced with new parts.

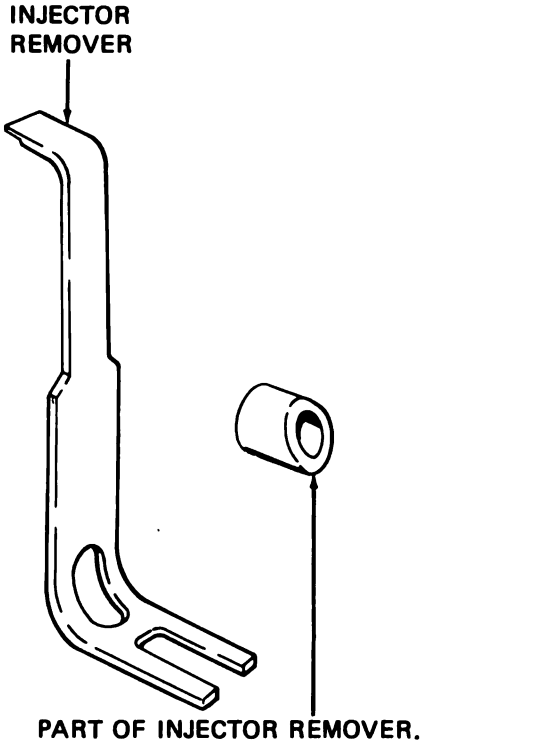



*Figure 4-7. Injector Remover Tool*

*(4)* Inspect the teeth on the control rack and spur gear for excessive wear and damage. Replace the gear and rack if damaged or defective.

*(5)* Remove all carbon deposits, paying particular attention to the spray tip seat of the injector retaining nut.

*(6)* Clean the spray tip orifices, plunger bushing, and rack opening in the injector body with a suitable tool.

1. Follower
2. Filter cap
3. Gasket
4. Spring
5. Filter element
6. Control rack
7. Body
8. Straight pin (spec)
9. Spur gear
10. Gear retainer
11. Deflector
12. Seal
13. Valve nut
14. Straight pin (spec)
15. Bushing
16. Spray tip
17. Check valve
18. Check valve cage
19. Valve stop
20. Spring
21. Injector valve
22. Valve seat spacer
23. Stop pin
24. Spring
25. Plunger

*Figure 4-8. Fuel Injector, Disassembly and Reassembly*

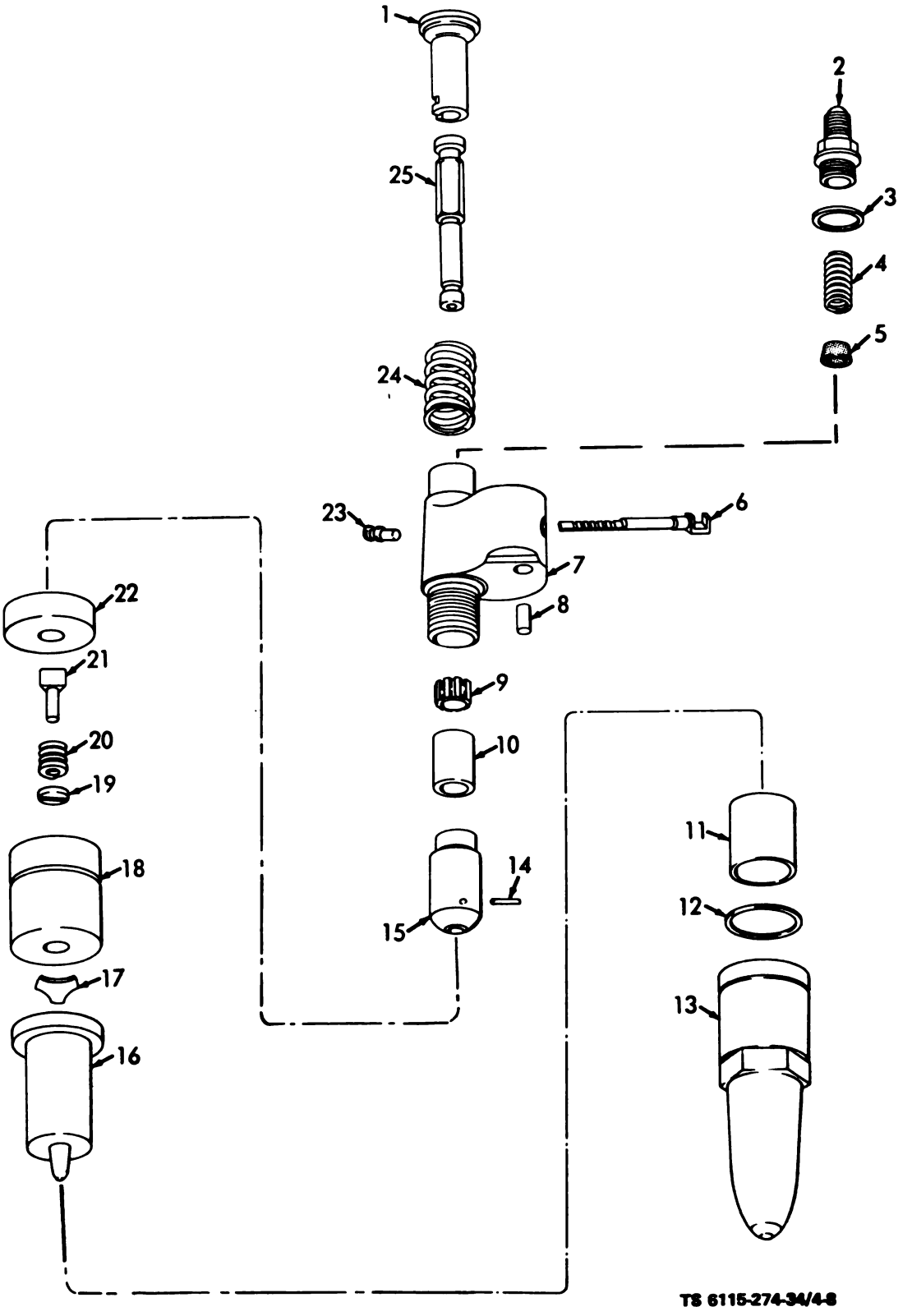
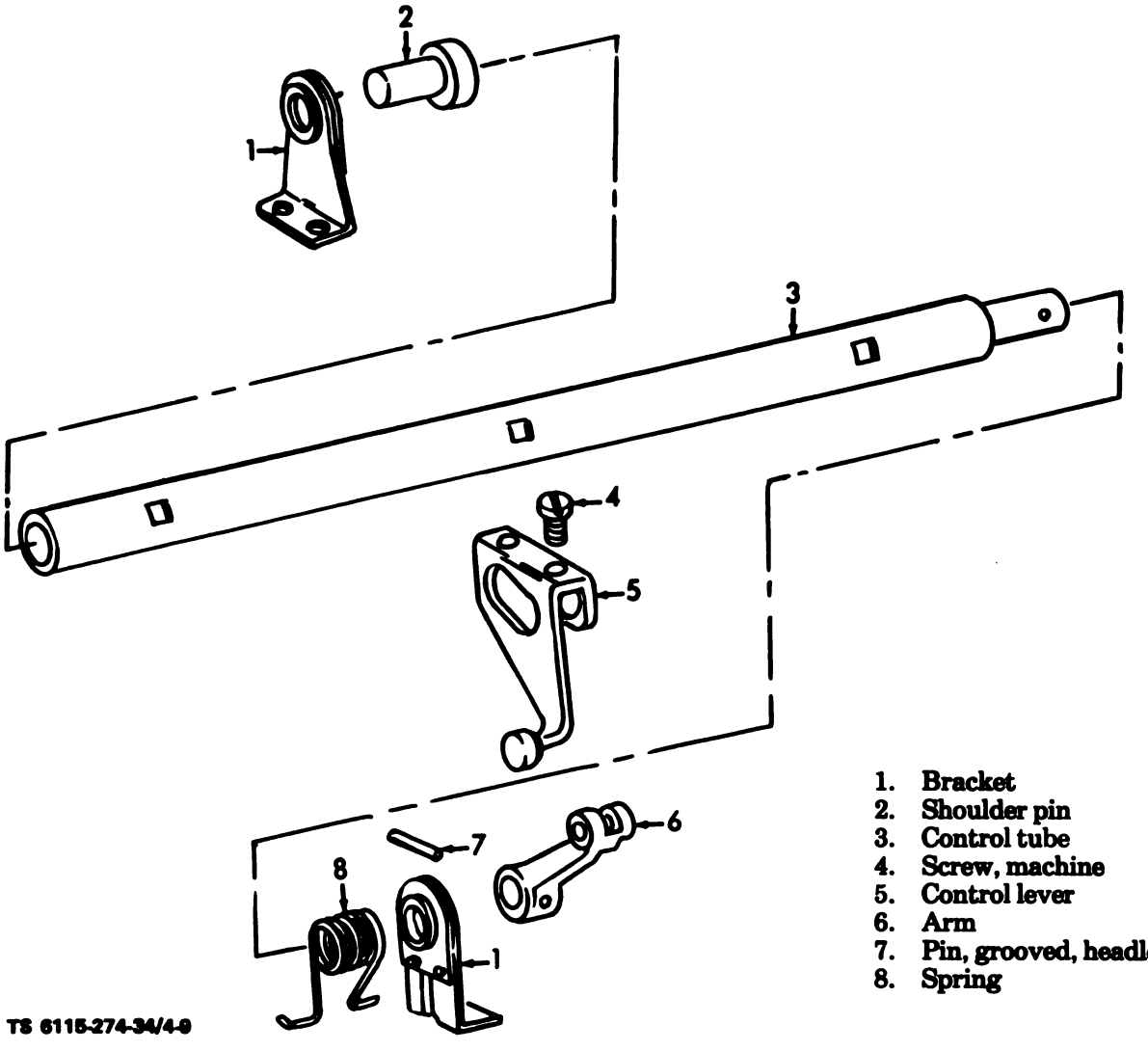



*Figure 4-8. Fuel Injector, Disassembly and Reassembly (cont)*




1. Bracket
2. Shoulder pin
3. Control tube
4. Screw, machine
5. Control lever
6. Arm
7. Pin, grooved, headless
8. Spring

*Figure 4-9. Fuel Injector Control Tube, Disassembly and Reassembly*

*(7)* Inspect the plunger and plunger bushing. Place the plunger bushing on the plunger and revolve. Since they are matched parts, the bushing should revolve freely on the plunger. Replace them as a matched set.

*(8)* Replace all other damaged or defective parts.

*d. Assembly.*

*(1)* Attach control levers (5, fig. 4-9) to tube (3) with screws (4).

*(2)* Assemble arm (6), brackets (1), spring (8), pin (7) and shoulder pin (2).

*(3)* Assemble valve nut (13, fig. 4-8), seal (12), deflector (11), spray tip (16), check valve (17), check valve cage (18), valve stop (19), spring (20), injector valve (21), valve seat spacer (22), bushing (15), pin (14), gear retainer (10), and spur gear (9).

*(4)* Install control rack (6) and pin (8).

*(5)* Install spring (24), plunger (25), follower (1), and stop pin (23).

*(6)* Install filter elements (5), springs (4), gasket (3), and filter caps (2).

*e. Testing.*

*(1)* Spray tip runout. Position the injector in a fixture suitable for measuring spray tip runout. The runout should not exceed 0.008 inch (0.020 cm). If runout exceeds 0.009 inch (0.023 cm), loosen the fuel injector retaining nut and center the spray tip. Tighten the nut.

## WARNING

**Do not allow the spray from the fuel injectors to be directed upon any part of the body. The high pressure of the fuel being forced from the injector has sufficient power to penetrate the skin.**

*(2)* Rack freedom. Hold the injector at both ends in a horizontal position, with the plain end of the rack pointing downward. Turn the injector about its longitudinal axis until the rack coupling end points downward. The rack should move through its full travel by its own weight when the injector is turned. If the rack does not fall freely, loosen the fuel retaining nut and turn the spray tip slightly. Tighten the retaining nut and again check for freedom. If the rack still does not move freely, disassemble and inspect the injector.

*(3)* Plunger freedom.

*(a)* Install the injector, with the spring side up, in a suitable holding fixture. Depress the plunger and release it. Observe the plunger on its return stroke for freedom of movement.

*(b)* Perform the test with the control rack in three different positions; full fuel position, no fuel position, and midway between the two positions.

*(c)* If the plunger sticks or binds, disassemble the injector and inspect it.

*(4)* Spray tip orifice.

*(a)* Install the injector in a suitable testing fixture, with the dowel on the injector body, located in the hole in the fixture.

*(b)* Connect a fuel supply line and a fuel return line to the injector.

*(c)* Operate the test fixture and drive all entrapped air from the injector. Place a suitable container at the spray tip to catch the fuel as it comes from the spray tip.

## WARNING

**Do not allow the spray from the injector to be directed upon any part of the body. The high pressure of the fuel being forced from the injector has sufficient power to penetrate the skin.**

*(d)* Operate the test fixture and maintain a fuel pressure of 15 psi (1.0555 kg/sq cm). Pop the injector several times and observe the spray tip orifices. Fuel should be discharged from each orifice and the spray from the orifices should form a uniform pattern.

*(5)* Valve opening pressure.

*(a)* With the injector connected as in (4) (d) above, note the pressure at which the injector discharges fuel. The pressure should range from 350 to 850 psi (24.6 to 59.8 kg/sq cm).

*(b)* If the valve opens at a pressure below 350 psi (24.6 kg/sq cm), either a defective or dirty sealing surface or a defective or worn valve spring is indicated. Disassemble and repair the injector.

*(6)* Holding pressure.

*(a)* With the injector connected as in (4) (d) above, bring the pressure to a point just below valve opening pressure.

*(b)* Close off the pressure from the supply source and observe the amount of time required for the pressure to drop from 350 psi (24.6 kg/sq cm) to 150 psi (10.55 kg/sq cm). This time should not exceed 50 seconds on a new injector and 35 seconds on a used injector.

*(c)* Repair or replace a damaged or defective injector.

*f. Installation.*

*(1)* Install fuel injectors (fig. 4-6, View C) using injector tool (fig. 4-7).

*(2)* Install fuel injector clamps (fig. 4-6, View B) with screws and special washers.

*(3)* Install fuel injector tube (fig. 4-6, View A) and tighten nuts.

*(4)* Install fuel injector control tube (fig. 4-5) and attach with four screws.

*(5)* Attach control tube lever to control rod with pins.

*g. Adjustment.*

*(1)* Following installation of the fuel injectors, adjust the fuel control tube and lever assembly (fig. 4-10).

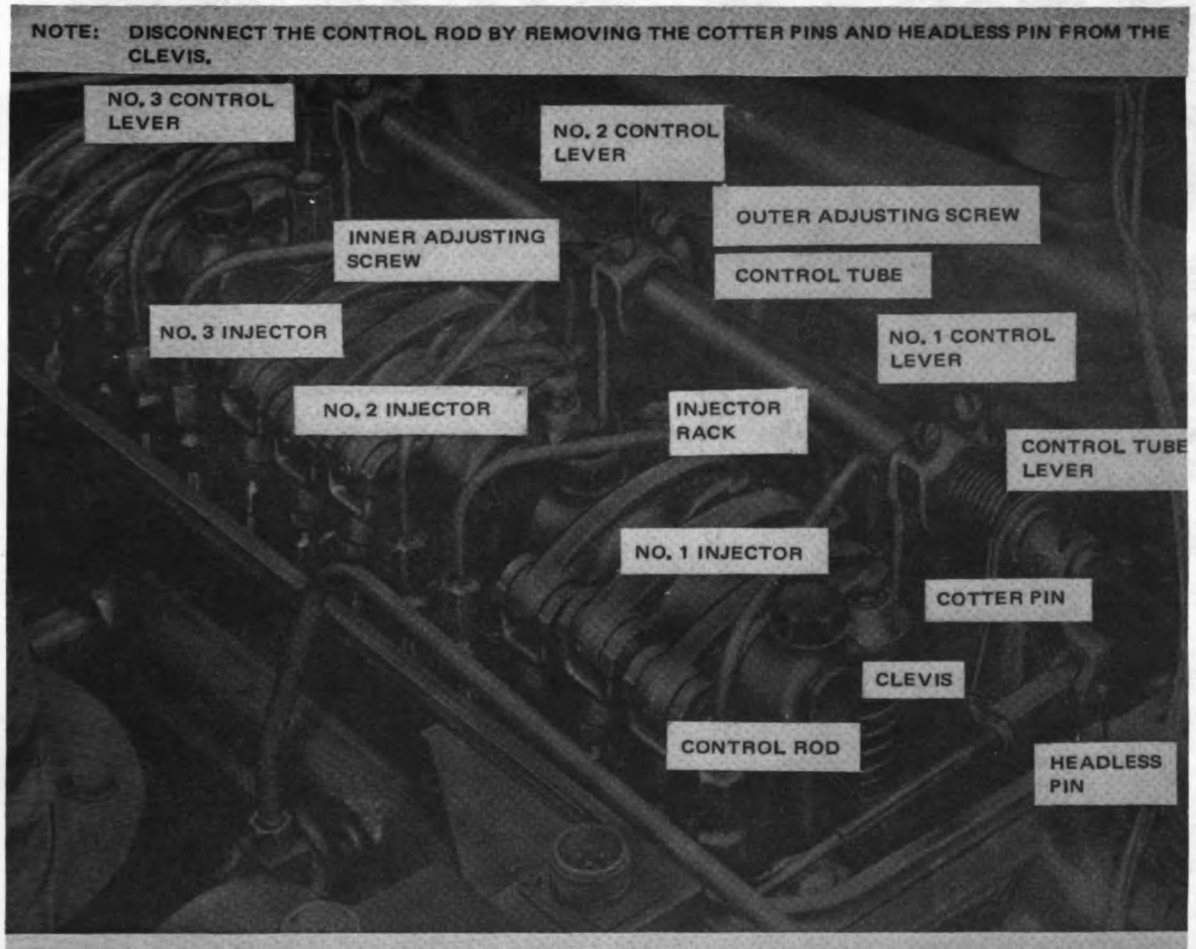
*(2)* The outlined steps on figure 4-10 simplify the adjustment procedure.

*(3)* Following adjustment of the fuel control tube and lever assembly, time the fuel injectors using the injector timing gage (fig. 4-11).

*(4)* The outlined steps on figure 4-12 simplify the timing procedure.

*(5)* Install rocker arm cover and tighten thumbscrews.

*(6)* Install engine hood and doors.




STEP 1. DISCONNECT THE CONTROL ROD FROM THE CONTROL TUBE LEVER.

STEP 2. LOOSEN ALL INNER AND OUTER ADJUSTING SCREWS.

STEP 3. POSITION THE NO. 1 CONTROL LEVER UNTIL BOTH SCREWS ARE THE SAME HEIGHT WHEN TIGHTENED.

STEP 4. MANUALLY HOLD THE NO. 1 INJECTOR IN FULL FUEL POSITION WITH THE CONTROL TUBE LEVER AND THEN TURN DOWN THE INNER ADJUSTING SCREW OF NO. 2 INJECTOR UNTIL THE ADJUSTING SCREW HAS BOTTOMED AGAINST THE CONTROL TUBE. ALTERNATELY TIGHTEN THE INNER AND OUTER ADJUSTING SCREWS EVENLY UNTIL THEY ARE TIGHT.

STEP 5. RECHECK NO. 1 INJECTOR CONTROL RACK TO BE SURE IT HAS REMAINED SNUG ON THE END OF THE NO. 1 CONTROL LEVER WHILE ADJUSTING NO. 2 INJECTOR. IF THE NO. 1 INJECTOR HAS BECOME LOOSE, BACK OFF SLIGHTLY ON THE INNER ADJUSTING SCREW OF NO. 2 INJECTOR CONTROL LEVER. TIGHTEN THE OUTER ADJUSTING SCREW. WHEN SETTINGS ARE CORRECT, THE RACKS OF BOTH INJECTORS MUST BE SNUG ON THE ENDS OF THE CONTROL LEVERS.

STEP 6. POSITION THE NO. 3 CONTROL LEVER AS IN STEPS 4 AND 5 ABOVE.

TS 6115-274-34/4-10

*Figure 4-10. Fuel Control Tube and Lever Assembly Adjustment*

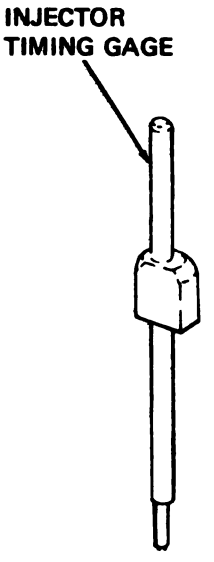



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*Figure 4-11. Injector Timing Gage*

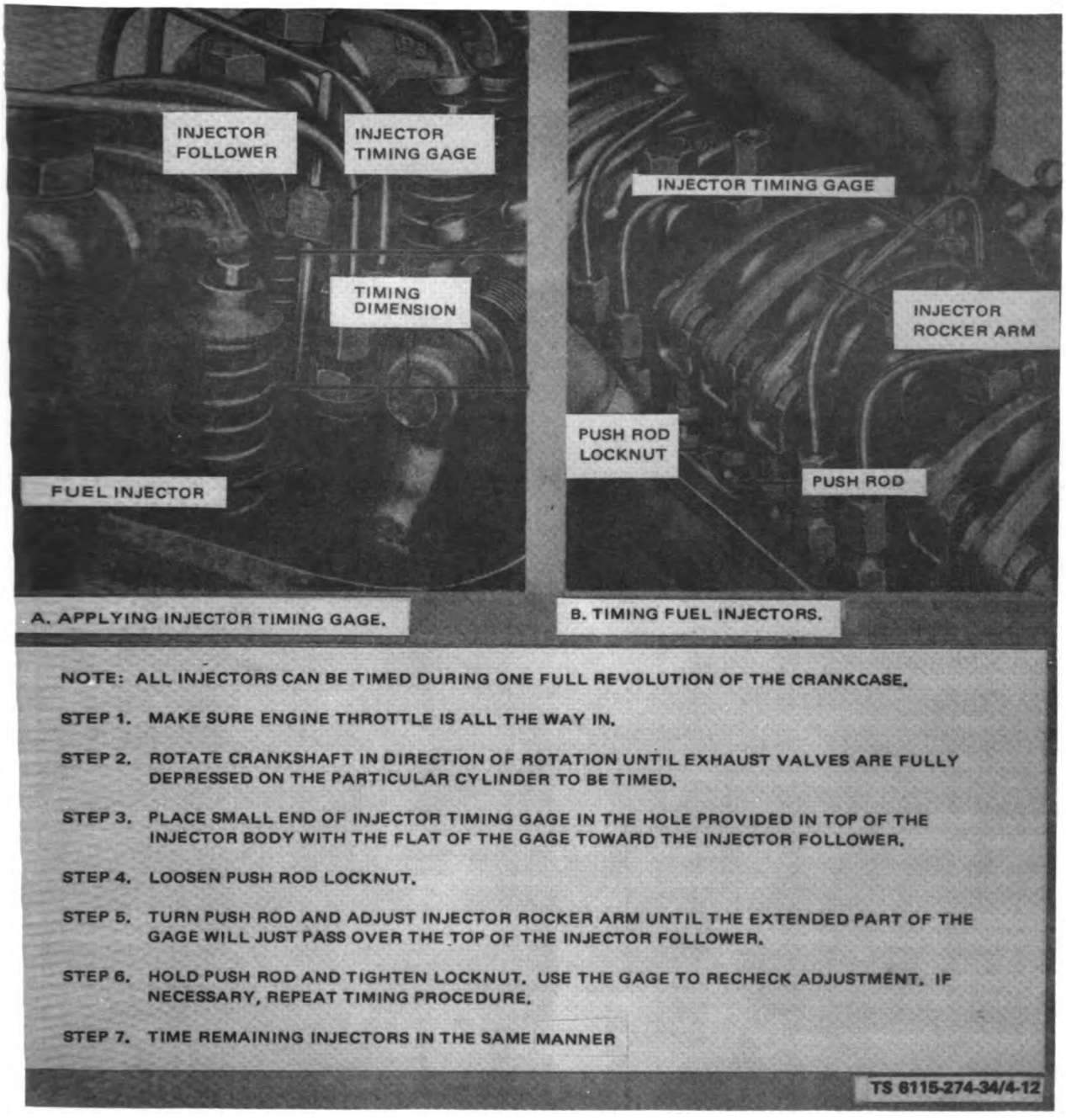


*Figure 4-12. Fuel Injector Timing*

# CHAPTER 5

# REPAIR OF GOVERNING SYSTEM

## Section I. HYDRAULIC PUMP

**5-1. General.**

The hydraulic pump is a part of the electro-hydraulic governing system and is located near the blower in the engine compartment.

**5-2. Type of Repair.**

Repairs may involve loose or missing parts, dents, or scratches.

**5-3. Hydraulic Pump.**

*a. Removal.*

*(1)* Refer to figure 5-1 and the following steps to remove the hydraulic pump.

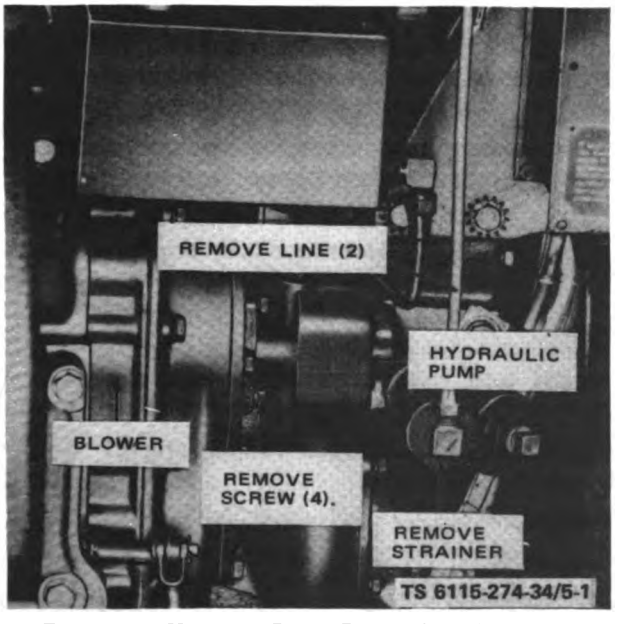


*Figure 5-1. Hydraulic Pump, Removal and Installation*

*(2)* Remove the plug and drain the hydraulic tank fluid into a suitable container.

*(3)* Remove strainer.

*(4)* Disconnect hydraulic lines.

*(5)* Remove screws and remove pump.

*b. Disassembly.*

*(1)* Refer to figure 5-2 and disassemble the hydraulic pump as follows.

*(2)* Disassemble relief valve cap (1, fig. 5-2), adjusting screw (2), flat washer (3), relief valve spring (4), relief valve plunger (5), elbow (6), expansion plug (7), screw (8), washer (9), pin (10), retaining ring (11), housing (16), retaining ring (17), gear (18), retaining ring (19), bearing (20), pin (21), drive shaft (22), seal (23), bearing (24), and pump housing (25).

*c. Cleaning, Inspection, and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the drive shaft and idler shaft for cracks, breaks, distortion, and excessively worn splines.

*(3)* Inspect the drive gears for worn or damaged teeth. Inspect the bores of the gears for damage and wear. Remove all nicks and burrs with a fine tooth file.

*(4)* Inspect the valve plunger for nicks, burrs, and improper seating. Inspect the valve spring for distortion and other damage.

*(5)* Inspect the pump housing for cracks, breaks, and defective machined surfaces.

*(6)* Inspect the needle bearings for evidence of damage.

*(7)* Discard all seals and gaskets. Replace or repair a damaged or defective part.

*d. Assembly.*

*(1)* Assemble pump housing (25, fig. 5-2), bearing (24), seal (23), drive shaft (22), pin (21), bearing (20), retaining ring (19), gear (18), retaining ring (17), gear housing (16).

*(2)* Assemble bearing (15), retaining ring (14), gear (13), idler shaft and pin (12), retaining ring (11), pin (10), washer (9), screw (8), expansion plug (7), elbow (6), relief valve plunger (5), relief valve spring (4), flat washer (3), adjusting screw (2) and relief valve cap (1).

1. Relief valve cap
2. Adjusting screw
3. Flat Washer (spec)
4. Relief valve spring
5. Relief valve plunger
6. Elbow
7. Expansion plug
8. Screw, machine
9. Washer, lock
10. Pin
11. Retaining ring
12. Idler shaft and pin
13. Gear
14. Retaining ring
15. Needle bearing
16. Gear housing
17. Retaining ring
18. Gear
19. Retaining ring
20. Needle bearing
21. Pin
22. Drive shaft
23. Seal
24. Needle bearing
25. Pump housing

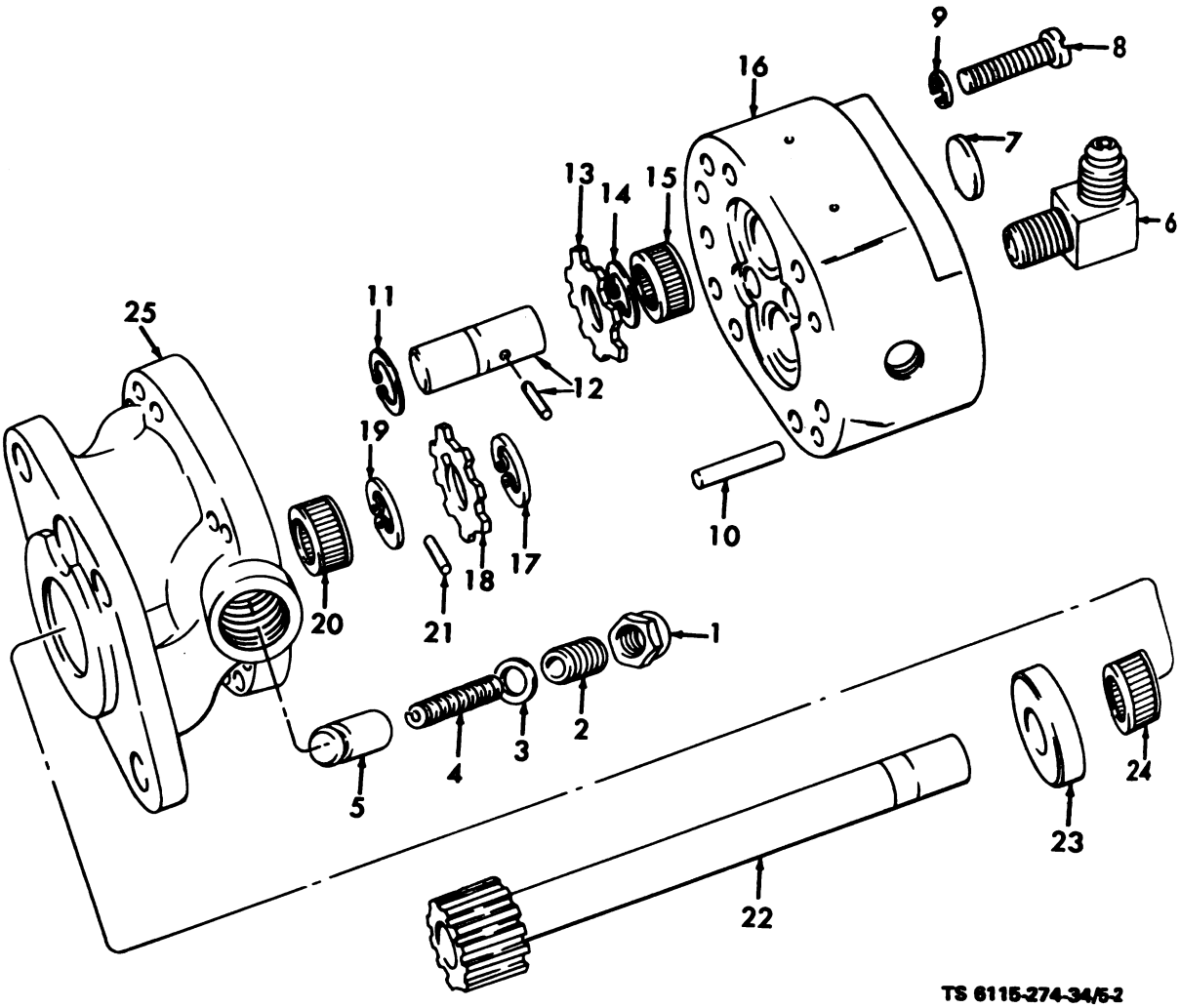


*Figure 5-2. Hydraulic Pump, Disassembly and Reassembly*

*e. Installation.*

*(1)* Refer to figure 5-1 and attach pump to blower housing with screws.

*(2)* Connect hydraulic lines.

*(3)* Install strainer.

*(4)* Install plug and service hydraulic tank.

*f. Testing.* Disconnect the hydraulic pump-to-actuator line from the pump and connect a pressure gage capable of indicating a pressure of 0 to 500 psi (0 to 3.15 kg/sq cm) between the pump and the actuator. With the engine operating at rated speed, the output pressure should be 320 psi (22.50 kg/sq cm). To adjust the pressure, remove the relief valve cap and turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure.

## Section II. HYDRAULIC ACTUATOR

**5-4. General.**

The hydraulic actuator is attached to the cylinder head and operates the fuel control tube.

**5-5. Type of Repair.**

Repairs consist of testing and adjusting the actuator, replacing or repairing damaged parts, and overhauling the actuator.

**5-6. Hydraulic Actuator.**

*a. Removal.*

*(1)* Loosen thumbscrews and remove the rocker arm cover. Disconnect the throttle cable and the actuator shutdown solenoid.

*(2)* Refer to figure 5-3 and the following steps for removal of the hydraulic actuator.

*(3)* Remove pin and cotter pins and detach control rod from control tube arm.

*(4)* Tag and disconnect electrical leads.

*(5)* Disconnect hydraulic lines and remove elbow and adapter.

*(6)* Remove screws and remove actuator.

*b. Disassembly.*

*(1)* Disassemble clevis (1, fig. 5-4), nut (2), control rod (3), cotter pin (4), washer (5), connecting rod (6), nut (7), gasket (8), electrical receptacle (9), coil (10), screws (11), washers (12) and actuator block (13).

*(2)* Disassemble retaining ring (14), packing (15), collar (16), packing (17), and piston rod (18).

*(3)* Disassemble washers (19), screws (20), pin (21), lever arm (22), and arm support lever (23).

*(4)* Disassemble pin (24), screws (25), washers (26), connecting link support (27), connecting link (28), pin (29), retaining ring (30), collar (31), packing (32, 33), and piston (34).

*(5)* Disassemble screws (35), washers (36), cover (37), gasket (38), core and armature assembly (39) and valve block (40).

*(6)* Remove actuator plugs (41) and packing (42).

*(7)* Remove adapter (43), elbow (44) and packing (45).

*(8)* Remove screws (46), washers (47), electrical receptacle (48) and gasket (49).

*c. Cleaning, Inspection, and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect all parts for cracks, breaks, and other damage.

*(3)* Make sure the piston is not binding and is completing its travel in the actuator valve block.

*(4)* Inspect the linkage leading to the fuel injector control tube for damage.

*(5)* Inspect the core and armature for evidence of damage. Test the resistance of the core and armature assembly with the ohmmeter by testing between terminals A and B as marked on the unit. The resistance of the coils should be 12 to 14 ohms.

*(6)* Inspect the top and bottom orifices, needle valves, fluted valves and spacers for pitting, wear, and other damage, using a magnifying glass if necessary. Make sure the pushrod is not bent. Replace all damaged or defective valve parts.

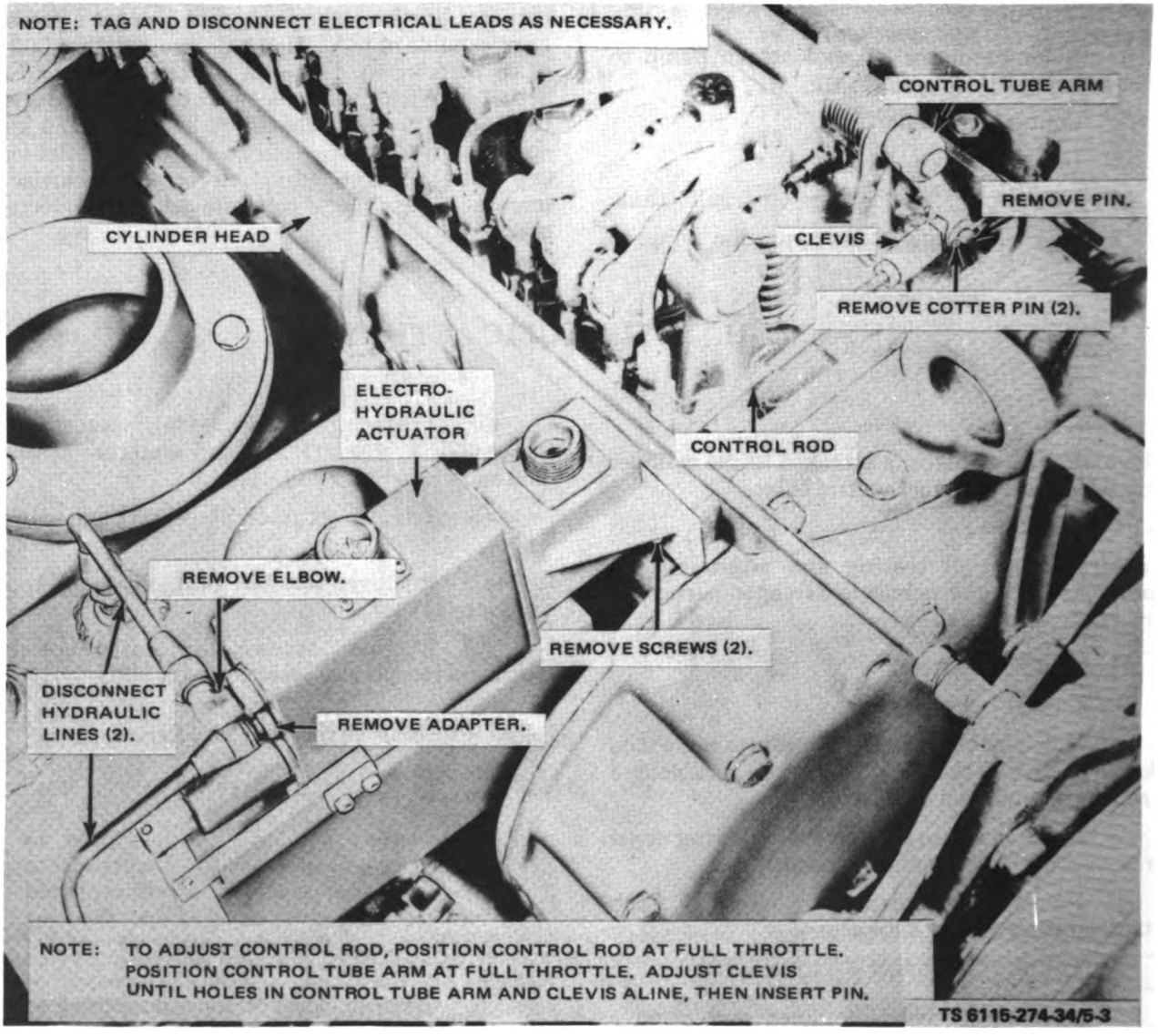


*Figure 5-3. Electrohydraulic Actuator, Removal and Installation*

*(7)* Use an ohmmeter and test the resistance of the sensing coil by testing between leads A and B and C and D. A resistance value of 33 to 36 ohms should be obtained.

*(8)* Discard and replace all seals and gaskets. Replace or repair all damaged or defective parts.

*d. Assembly.*

*(1)* Assemble electrical receptacle (48, fig. 5-4), and gasket (49) to valve block (40) with screws (46) and washers (47).

*(2)* Install adapter (43), elbow (44) and packing (45).

*(3)* Install actuator plugs (41) and packing (42).

*(4)* Assemble core and armature assembly (39), gasket (38), cover (37) to valve block with screws (35) and washers (36).

*(5)* Assemble piston (34), packing (32, 33), collar (31), retaining ring (30), pin (29), connecting link (28), connecting link support (27), washers (26), screws (25), and pin (24).

*(6)* Assemble arm support lever (23), lever arm (22), pin (21), screws (20), and washers (19).

*(7)* Assemble piston rod (18), packing (17), collar (16), packing (15), and retaining ring (14).

*(8)* Attach actuator block (13) to valve block with screws (11) and washers (12).

1. Clevis
2. Nut, hex
3. Control rod
4. Pin, cotter
5. Flat washer (spec)
6. Connecting rod
7. Nut, hex
8. Gasket
9. Electrical receptacle
10. Coil
11. Screw, machine
12. Washer, lock
13. Actuator block
14. Retaining ring
15. Preformed packing
16. Collar
17. Preformed packing
18. Piston rod
19. Washer, lock
20. Screw, machine
21. Pin, straight, roll
22. Lever arm
23. Arm support lever
24. Pin (spec)
25. Screw, machine
26. Washer, lock
27. Connecting link support
28. Connecting link
29. Pin, straight, brass
30. Retaining ring
31. Collar
32. Preformed packing
33. Preformed packing
34. Piston
35. Screw, machine
36. Washer, lock
37. Cover
38. Gasket
39. Core and armature assembly
40. Valve block
41. Actuator plug
42. Preformed packing
43. Adapter
44. Elbow, 90 degrees
45. Preformed packing
46. Screw, machine
47. Washer, lock
48. Electrical receptacle
49. Gasket

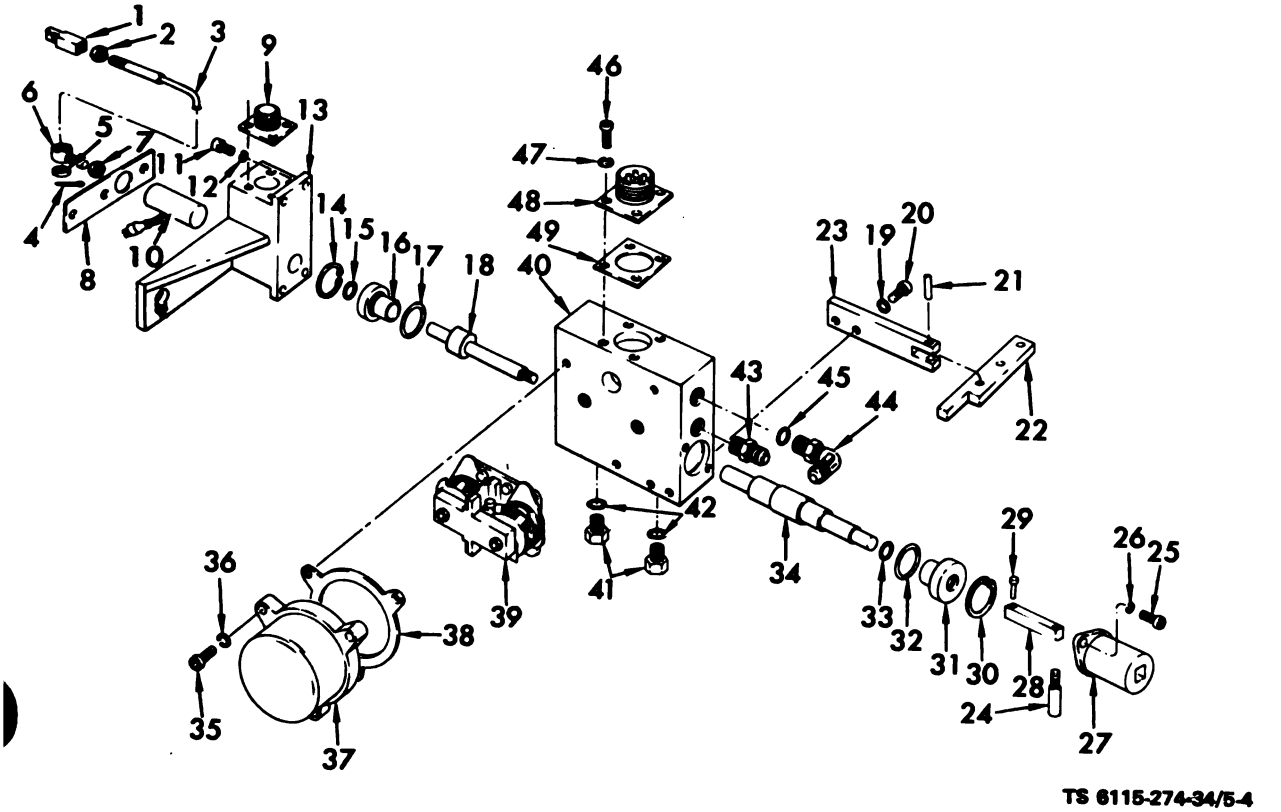


*Figure 5-4. Electrohydraulic Actuator, Disassembly and Reassembly*

*(9)* Assemble coil (10), electrical receptacle (9), gasket (8), nut (7), connecting rod (6), washer (5), cotter pin (4), control rod (3), nut (2), and clevis (1).

*e. Bench Test and Adjustment.*

*(1)* Mount the electrohydraulic actuator on a test bench using a gear pump with a motor drive, a hydraulic fluid reservoir, hydraulic oil catch pan, 3 pressure gages, and interconnecting tubing. The pump should be capable of producing hydraulic fluid in the quantity of 2 gpm at 320 psi (22.50 kg/sq cm). The pump input should be connected to the electrohydraulic actuator filter port marked P on the valve block. A pressure gage of approximately 0 to 500 psi (0 to 35.15 kg/sq cm) range is inserted in the input line to read incoming pressure as adjusted by the relief valve in the pump. Actuator plugs at the bottom of the valve block are removed and 2 pressure gages of a 0 to 500 psi (0 to 35.15 kg/sq cm) range are inserted. Remove the cover and place the actuator in the catch pan. The catch pan should incorporate provisions for draining the hydraulic fluid back to the reservoir.

*(2)* Turn the pump drive on and adjust the pump relief valve to give a pressure input at port P of 320 psi (22.50 kg/sq cm).

*(3)* With no current applied to the coils of the core and armature assembly, loosen the adjusting nuts of the core and armature assembly. The throttle is adjusted to a biased-to-close setting by adjusting the screws at either end of the armature to give a desired pressure at valve block ports. Turn clockwise to increase pressure and counterclockwise to decrease pressure. Adjust the screw on the right until the pressure gage reading at port is 200 psi (14.06 kg/sq cm) and lock in position by tightening the nut. Adjust the screw to the left to give a pressure reading of 150 psi (10.55 kg/sq cm) at port and tighten the nut.

*(4)* Remove the electrohydraulic actuator from the test bench.

*f. Installation.*

*(1)* Refer to figure 5-3 for installation of actuator.

*(2)* Install actuator to cylinder head with screws.

*(3)* Install elbow and adapter and connect hydraulic lines.

*(4)* Connect electrical leads.

*(5)* Attach control rod to control tube arm. Position control rod at full throttle. Position control tube arm at full throttle. Adjust clevis until holes in control tube arm and clevis align, then insert pin and cotter pins.

*(6)* Connect the throttle cable and the actuator shutdown solenoid.

*(7)* Install rocker arm cover and tighten thumbscrews.

## Section III. ELECTRIC GOVERNOR CONTROL UNIT

### 5-7. General.

The electric governing system consists of a governor control unit and an electrohydraulic actuator. The governing system provides high control sensitivity, fast response, and minimum frequency deviation with change in load. The governor control unit is a static device containing no electronic tubes. This control unit monitors three signals: frequency, kilowatt load, and throttle rate. An electrical summation of these signals is magnetically amplified, and the resulting signal is applied to the hydraulic actuator. The power piston of the hydraulic actuator is directly doupled to the engine throttle. The position of this piston is controlled by two hydraulic valves in the actuator, which are in turn controlled by the output of the electric governor control unit. The governor control unit contains two magnetic amplifiers. The output of each magnetic amplifier is connected to a control valve of the electrohydraulic actuator. The actions of the magnetic amplifiers are equal and opposite. A decrease in output of amplifier one will accompany an increase in the output of amplifier two, resulting in moving the power piston and the engine throttle to allow an increase in fuel supplied to the engine. There are six windings in each magnetic amplifier in addition to the output winding. The bias winding receives direct current voltage from a single-phase, full-wave rectifier, which in turn receives alternating current voltage from the power supply transformer. The amount of current through the bias winding determines the output of the magnetic amplifiers. This bias current is adjustable by means of a variable resistor connected in series with the bias winding. It is the function of the control feedback, paralleling droop, and the droop-canceling windings to increase or reduce the effect of the bias winding, thereby increasing or decreasing the output of the magnetic amplifier. The frequency sensing circuit receives

120 volts, alternating current, from the generator output. It is the purpose of this circuit to produce a voltage proportional to the frequency of the generated voltage. A conductance capacitance circuit, consisting of a choke and two capacitors, produces a voltage that is inversely proportional to frequency. The alternating current output of the conductance capacitance circuit is rectified, and the direct current output is fed through the frequency adjusting potentiometer to the control winding of the magnetic amplifier. A small change in direct current in the control winding of the magnetic amplifier results in a comparatively large change in magnetic amplifier output to control the hydraulic actuator. A variable transformer, whose core is geared to the piston movement of the hydraulic actuator, is used to give a voltage signal proportional to the throttle position. The primary of the variable transformer receives single-phase, alternating current voltage from the power supply transformer in the governor control unit. The secondary of the variable transformer is connected to a full-wave rectifier, whose output is connected to a resistor. The resulting direct current voltage across the resistor is proportional to the position of the piston of the hydraulic actuator. This direct current voltage is fed to the feedback winding of the magnetic amplifier through a series-connected capacitor and resistor. It is the function of the capacitor to allow voltage to reach the feedback winding only while the throttle is moving. During steady-state conditions, the voltage across the feedback winding will be zero, resulting in isochronous governor operation. The amount of voltage to the feedback winding may be varied by changing the series resistance. This will affect speed of recovery and stability during changes of generator load. In normal operation, the governor operates isochronously. However, droop may be incorporated in the governor for certain operations. The droop and droop-canceling circuits receive direct current voltage from the three-phase load-sensing circuit. The amount of voltage produced by the load-sensing circuit is directly proportional to the generator kilowatt load. The affects of the droop and droop-canceling winding are equal and opposite. The total affect on magnetic amplifier output is zero regardless of generator kilowatt load. To operate the governor with droop, the droop-canceling circuit is opened by turning the unit parallel switch to the ON position. The magnetic amplifier output voltage is then changed in proportion to the generator kilowatt load, which results in a frequency droop proportional to this load. The amount of frequency droop may be varied with the frequency droop adjusting variable resistor. When two units are operating in parallel, each governor will operate isochronously at a frequency which is the mean frequency of the individual governor setting. Each unit will carry one-half the total kilowatt load. This is accomplished by the governor parallel circuit. The governor parallel circuit consists of the parallel winding of the magnetic amplifier and the three-phase load-sensing circuit. The parallel circuits of the two units are connected through the parallel cable and circuit breaker auxiliary contacts to form a closed loop. The load-sensing circuits are connected so that their outputs are opposing. When each unit is carrying one-half the kilowatt load, the total output of the load-sensing circuits is zero and no current will flow in the parallel windings. When one unit is carrying less than one-half the kilowatt load, current will flow through the parallel windings toward the set with the lower output. The magnetic amplifier outputs will change, moving the lower pistons in the hydraulic actuators to increase the speed of the low-output unit and decrease the speed of the high-output unit until their kilowatt outputs are equal. When this is accomplished, there will be no current flow in the parallel windings of the magnetic amplifiers.

### 5-8. Type of Repair.

Repairs may involve loose or missing parts, dents, and scratches. Replace parts damaged beyond repair. Test and align the unit.

### 5-9. Electric Governor Control Unit.

*a. Removal.*

*(1)* Refer to figure 5-5 and the following steps for removal of the electric governor control unit.

*(2)* Disconnect receptacle connectors.

*(3)* Remove nuts and washers and remove control unit.

*b. Testing Before Disassembly.*

*(1)* Use a volt-ohmmeter and test the diodes. A good diode will read 20 ohms in one direction and open in the other. A defective diode will read short in both directions or open in both directions.

*(2)* Test the resistance of transformer windings to ground using the high scale on the ohmmeter. All windings should read open to ground.

*(3)* Test the resistance of magnetic amplifiers to ground. All windings should read open to ground.

*(4)* Test the resistance across the transformer windings using the low scale on the ohmmeter. Readings should be 1/2 ohm across the center output windings, 11 ohms across first- and third-input windings and six ohms across all other windings.

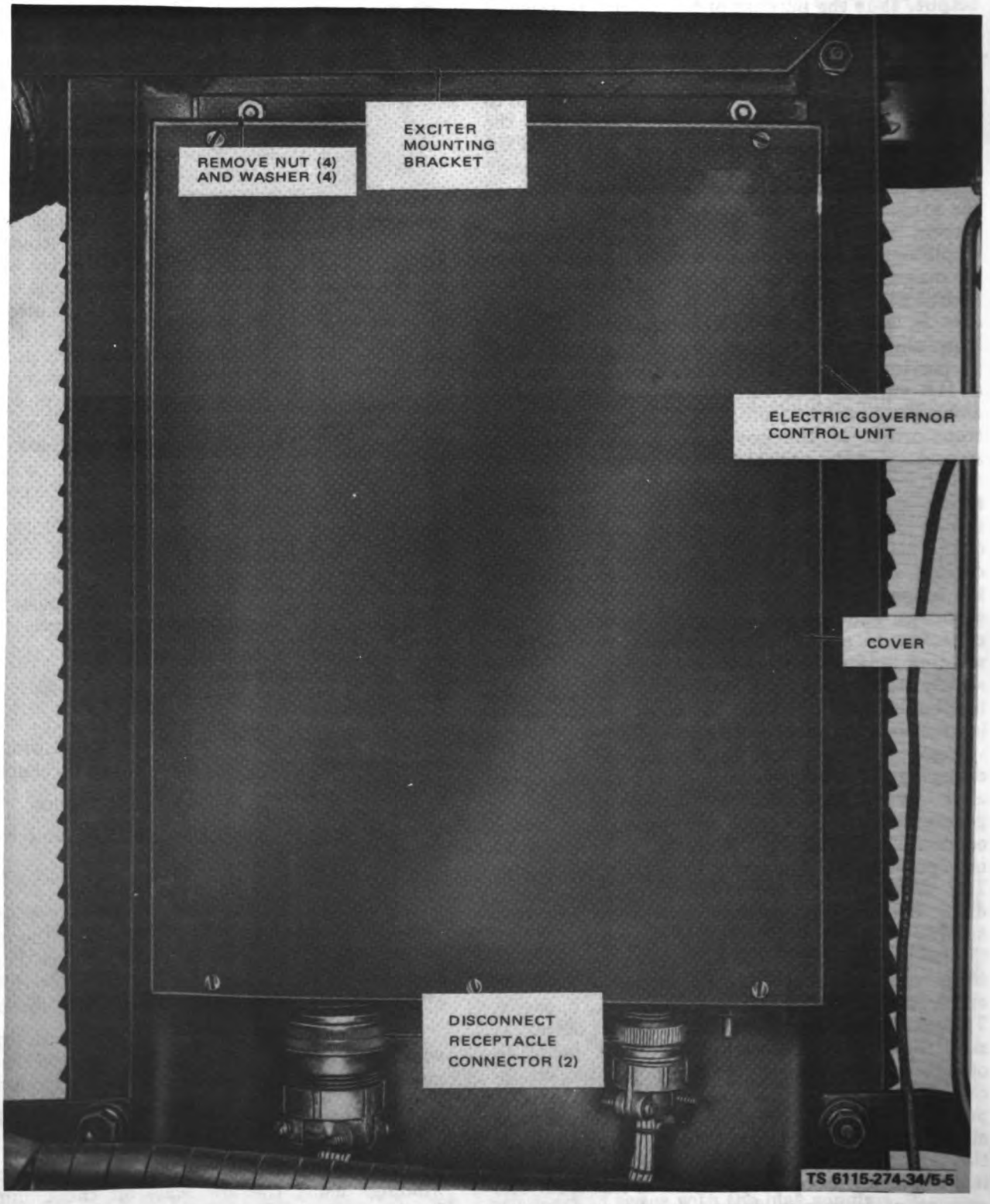


*Figure 5-5. Electric Governor Control Unit, Removal and Installation*

*(5)* Test the resistance across the magnetic amplifier windings, using the following values:

| Winding | Resistance in Ohms |
|---|---|
| 1-3 | 1/2 |
| 2-4 | 1/2 |
| 5-6 | 6 |
| 7-8 | 1 |
| 9-10 | 1/2 |
| 11-12 | 5 |
| 13-14 | 5 |
| 15-16 | 5 |

*(6)* Test the resistance across the choke. Resistance should be approximately 12 1/2 ohms.

*c. Disassembly.*

*NOTE*

*Tag and disconnect electrical leads, as necessary.*

*NOTE*

*Although total disassembly is shown, only that necessary for repair or replacement of defective parts will be performed.*

*(1)* Remove screws (1, fig. 5-6) and washers (2) and remove cover (3).

*(2)* To remove the magamp coil assembly, remove nut (4), washer (5) and screw (6). This releases lug assemblies (8, 12) with diodes (7, 11), magamp coils (9, 13) and insulating plates (10, 14).

*(3)* To remove the oil filled capacitors, remove nuts (15), washers (16), and screws (19). This releases capacitor strap (17) and capacitors (18).

*(4)* To remove resistor (35), first remove nut (31), washer (32) and screw (33). This releases insulating washers (34, 36) and resistor (35).

*(5)* To remove resistor assembly, remove nuts (20), washers (21) and rods (22). This releases resistors (25, 26), insulating washers (23) and washers (24).

*(6)* To remove resistor mounting brackets (30), remove nuts (27), washers (28) and screws (29).

*(7)* Remove bottom plate (1, fig. 5-7) from chassis (41).

1. Screw, machine
2. Washer, lock
3. Cover
4. Nut, hex
5. Washer, lock
6. Screw, machine
7. Diodes
8. Lug assembly
9. Magamp coil
10. Insulating plate
11. Diodes
12. Lug assembly
13. Magamp coil
14. Insulating plate
15. Nut, hex
16. Washer, lock
17. Capacitor strap
18. Capacitor, oil filled
19. Screw, machine
20. Nut, hex
21. Washer, lock
22. Rod, threaded
23. Insulating washer
24. Washer
25. Variable resistors
26. Fixed resistors
27. Nut, hex
28. Washer, lock
29. Screw, machine
30. Resistor mounting brackets
31. Nut, hex
32. Washer, lock
33. Screw, machine
34. Insulating washer
35. Variable resistor
36. Insulating washer

*Figure 5-6. Electric Governor Control Unit Magamp Coil, Resistors and Capacitors, Disassembly and Assembly*

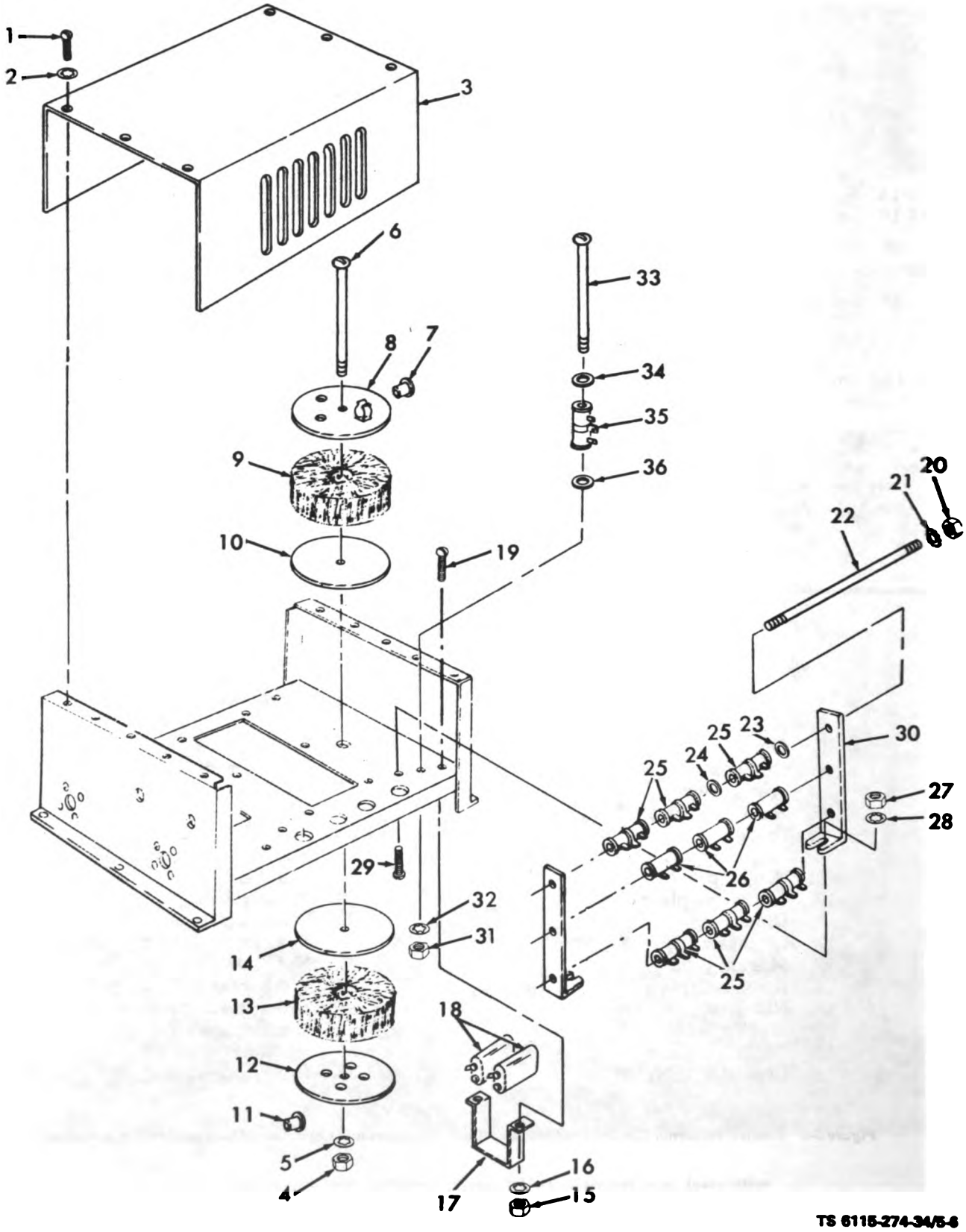


*Figure 5-6. Electric Governor Control Unit Magamp Coil, Resistors and Capacitors, Disassembly and Assembly (con't.)*

*(8)* To remove the transformer (16), remove nuts (13), washers (14) and screws (15).

*(9)* To remove the choke (12), remove nuts (9), washers (10) and screws (11).

*(10)* To remove the diode board (39), remove nuts (29), washers (30) and screws (31).

*(11)* To remove rheostats (19, 20), remove nuts (17) and washers (18).

*(12)* To remove resistor (7), remove nut (2), washer (3), screw (4) and washers (5, 6, 8).

*(13)* To remove electrical receptacle (24), remove nuts (21), washers (22) and screws (23).

*(14)* To remove electrical receptacle (28), remove nuts (25), washers (26) and screws (27).

*(15)* Diode board components (32, 33, 34, 35, 36, 37, 38) are removed as necessary.

*d. Cleaning and Inspection.*

*(1)* Wipe all parts free of dirt and grease with a clean, dry cloth.

*(2)* Inspect all threaded components for damaged or defective threads.

*(3)* Inspect the transformer, choke, and magnetic amplifiers for damaged terminals.

*(4)* Inspect the resistors for broken wires, damaged terminals, and defective insulation. Test the capacitors on a capacitor tester.

*(5)* Inspect the chassis for cracks, breaks, and other damage.

*(6)* Replace all damaged or defective parts.

*e. Assembly.*

*(1)* Install the transformer (16, fig. 5-7) with screws (15), washers (14) and nuts (13).

*(2)* Install the choke (12) with screws (11), washers (10) and nuts (9).

*(3)* Install the diode board (39) with screws (31), washers (30) and nuts (29).

*(4)* Install rheostats (19, 20) with washers (18) and nuts (17).

*(5)* Install resistor (7) with screw (4), washers (3, 5, 6, 8) and nut (2).

*(6)* Install electrical receptacle (24) with screws (23), washers (22) and nuts (21).

*(7)* Install electrical receptacle (28) with screws (27), washers (26) and nuts (25).

1. Bottom plate
2. Nut, hex
3. Washer, lock
4. Screw, machine
5. Washer, flat
6. Insulating washer
7. Fixed resistor
8. Insulating washer
9. Nut, hex
10. Washer, lock
11. Screw, machine
12. Choke
13. Nut, hex
14. Washer, lock
15. Screw, machine
16. Transformer
17. Nut, hex
18. Washer, lock
19. Rheostat
20. Rheostat
21. Nut, hex
22. Washer, lock
23. Screw, machine
24. Electrical receptacle
25. Nut, hex
26. Washer, lock
27. Screw, machine
28. Electrical receptacle
29. Nut, hex
30. Washer, lock
31. Screw, machine
32. Capacitor
33. Resistor
34. Resistor
35. Capacitor, fixed
36. Diode
37. Diode
38. Diode
39. Diode board
40. Grommet
41. Chassis

*Figure 5-7. Electric Governor Control Unit Transformer, Choke, Diode Board, Resistors and Receptacles, Disassembly and Assembly*

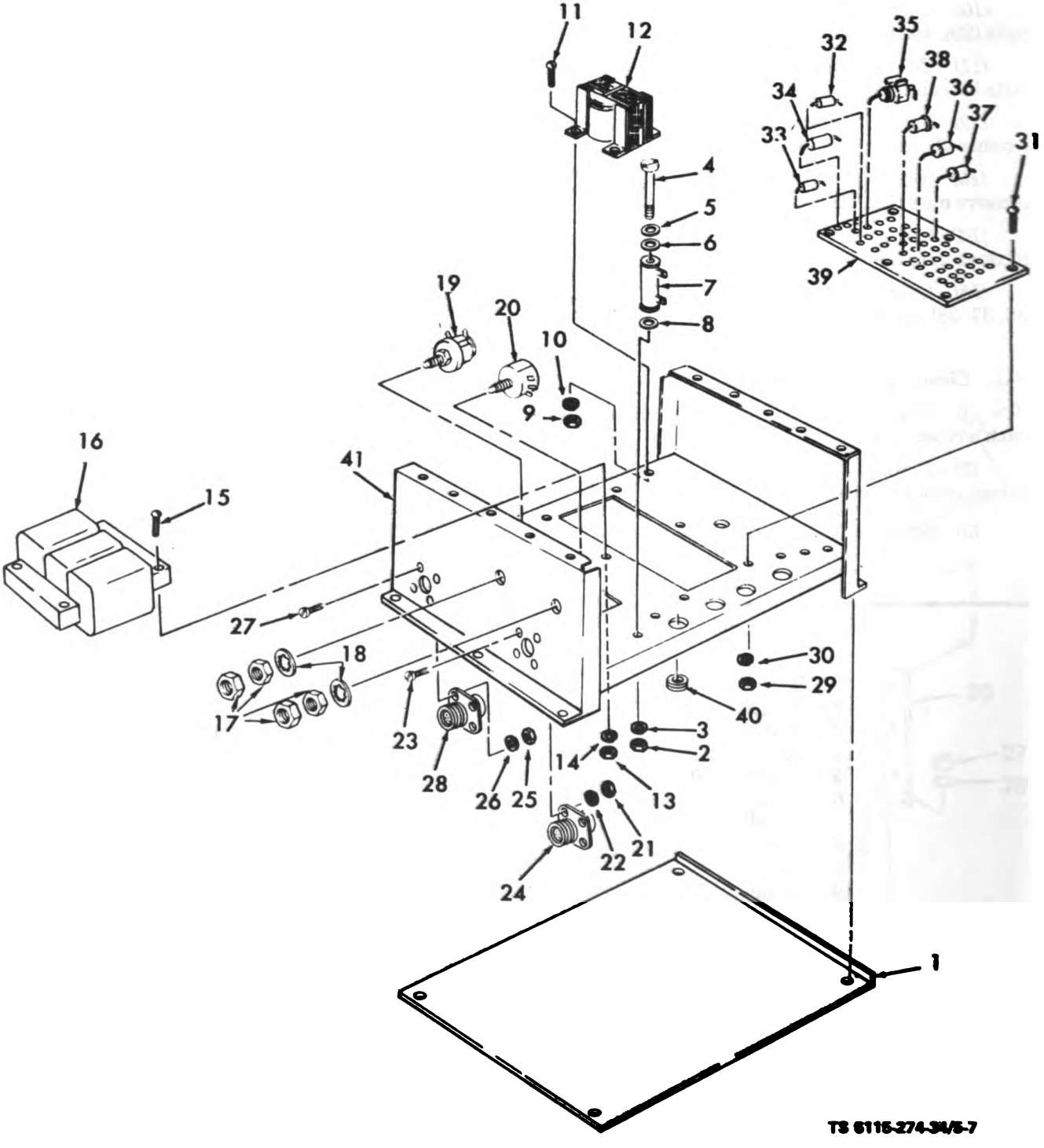


*Figure 5-7. Electric Governor Control Unit Transformer, Choke, Diode Board, Resistors and Receptacles, Disassembly and Assembly (Con't.)*

*(8)* Install the magamp coil assembly by assembling the insulating plates (10, 14, fig. 5-6), magamp coils (9, 13), diodes (7, 11), lug assemblies (8, 10) with screw (6), washer (5) and nut (4).

*(9)* Install capacitors (18) with strap (17), screws (19), washers (16) and nuts (15).

*(10)* Install resistor (35) by assembling it with washers (34, 36), screw (33), washer (32) and nut (31).

*(11)* Install resistor mounting brackets (30) with screws (29), washers (28) and nuts (27).

*(12)* Install resistor assembly by assembling resistors (25, 26), insulating washers (23) and washers (24) with rods (22), washers (21) and nuts (20).

*f. Installation.*

*(1)* Place bottom plate on chassis and install control unit.

*(2)* Install nuts and washers holding unit in place.

*(3)* Connect receptacle connectors.

*g. Alignment.*

*(1)* Position the probes of a 10 volt, direct current voltmeter across terminals 1 and 4 of the magnetic amplifier (red dot indicates the number 1 terminal with numbering running clockwise.)

*(2)* Operate the set at correct voltage and approximately 400 Hz. An indication of from four to five volts should be indicated. This voltage can be varied with the 175 ohm variable resistor. If this voltage is adjusted too high, a high frequency oscillation will occur at no load; if adjusted too low, no load response will be slow and on-load stability will be poor.

*(3)* A 500 ohm variable resistor is provided to adjust the performance of the overall system under load conditions. Reducing the resistance provides a quick response, but too low a setting will cause instability under load. Increasing resistance will provide greater on-load stability, but too high a setting will cause a slow response.

*(4)* Replace cover with screws and washers.

## Section IV. OVERSPEED GOVERNOR

### 5-10. General.

The overspeed governor is mounted on the flywheel housing and functions to open the circuit to the air intake housing solenoid, stopping the engine if speed should exceed 2,123 revolutions per minute.

### 5-11. Type of Repairs.

Repairs may involve loose or missing parts, cracks, and other damages.

### 5-12. Overspeed Governor.

*a. Removal.*

*(1)* Remove the air cleaner.

*(2)* Refer to figure 5-8 and the following steps to remove the overspeed governor.

*(3)* Remove screws and slide generator shroud away from flywheel housing.

*(4)* Tag and disconnect electrical leads.

*(5)* Remove screws and remove microswitch and bracket.

*(6)* Turn locknut clockwise to loosen, then turn overspeed governor counterclockwise to remove.

*b. Disassembly.*

*(1)* Remove screws (1, fig. 5-9) and washers (2) and separate governor base (7) from body (44).

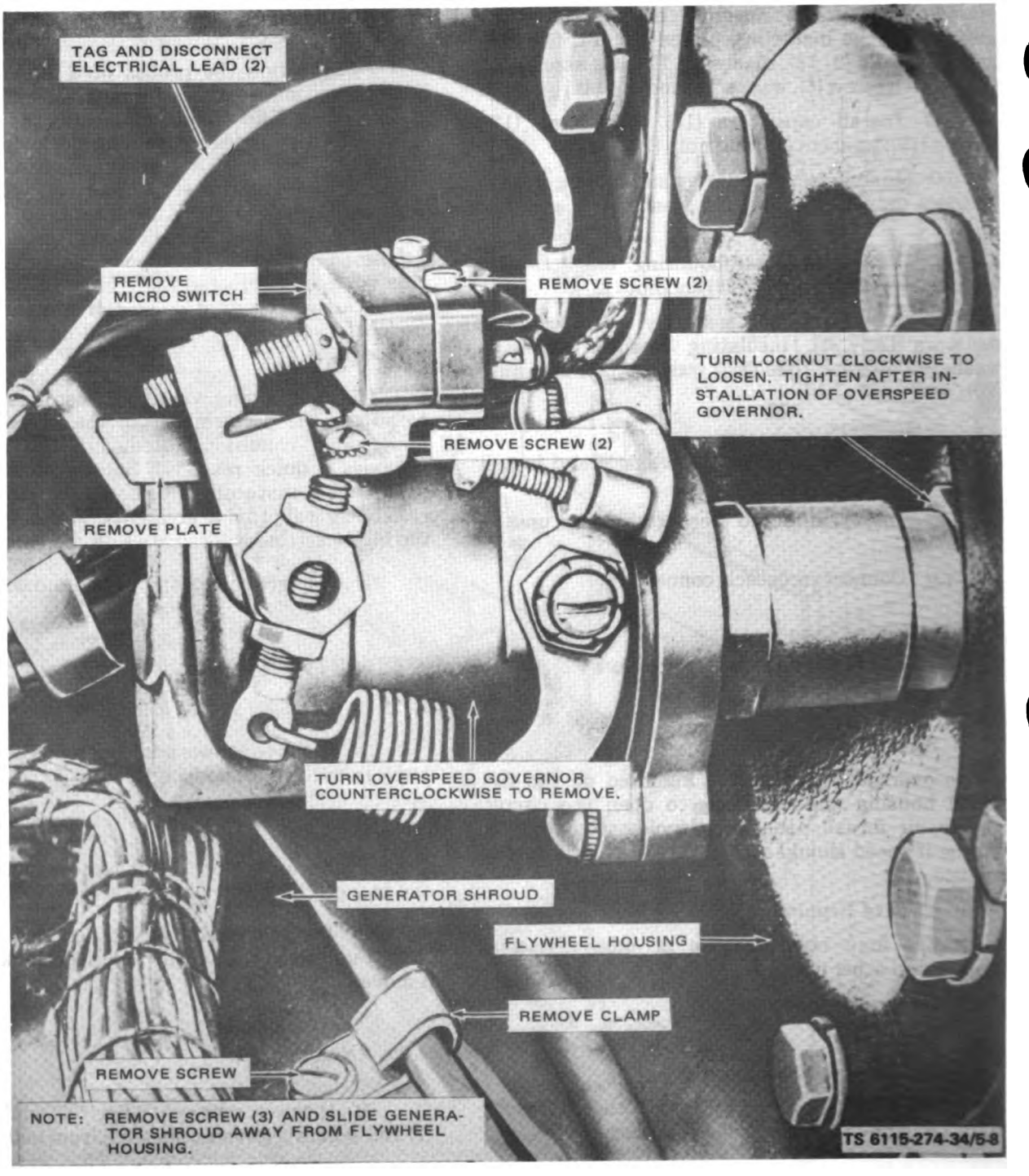


*Figure 5-8. Overspeed Governor, Removal and Installation*

1. Screw
2. Washer
3. Shaft
4. Retaining ring
5. Washer
6. Seal
7. Governor base
8. Bushing
9. Thrust washer
10. Retaining ring
11. Retaining ring
12. Governor weight pin
13. Governor weight
14. Screw
15. Washer
16. Bearing yoke
17. Retaining ring
18. Thrust bearing
19. Thrust sleeve
20. Spider and shaft assembly
21. Gasket
22. Gasket
23. Nut
24. Washer
25. Stud (spec)
26. Screw
27. Nut
28. Spring adjusting lever
29. Stop bracket
30. Nut
31. Spring adjusting stud
32. Nut
33. Governor spring
34. Screw
35. Nut
36. Pin, roll
37. Governor lever
38. Washer
39. Packing
40. Bushing
41. Retaining ring
42. Rocker shaft
43. Bushing
44. Governor body

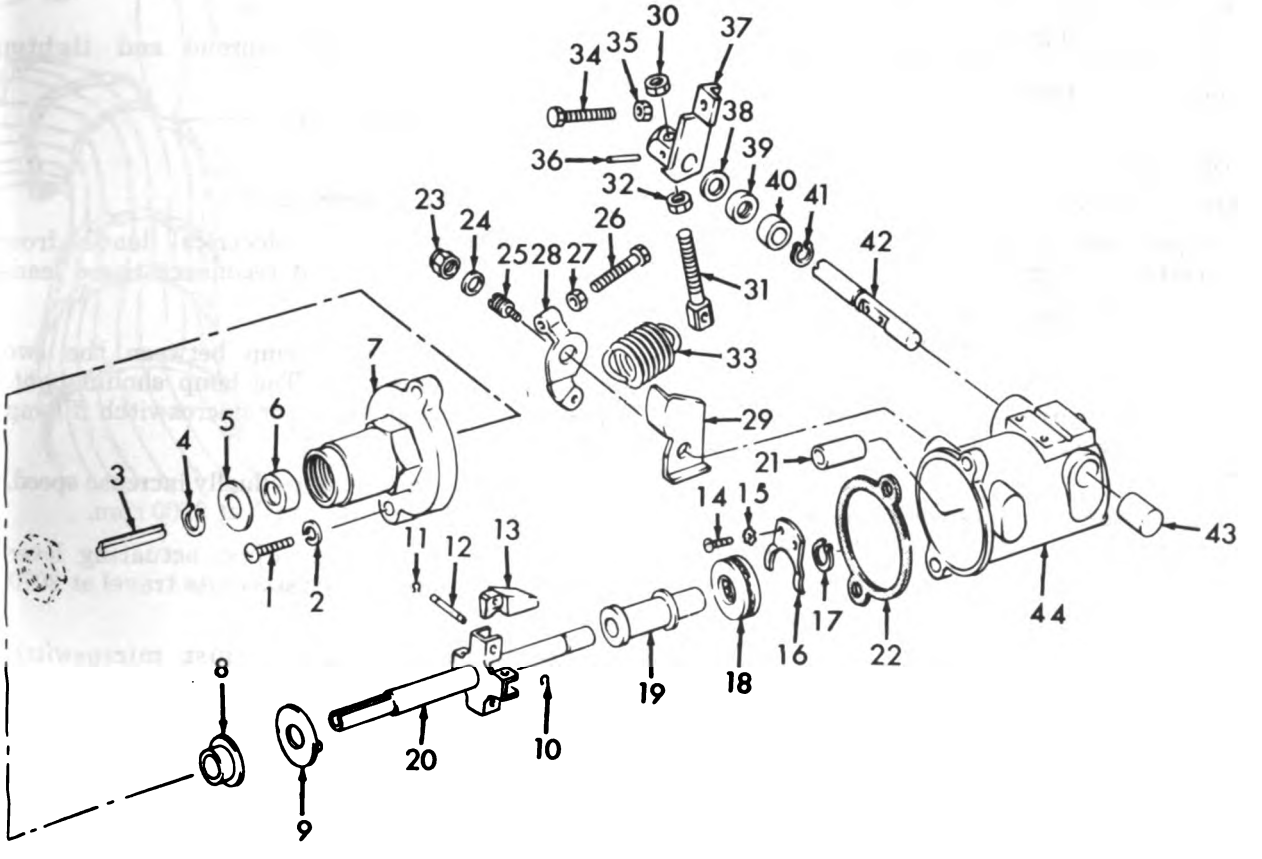


*Figure 5-9. Overspeed Governor, Disassembly and Assembly*

*(2)* Disassemble shaft (3), retaining ring (4), washer (5), seal (6), bushing (8), thrust washer (9), retaining rings (10, 11), governor weight pin (12), governor weight (13).

*(3)* Remove screws (14) and washers (15) allowing spider assembly to be extracted from body.

*(4)* Disassemble bearing yoke (16), retaining ring (17), thrust bearing (18), thrust sleeve (19), spider and shaft assembly (20) and gasket (21).

*(5)* Remove gasket (22) from body.

*(6)* Disassemble nut (23), washer (24), stud (25), screw (26), nut (27), spring adjusting lever (28) and stop bracket (29).

*(7)* Disassemble nut (30), spring adjusting stud (31), nut (32), governor (38), packing (39), bushing (40), retaining ring (41), rocker shaft (42) and bushing (43).

*c. Cleaning, Inspection, and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect all parts for cracks, breaks, scoring, and other damage.

*(3)* Inspect the weights and spider assembly for distortion and excessive wear. Make sure the shaft bearing revolves freely and smoothly.

*(4)* Inspect the yoke for worn flat spots on the radii contacting thrust bearing and for cracks and other damage.

*(5)* Inspect the thrust sleeve for wear, roughness, and worn groove at the base where contacted by weight noses.

*(6)* Replace a damaged or defective part.

*d. Assembly.*

*(1)* Assemble bushing (43, fig. 5-9), rocker shaft (42), retaining ring (41), bushing (40), packing (39), washer (38), governor lever (37), rollpin (36), nut (35), screw (34), governor spring (33), nut (32), spring adjusting stud (31) and nut (30).

*(2)* Assemble stop bracket (29), spring adjusting lever (28), nut (27), screw (26), stud (25), washer (24), and nut (23).

*(3)* Assemble gasket (21), spider and shaft assembly (20), thrust sleeve (19), thrust bearing (18), retaining ring (17) and bearing yoke (16).

*(4)* Insert spider assembly into governor body and attach screws (14) and washers (15) to rocker shaft.

*(5)* Assemble governor weight (13), governor weight pin (12), retaining rings (10, 11), thrust washer (9), bushing (8), seal (6), washer (5), retaining ring (4), and shaft (3).

*(6)* Assemble base (7), gasket (22) and body (44) with washers (2) and screws z)1).

*e. Installation.*

*(1)* Refer to figure 5-8 and install overspeed governor by turning clockwise. Tighten locknut by turning counterclockwise.

*(2)* Attach microswitch and bracket with screws.

*(3)* Connect electrical leads.

*(4)* Replace generator shroud and tighten screws.

*(5)* Install the air cleaner.

*f. Testing and Adjustment.*

*(1)* Disconnect the electrical leads from microswitch (fig. 5-10) and reconnect these leads together.

*(2)* Connect a test lamp between the two terminals of microswitch. The lamp should light. Replace overspeed governor or microswitch if lamp does not light.

*(3)* Start engine and gradually increase speed. The test lamp should extinguish at 2100 rpm.

*(4)* Loosen nut and adjust actuating lever screw until actuating lever starts its travel at 2070 rpm. Tighten nut.

*(5)* Loosen nut and adjust microswitch adjusting screw until microswitch is actuated and causes test lamp to extinguish at 2100 rpm. Replace the overspeed governor if adjustments do not correct deficiency.

*(6)* Remove test lamp and reconnect electrical leads to microswitch.

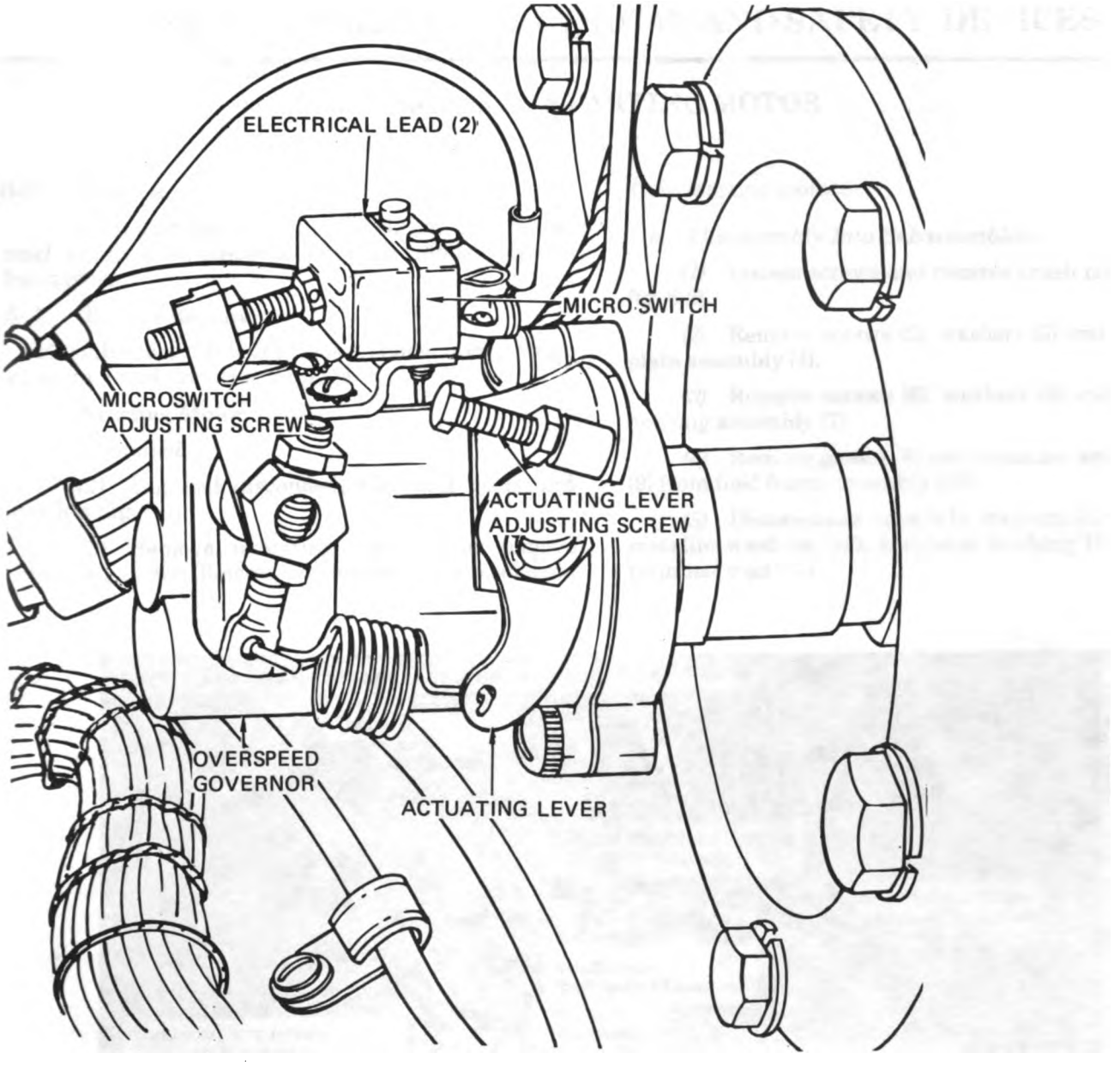


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*Figure 5-10. Overspeed Governor, Testing and Adjustment*

# CHAPTER 6

# REPAIR OF ENGINE ELECTRICAL AND SAFETY DEVICES

## Section I. STARTING MOTOR

**6-1. General.**

The starting motor is a part of the 24 volt system and receives its power to start the engine from the batteries.

**6-2. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**6-3. Starting Motor.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads and cables (fig. 6-1).

*(2)* Remove mounting screws and remove starting motor. Remove screws to separate solenoid from starting motor.

*b. Disassembly Into Subassemblies.*

*(1)* Loosen screws and remove brush cover (1, fig. 6-2).

*(2)* Remove screws (2), washers (3) and brush plate assembly (4).

*(3)* Remove screws (5), washers (6) and drive housing assembly (7).

*(4)* Remove gasket (8) and armature assembly (9) from field frame assembly (10).

*(5)* Disassemble nuts (11), washers (12), non-metallic washers (13), insulator bushing (14) and terminal stud (15).

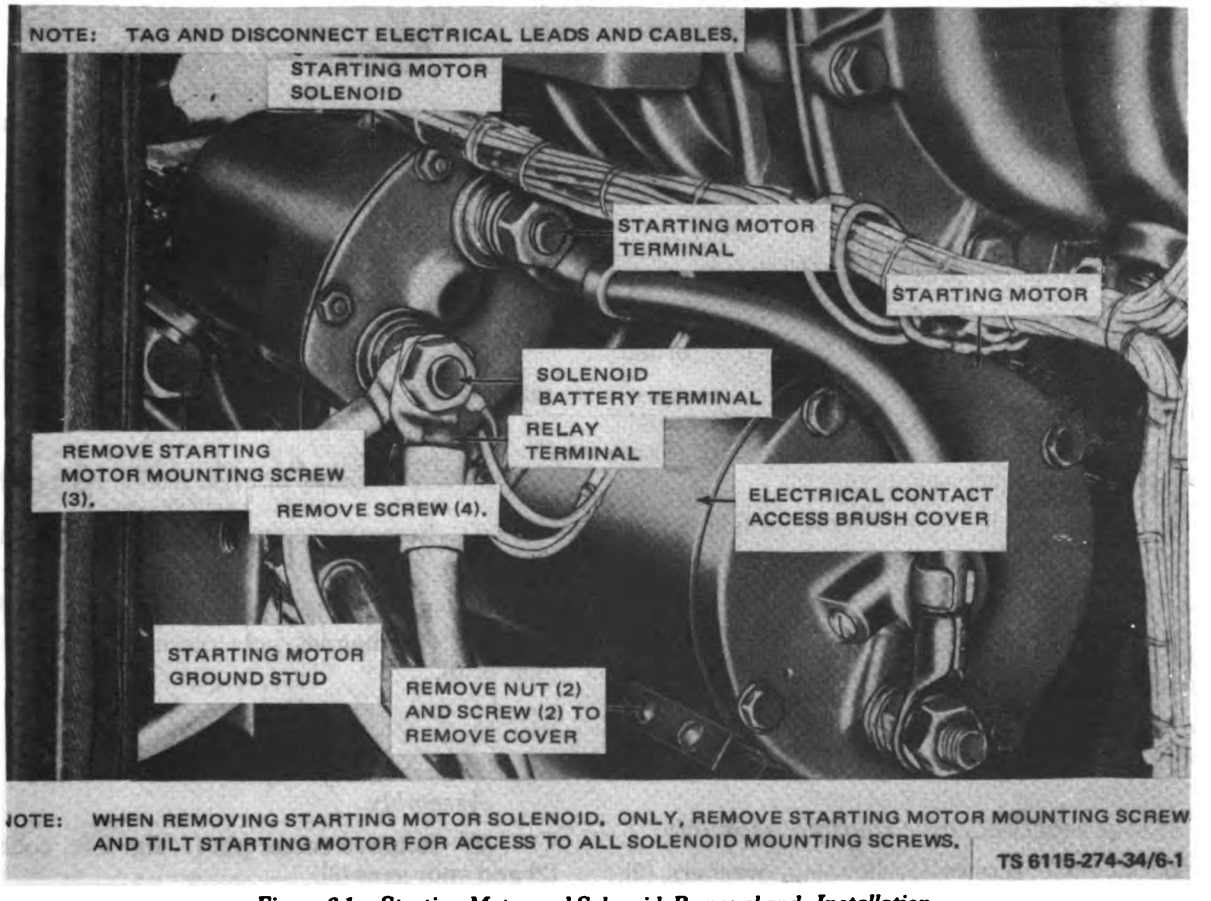


*Figure 6-1. Starting Motor and Solenoid, Removal and Installation*

1. Brush cover
2. Screw, machine
3. Washer, key
4. Brush plate assembly
5. Screw, cap, hex-hd
6. Washer, lock
7. Drive housing assembly
8. Gasket
9. Armature assembly
10. Field frame assembly
11. Nut, hex
12. Washer, lock
13. Nonmetallic washer
14. Insulator bushing
15. Terminal stud

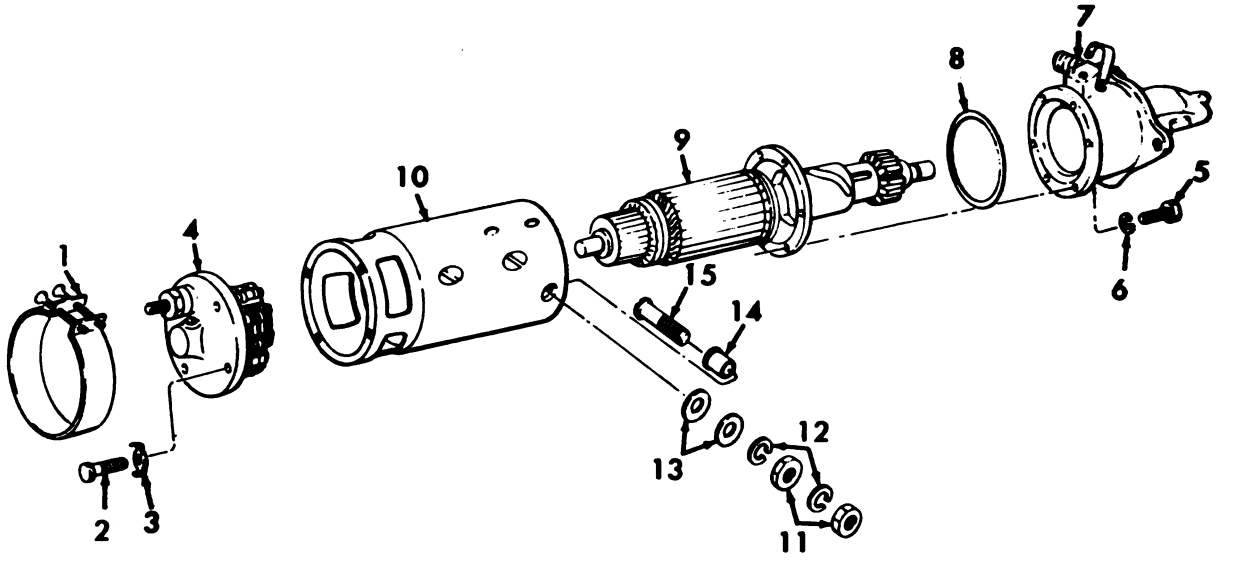


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*Figure 6-2. Engine Starting Motor, Disassembly and Reassembly of Subassemblies*

*c. Disassembly of Brush Plate Assembly.*

*(1)* Remove shoulder bolts (1, fig. 6-3), brush springs (2), and washers (3).

*(2)* Disassemble screws (4), washers (5), brush holders (6), brush plate holders (7), and plate insulators (8) from brush ring holder (9).

*(3)* Disassemble screws (10), washer (11), brush holder insulating plate (12), brush holder spacer plate (13), shaft collar (14), and nonmetallic washer (15) from brush end plate (18).

*(4)* Remove pipe plug (16), oil wick (17), bushing (19) and expansion plug (20).

*(5)* Remove nut (21), washers (22, 23), insulator washers (24) and bushing (25).

*d. Disassembly of Drive Housing Assembly.*

*(1)* Remove screws (1, fig. 6-4), washers (2), cover (3), lever (4) and spring (5) from drive housing (6).

*(2)* Remove pipe plug (7), oil wick (8) and bushing (9).

*e. Disassembly of Field Frame Assembly.*

*(1)* Remove screws (2, fig. 6-5) from field frame (1).

*(2)* Remove left field winding (3), right field winding (4), magnet pole pieces (5) and insulator plates (6).

*f. Disassembly of Armature and Drive Assembly.*

*(1)* Remove cotter pin (1, fig. 6-6), collar stop (2) and spur gear (3).

1. Shoulder bolt
2. Brush spring
3. Washer, lock
4. Screw, cap, hex hd
5. Washer, lock
6. Brush holder
7. Brush plate holder
8. Plate insulator
9. Brush ring holder
10. Screw, machine
11. Washer, lock
12. Brush holder insulating plate
13. Brush holder spacer plate
14. Shaft collar
15. Nonmetallic washer
16. Plug, pipe
17. Oil wick
18. Brush end plate
19. Bushing
20. Expansion plug
21. Nut, hex
22. Washer, lock
23. Washer, flat
24. Insulator washer
25. Bushing

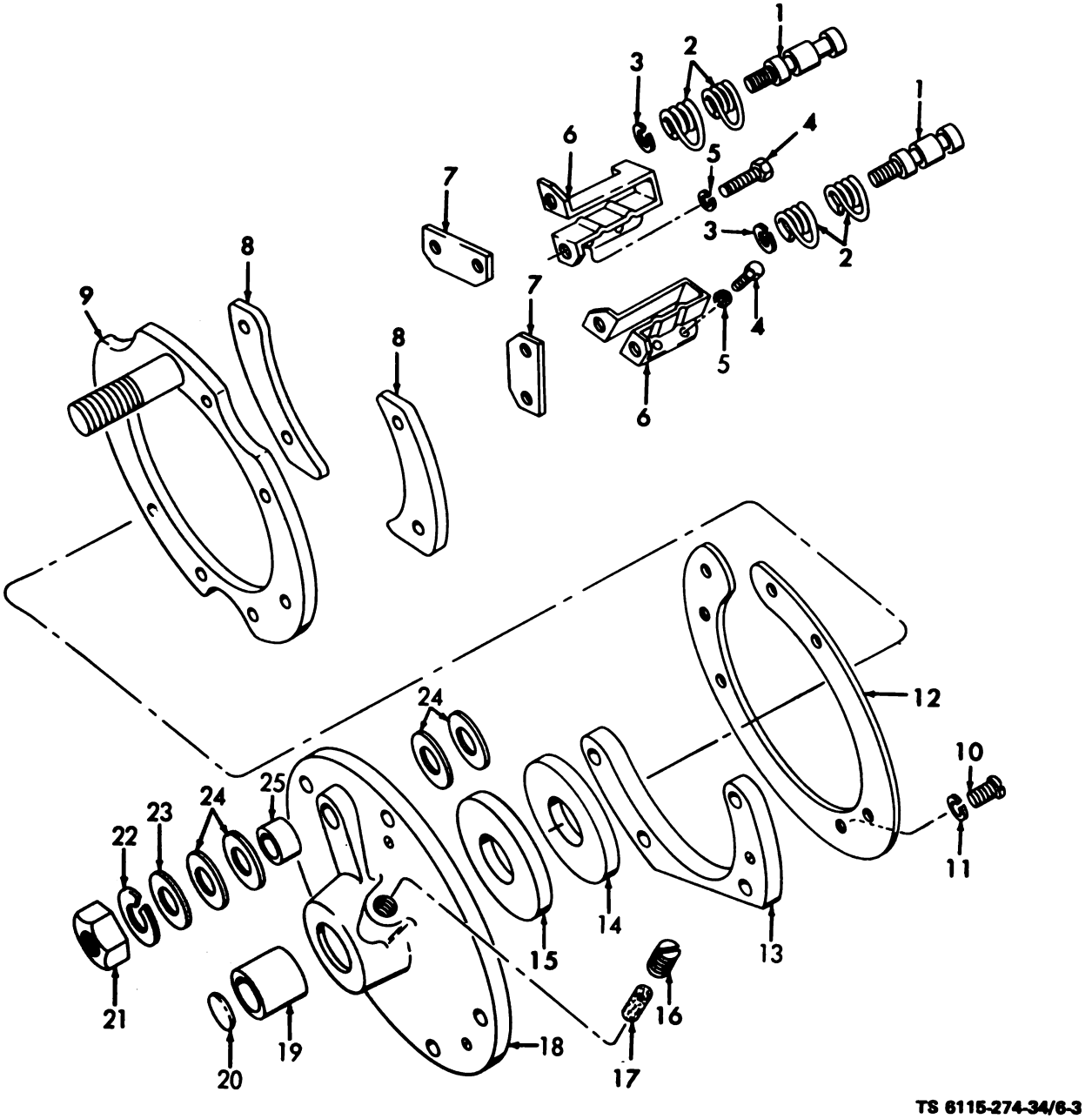



*Figure 6-3. Engine Starting Motor Brush Plate Assembly, Disassembly and Reassembly*

1. Screw, machine
2. Washer
3. Cover
4. Lever
5. Spring
6. Drive housing
7. Plug, pipe
8. Oil wick
9. Bushing

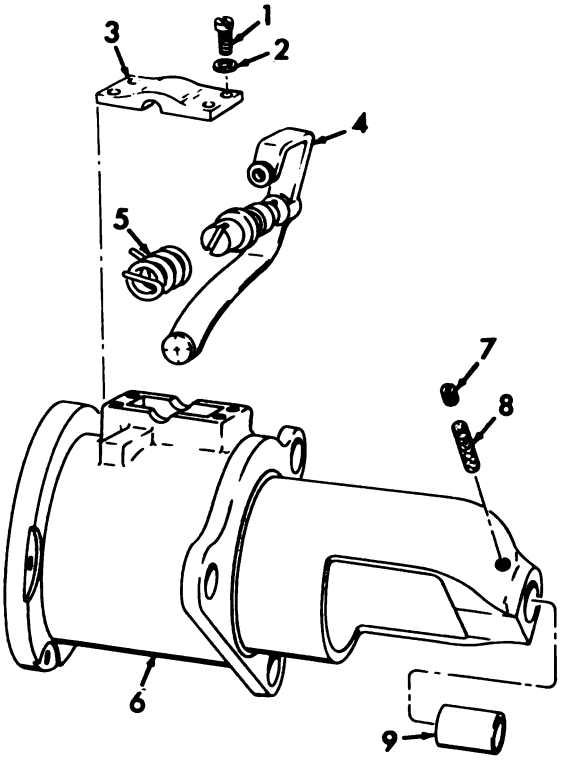



*Figure 6-4. Starting Motor Drive Housing Assembly, Disassembly and Reassembly*

*(2)* Disassemble spring (4), drive gear guide (5), shift sleeve (6), recessed washer (7), washer (8), seal (9), drive end plate (10), collar (11), seal (12), spacer (13) and armature (14).

*(3)* Remove pipe plug (15) and oil wick (16).

*g. Cleaning, Inspection and Repair.*

## WARNING

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly. Clean all nonmetal parts with a cloth dampened with an approved cleaning solvent and dry thoroughly.

*(2)* Inspect the commutator bars for burns and wear. If necessary, stone the commutator or turn down on a lathe or remove the burned material or worn spots. Undercut the mica, as necessary, as instructed in TM 5-764.

*(3)* Inspect the armature coil leads at the commutator bars for loose connections. If loose, resolder the leads in the riser.

*(4)* Inspect the field winding insulation plates, terminals, and pole pieces for wear or damage.

*(5)* Inspect the brushes for wear and the brush springs for proper tension. The proper spring tension is 35 to 40 ounces.

1. Field frame
2. Screw, machine
3. Left field winding
4. Right field winding
5. Magnet pole piece
6. Insulator plate

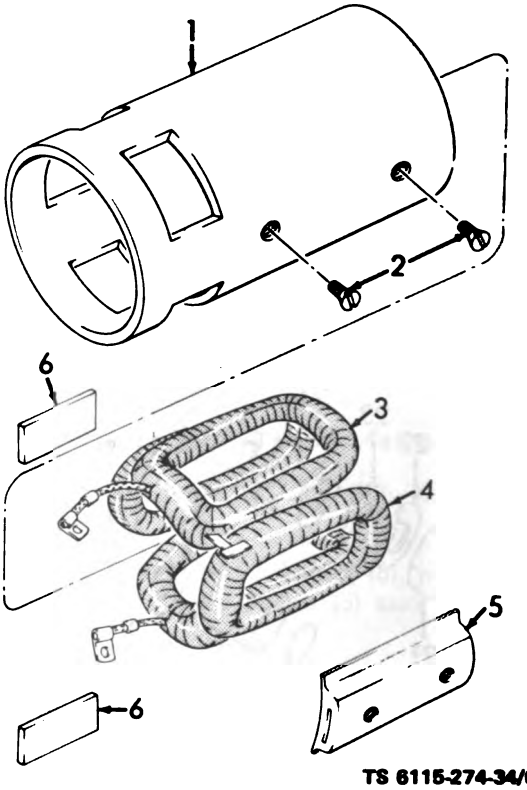



*Figure 6-5. Starting Motor Field Frame Assembly, Disassembly and Reassembly*

1. Pin, cotter
2. Collar stop
3. Spur gear
4. Spring
5. Drive gear guide
6. Shift sleeve
7. Recessed washer (spec)
8. Washer, flat
9. Seal
10. Drive end plate
11. Collar
12. Seal
13. Spacer
14. Armature
15. Plug, pipe
16. Oil wick

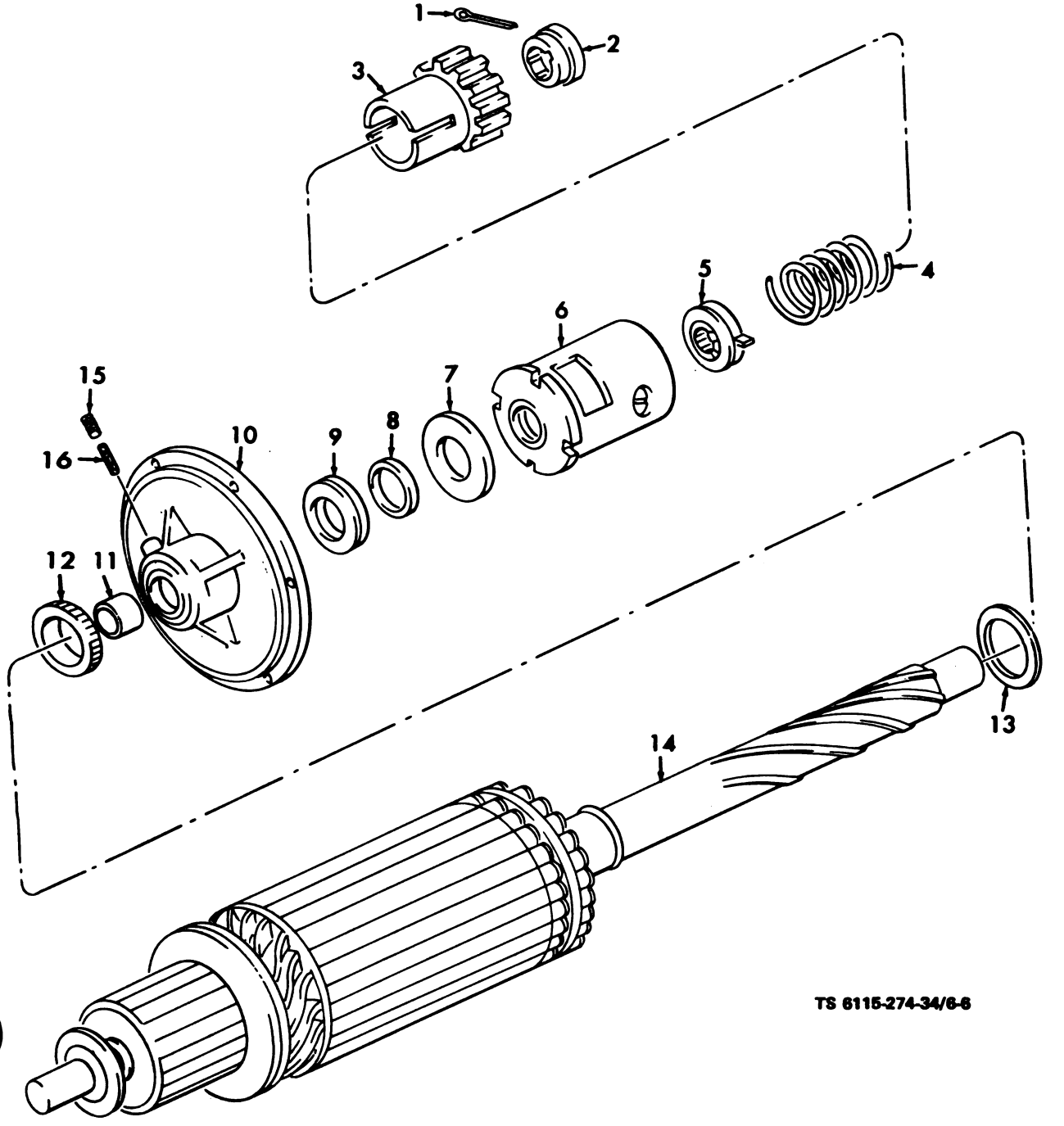



*Figure 6-6. Starting Motor Armature and Drive Assembly, Disassembly*

*(6)* Inspect the drive housing, center bearing support, and field frame for cracks, breaks, and other damage. Inspect all bushings for wear, scoring, and other damage.

*(7)* Repair or replace a damaged or defective part.

*h. Testing After Disassembly.* Test the armature on a growler for shorts, open circuits, and grounds as instructed in TM 5-764. Replace a defective armature. Test the field coils with a multimeter for continuity and grounds as instructed in TM 5-764. Replace a defective coil or coil group. Use a multimeter and test for continuity between each adjacent pair of brush holders. If continuity is indicated, the insulating bushings or washers are defective and must be replaced.

*i. Reassembly of Armature and Drive Assembly.*

*(1)* Install oil wick (16, fig. 6-6) and pipe plug (15).

*(2)* Assemble onto the armature (14) the spacer (13), seal (12), collar (11), drive end plate (10), seal (9), washer (8), recessed washer (7), shift sleeve (6), drive gear guide (5) and spring (4).

*(3)* Install spur gear (3), collar stop (2) and cotter pin (1).

*j. Reassembly of Field Frame Assembly.*

*(1)* Install insulator plates (6, fig. 6-5), magnet pole pieces (5), right field winding (4) and left field winding (3) into field frame (1).

*(2)* Install screws (2).

*k. Reassembly of Drive Housing Assembly.*

*(1)* Install bushing (9, fig. 6-4), oil wick (8) and pipe plug (7).

*(2)* Assemble to housing (6) the spring (5), lever (4), cover (3), washers (2) and screws (1).

*l. Reassembly of Brush Plate Assembly.*

*(1)* Assemble bushing (25, fig. 6-3), insulator washers (24), washers (22, 23), and nut (21).

*(2)* Install bushing (19), expansion plug (20), oil wick (17) and pipe plug (16).

*(3)* Assemble brush end plate (18), nonmetallic washer (15), shaft collar (14), brush holder spacer plate (13), brush holder insulating plate (12), washers (11) and screws (10).

*(4)* Assemble brush ring holder (9), plate insulators (8), brush plate holders (7), brush holders (6), washers (5) and screws (4).

*(5)* Install washers (3), brush springs (2) and shoulder bolts (1).

*m. Reassembly of Subassemblies.*

*(1)* Install terminal stud (15, fig. 6-2), insulator bushing (14), nonmetallic washers (13), washers (12) and nuts (11).

*(2)* Install gasket (8) and armature assembly (9) to field frame assembly (10).

*(3)* Install drive housing assembly (7) with washers (6) and screws (5).

*(4)* Install brush plate assembly (4) with washers (3) and screws (2).

*(5)* Install brush cover (1) and tighten screws.

*n. Bench Testing.*

*(1)* No load test. Connect a 24 volt battery in series with a load theostat and ammeter shunt of a capacity greater than 600 amperes and connect the group between the starting motor terminals. Connect an ammeter to the shunt and connect a direct current voltmeter between the starter terminals. With the voltage adjusted to 24 volts, the current should be approximately 100 amperes maximum at a speed of approximately 8,000 revolutions per minute. The direction of rotation should be clockwise, as viewed from the drive end. If the current and speed are both low, inspect for high resistance in the internal connections. If the current is high and the speed is low, inspect the bearings and armature for binding and incorrect alignment.

*(2)* Stall torque test. With the starting motor connected as in (1) above, fasten a torque arm and spring scale to the armature at the driven end. Adjust the rheostat to give three volts. The correct readings are 500 amperes maximum and a stall torque of 28 ft-lb minimum. The stall torque is the product of the spring scale reading in pounds, multiplied by the length of the torque arm in feet. If the current and torque are both low, inspect for high resistance in the internal connections and for improper brush contact. High current and low torque may be caused by a defective armature of field coil.

*o. Installation.*

*(1)* Refer to figure 6-1 and attach solenoid to starting motor and install motor with screws.

*(2)* Connect electrical leads and cables.

## Section II. BATTERY BOX AND THERMOSTAT

### 6-4. General.

The engine electrical system has two 12 volt storage batteries in series. They are situated in a battery box located at the lower left side of the engine.

### 6-5. Type of Repairs.

Repair, if possible, cracks, breaks, broken welds, and damaged terminals. Replace any part damaged beyond repair.

### 6-6. Battery Box and Thermostat.

*a. Removal.*

*(1)* Release latches and remove battery box cover.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(2)* Loosen nuts and remove battery leads and jumper lead.

*(3)* Release battery holddown and remove batteries.

*(4)* Refer to paragraph 2-6 and remove nuts and screws to remove left-side panel.

*(5)* Loosen clamps and remove heater-to-battery hose.

*(6)* Loosen hose clamp and remove drain hose.

*(7)* Remove thermostat.

*(8)* Remove nuts, screws and clamps on electrical harness.

*(9)* Tag and disconnect electrical leads.

*(10)* Remove screws and remove latches.

*(11)* Remove spacers.

*(12)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(13)* Remove nuts and screws holding battery box side supports.

*(14)* Remove battery box.

*b. Cleaning and Inspection.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean the battery box and thermostat with a cloth dampened with cleaning solvent (Item 4, App. B) and dry thoroughly. Clean the batteries with a wire brush.

*(2)* Inspect for cracks, breaks, broken welds on the battery box, damaged terminals on the thermostat, and other damage.

*(3)* Replace or repair a damaged or defective battery, battery box, and thermostat.

*c. Installation.*

*(1)* Install battery box.

*(2)* Attach side supports with nuts and screws.

*(3)* Attach support to front engine mount with nuts and screws.

*(4)* Install spacers.

*(5)* Install latches with screws.

*(6)* Connect electrical leads.

*(7)* Attach electrical harness with clamps, nuts and screws.

*(8)* Install thermostat.

*(9)* Attach drain hose and tighten clamp.

*(10)* Attach heater-to-battery hose and tighten clamps.

*(11)* Attach left-side panel and screws and nuts.

*(12)* Install batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(13)* Install battery leads and tighten nuts.

*(14)* Replace battery box cover and fasten latches.

## Section III. ENGINE ACCESSORY GENERATOR, MOUNTING BRACKET, ADJUSTING STRAP AND DRIVE BELTS

### 6-7. General.

The alternating current of the accessory generator is converted to direct current by the rectifier. The output of the generator is used to keep the batteries fully charged and to supply the other electrical components requiring this rated voltage.

### 6-8. Type of Repairs.

Check for cracks, breaks, frayed or deteriorated belts, and other damage.

### 6-9. Engine Accessory Generator, Mounting Bracket, Adjusting Strap and Drivebelts.

*a. Removal.*

*(1)* Refer to figure 9-5 and remove screws and nuts holding fan guard. Rotate fan guard to remove.

*(2)* To remove fan V-belts (fig. 6-7), loosen screws securing the fan support assembly to the bracket and move the fan support assembly down to relieve tension. The belts are removed from the lower pulley only.

*(3)* Disconnect wiring harness from engine accessory generator as shown on figure 6-8.

*(4)* Remove nuts and screws and adjusting strap.

*(5)* Remove drivebelts.

*(6)* Remove screws holding mounting bracket and remove bracket.

*(7)* Remove generator.

*b. Disassembly.*

*(1)* Remove nut (41, fig. 6-9) and washer (42) and remove pulley.

*(2)* Tag and disconnect electrical leads as necessary.

*(3)* Remove screws (38) and washers (39) and disassemble drive end housing (40), ball bearing (44), washer (45), key (43), rotor (46), slipring (37), stator (36) from stator guard (35). Remove screws (34) from guard.

*(4)* Remove and disassemble screws (14), brush (23), spring (24), nuts (25), washers (26), washers (27), screws (28), rh brush arm (29), lh brush arm (30), cotter pin (31), brush holder (32) and bearing retainer (33).

*(5)* Disassemble screws (15 and 18), washer (16 and 19), terminal cover (17) and receptacle connector (20).

*(6)* Remove screws (12) and washers (13) and separate slipring end housing (21) from stator guard.

*(7)* Remove screws (2) and washers (3) and disassemble bearing (11), bearing retainer (10), screws (9), key (8), hub (7), nut (5), washer (6), fan (4) and fan guard (1).

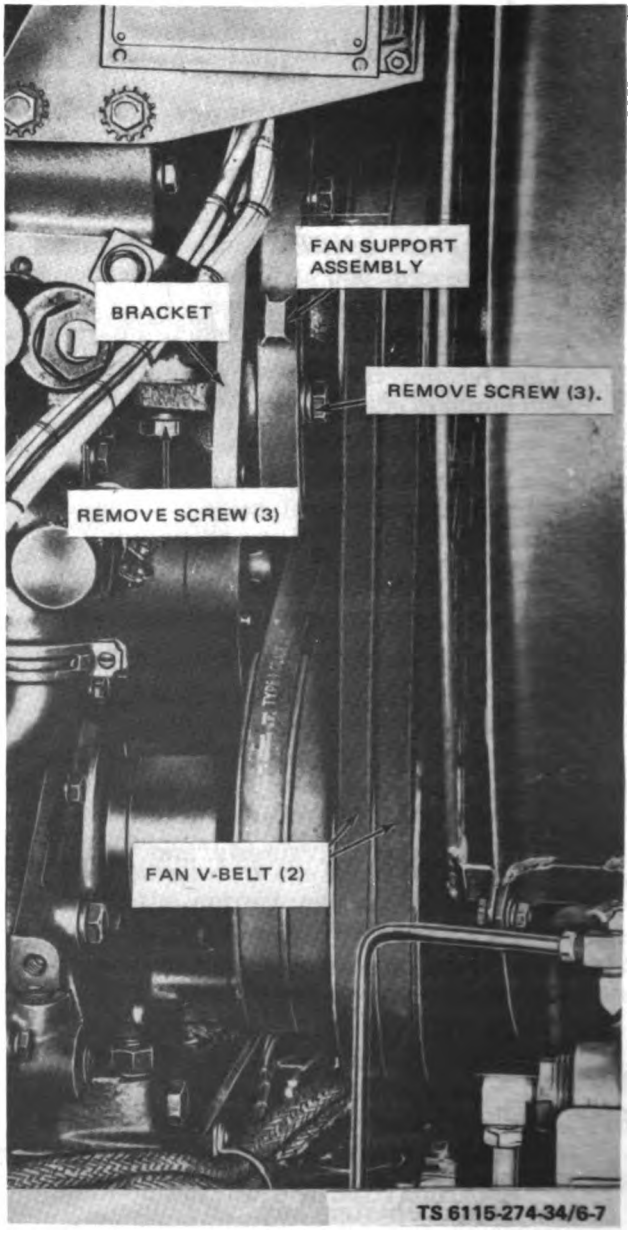



*Figure 6-7. Fan V-Belts, Removal and Installation*

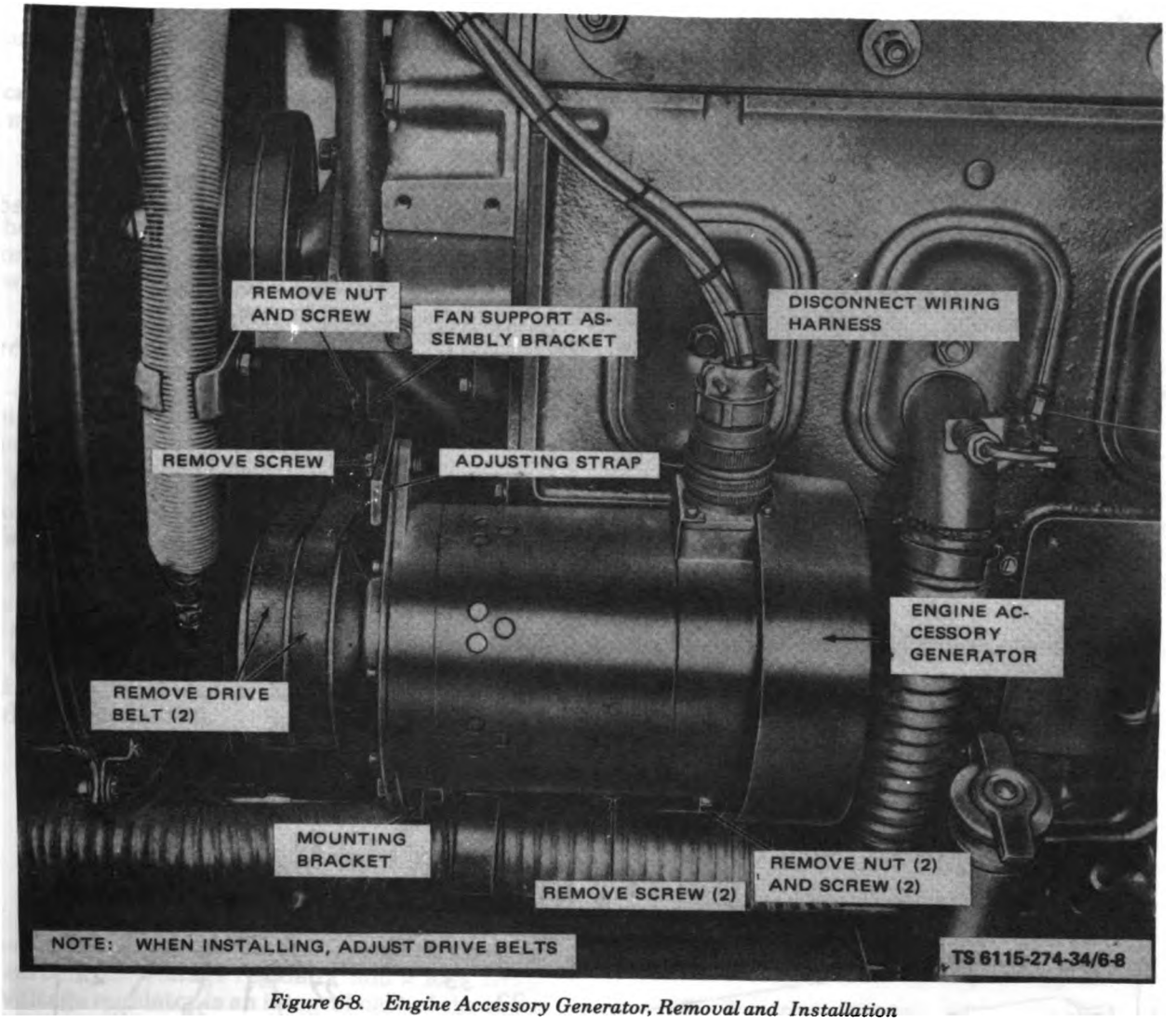



*Figure 6-8. Engine Accessory Generator, Removal and Installation*

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly. Clean all nonmetal parts with a cloth dampened with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect all parts for cracks, breaks, wear, and other damage. Inspect the bearing retainers and baffle washers for bends and distortion. Inspect bearings for defective seals.

*(3)* Inspect the rotor for scoring, burred shaft, defective threads, and other damage.

*(4)* Inspect the brush arms and springs for damage.

*(5)* Inspect the sliprings with a micrometer for roughness and uneven wear. Check eccentricity with a dial indicator. If roughness or eccentricity is indicated, turn and polish the rings in a lathe. The minimum allowable diameter of the sliprings is 1.812 inches (4.6 cm) and the maximum allowable eccentricity is 0.001 inch (0.0254 mm) total reading.

*(6)* Repair or replace defective parts.

*d. Testing After Disassembly.* Test the rotor on a growler for shorts, opens, and grounds as instructed in TM 5-764. Replace a defective rotor. Test the stator with a multimeter for continuity and grounds as instructed in TM 5-764. Replace a defective stator. Use a multimeter and test for

1. Fan guard
2. Screw, machine
3. Washer, lock
4. Fan
5. Nut, self-locking
6. Washer, flat
7. Hub, fan
8. Key, Woodruff
9. Screw, machine
10. Bearing retainer
11. Ball bearing
12. Screw, cap, socket head
13. Washer, lock
14. Screw, machine
15. Screw, machine
16. Washer, lock
17. Cover, terminal
18. Screw, machine
19. Washer, lock
20. Connector, receptacle
21. Slipring and housing
22. Pin, straight, headless
23. Brush
24. Spring, brush
25. Nut, plain
26. Washer, lock
27. Washer, key
28. Screw, machine
29. Arm, brush, rh
30. Arm, brush, lh
31. Pin, cotter
32. Holder, brush
33. Bearing retainer
34. Screw, drive
35. Stator guard
36. Stator
37. Slipring assembly
38. Screw, cap, socket head
39. Washer, lock
40. Drive end housing
41. Nut, plain, hex
42. Washer, flat
43. Key, Woodruff
44. Ball bearing
45. Washer, baffle
46. Rotor

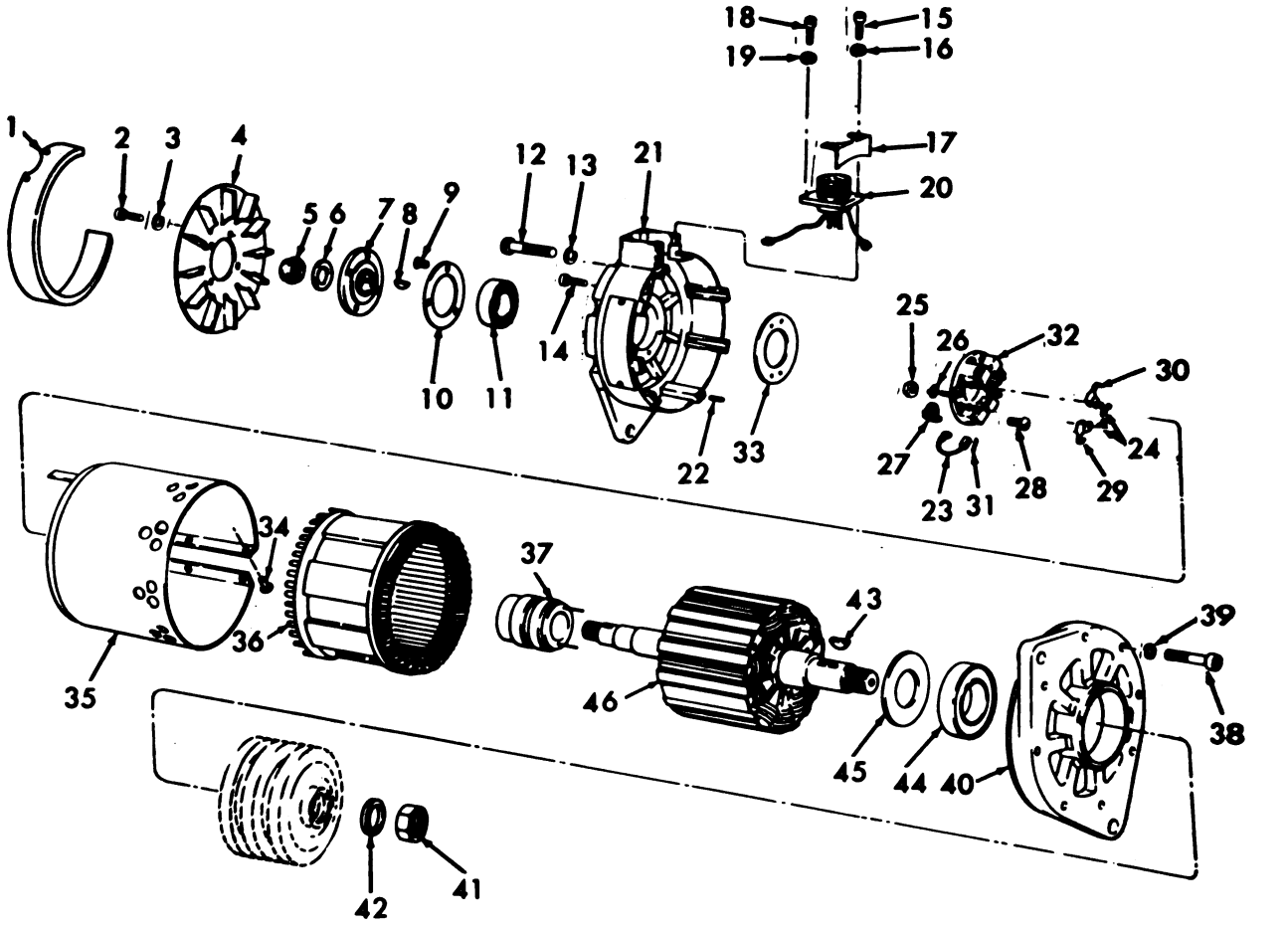



*Figure 6-9. Engine Generator, Disassembly and Reassembly*

continuity between the insulated brush holders and commutator end frame. If continuity is indicated, the commutator end frame is defective and must be replaced.

*e. Reassembly.*

*(1)* Assemble fan guard (1, fig. 6-9), fan (4), washer (6), nut (5), hub (7), key (8), screws (9), bearing retainer (10), bearing (11), washers (3) and screws (2).

*(2)* Attach slipring end housing (21) to stator guard with washers (13) and screws (12).

*(3)* Assemble receptacle connector (20), terminal cover (17), washers (16 and 19) and screws (15 and 18).

*(4)* Assemble bearing retasiner (33), brush holder (32), cotter pin (31), lh brush arm (30), rh brush arm (29), screws (28), washers (27), washers (26), nuts (25), spring (24), brush (23) and screws (14).

*(5)* Assemble stator (36), slipring (37), rotor (46), key (43), washer (45), bearing (44), drive end housing (40), washers (39) and screws (38). Attach guard with screws (34).

*(6)* Connect electrical leads.

*(7)* Attach pulley with washer (42) and nut (41).

*f. Installation.*

*(1)* Install generator (fig. 6-8) and mounting bracket with screws.

*(2)* Attach adjusting strap with nuts and screws but do not tighten.

*(3)* Install drivebelts and position generator so that belts deflect 5/8 inch midway between pulleys. Tighten adjusting strap screws.

*(4)* Connect wiring harness.

*(5)* Refer to figure 6-7 and replace fan belts over lower pulley. Adjust fan support assembly so that the belts deflect 5/8 inch midway between the pulleys. Tighten screws on fan support assembly.

*(6)* Install fan guard and attach with nuts and screws.

## Section IV. VOLTAGE REGULATOR AND BRACKET

### 6-10. General.

The engine generator voltage regulator consists of a carbon pile voltage regulator and a load relay. The voltage regulator is an integral part of the cover for the watertight box which contains the load relay, a voltage adjusting rheostat, and two feed-through capacitors. An internal wiring diagram is shown in figure 6-10.

### 6-11. Type of Repairs.

Repair involves parts that are bracked, bent or broken, corroded or burned.

### 6-12. Voltage Regulator and Bracket.

*a. Removal.*

*(1)* Disconnect electrical receptacle connectors (fig. 6-11).

*(2)* Remove nuts and screws and remove voltage regulator and bracket.

*b. Disassembly of Voltage Regulator Box.*

*(1)* Remove nuts (1, fig. 6-12), washers (2) and electrical lead (3).

*(2)* Remove regulator box (4), mounts (5), washers (6), mounting brackets (7), screws (8), washers (9), brackets (10) and pipe plug (11).

*(3)* Remove screws (12), washers (13), regulator cover (14) and packing (15).

*(4)* Tag and disconnect electrical leads as necessary.

*(5)* Remove screws (16), washers (17), receptacle connectors (18 and 19) and gaskets (20).

*(6)* Remove screws (21, 22 and 23), panel (24), spacers (25 and 26), screws (27), washers (28) and shield (29).

*(7)* Remove screws (30), washers (31 and 32), nuts (33), washers (34) and capacitor assembly (35).

*(8)* Remove screws (36), washers (37 and 38) and load relay assembly (39).

*c. Disassembly of Load Relay Assembly.*

*(1)* Remove screws (1, fig. 6-13), washers (2 and 3( and clip (4).

*(2)* Remove nut (5), washer (6), nut (7), washer (8), insulating washer (9), bushing (10), washer (11), contact plate (12), plate (13) and armature stop (14).

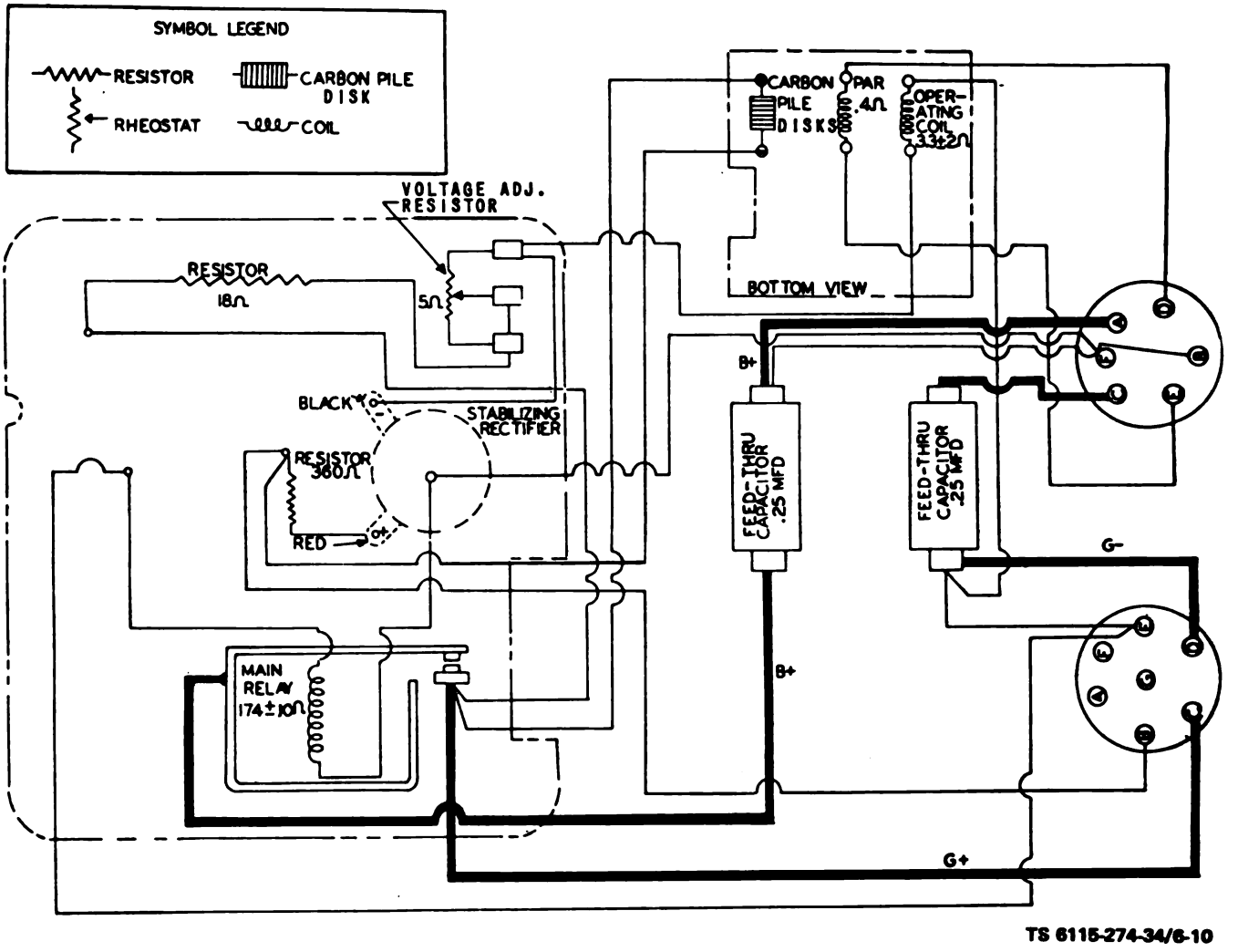



*Figure 6-10. Generator Voltage Regulator, Internal Wiring Diagram*

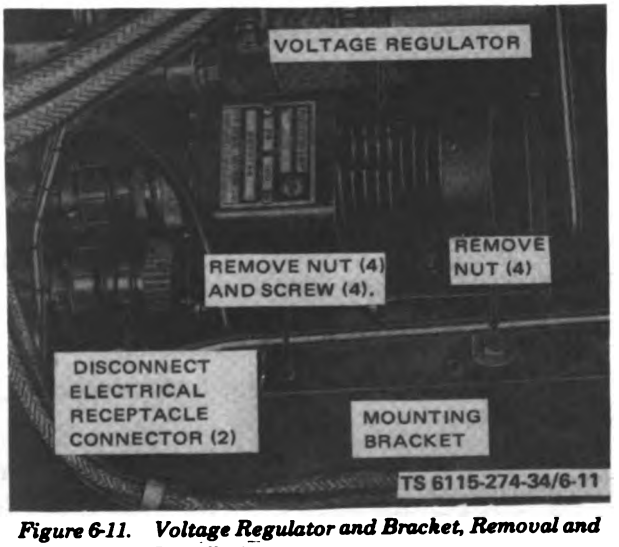



*Figure 6-11. Voltage Regulator and Bracket, Removal and Installation*

*(3)* Remove screws (15), washers (16 and 17), adjusting nut (18), adjusting screw (19), spring (20), armature assembly (21), and coil assembly (22).

*(4)* Remove nut (23), washers (24, 25 and 26), resistor (27), screw (28) and electrical lead (29).

*(5)* Remove nut (30), washers (31 and 32), screw (33) and resistor (34).

*(6)* Remove nut (35), washer (36), nut (37), washers (38 and 39) and screw (45).

*(7)* Remove nut (40), washer (41), nut (42), washers (43 and 44), screw (51) and resistor (52).

*(8)* Remove nut (46), washer (47), nut (48), washers (49 and 50), screw (53), rectifier (54), and electrical lead (55).

*(9)* Remove screw (56) and washers (57 and 58).

1. Nut, plain, hex
2. Washer, lock, IT
3. Lead, electrical
4. Regulator box
5. Mount
6. Washer, flat
7. Bracket, mounting
8. Screw, machine
9. Washer, lock
10. Bracket
11. Plug, pipe
12. Screw, machine
13. Washer, lock
14. Regulator cover
15. Preformed packing
16. Screw, machine
17. Washer, lock
18. Receptacle connector
19. Receptacle connector
20. Gasket
21. Screw, machine
22. Screw, machine
23. Screw, machine
24. Panel
25. Spacer
26. Spacer
27. Screw, machine
28. Washer, lock
29. Shield
30. Screw
31. Washer, lock
32. Washer
33. Nut, plain, hex
34. Washer, lock
35. Capacitor assembly
36. Screw, machine (spec)
37. Lockwasher (spec)
38. Washer (spec)
39. Load relay assembly

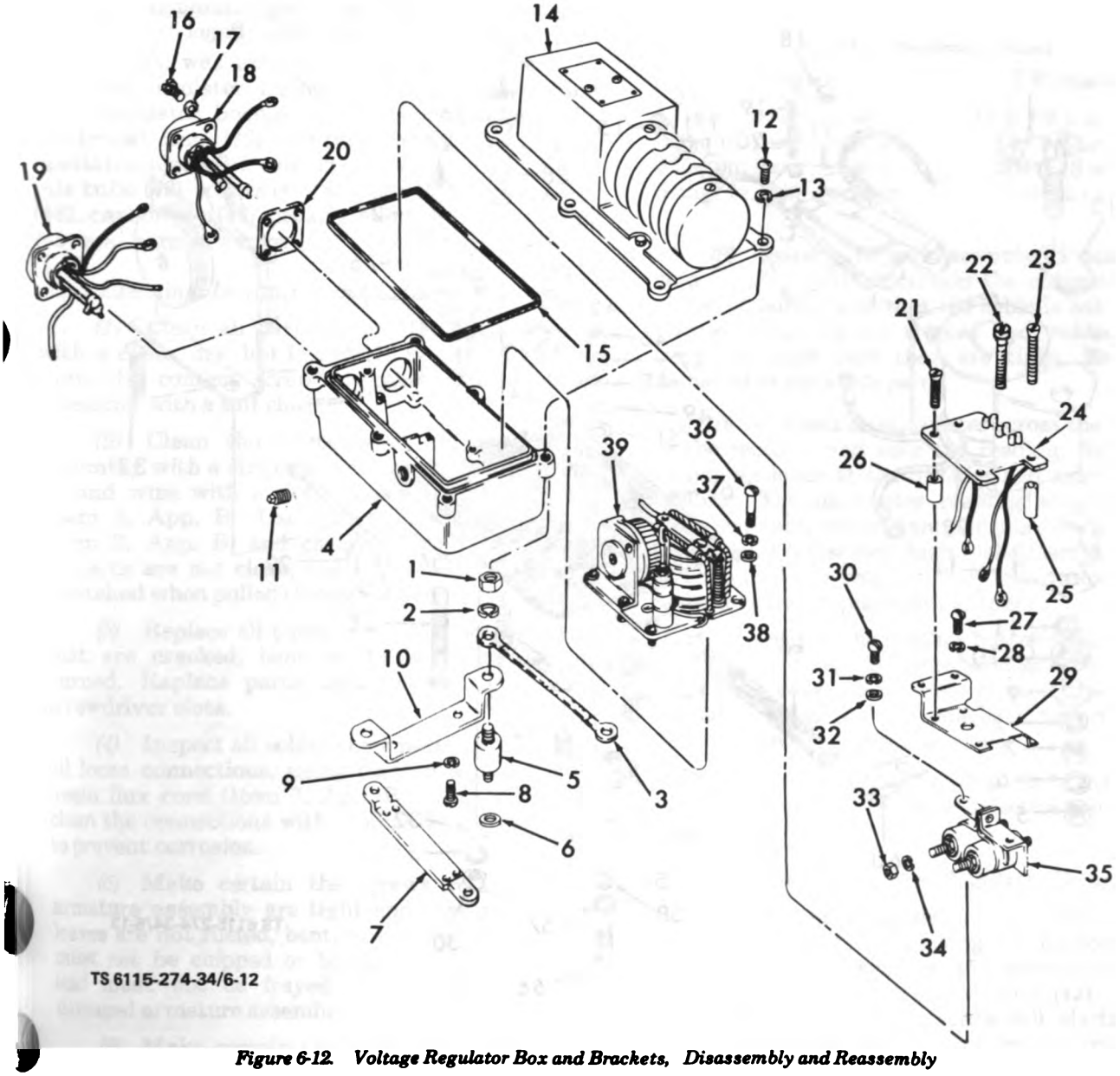



*Figure 6-12. Voltage Regulator Box and Brackets, Disassembly and Reassembly*

1. Screw, machine
2. Washer, lock
3. Washer, flat
4. Clip
5. Nut, hex
6. Washer, lock
7. Nut, hex
8. Washer, lock
9. Washer, insulator
10. Bushing, insulator
11. Washer, flat
12. Contact plate
13. Plate, insulator
14. Stop, armature
15. Screw, machine
16. Washer, lock
17. Washer, flat
18. Adjusting nut (spec)
19. Adjusting screw (spec)
20. Spring
21. Armature assembly
22. Coil assembly
23. Nut, hex
24. Washer, lock
25. Washer, flat
26. Insulating washer
27. Resistor, 18 ohm
28. Screw, machine
29. Electrical lead
30. Nut, hex
31. Washer, lock
32. Washer, flat
33. Screw, machine
34. Adjustable resistor, 5 ohm
35. Nut, hex
36. Washer, lock
37. Nut, hex
38. Washer, lock
39. Washer, flat
40. Nut, hex
41. Washer, lock
42. Nut, hex
43. Washer, lock
44. Washer, flat
45. Screw, machine
46. Nut, hex
47. Washer, lock
48. Nut, hex
49. Washer, lock IT
50. Washer, flat
51. Screw, machine
52. Resistor, 360 ohm
53. Screw, machine
54. Rectifier, stabilizing
55. Electrical lead
56. Screw, machine
57. Washer, lock
58. Washer, flat
59. Insulation
60. Terminal
61. Panel

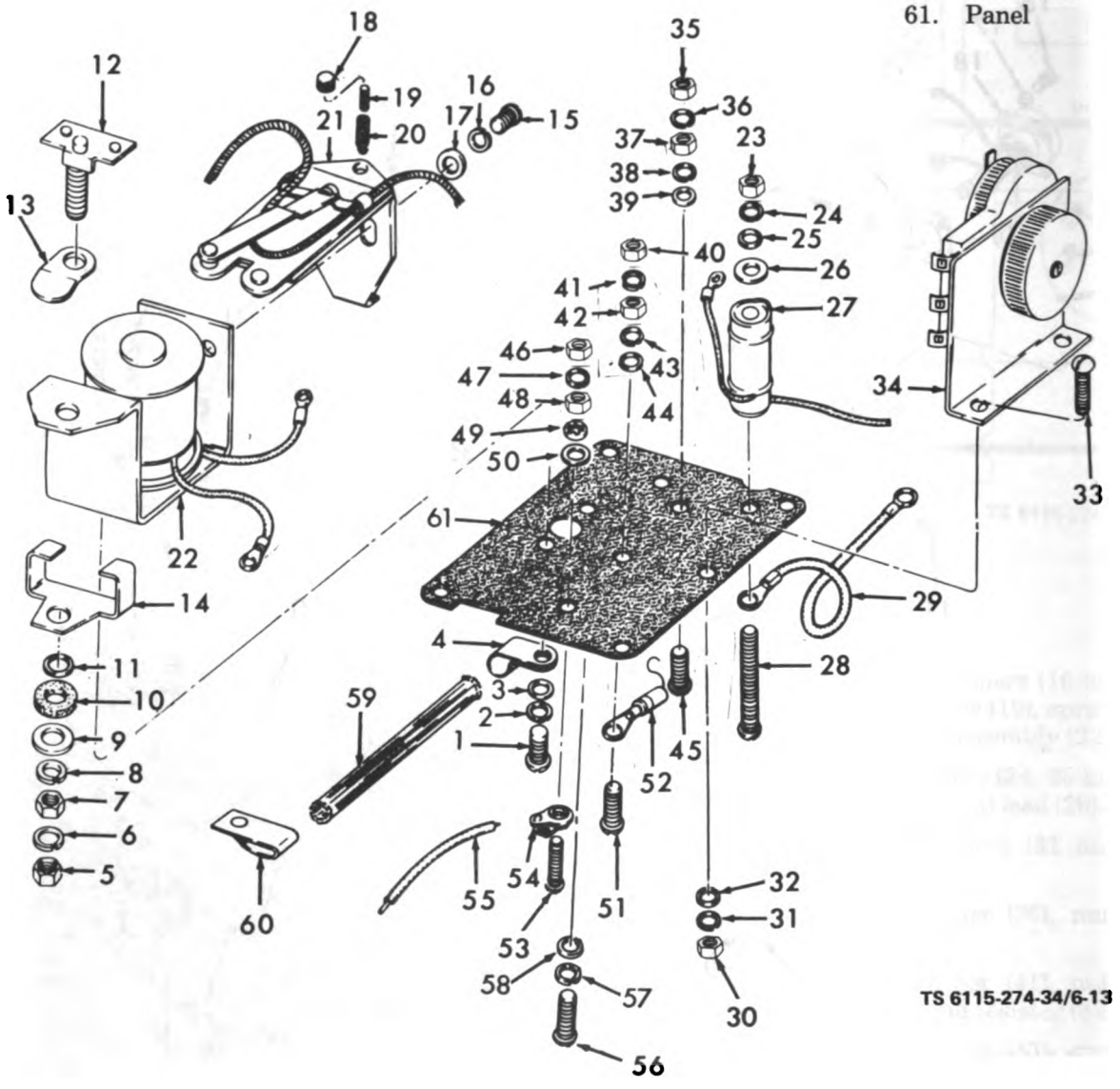



*Figure 6-13. Load Relay Assembly, Disassembly and Reassembly*

*(10)* Remove insulation (59) and terminal (60) leaving panel (61).

*d. Disassembly of Voltage Regulator Cover.*

*(1)* Remove screws (1, fig. 6-14) and washers (2).

*(2)* Remove screws (3), spacers (4), contact panel (5) and plug (6).

*(3)* Remove screws (7), washers (8), end plate cover (9), packing (10), screws (11), washers (12), screws (13), washers (14 and 15), coil pot end plate (16), coil core (17), paralleling coil (18), operating coil (9), coil pot (20), shim (21), bimetal ring (22), spacer (23), armature (24), and contact and lead (25).

*(4)* Disassemble screws (26), washers (27), packing (28), disk and tube support cover (29), screws (30), washers (31), screws (32), washers (33 and 34), insulator washer (35), insulator bushing (36), insulator bushing (37), insulator plate (38), electrical lead (39), contact carrier screw (40), insulator plate (41), contact screw plate (42), carbon pile tube (43), screws (44), washers (45), key washers (46), carbon pile (47), packing (48), regulator element (49) and regulator cover (50).

*e. Cleaning, Inspection and Repair.*

*(1)* Clean all parts except the carbon disks with a clean, dry, lint-free cloth. Wipe carbon dust from the contact screw assembly and armature assembly with a soft cloth.

*(2)* Clean the contacts of the load relay assembly with a strip of crocus cloth (Item 6, App. B) and wipe with a cloth moistened with cleaner (Item 3, App. B). Use hard-surfaced bond paper (Item 2, App. B) and check the contacts. If the contacts are not clean, the sheet of paper will be scratched when pulled through the contacts.

*(3)* Replace all parts of the voltage regulator that are cracked, bent, or broken, corroded or burned. Replace parts that have unserviceable screwdriver slots.

*(4)* Inspect all soldered connections. Resolder all loose connections, using tin-lead solder (50/50) (resin flux core) (Item 7, App. B). After soldering, clean the connections with alcohol (Item 1, App. B) to prevent corrosion.

*(5)* Make certain the screws retaining the armature assembly are tight and that the spring leaves are not rusted, bent, or broken. The contact must not be chipped or broken and the electrical lead must not be frayed or burned. Replace a damaged armature assembly.

*(6)* Make certain the contact washer of the contact screw assembly is not pitted or chipped. Inspect the screw threads for damage and wear. Replace a damaged or defective contact screw assembly.

*(7)* Inspect the coils for frayed leads and broken or burned insulation. Replace a damaged or defective coil.

*(8)* Examine the resistors for broken leads and windings, burning, and damage to the insulation. Make certain the lock clip locks the adjusting knob of the 5 ohm adjustable resistor in any given position. Using an ohmmeter, check all resistors for electrical continuity. Check the 5 ohm adjustable resistor through the entire range of rotation. Using an ohmmeter, measure the resistance of each resistor; resistance values should be shown in table 6-1.

*Table 6-1. Resistance Values*

| Resistor | Resistance |
|---|---|
| 18-ohm fixed resistor | 18.0 +0.9 or -0.9 ohms |
| 339-ohm fixed resistor | 330 +33 or -33 ohms |
| 360-ohm fixed resistor | 360 +18 or -18 ohms |
| 5-ohm variable resistor | 5.0 +0.5 or -0.5 ohms |

*(9)* Inspect the coil assembly as described in step (1) above. Make certain the contacts are not pitted or burned and that the cable is not frayed or burned. Examine the riveted and welded connections to make sure they are tight. Replace all damaged or defective parts.

*(10)* Connect an ohmmeter across the terminals of the rectifier and note the reading. Reverse the ohmmeter leads at the rectifier and again note the reading. The ohmmeter reading should show a closed circuit (low resistance) in one direction and an open circuit (extremely high resistance) in the other direction. If the rectifier does not conform to the resistance test, replace the rectifier.

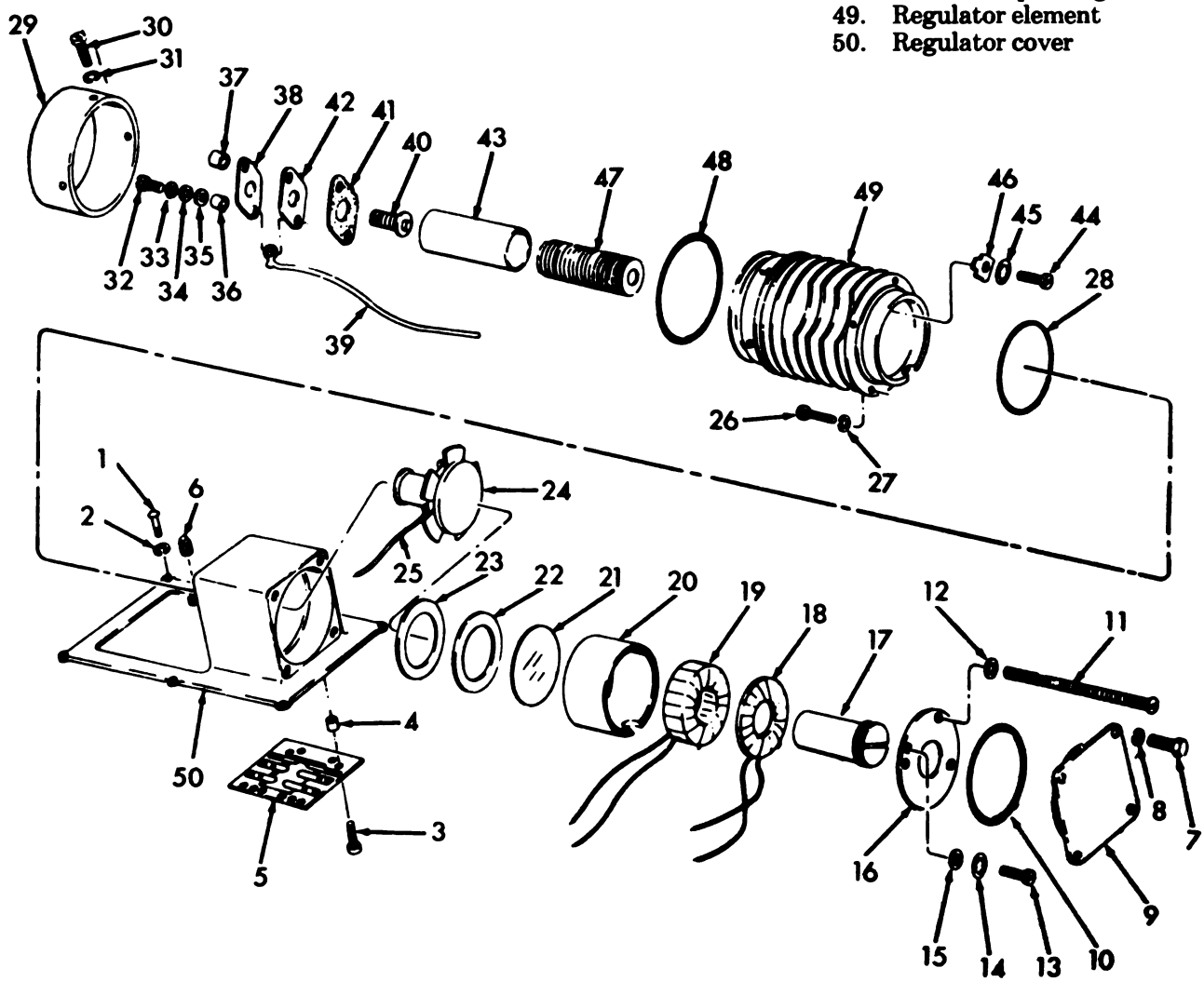
*(11)* Inspect the contact buttons and blades of the contact panels for corrosion and burning and make sure they are securely riveted. See that the insulating paint on the panels is not chipped or peeling. Replace a defective panel.

*(12)* Inspect the packing and gaskets for tears and cracking; replace defective packing and gaskets.

*f. Assembly of Voltage Regulator Cover.*

*(1)* Assemble regulator cover (50, fig. 6-14), regulator element (49), packing (48), carbon pile (47), key washers (46), washers (45), screws (44), carbon pile tube (43), contact screw plate (42), insulator plate (41), contact carrier screw (40), electrical lead (39), insulator plate (38), insulator bushing (37), insulator bushing (36), insulator washer (35),

1. Screw, machine
2. Washer, lock
3. Screw, machine
4. Spacer
5. Contact panel
6. Plug, pipe
7. Screw, cap
8. Washer, lock
9. End plate cover
10. Preformed packing
11. Screw, machine
12. Washer, lock, IT
13. Screw, machine
14. Washer, flat
15. Washer, lock, IT
16. Coil pot end plate
17. Coil core
18. Paralleling coil
19. Operating coil
20. Coil pot
21. Shim
22. Bimetal ring
23. Spacer
24. Armature
25. Contact and lead
26. Screw, machine
27. Washer, lock, IT
28. Preformed packing
29. Disk and tube support cover
30. Screw, machine
31. Washer, lock
32. Scre, machine
33. Washer, lock, IT
34. Washer, flat
35. Insulator washer
36. Insulator bushing
37. Insulator bushing
38. Insulator plate
39. Contact screw electrical lead
40. Contact carrier screw
41. Insulator plate
42. Contact screw plate
43. Carbon pile tube
44. Screw, machine
45. Washer, lock
46. Washer, key
47. Carbon pile
48. Preformed packing
49. Regulator element
50. Regulator cover




TS 6115-274-34/6-14

*Figure 6-14. Voltage Regulator Cover, Disassembly and Reassembly*

washers (33 and 34), screws (32), washers (31), screws (30), disk and tube support cover (29), packing (28), washers (27), screws (26).

*(2)* Disassemble contact and lead (25), armature (24), spacer (23), bimetal ring (22), shim (21), coil pot (20), operating coil (19), paralleling coil (18), coil core (17), coil pot end plate (16), washers (14 and 15), screws (13), washers (12), screws (11), packing (10), end plate cover (9), washers (8), and screws (7).

*(3)* Assemble plug (6), contact panel (5), spacers (4) and screws (3).

*(4)* Install washers (2) and screws (1).

*g. Assembly of Load Relay.*

*(1)* Assemble panel (61, fig. 6-13), terminal (60) and insulation (59).

*(2)* Install washers (57 and 58) and screws (56).

*(3)* Assemble electrical lead (55), rectifier (54), screw (53), washers z)49 and 50), nut (48), washer (47) and nut (46).

*(4)* Assemble resistor (52), screw (51), washers (43 and 44), nut (42), washer (41) and nut (40).

*(5)* Install screw (45), washers (38 and 39), nut (37), washer (36) and nut (35).

*(6)* Assemble resistor (34), screw (33), washers (31 and 32) and nut (30).

*(7)* Assemble electrical lead (29), screw (28), resistor (27), washers (24, 25 and 26) and nut (23).

*(8)* Install coil assembly (22), armature assembly (21), spring (20), adjusting screw (19), adjusting nut (18), washers (16 and 17), and screws (15).

*(9)* Install armature stop (14), plate (13), contact plate (12), washer (11), bushing (10), insulating washer (9), washer (8), nut (7), washer (6) and nut (5).

*(10)* Install clip (4), washers (2 and 3) and screws (1).

*h. Assembly of Voltage Regulator Box.*

*(1)* Install load relay assembly (39, fig. 6-12), washers (37 and 38) and screws (36).

*(2)* Install capacitor assembly (35), washers (34), nuts (33), washers (31 and 32) and screws (30).

*(3)* Install shield (29), washers (28), screws (27), spacers (25 and 26), panel (24) and screws (21, 22 and 23).

*(4)* Install gaskets (20), receptacle connectors (18 and 19), washers (17) and screws (16).

*(5)* Connect all electrical leads.

*(6)* Install packing (15), regulator (14), washers (13), and screws (12).

*(7)* Install pipe plug (11), brackets (10), washers (9), screws (8), mounting brackets (7), washers (6), mounts (5), and regulator box (4).

*(8)* Install electrical lead (3), washers (2) and nuts (1).

*i. Load Relay Adjustment.* Refer to figure 6-15 and adjust the load relay.

*j. Bench Test and Adjustment.*

*(1)* Load relay closing voltage adjustment. With the cover off connect a 24 volt battery, variable resistor (0-100 ohm, 5 watt), and a 0 to 20 volt voltmeter across C and F pins of the 6 cable electrical receptacle. Slowly increase the voltage by adjusting the voltage regulator variable resistor until the relay closes. The correct closing voltage is 13-1.0 volts. To adjust the closing voltage, turn the relay voltage adjusting nut clockwise to increase and counterclockwise to decrease. The relay should open when the voltage is increased to between 9 and 11 volts.

*(2)* Ground test. Test from each regulator terminal to ground. No circuit should be indicated.

*(3)* Carbon pile setting adjusting. Connect the voltage regulator into a test circuit that incorporates a 7 horsepower drive motor.

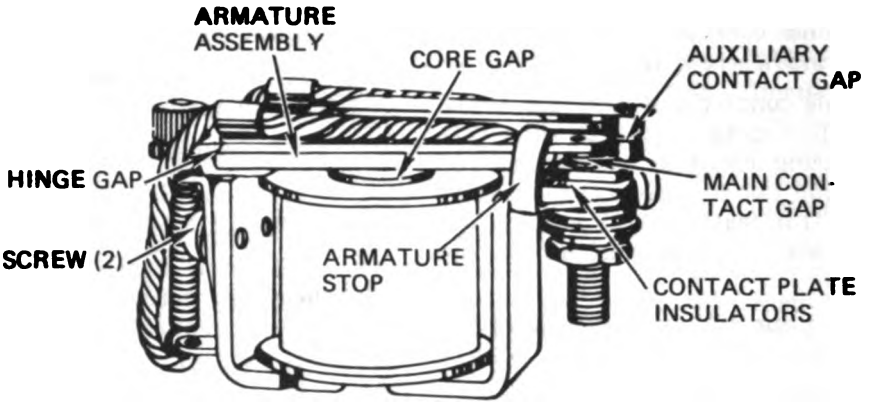
**CAUTION**

**Never allow the voltage to exceed 32 volts during these tests or the rectifier will be damaged. Unless otherwise stated, a battery must be connected in the load circuit at all times during the test.**

*(4)* Operational test and adjustments.

*(a)* Remove the cover from the regulator box and connect the carbon pile for setting as described in figure 6-16.

*b)* Adjust the variable resistor so that a 0 to 20 volt voltmeter reads 12 to 14 volts direct current. A crackle in the earphone or an erratic vibration indicates loose adjustment of the carbon pile.




TS 6115-274-34/6-15

STEP 1. WITH MAIN CONTACTS CLOSED, MEASURE CLEARANCE BETWEEN HINGE SPRING OF ARMATURE ASSEMBLY AND BRACKET OF COIL ASSEMBLY. CORRECT HINGE GAP SETTING IS 0.006 ± 0.002 INCH (0.015 ± 0.005 CM). SET GAP BY LOOSENING SCREWS AND MOVING ARMATURE ASSEMBLY UP OR DOWN.

STEP 2. WITH MAIN CONTACTS CLOSED, MEASURE GAP BETWEEN COIL CORE AND ARMATURE ASSEMBLY. CORRECT CORE GAP SETTING IS 0.028 ± 0.003 INCH (0.071 ± 0.008 CM). SET GAP BY BENDING ARMATURE OR BY ADDING OR SUBTRACTING CONTACT PLATE INSULATORS.

STEP 3. CORRECT MAIN CONTACT GAP SETTING IS 0.060 ± 0.002 INCH (0.152 ± 0.005 CM). ADJUST GAP SITTING BY BENDING ARMATURE ASSEMBLY. IF ARMATURE HITS ARMATURE STOP BEFORE CORRECT CLEARANCE IS OBTAINED, ADJUST GAP SETTING BY REMOVING CONTACT PLATE INSULATORS.

STEP 4. CORRECT AUXILIARY CONTACT GAP SETTING IS 0.030 ± 0.002 INCH (0.076 ± 0.005 CM). ADJUST GAP SETTING BY BENDING THE AUXILIARY CONTACT CARRIER.

*Figure 6-15. Load Relay Adjustment*

Remove the tube and disk support cover and tighten the carbon pile by turning the contact screw. Adjust the contact screw only enough to eliminate the crackle, and leave a distinct high-frequency hum. If the hum does not start at the beginning of the operation, adjust the carbon pile until the hum begins. Allow the carbon pile to settle for no less than 30 minutes but no more than two hours. Listen occasionally to make sure that the hum does not stop.

*(c)* Remove the end plate cover from the regulator cover, loosen the core locking screw, and adjust the position of the core so that the flush marks (two dabs of paint) line up when the core is in a flush position.

*(d)* Loosen the contact carrier screw turning it counterclockwise.

*NOTE*

*To loosen the carrier screw, loosen screw opposite the screw that holds the electrical lead. Loosen the screw approximately 1/2 turn: then loosen the carrier screw all the way (about 2-1/2 turns). Do not force the carrier screw beyond this point.*

*(e)* Place the test circuit battery switch in the ON position to close the regulator relay. Place the switch in the F circuit of the regulator and bring the alternator speed up to 900 rpm. Place the battery switch in the OFF position.

*(f)* Remove the pipe plug from the side of the regulator box and adjust the rheostat to the full clockwise position. Adjust the contact carrier screw until a stable voltage is reached. As the screw is turned in, the voltage rises to a peak of 28 to 32 volts, then drops to some lesser value (24 to 26

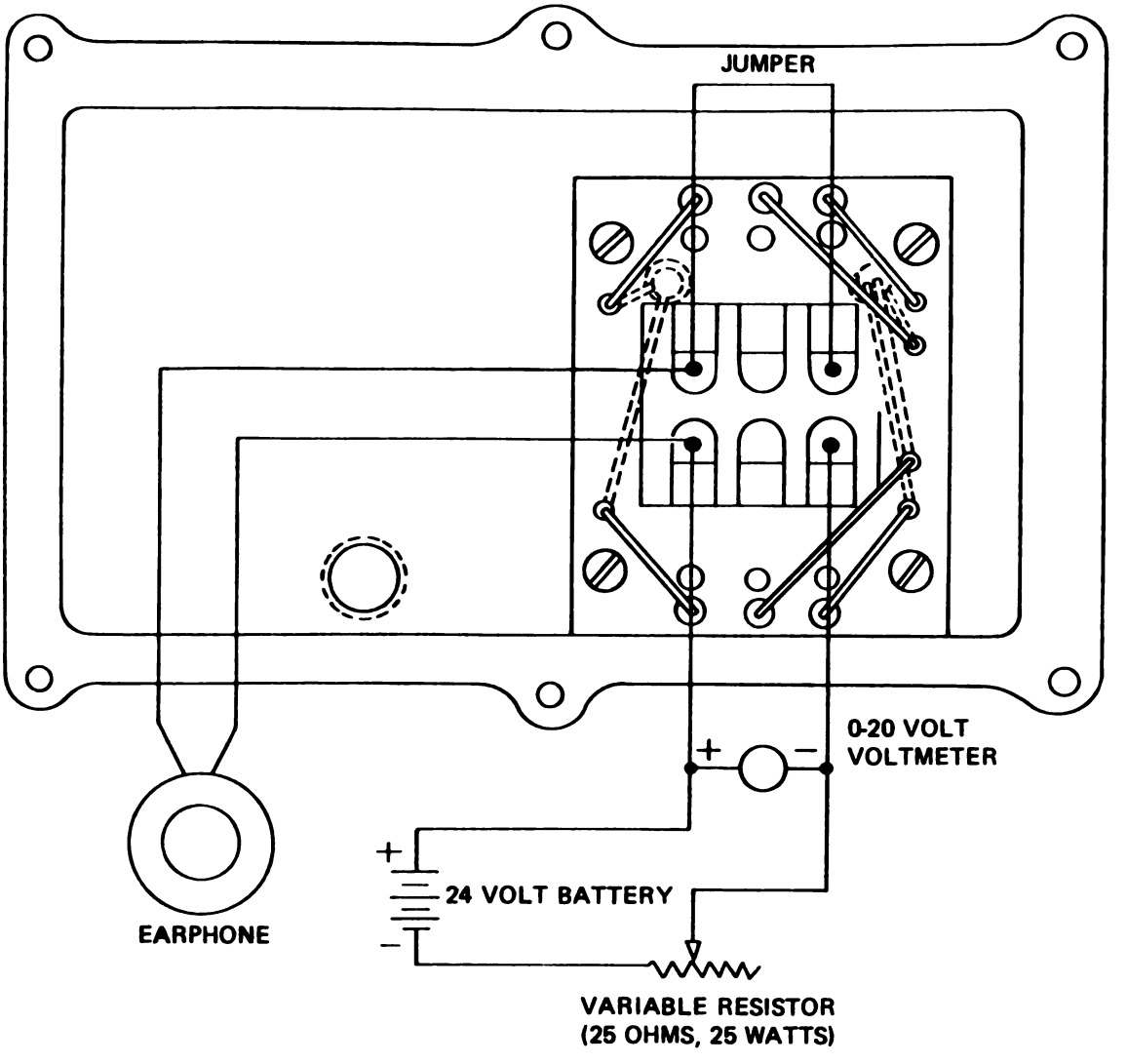



*Figure 6-16. Setting Carbon Pile, Wiring Diagram*

volts), and then rises again. The proper point of adjustment is the point where the voltage just begins to rise for the second time.

*(g)* Adjust the regulator open circuit voltage to 29.5 -0.1 volts by screwing one core out if the voltage is too low and in if the voltage is too high.

*(h)* When the regulator is in proper adjustment, the core flush marks should line up within 1/8 turn clockwise direction. If the core mark is more than 1/8 turn clockwise, the regulator should be disassembled and shims should be removed. If the core mark is more than 1/4 turn counterclockwise, the regulator should be disassembled and shims should be added. One shim is equivalent to about 1/8 turn.

*NOTE*

*Never leave less than two shims in the regulator. If it is necessary to leave more than two shims, replace the armature core assembly.*

*(i)* Turn the regulator rheostat counterclockwise to obtain 28.5 volts at 900 rpm. Check the paralleled winding. When 0.25 volts is applied to the paralleled winding, with D terminal positive and E terminal negative, the terminal voltage should drop 2.5 -0.25 volts. Check the range of adjustment of the regulator by turning the rheostat. The range should be at least 25.0 to 29.0 volts. If the voltage range is off center, the core position should be reset.

*(j)* Place the battery switch in the ON position and increase the generator speed to 2,000 rpm. Observe the terminal voltage while applying a 50 ampere load. If the voltage goes up, turn the contact carrier screw in. If the voltage goes down more than 0.6 volt, turn the screw out. This adjustment must be made very gradually. After each adjustment of the carrier screw, readjust the core to give 27.8 to 28.0 volts with no load. Repeat this process until the regulator controls the voltage within the limits of 27.4 to 28.0 volts with the load shocked on and off several times.

*(k)* Heat the regulator for a minimum of 30 minutes after settling. The regulator may be heated on the test stand by connecting it to the system, and running the generator at 2,000 rpm with a 50 ampere load. Increase the speed to 4,000 rpm and shock full load off and on. The voltage should not drop below 27.3 volts or rise above 28.3 volts after being shocked several times. If the voltage drops below 27.3 volts when full load is applied, loosen the contact carrier screw and shock full load off and on several times. Check the voltage rises when full load is applied, tighten the carrier screw. Shock full load on and off several times. Check the voltage. When the regulator is in proper adjustment, the core flush marks should line up within 1/8 turn clockwise and 1/4 turn in the counterclockwise direction.

*(l)* Check the core locking screw and two pile locking screws to make sure they are tight. If not, tighten them. Reduce speed to 2,000 rpm. The voltage, after shocking the load off and on several times, should be 27.8 to 28 volts, with a 5- to 10-ampere load. If necessary, reset the voltage to 27.8 to 28.0 volts with the voltage adjusting rheostat.

*(m)* Refer to table 6-2, Performance Check Chart, for additional speed load check information.

*(n)* To perform the minimum resistance test, apply a 70 to 90 ampere load to the system and reduce the speed of the alternator until the terminal voltage reaches 26.0 to 26.5 volts at approximately 1,300 rpm. Read the field current and carbon pile voltage. Divide the carbon pile voltage by the field current. This value should never exceed 0.5 ohm.

*(o)* Reduce the generator speed to 1,000 rpm and remove all load, including the battery. Recheck the voltage range of the regulator by turning the voltage adjusting rheostat. The range should be at least 25.0 to 29.0 volts. If the adjustments up to step (j) above are correct, this range should be met.

*(p)* Inspect the core locking screw and two pile locking screws to be sure they are tight. If they are not, tighten them and repeat (n) above.

*(q)* Turn the test circuit off and permit generator to come to a standstill. Turn the battery switch on and place the test circuit in operation. Run the generator through its speed range up to 7,000 to 8,000 rpm and return the speed to 2,000 rpm. Shock full load on and off several times and check the voltage. Reset the regulator to 27.8 to 28.0 volts with the voltage adjusting theostat. Shock full load on and off several times and check the voltage. If an adjustment is necessary, repeat this step until the voltage remains constant when the system is shut down and restarted.

*k. Installation.*

*(1)* Refer to figure 6-11 and install voltage regulator and brackets, using nuts and screws.

*(2)* Connect electrical receptacle connectors.

*Table 6-2. Performance Check Chart*

| Load | 2,000 rpm | 4,000 rpm | 8,000 rpm |
|---|---|---|---|
| 5-10 Amperes | 27.8-28.0 Volts | 27.9-28.3 Volts | 27.9-28.6 Volts |
| 25-50-100 Amperes | Minimum Volts 27.4 | 27.3 Volts | 27.3 Volts |
| | Maximum Volts 28.0 | 28.3 Volts | 28.7 Volts |

# CHAPTER 7

# REPAIR OF COOLING SYSTEM

## Section I. PULLEY AND ASSEMBLY

**7-1. General.**

The pulley and hub assembly controls the operation of the cooling fan and derives the power through V-belts connected to the crankshaft.

**7-2. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-3. Pulley and Hub.**

*a. Removal.*

*(1)* Remove the four nuts and screws holding the fan guard in place and rotate to remove fan guard.

*(2)* Remove six nuts and screws and remove fan (fig. 1-1).

*b. Disassembly.*

*(1)* Remove the fan hubcap (1, fig. 7-2).

*(2)* Loosen adjusting bracket (10) so that V-belts can be removed.

*(3)* Remove screws (12), washers (11) and bracket (10).

*(4)* Remove retaining ring (2), roller bearing (3), pipe plug (4) and pulley (5).

*(5)* Remove fan shaft (6), retaining ring (9), retaining ring (8), and bearing (7).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the bearings for worn or indented raceways or rough operation.

*(3)* Inspect the shaft for scores, scratches, cracks, and evidence of being bent.

*(4)* Inspect the fan pulley for cracks, breaks, and burrs. Remove all nicks and burrs from the pulley.

*(5)* Replace or repair a damaged or defective part.

*d. Reassembly.*

*(1)* Assemble fan shaft (6, fig. 7-2), bearing (7), retaining ring (8), bracket (10) and retaining ring (9).

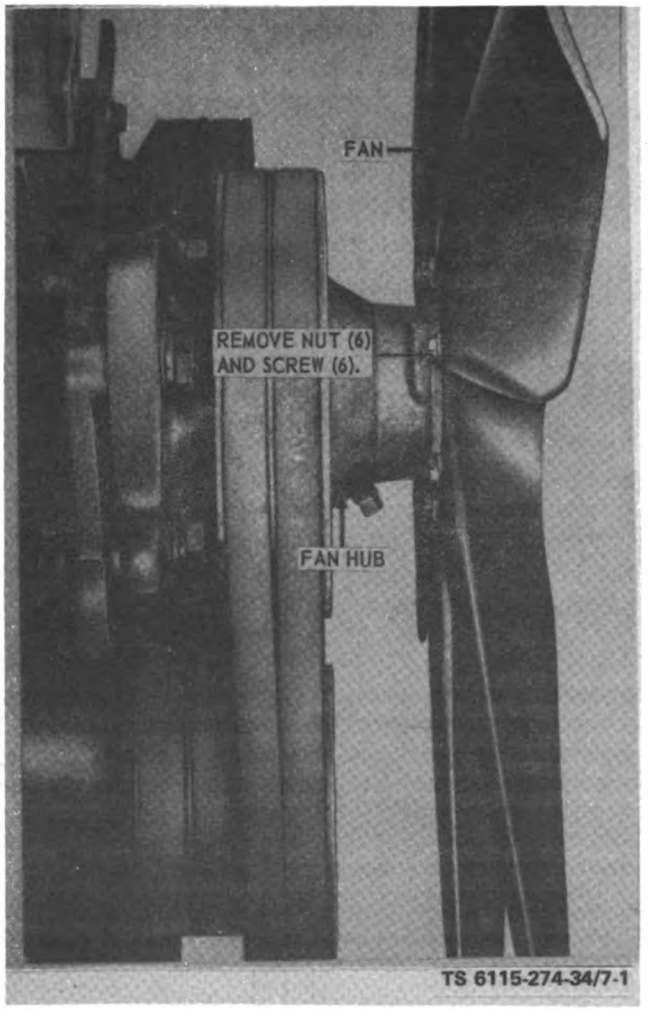



*Figure 7-1. Fan, Removal and Installation*

1. Fan hubcap
2. Retaining ring
3. Roller bearing
4. Plug, pipe
5. Groove pulley
6. Fan shaft
7. Ball bearing
8. Retaining ring
9. Retaining ring
10. Adjusting bracket
11. Washer, lock
12. Screw, cap, hex hd

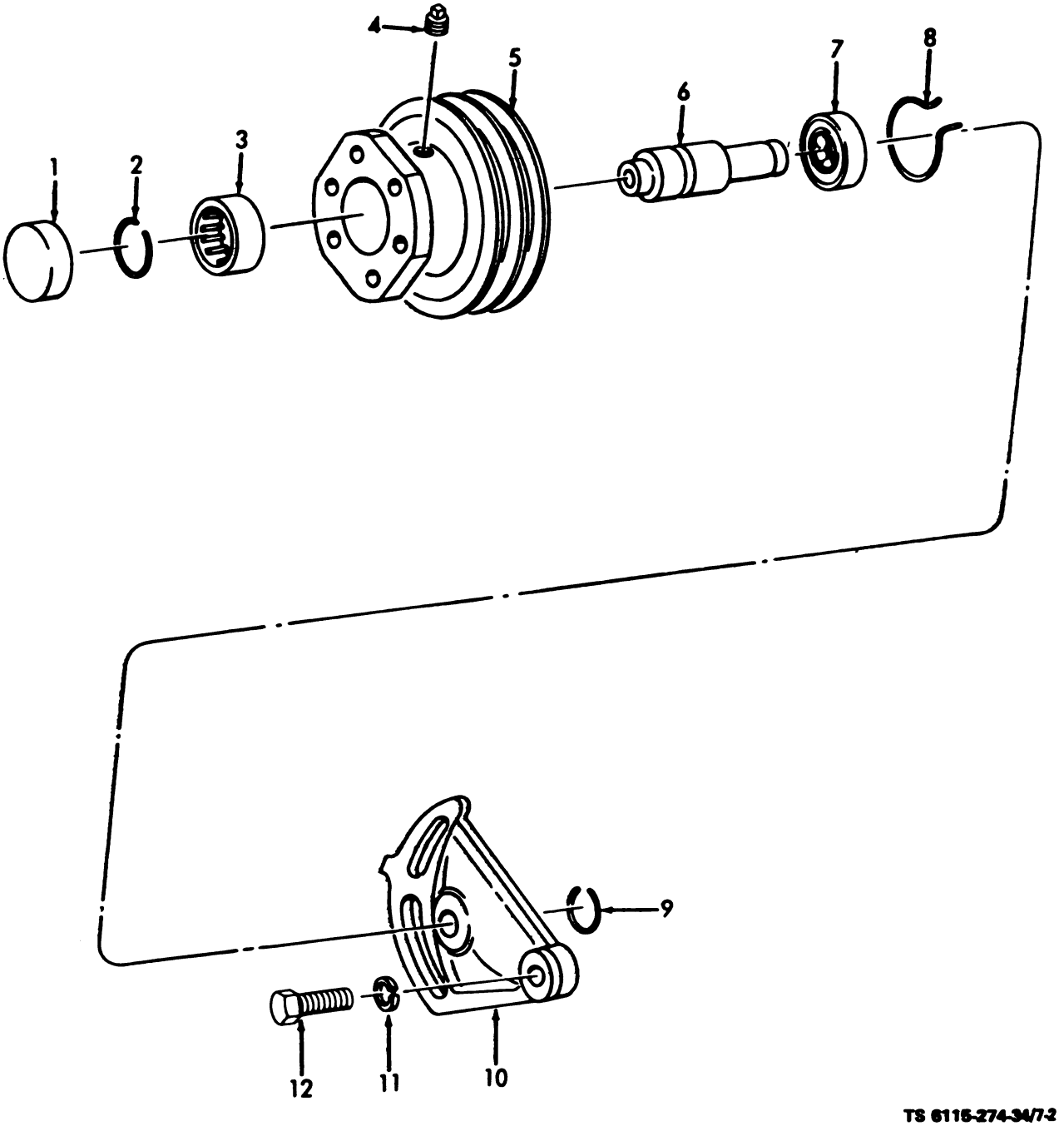



*Figure 7-2. Fan Pulley, Disassembly and Reassembly*

*(2)* Assemble to shaft (6), the pulley (5), plug (4), bearing (3), retaining ring (2) and hubcap (1).

*(3)* Attach bracket (10) with screws (12) and washers (11).

*(4)* To lubricate hub bearings remove plug, install fitting, lubricate with GAA and reinstall plug.

*(5)* Install V-belts and adjust tension so that belts deflect 5/8 inch midway between pulleys.

*e. Installation.*

*(1)* Install fan with six screws and nuts (refer to fig. 7-1).

*(2)* Install fan guard by rotating into place and fasten with four screws and nuts.

## Section II. WATER PUMP AND COVER

**7-4. General.**

The water pump forces the engine coolant through the cooling system.

**7-5. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-6. Water Pump and Cover.**

*a. Removal.*

*(1)* Remove radiator drainplug and drain coolant into suitable container.

*(2)* Remove water pump drainplug (fig. 7-3).

*(3)* Loose screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(4)* Remove four nuts and washers holding cover to water pump. Remove cover and gasket.

*(5)* Remove two screws and washers and remove outlet seal and retainer.

*(6)* Remove three screws and washers and remove pump and gasket.

*b. Cleaning and Inspection.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and a wire brush. Dry thoroughly.

*(2)* Inspect for cracks, breaks, leaks, and other damage.

*(3)* Replace a damaged or defective water pump and cover.

*(4)* Replace damaged gaskets or seals.

*c. Installation.*

*(1)* Assemble gasket and cover to pump with four nuts and washers (refer to fig. 7-3).

*(2)* Attach pump with gasket and three screws and washers.

*(3)* Attach outlet seal and retainer with two screws and washers.

*(4)* Connect hoses to bypass line and inlet line with clamps and tighten screws. Attach clamp spacer and tighten screw.

*(5)* Install pump drainplug.

*(6)* Install radiator drainplug and fill radiator with proper solution.

*NOTE*

*Open bleeder valve atop the bypass line assembly while radiator is being filled to bleed system of air.*

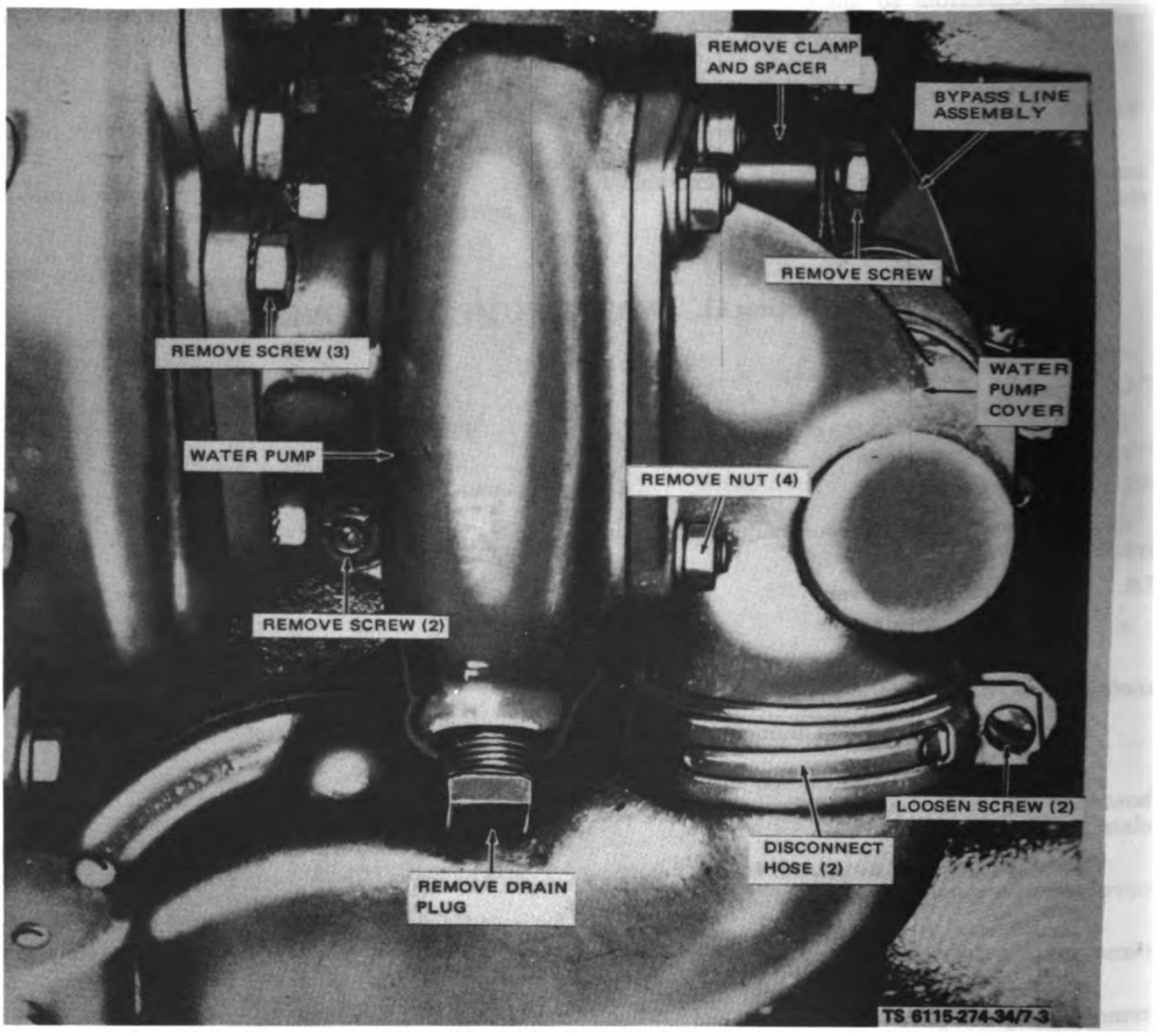



*Figure 7-3. Water Pump and Cover, Removal and Installation*

## Section III. RADIATOR PIPES AND HOSE

**7-7. General.**

The inlet and outlet pipes enable the coolant to circulate through the radiator.

**7-8. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-9. Radiator Pipes and Hose.**

*a. Removal.*

*(1)* Remove the radiator drainplug and drain the coolant into a suitable container.

*(2)* Remove hose clamps, hose and inlet pipe (fig. 7-4).

*(3)* Remove outlet pipe from between bottom of radiator and oil cooler in a similar manner.

*(4)* Remove hose clamp and remove overflow hose.

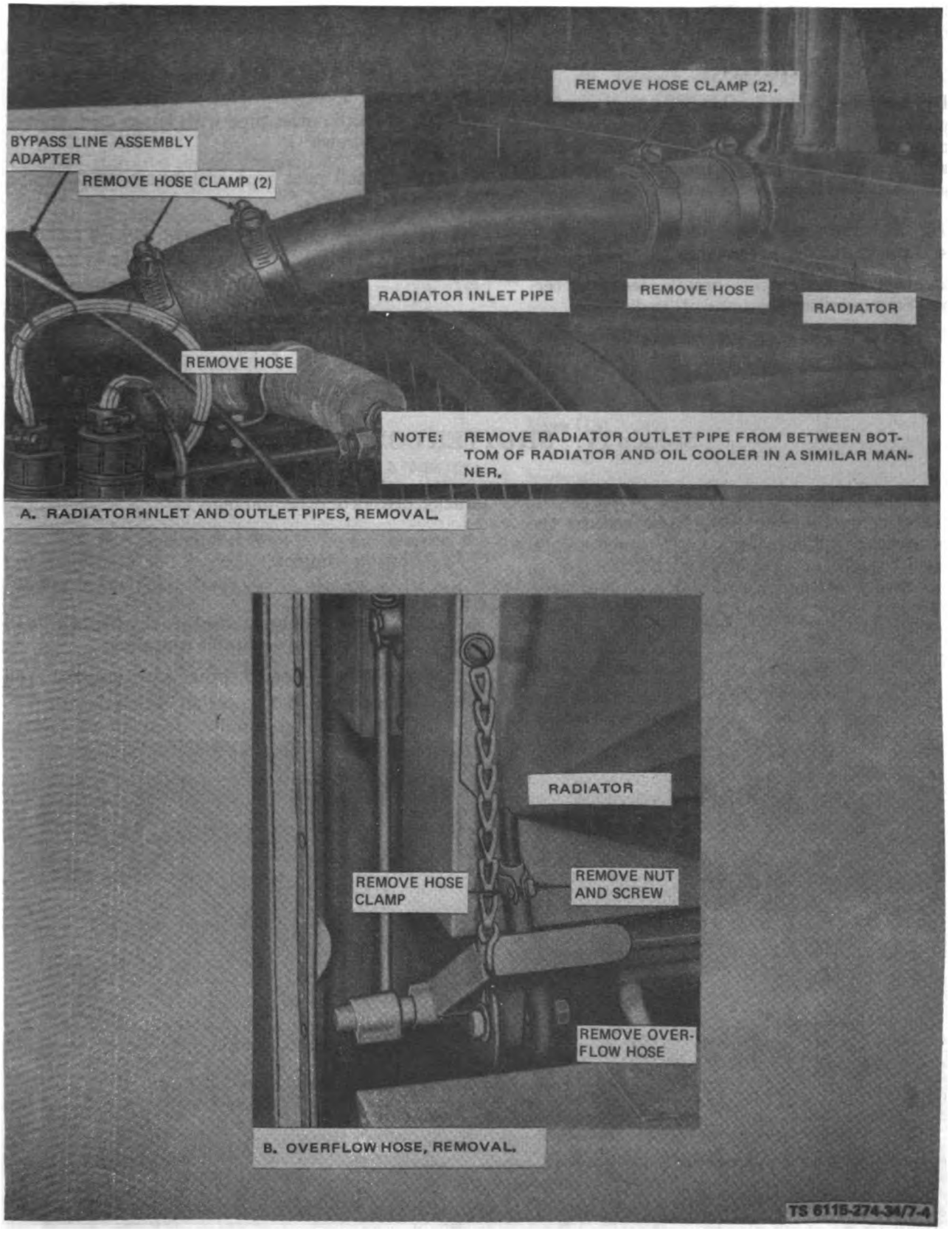



*Figure 7-4. Radiator Inlet and Outlet Pipes and Overflow Hose, Removal and Installation*

*b. Cleaning and Inspection.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean the pipes with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect for cracks, breaks, leaks, deterioration of the overflow hose, and other damage.

*(3)* Replace a damaged or defective radiator inlet and outlet pipe and overflow hose.

*c. Installation.*

*(1)* Install overflow hose with clamp and tighten screw.

*(2)* Install outlet pipe with hoses and clamps and tighten screws.

*(3)* Install inlet pipe with hoses and clamps and tighten screws.

*(4)* Install radiator drainplug and fill radiator with proper solution.

*NOTE*

*Open bleeder valve atop the bypass line assembly while radiator is being filled to bleed system of air.*

## Section IV. SHUTTER CONTROL

**7-10. General.**

A shutter control assembly is mounted to the bottom of the radiator and is thermostatically controlled to open or close the radiator shutter to maintain constant engine operating temperature. The shutter control assembly also incorporates a manual control lever.

**7-11. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-12. Shutter Control.**

*a. Removal.*

*(1)* Remove the radiator drainplug and drain the coolant into a suitable container.

*(2)* Remove cotter pins and control rod (fig. 7-5).

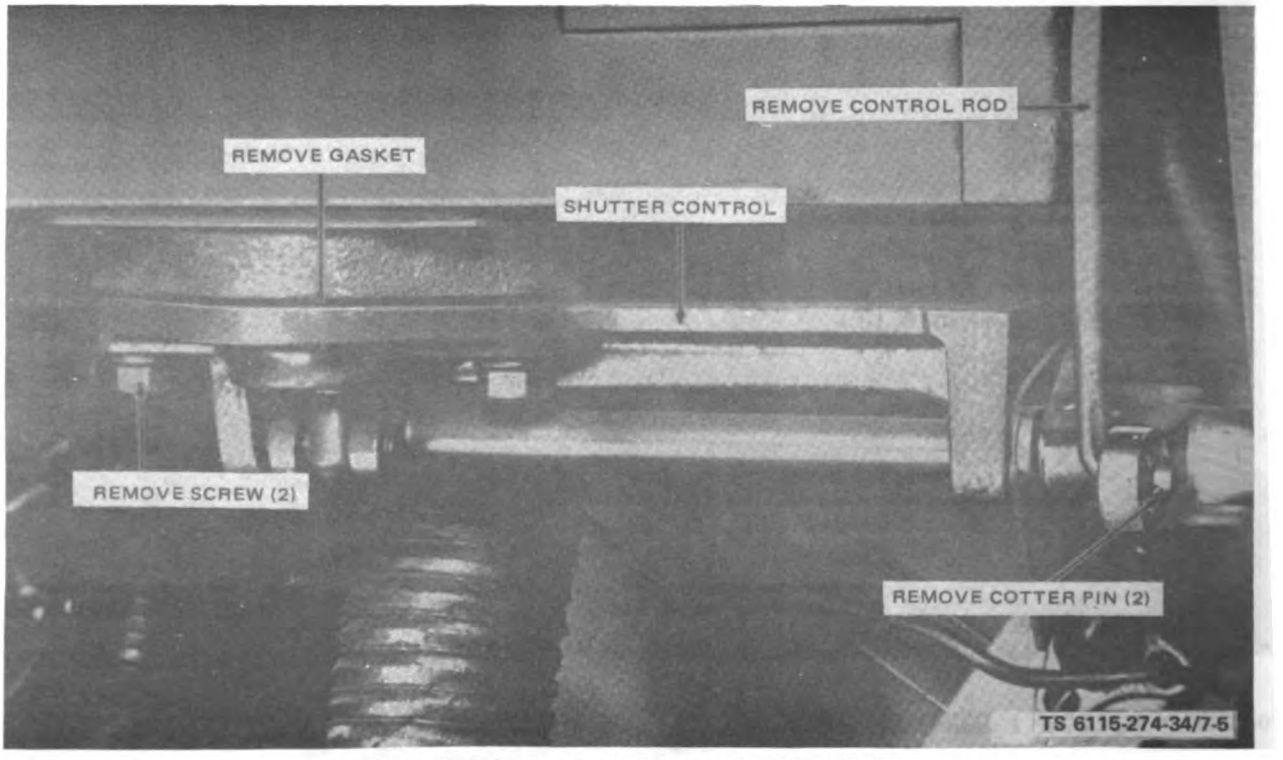



*Figure 7-5. Shutter Control, Removal and Installation*

*(3)* Remove screws and remove shutter control and gasket.

*b. Disassembly.*

*(1)* Remove setscrews (1, fig. 7-6).

*(2)* Remove power element (12), nut (11) and washer (10).

*(3)* Disassemble activator lever (2), retaining ring (3), spring seat washers (4), felt washer (5), spring (6) and nipple disk (7) from holder (8).

*(4)* Remove nut (13), spring (14), washer (16) and bolt (17).

*(5)* Remove bushings (9), control lever (19), shaft (18), throttle stop (20) and manual control lever (15).

*c. Testing.*

*(1)* Immerse the thermostat and a thermometer in a container of water and slowly heat the water.

*(2)* The thermostat should begin to open at 140 degrees F (60 degrees C) and be fully open at 160 degrees F (71 degrees C).

*d. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect for cracks, breaks, wear, spring distortion, and other damage.

*(3)* Replace or repair a damaged or defective part.

*e. Reassembly.*

*(1)* Install the thermostat (12, fig. 7-6), nut (11) and washer (10).

*(2)* Assemble and install activator lever (2), retaining ring (3), spring seat washers (4), felt washer (5), spring (6), and nipple disk (7) to holder (8).

*(3)* Assemble control lever (19), shaft (18), control stop (20), bushings (9) and manual control lever (15). Install setscrews (1).

*(4)* Install bolt (17), washer (16), spring (14) and nut (13).

*f. Installation.*

*(1)* Refer to figure 7-5 and install gasket and shutter control with screws.

*(2)* Attach control rod and install cotter pins.

*(3)* Install radiator drainplug and fill radiator with proper solution.

*NOTE*

*Open bleeder valve atop the bypass valve assembly while radiator is being filled to bleed system of air.*

1. Setscrew
2. Activator lever
3. Retaining ring
4. Large spring seat washer (spec)
5. Felt washer (spec)
6. Thermostat control spring
7. Nipple disk
8. Holder
9. Control shaft bushing
10. Nonmetallic washer (spec)
11. Plain hex nut (spec)
12. Power element (thermostat)
13. Nut, hex
14. Helical spring
15. Manual control lever
16. Washer, flat
17. Bolt, machine
18. Throttle control shaft
19. Control lever
20. Throttle control stop

*Figure 7-6. Shutter Control, Disassembly and Reassembly*

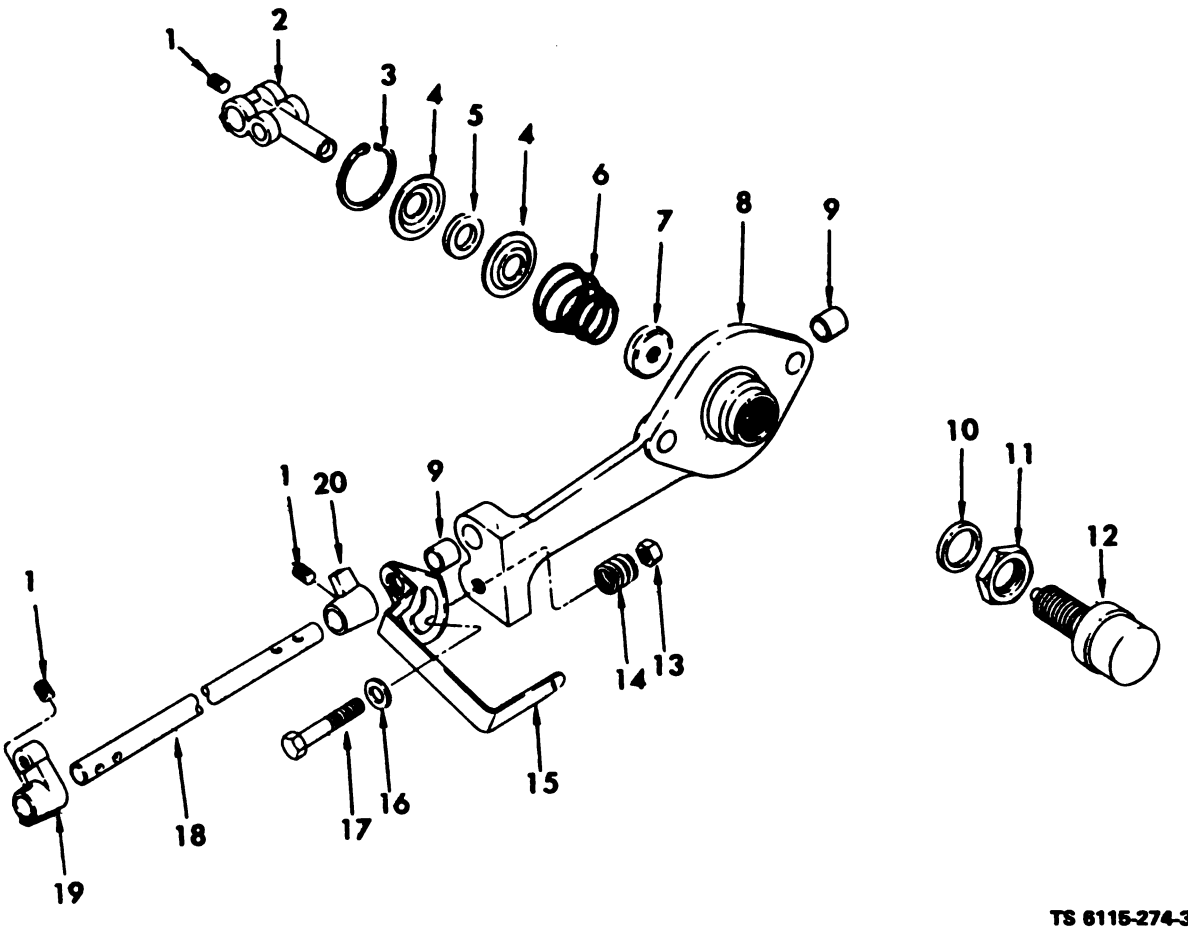



*Figure 7-6. Shutter Control, Disassembly and Reassembly (cont'd).*

## Section V. BLOWER ASSEMBLY

**7-13. General.**

Fresh air is drawn through the intake air cleaner and the air inlet housing to the blower. The blower forces the fresh air into the cylinders and then expels the burned exhaust gases from the combustion chamber.

**7-14. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-15. Blower Assembly.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads to solenoid (fig. 7-7).

*(2)* Remove clevis pin and cotter pin.

*(3)* Remove screws and remove solenoid.

*(4)* Remove screws and spacers and remove solenoid bracket.

*(5)* Remove plug and drain hydraulic tank. Disconnect hydraulic fittings and remove tank.

*(6)* Loosen clamp and disconnect air hose.

*(7)* Disconnect ether primer line from air intake housing assembly. Remove screws and remove air intake housing.

*(8)* Remove radiator drainplug and drain coolant into suitable container.

*(9)* Remove water pump drainplug (refer to figure 7-3).

*(10)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(11)* Remove two screws and washers and remove outlet seal and retainer.

*(12)* Remove three screws and washers and remove water pump.

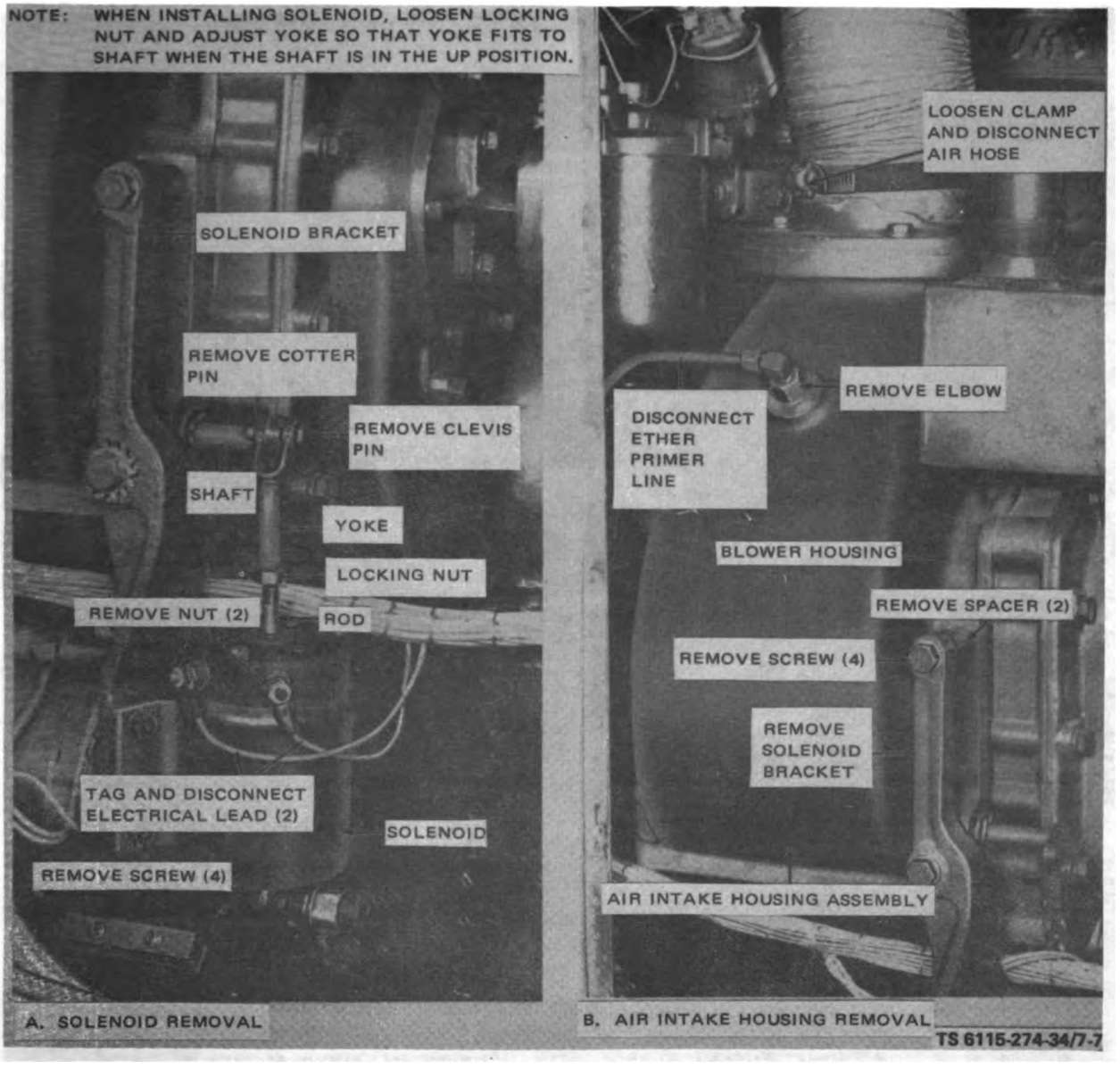



*Figure 7-7. Air Intake Housing and Hydraulic Tank Removal and Installation*

*(13)* Remove the plug and drain the hydraulic tank fluid into a suitable container (para 5-3).

*(14)* Remove strainer.

*(15)* Disconnect hydraulic lines.

*(16)* Remove four screws and remove hydraulic pump.

*(17)* Remove clamp (fig. 7-8).

*(18)* Disconnect fuel lines from main fuel pump.

*(19)* Remove four screws and remove blower.

*(20)* Remove main fuel pump.

*b. Disassembly.*

*(1)* Remove the 20 capscrews (15, fig. 7-9) and lockwashers (2) that secure the housing end plate covers (14 and 30) to the blower housing (23). Tap the end plate covers off the dowels at the top and bottom of the bolting flange with a soft hammer. Remove the two blower end plate cover gaskets (13 and 31).

**CAUTION**

**Do not pry between the cover and end plate, as this will damage the gasket surfaces.**

*(2)* Lock the rotors with a clean cloth and remove the screw (32) from the blower rotor shaft and shaft coupling (33) with a socket head wrench.

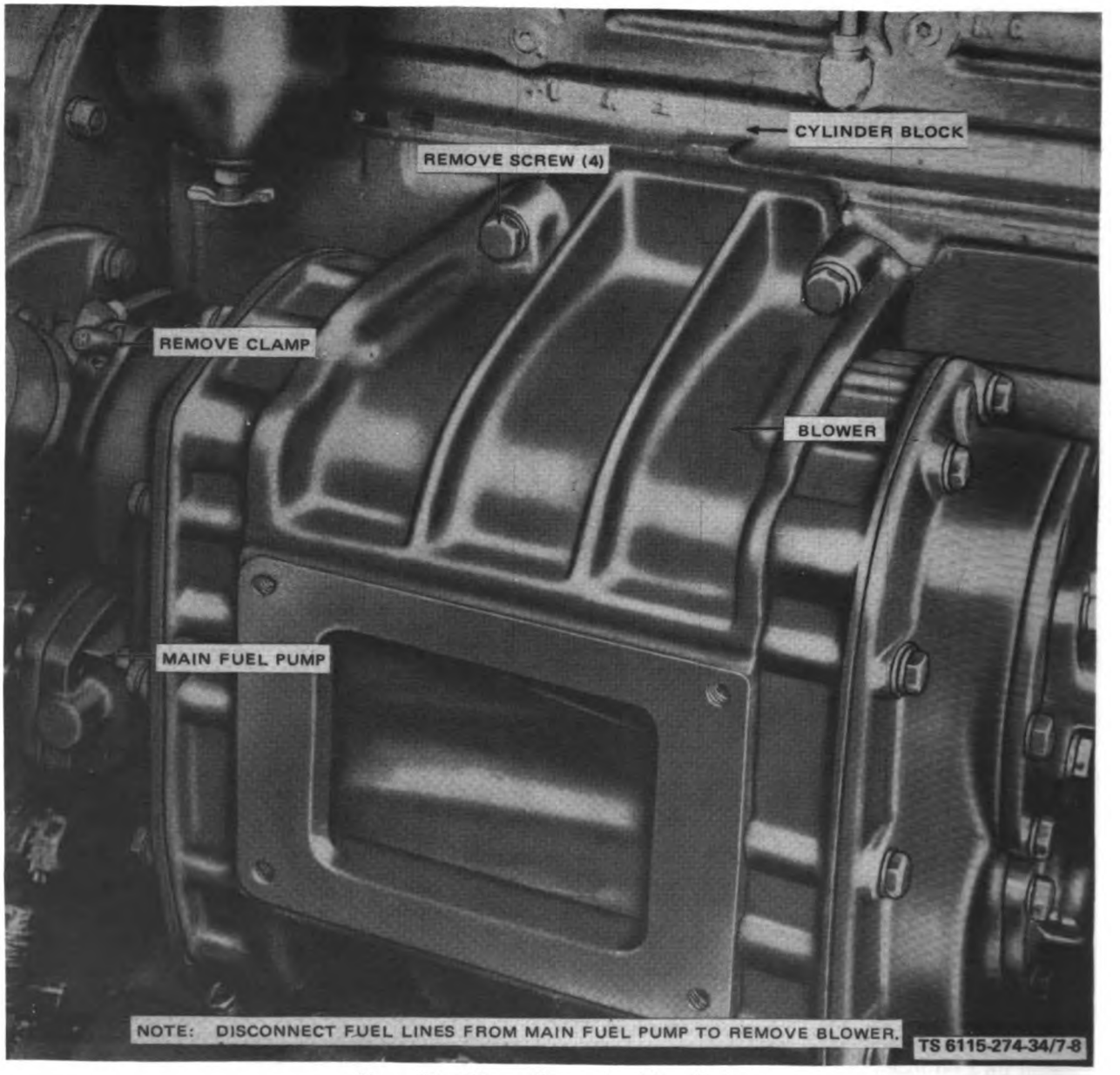



*Figure 7-8. Blower, Removal and Installation*

1. Bolt, externally relieved body
2. Washer, lock
3. Washer, flat
4. Gear hub plate
5. Bolt, externally relieved body
6. Fuel pump coupling disk
7. Blower gear
8. Bearing retainer
9. Shim
10. Ball bearing
11. Housing end plate
13. End plate cover gasket
14. Housing end plate cover
15. Screw, cap, hex hd
16. Gear hub
17. Screw, cap, hex hd
18. Lockwasher (spec)
19. Gear hub spacer
20. Retaining washer
21. Screw, cap, hex hd
22. Washer, lock 1/4 in.
23. Blower housing
24. Pin, straight headless
25. Roller bearing
26. Housing end plate
28. Bolt, machine
29. Housing cover plate
30. Housing end plate cover
31. End plate cover gasket
32. Screw, socket hd
33. Shaft and coupling

*Figure 7-9. Blower, Disassembly and Reassembly*

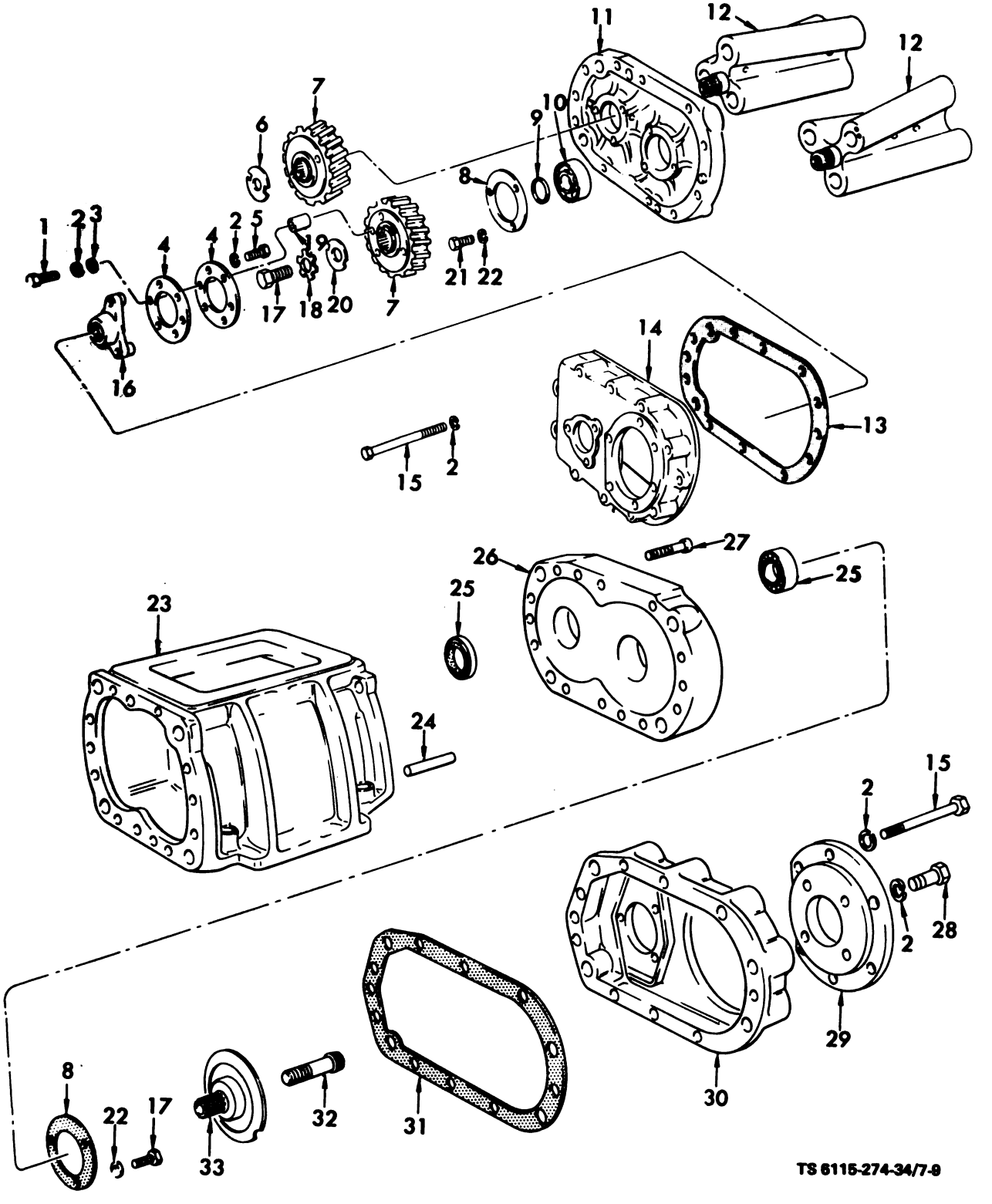



*Figure 7-9. Blower, Disassembly and Reassembly, cont'd.*

Pull the coupling from the shaft by threading a bolt into the tapped hole in the coupling.

*(3)* Remove the three bolts (1), lockwashers (2) and flat washers (3) that secure the two gear hub plates (4) to the rear face of the upper rotor blower gear (7) and remove the plates, gear hub (16) and gear hub spacers (19) from the gear. Separate the gear hub plates from the hub by removing the three bolts (5) and lockwashers (2).

*(4)* Remove the two screws (17), lockwashers (18), retaining washer (20), and blower rotor fuel pump coupling disk (6) from the blower gears (7). Remove the two blower gears at the same time and with the same pullers as described in the removal of the end plates and bearings below.

*NOTE*

*Observe the number and thickness of shims on the rotor shaft. Remove the shims from the shaft and replace them accordingly during assembly of the blower.*

*(5)* Remove the three screws (21) and lockwashers (22) and remove the rear bearing retainer (8) from the housing end plate (11). Remove the other rear bearing retainer in a similar manner.

*(6)* Remove the two front bearing retainers in the manner described in (5) above.

*(7)* Remove the two screws (27) from the housing end plate cover (14).

*(8)* Release the housing plate (26) from the blower housing (23) by loosening the screws approximately three turns. Install the three puller plate anchor bolts (3, fig. 7-10), in the three equally spaced holes of each puller plate (5).

1. Blower housing
2. Housing end plate
3. Anchor bolt
4. Puller bolt
5. Puller plate

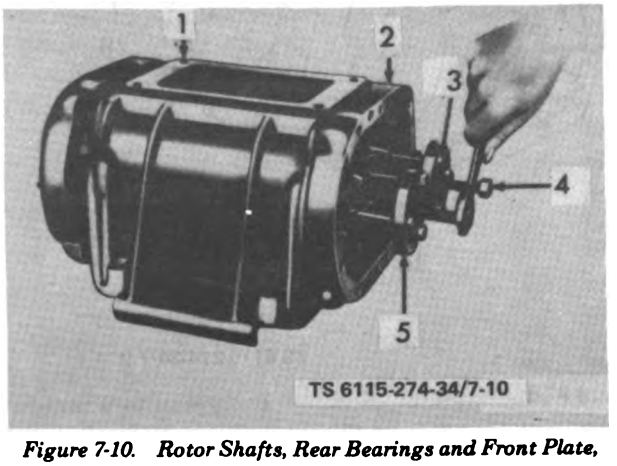



*Figure 7-10. Rotor Shafts, Rear Bearings and Front Plate, Removal and Installation*

*(9)* Install the anchor bolts in the holes from which the rear bearing retainer screws were removed so that the face of the plates are parallel with the face of the blower housing (1).

*(10)* Turn the two puller bolts uniformly clockwise. Rotor shafts will be pushed from the bearings in the housing end plate (2). The housing end plate, with rotor shafts still assembled in the bearings will be pushed from the blower housing simultaneously.

*(11)* Remove the puller from the housing end plate, remove the two screws that secure the housing end plate (2) to the blower housing (1), and then remove the housing plate.

**CAUTION**

**Inspect the rotors and blower housing to see whether they are scored to the extent that removal of the housing plate and assembled rotors will further damage the rotors. If the rotors and blower housing are badly scored, the rotor shafts should be pushed from the bearings in the housing plate before removing the rotors, as outlined in (10) and (11) above.**

*(12)* Withdraw the rotors and housing plate assembly from the blower housing. Remove the blower rotor (12, fig. 7-9) from the front cylindrical ball bearings (10) with the same tool and in exactly the same manner in which they are removed from the housing plate (26). Refer to (9) through (11) above.

*(13)* Remove the bearing (4, fig. 7-11) from the housing end plate (3) by inserting the bearing and oil seal removed (1) through the oil seal (2) from the inner face of the housing end plate (3). Position the tool so that the pilot enters the bore in the inner race of the bearing and the shoulder of the tool rests against the face of the bearing inner race. Drive the bearing from the housing end plate assembly; drive the oil seal (2) from the housing end plate. Follow this same method for removing all four of the bearings and seals from both housing end plates.

*(14)* Pull the two pins (24, fig. 7-9) from the blower housing (23).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* After the blower has been disassembled, wash all parts with cleaning solvent (Item 4, App. B) and dry thoroughly with compressed air.

## CAUTION

**Do not use a wire brush or emery cloth. Handle blower parts carefully; aluminum parts are easily dented and burned.**

1. Bearing and oil seal remover
2. Oil seal
3. Housing end plate
4. Bearing

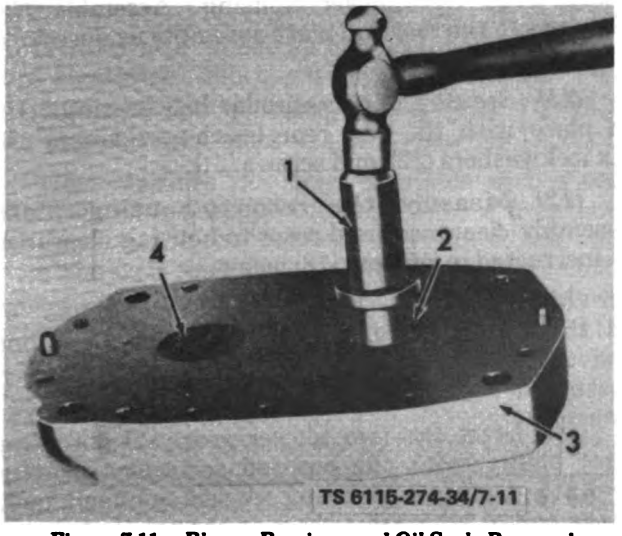



*Figure 7-11. Blower Bearings and Oil Seals Removal*

*(2)* Inspect the inside of the blower housing and all finished surfaces for smoothness. Inspect the housing for cracks, breaks, and distortion. Remove all rough spots or burrs with a fine mill file or scraper. Replace a housing that is badly scored, warped, or cracked.

*(3)* Inspect the rotor lobes for smoothness. Inspect the rotor shaft serrations and bearings surfaces for wear and burrs. Remove all high spots and burrs from the rotors with a fine mill file or scraper. Replace defective rotor assemblies.

*(4)* When washed clean and lubricated with light oil, all bearings should roll smoothly. Replace loose, rough or overheated bearings.

*(5)* The seal lip must be smooth, pliable, and leakproof. Replace all oil seals that have been removed from the housing plates or that are brittle, thin, or cut.

*(6)* Inspect the housing plates for cracks, breaks, distortion, and other damage. Inspect the finished surfaces of the housing plates to see that they are true, smooth, and unscored. Inspect the counterbores for the bearing and bearing bosses to see that they are not worn excessively or scored. The bearings must fit the counterbore with a slight push or tap fit. Remove all burrs or minor local score marks by filing or scraping carefully. Replace housing plates that are cracked, badly scored, or distorted or have worn bearing counterbores.

*(7)* Inspect the gears for worn splines and for cracked, broken, or worn teeth. Replace damaged or defective gears. The maximum allowable backlash for gears is 0.0080 inch (0.2032 mm) and the minimum is 0.0030 inch (0.0762 mm).

*(8)* Clean all gasket material from mating surfaces. Reassemble the blower with all new gaskets.

*d. Reassembly.*

*(1)* Support the housing end plate (5, fig. 7-12) between the soft jaws of a bench vise (6) and install the two oil seals (2) with the puller and seal installing plate (4). Back out the puller bolt (3) as far as possible and push the bolt through the bearing bore until the puller plate (1) rests against the outer (ribbed) face of the housing end plate. With the seal edge toward the bearing, slide the oil seal (2) over the head of the puller bolt and start it into the bearing bore by hand. Slip the oil seal installing plate (4) over the puller bolt, next to the head of the bolt.

1. Puller plate
2. Oil seal
3. Puller bolt
4. Oil seal installing plate
5. Housing end plate
6. Vise

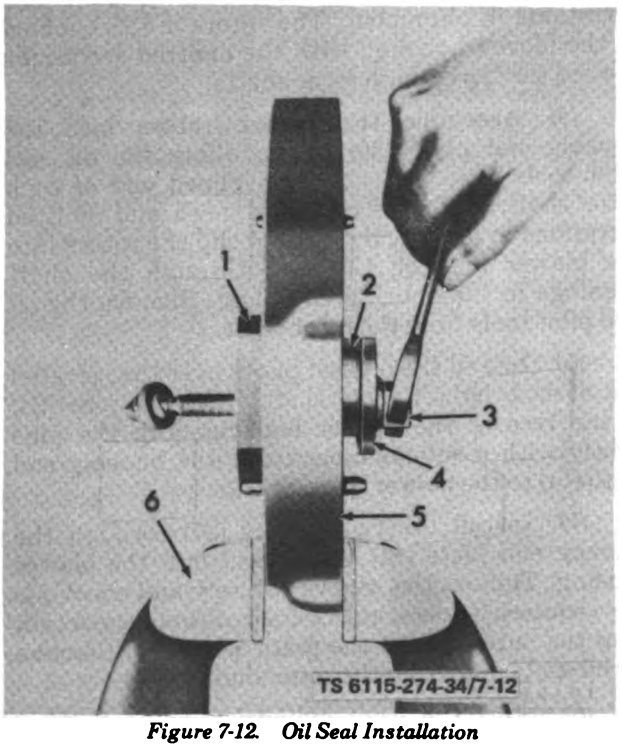



*Figure 7-12. Oil Seal Installation*

*(2)* Turn the puller bolt and force the seal into the seat until the oil seal installing plate sits tight against the inner face of the blower housing end plate. Remove the tool and install the three remaining seals in the housing end plate in a similar manner.

*NOTE*

*Make sure the TOP on the outer ribbed side of the housing plate is at the top of the blower housing.*

*(3)* Insert the two screws (27, fig. 7-9) through the housing plate and thread into the blower housing (23). Tighten the screws securely and check for the required three-eighths inch pin projection from the outer face of the housing plate.

*(4)* Assemble the blower rotors (12) in the blower housing (23). Before continuing the reassembly, certain checking operations are necessary to ensure the proper combination of parts. The lobes of one of the blower gears and the teeth of one of the timing gears form a right-hand helix; on the mating parts, a left-hand helix. The rotor with the right-hand helix must be used with the blower gear having the right-hand helical teeth. The rotor and gear with the right-hand helices are the upper units in the blower. Those with the left-hand helices are the lower units. One serration is omitted on the driven end of each rotor shaft, and a corresponding separation is omitted in each gear. The gears must be assembled on the rotor shafts with the omitted serrations in alignment. The rotors are assembled in the blower housing, with the omitted serrations toward the top on both rotor shafts.

*(5)* Assemble the blower rotors into the housing end plate (26) by installing the oil seal pilot tools over the short nonsplined end of each rotor shaft. With the rotors in mesh and omitted serrations in a vertical position, slip the rotors into the blower housing (23) and through the shaft openings in the housing end plate. Remove the oil seal pilot tools from the rotor shaft.

*(6)* Install the oil seal pilots over the serrated end of each blower rotor shaft. Start the pins (24) in the face of the blower housing. Tap the pins lightly with a soft hammer to fit the housing end plate (11) to the blower housing (23).

*(7)* Install the two screws (27) through the housing end plate (11) and thread into the blower housing. Tighten the screws securely and check for the required three-eighths inch dowel projection from the outer face of the plate assembly. Remove the oil seal pilots from the rotor shafts.

*(8)* Start the front cylindrical roller bearing (25) onto the forward end of the rotor shaft, with the numbered face of the bearing (extended outer race) facing out and away from the blower housing. Tap the front rotor bearing into the housing end plate assembly with the bearing installing tool. Install the other roller bearing in a similar manner.

*(9)* Secure the front rotor bearings in place with the two front bearing retainers (8), six lockwashers (22), and screws (21).

*(10)* Start the two rear annular ball bearings (10) onto the serrated rotor shafts. Be sure the markings on the bearing races are facing out and away from the blower housing. Assemble the bearings in the rear end plate assembly as described in (8) above.

*(11)* Secure the rear annular ball bearings (10) in place with the two rear bearing retainers (8), six lockwashers (22), and screws (21).

*(12)* Measure the rotor-to-housing plate assembly clearances and rotor-to-housing clearance as instructed in (16) and (18) below.

*(13)* Install the blower rotor gear shims (9) on the rotor shafts. Replace the same number and thickness of shims as were removed in disassembly.

*(14)* Start the two blower gears (7) onto the rotor shafts, with the omitted serrations on the shafts and gears registering. A center punchmark in the end of each rotor shaft at the omitted serrations will assist in aligning the gears on the shafts. Apply clean engine oil at the rotor shaft serrations and proceed as follows:

*(a)* Use the screws (17) and plain washers to hold the gears onto the upper and lower rotor shafts. Turn the screws into the shafts uniformly and draw the gears into position against the bearing races. Remove the screws and washers.

**CAUTION**

**The rotor gears must be pressed into position at the same time to avoid damage to gears and rotors. Do not pull the gears up tight if the rotors are in contact.**

*(b)* Assemble the lockwasher (18) on the lower rotor gear retaining screw (17). Assemble the retaining washer (20) on the upper rotor gear retaining screw (17). Install the assembly in the upper rotor gear and rotor shaft. Torque the rotor gear screw to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(c)* Secure the lower rotor gear to the rotor shaft by installing the rotor fuel pump coupling disk (6) on the screw (17) and lockwasher (18). Install the screw in the gear so the lugs of the

disk engage the slots in the hub of the gear and the lockwasher ear engages the slot in the coupling disk. Torque the rotor gear screw to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(15)* After the blower rotors and gears have been installed, the blower rotors must be timed. The blower rotors should be positioned in the housing with a slight clearance between the lobes. This clearance may be varied by moving one of the helical gears in or out on the shaft and by adding and removing the blower rotor gear shims (9) between the gear hub and bearing. If the upper rotor gear is moved out, the upper rotor will turn counterclockwise when viewed from the gear end. If the lower rotor gear is moved out, the lower rotor will turn clockwise. This positioning of the rotor gear to obtain proper clearance between the rotors is known as blower timing.

*(16)* Measure the rotor clearance with a one-half inch wide thickness gage. Measure from both the inlet and outlet sides of the blower, one inch from the front end of the blower. Insert the thickness gage through the air outlet side of the blower between the leading edge of the lower rotor and the trailing edge of the upper rotor. Time the rotors so there will be a minimum clearance of no less than 0.002 inch (0.050 mm) and a maximum clearance of no more than 0.006 inch (0.152 mm); then check the clearance between the leading edge of the upper rotor and the training edge of the lower rotor; minimum clearance is 0.014 inch (0.36 mm).

*(17)* Having determined the amount one rotor must be revolved to obtain the proper clearance, add the shims (9) back of either the upper or lower rotor gear. To do this, remove both rotor gears from the rotor shaft as instructed in (b) above. Placing a 0. 003 inch (0.076 mm) shim back of a rotor gear will revolve the rotor 0.001 inch (0.025 mm). Install the required thickness of shims back of the proper gear and draw the gears tightly into place. Remeasure the clearances between rotors. After the correct clearances are obtained, secure the rotor gears as instructed in (14) above.

*(18)* Insert the thickness gage between the housing plate assemblies and the ends of the rotors. This operation must be performed at the ends of each lobe, making 12 measurements in all. The minimum clearance at the gear end should be 0.007 inch (0.178 mm). The minimum clearance at the front housing plate assembly should be 0.009 inch (0.229 mm).

*(19)* Measure the clearance between each rotor and the blower housing at both the inlet and outlet side, 12 measurements in all. Minimum clearance at the inlet side of the blower is 0.016 inch (0.406 mm). Minimum clearance at the outlet side is 0.004 inch (0.100 mm).

*(20)* Assemble the two gear hub plates (4) on the gear hub (16) and secure with the three bolts (5) and lockwashers (2). Position the gear hub plates on the outer face of the upper rotor gear, installing the three gear hub spacers (19) between the plate and the face of the gear. Secure in place with the three bolts (1), lockwashers (2), and flat washers (3).

*(21)* Insert the splined end of the water pump shaft and coupling (33) onto the front end of the blower lower rotor shaft. Secure the water pump shaft and coupling to the rotor shaft with the screw (32).

*(22)* Cement (Item 8, App. B) the blower end plate cover gasket (31) to the housing end plate cover (30). Secure the cover to the blower housing (23) with the 10 screws (15) and lockwashers (2).

*(23)* Assemble the blower housing cover plate (29) to the housing end plate cover (30) with the six bolts (28) and lockwashers (2).

*(24)* Cement (Item 8, App. B) the end plate cover gasket (13) to the rear housing end plate cover (14). Secure the cover to the blower housing with the 10 screws (15) and lockwashers (2).

## CAUTION

**Before installing the blower assembly on the cylinder block, examine the inside of the blower for any foreign material and revolve the rotors by hand, checking for smooth turning.**

*e. Installation.*

*(1)* Install the main fuel pump; (refer to fig. 7-8).

*(2)* Attach blower with four screws.

*(3)* Connect fuel lines to main fuel pump.

*(4)* Install clamp.

*(5)* Install hydraulic pump with four screws (refer to para 5-3e.).

*(6)* Connect hydraulic lines.

*(7)* Install water pump with three screws and washers (refer to fig. 7-3).

*(8)* Attach outlet seal and retainer with screws and washers.

*(9)* Connect hoses to bypass line and inlet line. Tighten screws. Install screw, clamp and spacer.

*(10)* Install water pump drainplug.

*(11)* Install radiator drainplug and fill radiator with proper solution.

*NOTE*

*Open bleeder valve atop the bypass valve assembly while radiator is being filled to bleed system of air.*

*(12)* Install air intake housing (refer to fig. 7-7).

*(13)* Connect ether primer line.

*(14)* Connect air hose.

*(15)* Install hydraulic tank and attach fittings. Install drainplug and service tank with proper fluid.

*(16)* Install solenoid bracket.

*(17)* Install solenoid.

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(18)* Install clevis pin and cotter pin.

*(19)* Connect electrical leads to solenoid.

## Section VI. BLOWER DRIVE COUPLING

**7-16. General.**

The blower drive coupling derives its power from the crankshaft and in turn drives the blower to force fresh air into the cylinders.

**7-17. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-18. Blower Drive Coupling.**

*a. Removal.*

*(1)* Remove blower assembly (para 7-15).

*(2)* Remove line (fig. 7-13).

*(3)* Remove two screws. Remove four screws and nuts.

*(4)* Remove gear support and remove gasket from end plate. Remove coupling assembly.

*b. Disassembly.*

*(1)* Remove drive shaft (15, fig. 7-14).

*(2)* Remove nut (16), key washer (17), thrust washer (18) and bearings (11) from hub (10).

*(3)* Remove screws (1) and washers (2) and disassemble retainer (3), retaining ring (4), drive support (8), drive gear (9) and hub (10).

*(4)* Remove ball bearing (20) and elbow (14).

*(5)* Disassemble coupling cam (5), coupling spring seats (6), springs (7), spring plates (19) and drive support (8).

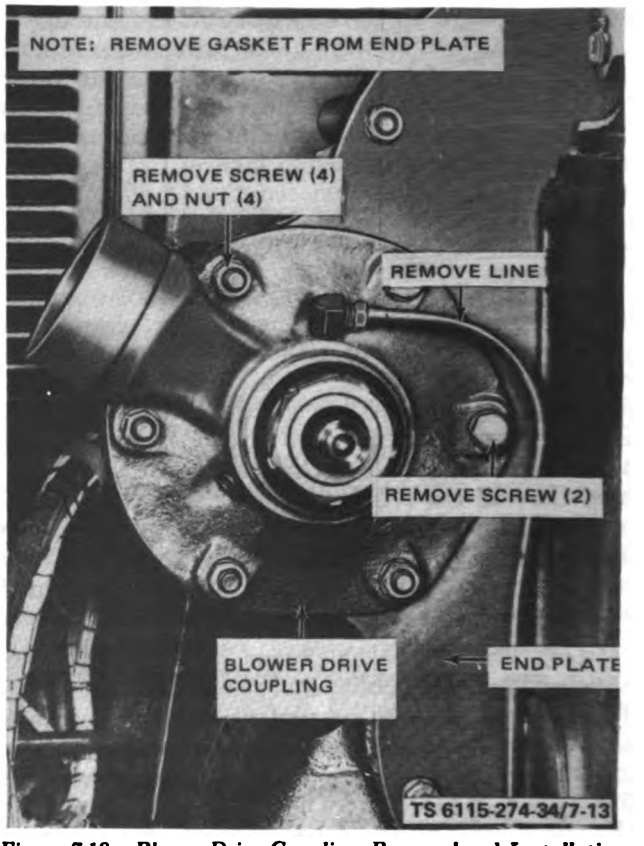



*Figure 7-13. Blower Drive Coupling, Removal and Installation*

c. *Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the blower drive shaft for cracks, breaks, and worn serrations. Replace a damaged or defective drive shaft.

*(3)* Inspect the idler gear, crankshaft timing gear, and blower driver gear for damage and for worn or broken teeth. Replace a damaged or defective part.

*(4)* Inspect the drive coupling cam for cracks, wear, and other damage. Replace if damaged or defective.

*(5)* Inspect the drive coupling leaf springs and spring seats for cracks, breaks, and wear.

*(6)* Inspect the outside surfaces and thrust surfaces of the blower gear hub sleeve bearings. If the sleeve bearings are worn or show score marks, replace them.

*(7)* Inspect the inside diameter of the blower gear hub sleeve bearings for wear and distortion; also inspect the outside diameter of the hub for wear. The bearing inside diameter should measure 1.6260 to 1.6265 inches (4.130 to 4.131 cm), the gear hub inside diameter should measure 1.6240 to 1.6250 inches (4.125 to 4.128 cm). If the sleeve bearings and hub are worn beyond the wear limits, replace the hub, bearings, and hub support.

1. Screw, machine
2. Washer, lock
3. Retainer
4. Retaining ring
5. Coupling cam
6. Coupling spring seat
7. Leaf spring
8. Drive support
9. Drive gear
10. Gear hub
11. Sleeve bearing
12. Gasket
13. Gear support
14. Elbow
15. Drive shaft
16. Gear hub nut
17. Key washer
18. Thrust washer
19. Leaf spring plate
20. Bearing, ball

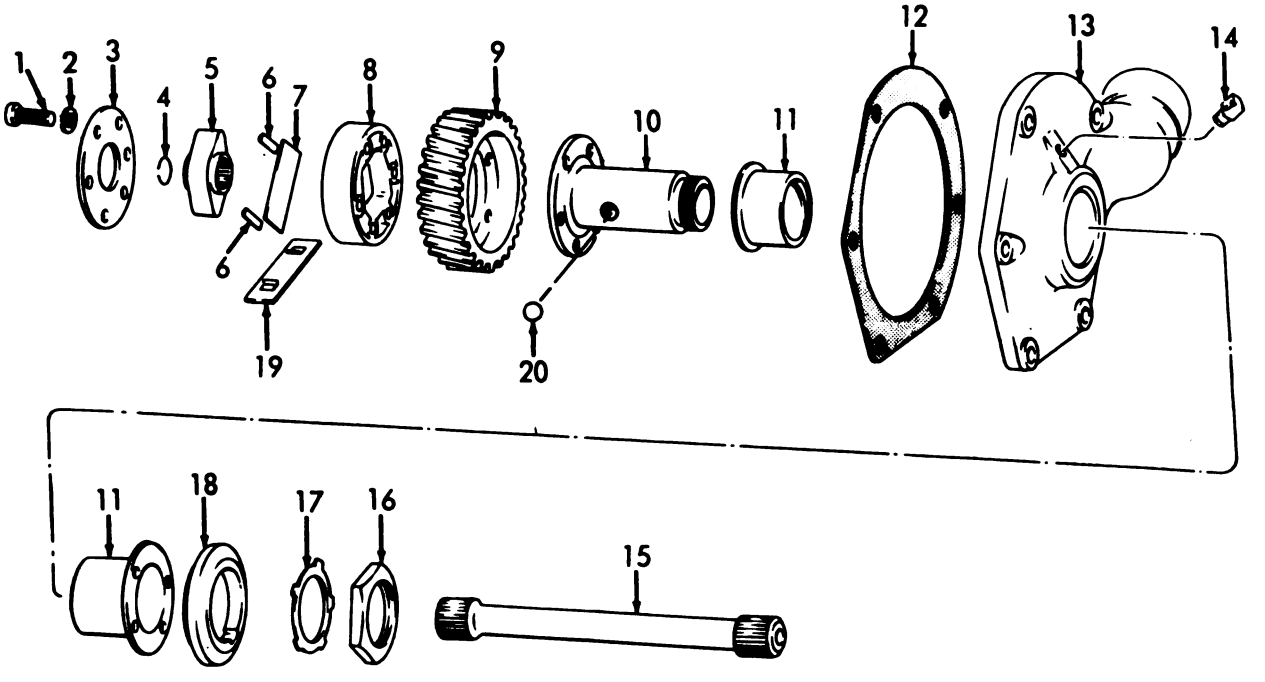



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*Figure 7-14. Blower Drive Coupling, Disassembly and Reassembly*

*(8)* Blow out the oil holes in the blower drive gear support. Replace the blower drive bearing, oil pipe elbows, drive gear support, and the plug if the threads are damaged. Replace the drive gear key washer if defective.

*(9)* Replace the ball bearing if it is worn or has flat spots.

*(10)* Replace or repair all damaged or defective parts.

*d. Reassembly.*

*(1)* Reassemble the blower drive support (fig. 7-15).

*(2)* Follow the steps shown on the figure to simplify the reassembly.

*(3)* Use special tool J-1471 to aid in spreading the springs. Refer to table 2-1 for tool list.

*(4)* Install elbow (14, fig. 7-14).

*(5)* Assemble hub (10), drive gear (9), drive support (8), retaining ring (4) and retainer (3) with screws (1) and washers (2).

*(6)* Assemble ball bearing (20), bearings (11), thrust washer (18), key washer (17) and nut (16) onto hub (10).

*(7)* Install drive shaft (15).

*e. Installation.*

*(1)* Install coupling assembly. Install gasket and gear support onto end plate. (Refer to fig. 7-11).

*(2)* Install blower assembly, hydraulic pump, water pump, air intake housing, hydraulic tank and solenoid (refer to para 7-15).

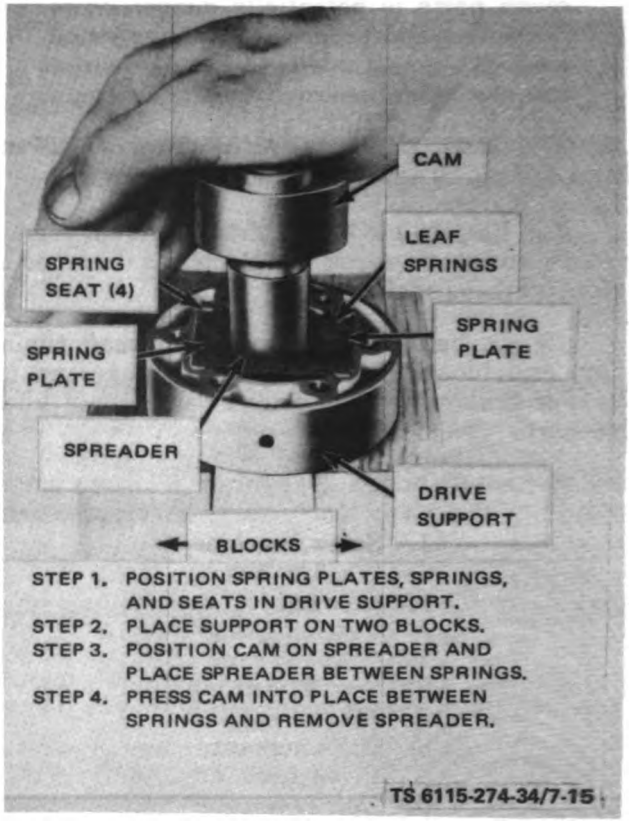


*Figure 7-15. Blower Drive Support, Reassembly*

## Section VII. GRILL GUARD, RADIATOR AND AIR SHROUD, AND SHUTTER ASSEMBLY

**7-19. General.**

The grill guard protects the radiator from foreign objects and the air shroud channels the air through the fan for better cooling. Engine coolant is circulated through the radiator where it gives up its heat to the air stream developed by the cooling fan. A shutter control assembly is attached to the bottom of the radiator and is thermostatically controlled to open or close the radiator shutter to maintain constant engine operating temperature. The shutter control assembly also incorporates a manual control lever.

**7-20. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**7-21. Grill Guard, Radiator, Air Shroud and Shutter Assembly.**

*a. Removal.*

*(1)* Remove the screws attaching the fan guard to the air shroud, rotate the fan guard and remove.

*(2)* Open the drainplug at the bottom of radiator and drain the coolant solution into a suitable container.

*(3)* Refer to figure 7-4 and remove hose clamps, hose, and inlet pipe.

*(4)* Remove outlet pipe from between bottom of radiator and oil cooler in a similar manner.

*(5)* Remove hose clamp and remove overflow hose.

*(6)* Refer to figure 7-5 and remove cotter pins and screws.

*(7)* Remove control rod and shutter control. Remove gasket.

*(8)* Disconnect the heater air duct from the air shroud.

*(9)* Remove RH engine door (1, fig. 7-16).

*(10)* Remove fuel control panel (2).

*(11)* Remove LH engine door (3) and left-front side panel (4).

*(12)* Remove engine hood (5).

*(13)* Remove grill guard (6) and front cowl assembly (7).

*(14)* Remove radiator and air shroud (8) and shutter assembly (9) from front cowl.

*b. Cleaning, Inspection and Repair.*

## WARNING

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

1. Engine door, rh
2. Fuel control panel
3. Engine door, lh
4. Left front side panel
5. Engine hood
6. Grill guard
7. Front cowl
8. Radiator and air shroud
9. Shutter assembly

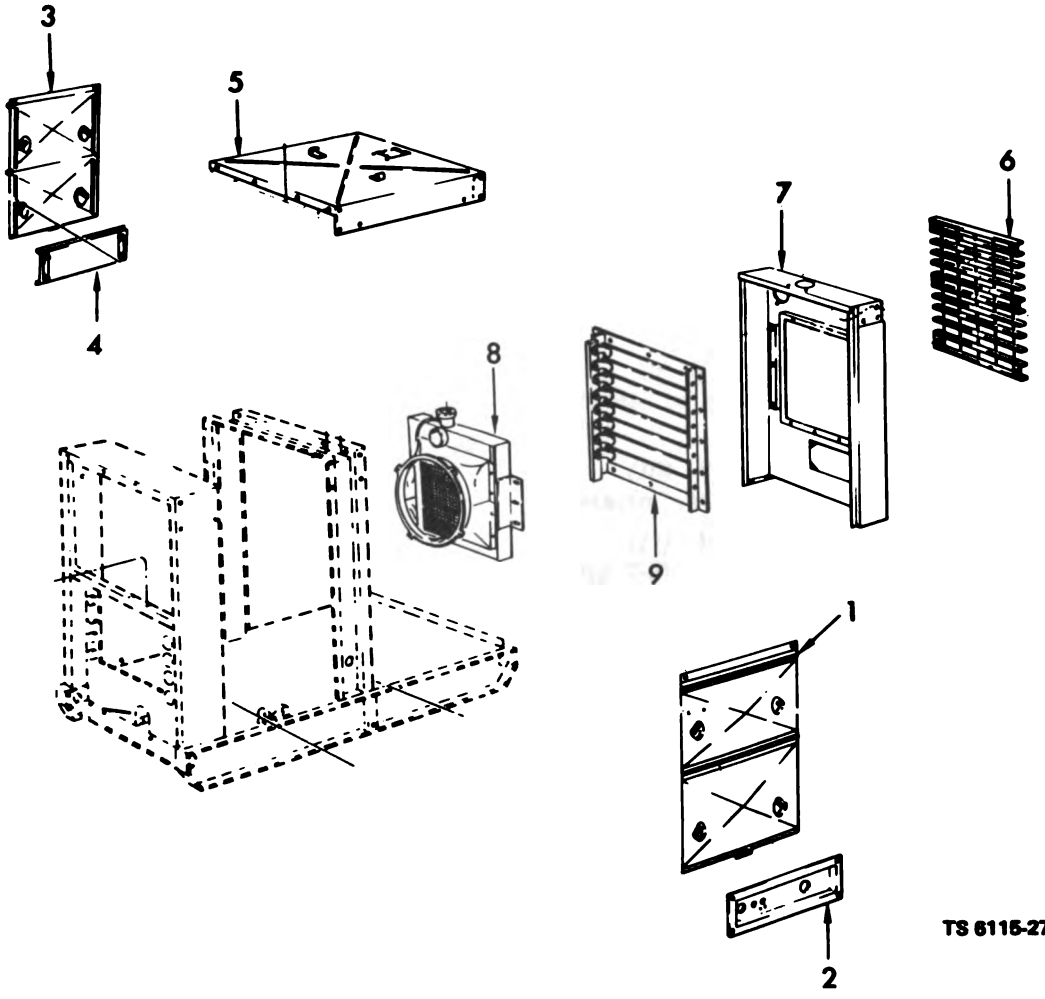


*Figure 7-16. Engine Enclosures, Removal and Installation*

*(1)* Clean the radiator and all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Clean the core and remove all foreign matter which may be lodged between the cooling fins with compressed air.

*(3)* Test the radiator for leaks by plugging all openings in the radiator except one. Connect a low-pressure source of compressed air (10 to 15 psi) (0.70 to 1.05 kg/sq cm) to the radiator and submerge it in water. Leaks will be indicated by air bubbles.

*(4)* Solder or braze all leaks in the tanks and core of the radiator.

*(5)* Replace a radiator that is beyond repair.

*(6)* Inspect for cracks, breaks, dents, bends, and other damage.

*(7)* Replace or repair a damaged or defective part.

*c. Installation.*

*(1)* Assemble radiator and air shroud (8) and shutter assembly (9) to front cowl (7).

*(2)* Install front cowl assembly (7) and grill guard (6).

*(3)* Install engine hood (5).

*(4)* Install LH engine door (3) and left-front panel (4).

*(5)* Install fuel control panel (2).

*(6)* Install RH engine door (1).

*(7)* Connect heater air duct to the air shroud.

*(8)* Refer to figure 7-5 and install gasket, shutter control and control rod.

*(9)* Attach screws and cotter pins.

*(10)* Refer to figure 7-4 and install overflow hose and hose clamp.

*(11)* Install inlet pipe with hoses and hose clamps.

*(12)* Install outlet pipe between bottom of radiator and oil cooler with hoses and hose clamps.

*(13)* Close radiator drainplug and fill radiator with proper coolant solution.

*NOTE*

*Open bleeder valve on top of the bypass valve assembly while radiator is being filled to bleed system of air.*

*(14)* Install fan guard, rotate to proper position and attach with screws.

# CHAPTER 8

# REPAIR OF LUBRICATING SYSTEM

## 8-1. General.

The lubrication system consists of the oil filter assembly, oil cooler and filter adapter, oil cooler housing and core assembly, fluid pressure filter, and oil pan drain pipe. The oil cooler and filter adapter provides the mounting and contains the bypass valves for both the full flow fluid pressure filter and the oil cooler. The oil filter bypass valve opens at 15 psi (1.05 kg/sq cm) and the oil cooler bypass valve opens at 40 psi &2.81 kg/sq cm).

## 8-2. Type of Repairs.

Repairs may involve loose connections, wear, cracks, breaks or other damage.

## 8-3. Oil Cooler and Filter Adapter.

*a. Removal.*

*(1)* Remove the radiator drainplug and drain the coolant into a suitable container.

*(2)* Refer to figure 8-1 and remove stud from end of fluid pressure filter and remove filter.

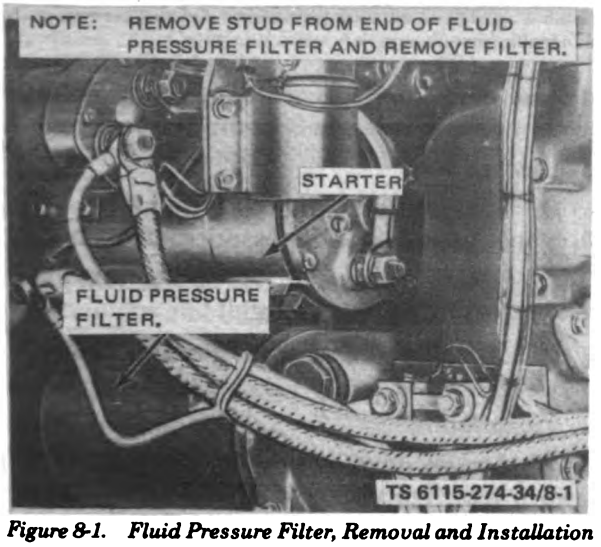


*Figure 8-1. Fluid Pressure Filter, Removal and Installation*

*(3)* Refer to figure 8-2 and remove cotter pin and clevis pin, thus separating yoke from shaft.

*(4)* Tag and disconnect electrical leads.

*(5)* Remove four screws and remove solenoid.

*(6)* Tag and disconnect cables (fig. 8-3).

*(7)* Tag and disconnect electrical leads.

*(8)* Remove screws and remove shunt and bracket.

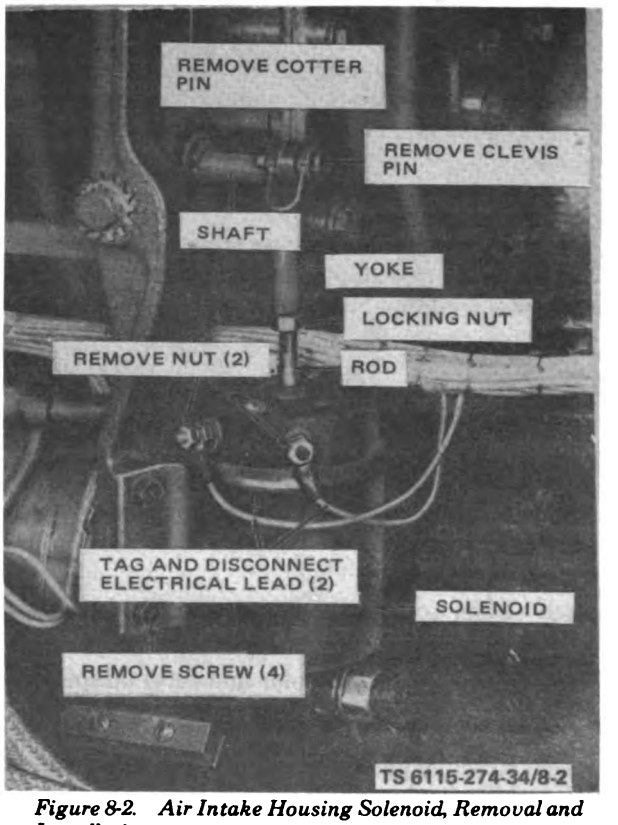


*Figure 8-2. Air Intake Housing Solenoid, Removal and Installation*

*(9)* Tag and disconnect electrical leads and cables to starting motor and solenoid (refer to fig. 6-1).

*(10)* Remove mounting screws and remove starter and solenoid.

*(11)* Remove water pump drainplug (refer to fig. 7-3).

*(12)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(13)* Remove two screws and washers and remove outlet seal and retainer.

*(14)* Remove three screws and washers and remove water pump and gasket.

*(15)* Disconnect the radiator outlet pipe from the oil cooler housing.

*(16)* Remove two screws from adapter (fig. 8-4).

*(17)* Remove six screws and remove oil cooler housing and core.

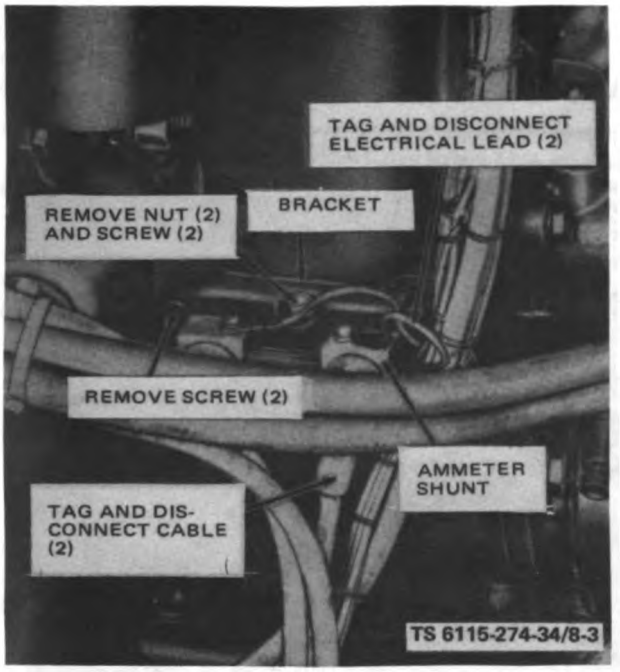


*Figure 8-3. Ammeter Shunt and Bracket, Removal and Installation*

*(18)* Refer to figure 8-5 and remove the screws indicated.

*(19)* Remove the oil cooler and filter adapter.

*b. Disassembly.*

*(1)* Remove gaskets (1 and 2, fig. 8-6) from oil cooler and filter adapter (3).

*(2)* Remove pressure regulator plug (4), gasket (5), spring (6), and valve (7).

*(3)* Remove pressure control plug (8), copper gasket (9), spring (10) and valve (11).

*c. Cleaning, Inspection and Repair.*

## WARNING

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App B) and dry thoroughly.

*(2)* Inspect the threaded areas of the screws, plugs, and oil cooler and adapter for stripped or damaged threads. Replace a damaged part.

*(3)* Inspect the springs, valves and oil cooler and filter adapter for cracks, breaks, and other damage. Replace a damaged or defective part.

*(4)* Inspect the gaskets for cracks, breaks, and other damage. Replace a damaged or defective gasket.

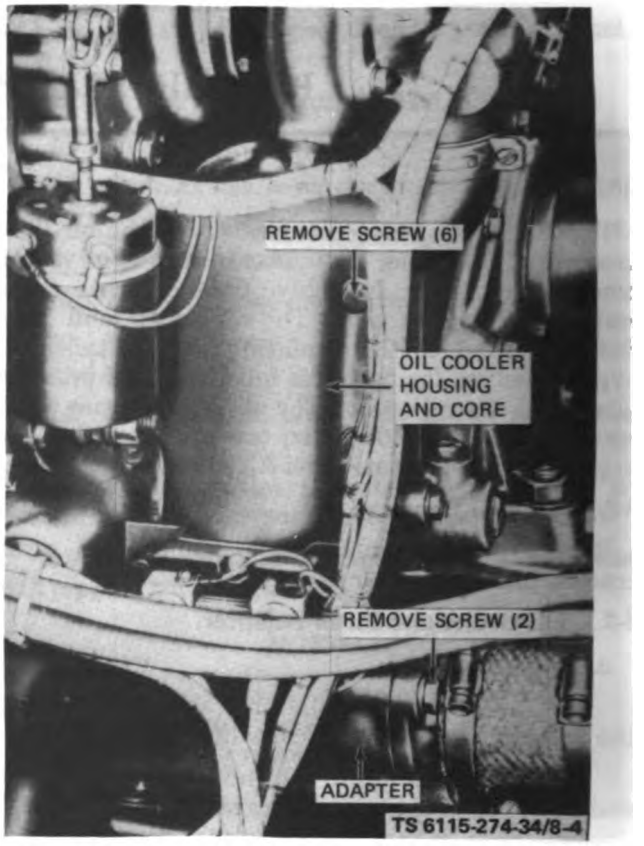


*Figure 8-4. Oil Cooler Housing and Core and Adapter, Removal and Installation*

*d. Reassembly.*

*(1)* Install the valve (11, fig. 8-6), spring (10), copper gasket (9) and pressure control plug (8).

*(2)* Install the valve (7), spring (6), gasket (5) and pressure regulator plug (4).

*(3)* Install gaskets (1 and 2) onto oil cooler and filter adapter (3).

*e. Installation.*

*(1)* Install oil cooler and filter adapter with screws in accordance with figure 8-5.

*NOTE*

*When reinstalling, insert three shorter screws in top of adapter. Copper washer goes on bottom screw.*

*(2)* Install oil cooler housing and core with screws in accordance with figure 8-4.

*(3)* Connect adapter with two screws.

*(4)* Connect the radiator outlet pipe to the oil cooler housing.

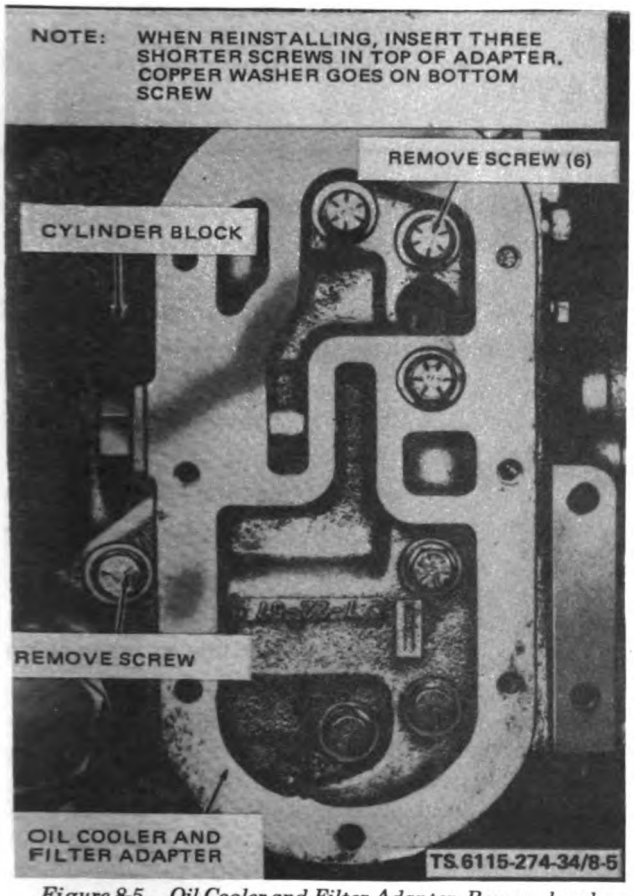


*Figure 8-5. Oil Cooler and Filter Adapter, Removal and Installation*

*(5)* Refer to figure 7-3 and install water pump and gasket with screws.

*(6)* Install outlet seal and gasket with screws.

*(7)* Install spacer, clamp and screws.

*(8)* Connect hoses to bypass line and inlet line with clamps and tighten screws.

*(9)* Install washer pump drainplug.

*(10)* Refer to figure 6-1 and install starter with mounting screws.

*(11)* Reconnect electrical leads and cables to starting motor and solenoid.

*(12)* Refer to figure 8-3 and install shunt and bracket with screws.

*(13)* Connect electrical leads and cables.

*(14)* Refer to figure 8-2 and install solenoid with four screws.

*(15)* Connect electrical leads.

*(16)* Install cotter pin and clevis pin connecting yoke and shaft.

1. Gasket
2. Gasket
3. Oil cooler and filter adapter
4. Pressure regulator plug
5. Pressure regulator gasket
6. Pressure regulator spring
7. Pressure regulator valve
8. Pressure control plug
9. Copper gasket
10. Helical compression spring
11. Pressure control valve

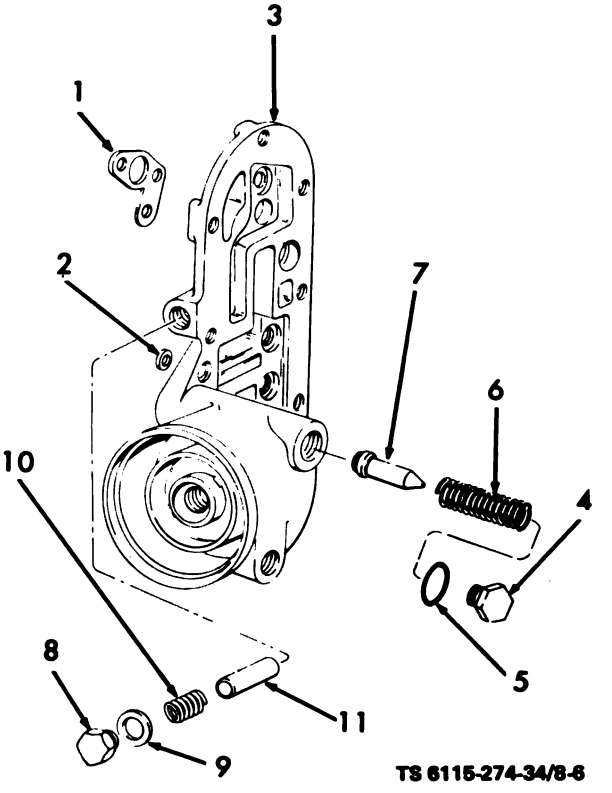


*Figure 8-6. Oil Cooler and Filter Adapter, Disassembly and Reassembly*

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(17)* Install the fluid pressure filter (refer to fig. 8-1) and install stud in end of filter.

*(18)* Install radiator drainplug and fill radiator with proper solution.

*NOTE*

*Open bleeder valve on top of the bypass valve assembly while radiator is being filled to bleed system of air.*

# CHAPTER 9
# REPAIR OF ENGINE

## Section I. FLYWHEEL HOUSING AND FLYWHEEL

**9-1. General.**

The flywheel housing provides a protective cover for the flywheel.

**9-2. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**9-3. Flywheel Housing and Flywheel.**

*a. Removal.*

*(1)* Remove radiator drainplug and drain coolant into a suitable container.

*(2)* Remove screws (1, fig. 9-1), washers (2), washers (18) and nuts (7) in the order necessary to remove engine doors (4 and 10), engine hood (6), generator doors (3 and 15), generator hood (5), left-side panels (16 and 17), fuel control panel (11) and right-rear panel (13) with canvas boot (12) and connector nut (14).

*(3)* Remove muffler rain cap and retainer (9).

*(4)* Remove screws attaching fan guard to shroud and remove fan guard.

*(5)* Remove radiator hose connections.

*(6)* Remove front cowl assembly (8).

*(7)* Refer to figure 2-3 to remove the batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(8)* Release latches and remove battery box cover. Loosen nuts, disconnect battery leads and remove jumper lead. Loosen battery holddowns and remove batteries.

*(9)* Refer to figure 2-4 to remove the battery box.

*(10)* Loosen clamps and remove heater-to-battery hose.

*(11)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(12)* Remove thermostat. Tag and disconnect electrical leads.

*(13)* Loosen hose clamp and remove drain hose.

*(14)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(15)* Remove nuts and screws holding battery box to frame and remove battery box.

*(16)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(17)* Remove screws and nuts holding generator stator frame cover and remove cover.

*(18)* Drain the fuel into a suitable container.

*(19)* Refer to figure 2-5 to remove the fuel tank cap and fuel filter.

*(20)* Remove fuel tank cap and strainer.

*(21)* Remove screws securing ring to filler neck and remove ring and gasket.

*(22)* Loosen the clamps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(23)* Remove the heater exhaust pipe at center cowl.

*(24)* Remove screws, washers and nuts holding center cowl to base frame and remove center cowl.

*(25)* Refer to figure 2-6 to remove the engine.

*NOTE*

*Position suitable blocking beneath rear of main generator before removing stator-to-flywheel housing screws.*

*(26)* Remove lockwire and screws holding stator frame to coupling plates.

*(27)* Remove screws holding stator frame to flywheel housing.

*(28)* Remove screws and nuts holding engine to skid base.

1. Screw, cap, hex hd
2. Washer, flat
3. Generator door, LH
4. Engine door, LH
5. Generator hood
6. Engine hood
7. Nut, hex
8. Front cowl
9. Muffler rain cap and retainer
10. Engine door, RH
11. Fuel control panel
12. Canvas boot
13. Right rear side panel
14. Connector nut (spec)
15. Generator door, RH
16. Left-rear side panel
17. Left-front side panel
18. Washer, lock
19. Center cowl

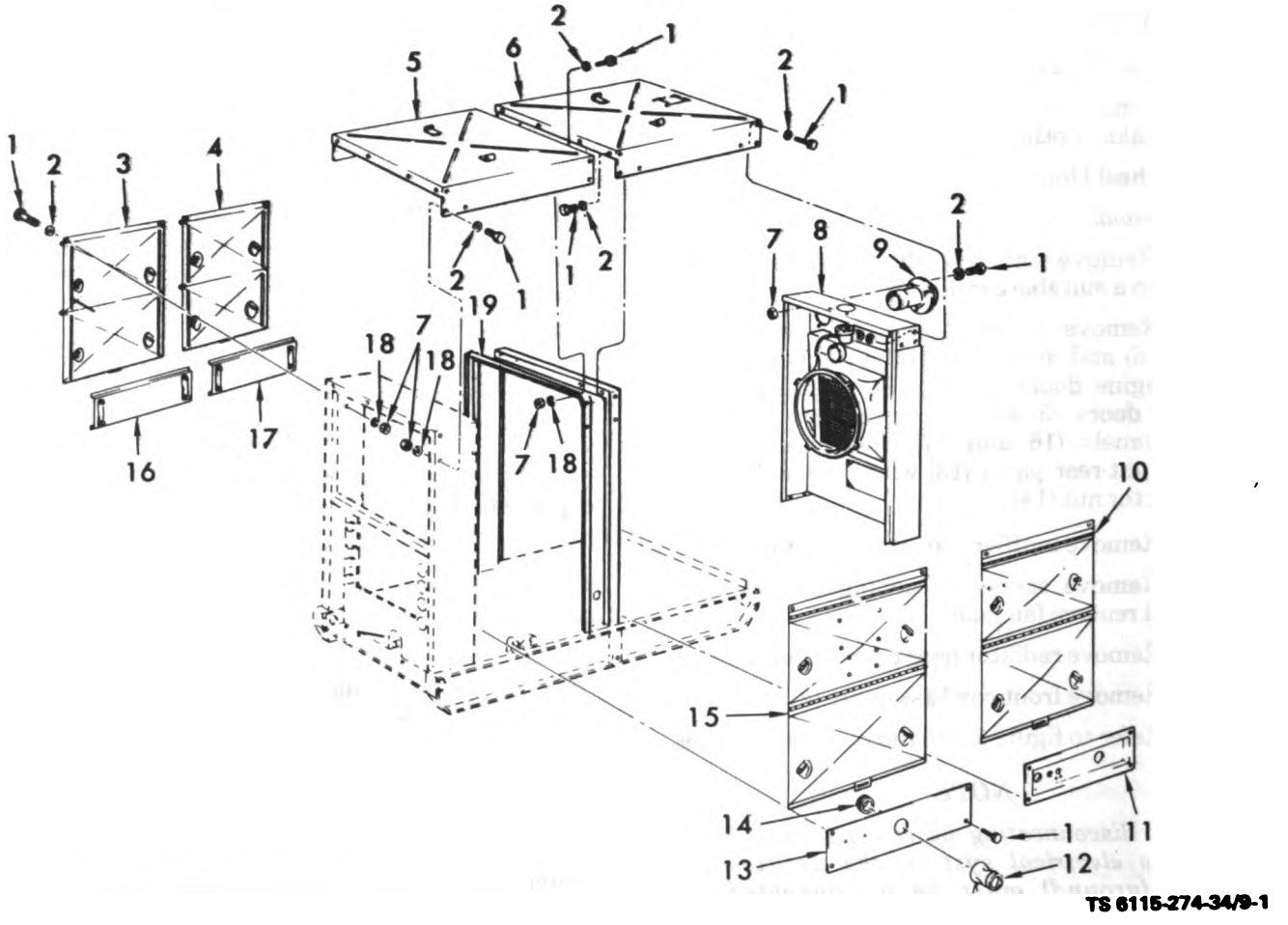


*Figure 9-1. Doors, HOods and Front and Center Cowls, Removal and Installation*

*(29)* Attach suitable lifting device to front and rear lifting brackets and remove engine. Place on suitable stand.

*(30)* Tag and disconnect electrical leads to solenoid (refer to fig. 8-2).

*(31)* Remove clevis pin and cotter pin.

*(32)* Remove screws and remove solenoid.

*(33)* Remove screws and spacers and remove solenoid bracket.

*(34)* Remove plug and drain hydraulic tank. Disconnect hydraulic fittings and remove tank.

*(35)* Loosen clamp and disconnect air hose.

*(36)* Disconnect ether primer line from air intake housing assembly. Remove screws and remove air intake housing.

*(37)* Remove water pump drainplug (refer to fig. 7-3).

*(38)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(39)* Remove two screws and washers and remove outlet seal and retainer.

*(40)* Remove three screws and washers and remove water pump.

*(41)* Disconnect hydraulic pump lines (refer to fig. 5-1).

*(42)* Remove four screws and remove hydraulic pump.

*(43)* Remove blower clamp (refer to fig. 7-8).

*(44)* Disconnect fuel lines from main fuel pump.

*(45)* Remove four screws and remove blower.

*(46)* Remove main fuel pump.

*(47)* Remove blower drive coupling line (refer to fig. 7-13).

*(48)* Remove two screws. Remove four screws and nuts.

*(49)* Remove gear support and remove gasket from end plate. Remove coupling assembly.

*(50)* Tag and disconnect electrical leads and cables to starting motor and solenoid (refer to fig. 6-1).

*(51)* Remove starting motor mounting screws and remove starter and solenoid.

*(52)* Remove lockwire and six bolts (fig. 9-2).

*(53)* Remove flywheel.

*(54)* Remove screws (1, fig. 9-3).

*(55)* Remove screws (2) and washers (3).

*(56)* Remove screws (4), washers (5), screws (6) and washers (7).

*(57)* Remove cover (8), seal (9) and gasket (10).

*(58)* Remove nuts (11), washers (12) and screws (13).

*(59)* Remove cover (14) and gasket (15).

*(60)* Remove screws (16), washers (17), cover (18) and gasket (19).

*(61)* Remove housing assembly (20) and gasket (21).

*(62)* Remove pipe plugs (22, 23, 24 and 25).

*b. Cleaning, Inspection and Repair of Flywheel and Housing.*

## WARNING

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the flywheel for cracks, breaks, warpage, and other damage.

*(3)* Inspect the spur gear for chipped or broken teeth.

*(4)* Inspect the oil seal for evidence of leakage.

*(5)* Replace a damaged or defective spur gear and other parts.

*c. Installation.*

*(1)* Install pipe plugs (22, 23, 24 and 25, fig. 9-3).

*NOTE*

*When installing flywheel housing, tighten mounting hardware only finger tight initially. Nut tightening sequence will follow after all screws are installed.*

*(2)* Install gasket (21) and housing assembly (20).

*(3)* Install gasket (19), cover (18), washers (17) and screws (16).

*(4)* Install gasket (15) and cover (14).

*(5)* Install screws (13), washers (12) and nuts (11).

*(6)* Install gasket (10), seal (9) and cover (8).

*(7)* Install washers (7), screws (6), washers (5) and screws (4).

*(8)* Install washers (3), screws (2) and screws (1).

*(9)* Refer to figure 9-4 for nut tightening sequence.

*(10)* Install flywheel with six bolts and lockwire (refer to fig. 9-2).

*(11)* Install starter and solenoid with mounting screws (refer to fig. 6-1).

*(12)* Connect electrical leads and cables.

*(13)* Install coupling assembly, gasket and gear support (refer to fig. 7-13).

*(14)* Install screws and nuts.

*(15)* Install line.

*(16)* Install main fuel pump (refer to fig. 7-8).

*(17)* Install blower with screws.

*(18)* Connect fuel lines to main fuel pump.

*(19)* Install clamp.

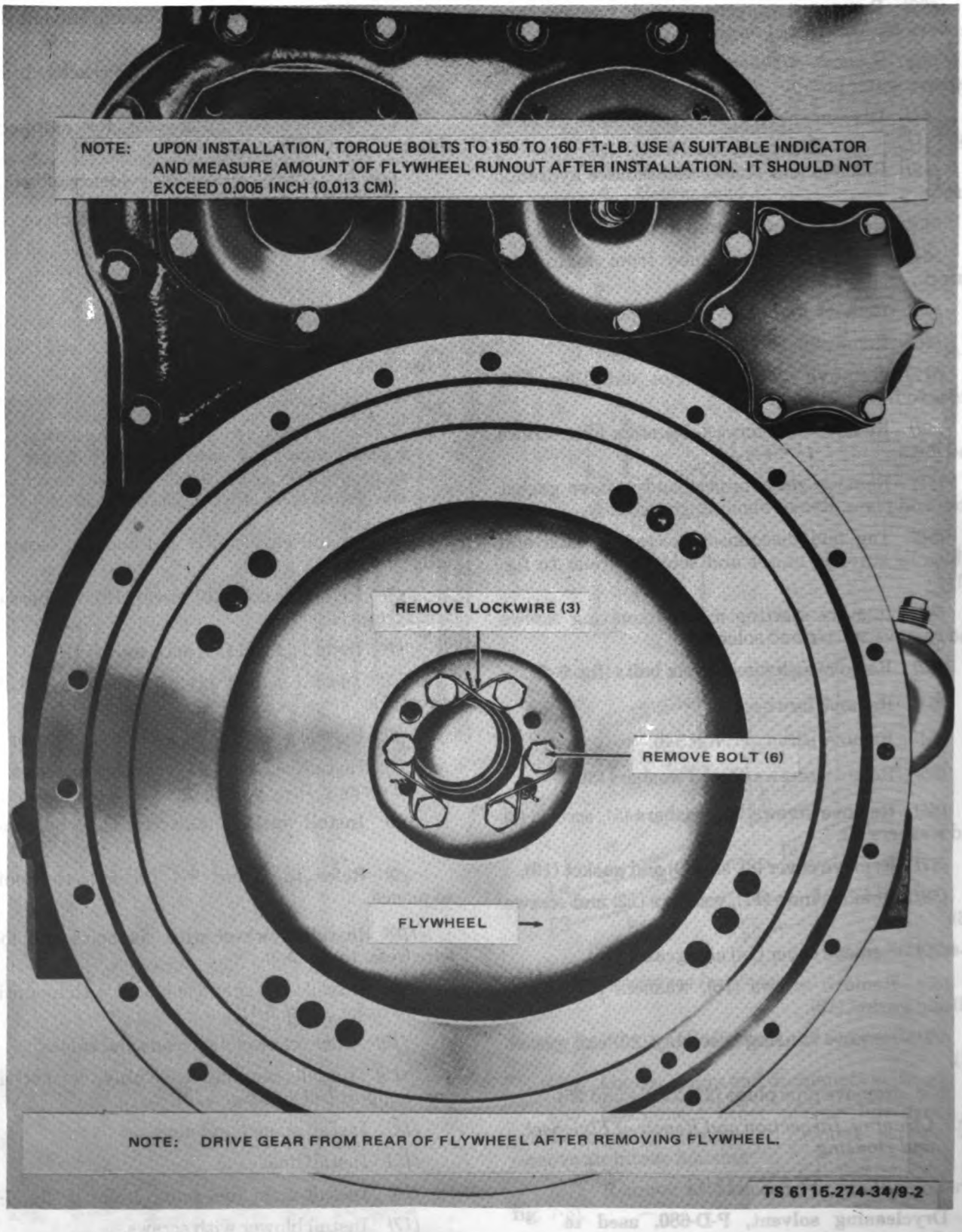


*Figure 9-2. Flywheel, Removal and Installation*

1. Screw, cap
2. Screw, cap
3. Washer, lock
4. Screw, cap
5. Washer, lock
6. Screw, cap
7. Washer, lock
8. Cover assembly
9. Seal, plain
10. Gasket
11. Nut, plain
12. Washer, lock
13. Screw, cap
14. Cover
15. Gasket
16. Screw, cap
17. Washer, lock
18. Cover, access plate
19. Gasket
20. Housing assembly
21. Gasket
22. Plug, pipe
23. Plug, pipe
24. Plug, pipe
25. Plug, pipe

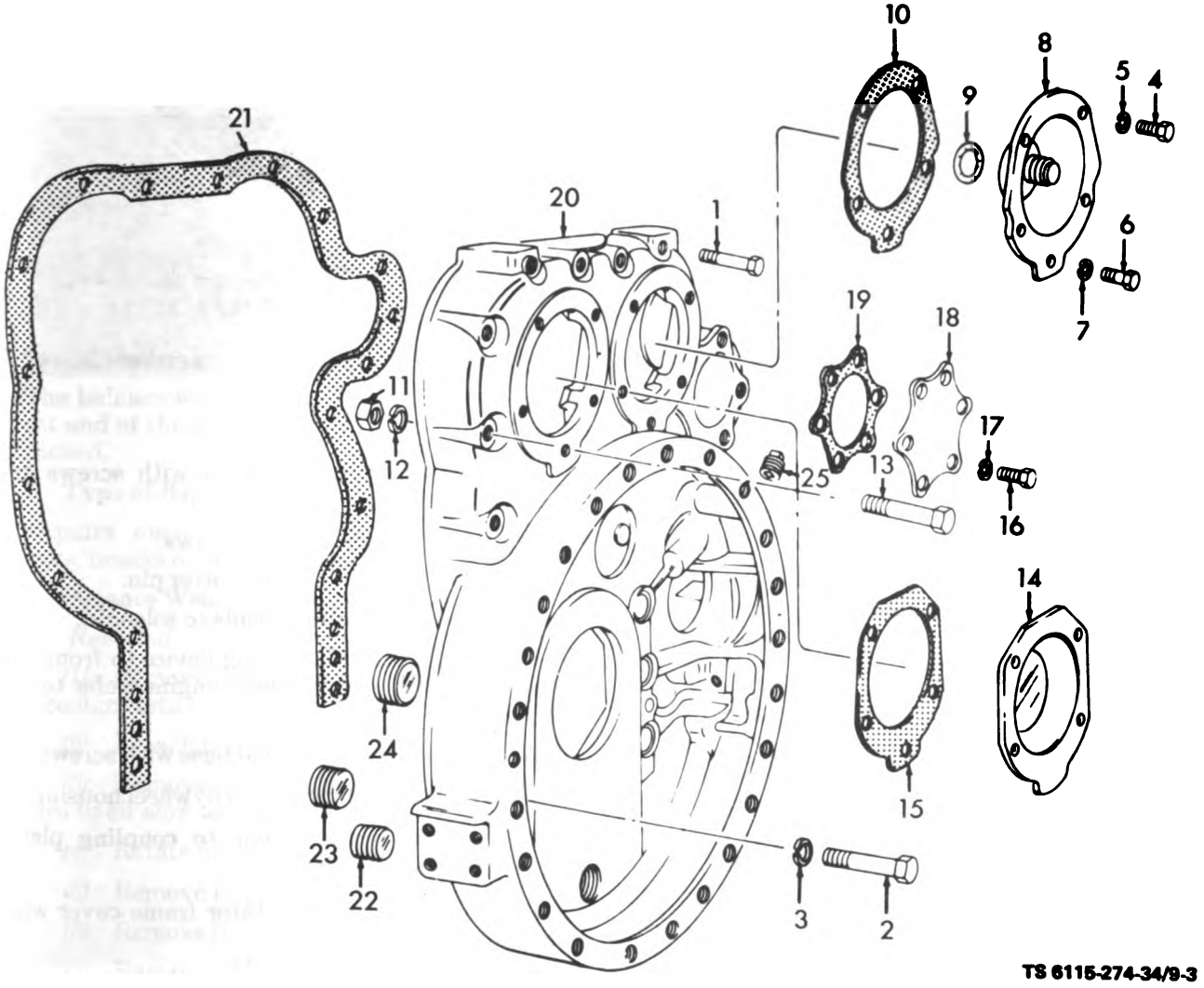


*Figure 9-3. Flywheel Housing, Removal, Disassembly, Reassembly and Installation*

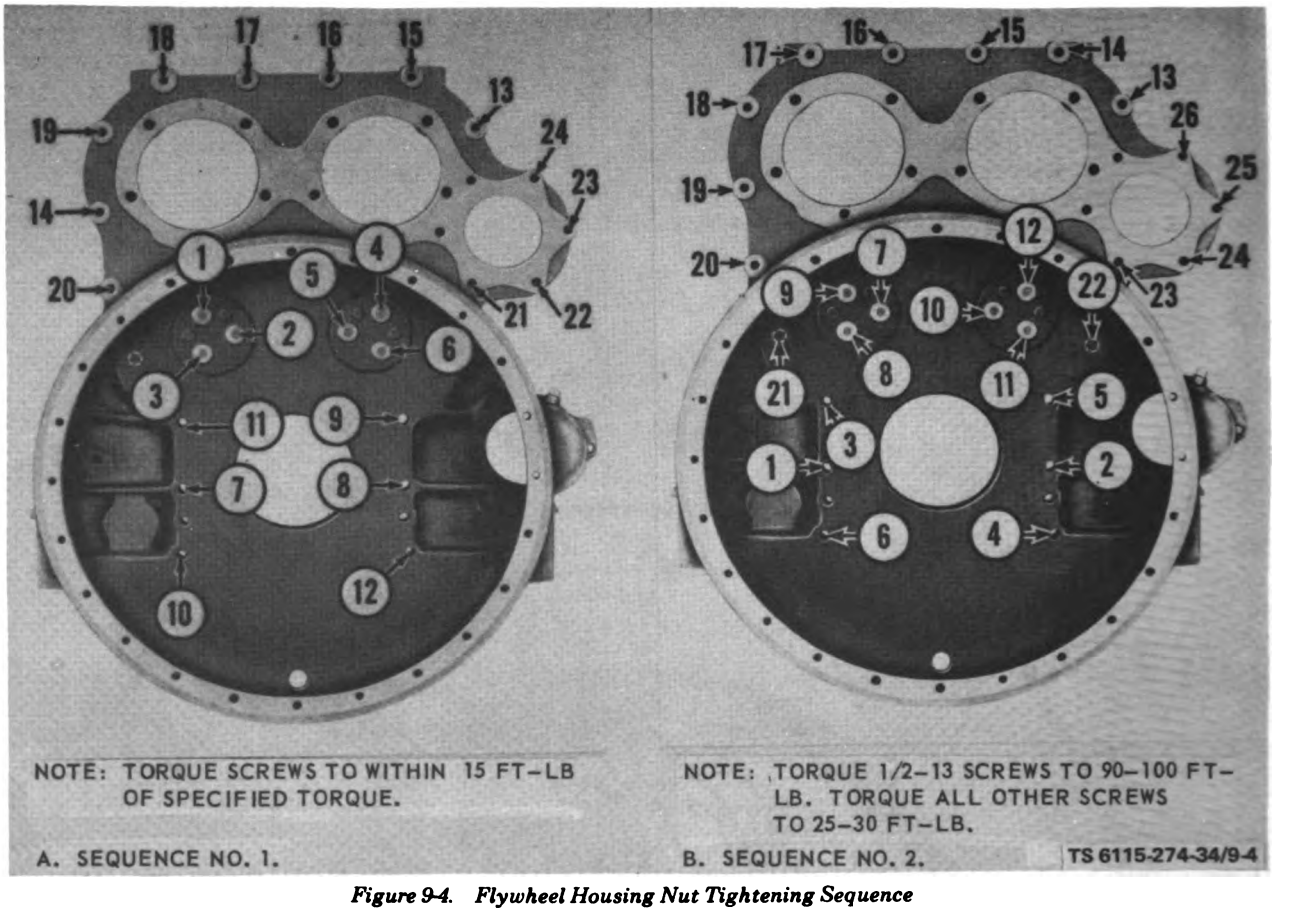


*Figure 9-4. Flywheel Housing Nut Tightening Sequence*

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(20)* Install hydraulic pump with four screws (refer to fig. 5-1).

*(21)* Connect hydraulic lines.

*(22)* Install water pump (refer to fig. 7-3).

*(23)* Install outlet seal and retainer with screws.

*(24)* Install spacer, clamp and screw.

*(25)* Connect hoses to bypass line and inlet line with clamps and tighten screws.

*(26)* Install water pump drainplug.

*(27)* Install air intake housing (refer to fig. 8-2).

*(28)* Connect ether primer line.

*(29)* Connect air hose with clamp.

*(30)* Install hydraulic tank and connect fittings.

*(31)* Install plug and service hydraulic tank.

*(32)* Install solenoid bracket with screws and spacers.

*(33)* Install solenoid with screws.

*(34)* Install clevis pin and cotter pin.

*(35)* Connect electrical leads to solenoid.

*(36)* Attach suitable lifting device to front and rear lifting brackets and install engine (refer to fig. 2-6).

*(37)* Attach engine to skid base with screws.

*(38)* Install stator frame to flywheel housing.

*(39)* Attach stator frame to coupling plates with screws and lockwire.

*(40)* Install generator stator frame cover with screws and nuts.

*(41)* Remove blocking from under rear of main generator.

*(42)* Install the heater exhaust pipe at center cowl.

*(43)* Install the fuel filler and hose into the fuel tank. Tighten clamp (refer to fig. 2-5).

*(44)* Attach ring and gasket to filler neck.

*(45)* Install fuel tank cap and strainer.

*(46)* Service the fuel tank.

*(47)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube to the engine.

*(48)* Attach battery box to frame with screws and nuts (refer to fig. 2-4).

*(49)* Attach battery box support to front engine mount with screws and nuts.

*(50)* Install drain hose and clamp.

*(51)* Install thermostat. Connect electrical leads.

*(52)* Attach electrical leads to battery box with clamps.

*(53)* Attach heater-to-battery hose with clamps.

*(54)* Install batteries (refer to fig. 2-3), and fasten holddowns.

*(55)* Connect battery leads and jumpter lead.

*NOTE*

*When reconnecting batteries, the positive lead (ground) must be connected last.*

*(56)* Install battery box cover and latch.

*(57)* Attach radiator and air shroud (8, fig. 9-1) and shutter assembly (9) to front cowl (7).

*(58)* Install front cowl (7) and grill guard (6).

*(59)* Install engine hood (5).

*(60)* Install LH engine door (3) and left-front side panel (4).

*(61)* Install fuel control panel (2) and RH engine door (1).

*(62)* Connect radiator inlet and outlet hoses and overflow hose with clamps and tighten screws.

*(63)* Service radiator with proper coolant.

## Section II. BALANCE WEIGHT COVER

**9-4. General.**

The balance weight cover is located on the upper front end of the engine and has the balance weights attached.

**9-5. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**9-6. Balance Weight Cover.**

*a. Removal.*

*(1)* Remove the radiator drainplug and drain the coolant into a suitable container.

*(2)* Detach radiator hoses from radiator.

*(3)* Remove screws and nuts attaching fan guard to air shroud (fig. 9-5).

*(4)* Rotate fan guard and remove.

*(5)* Remove RH engine door (1, fig. 7-16).

*(6)* Remove fuel control panel (2).

*(7)* Remove LH engine door (3) and left-front side panel (4).

*(8)* Remove engine hood (5).

*(9)* Remove grill guard (6) and front cowl assembly (7).

*(10)* Remove radiator and air shroud (8), and shutter assembly (9) from front cowl.

*(11)* Remove screws holding fan support assembly (fig. 9-6).

*(13)* Remove fan and belts.

*(14)* Remove studs (fig. 9-7).

*(15)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(16)* Remove and discard gasket.

*(17)* Tag and disconnect electrical leads to thermostatic switch (fig. 9-8).

*(18)* Remove four screws that attach bypass line assembly to water manifold.

*(19)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(20)* Remove thermostatic switch and heat deflector.

*(21)* Remove heat indicator sending unit (fig. 9-9).

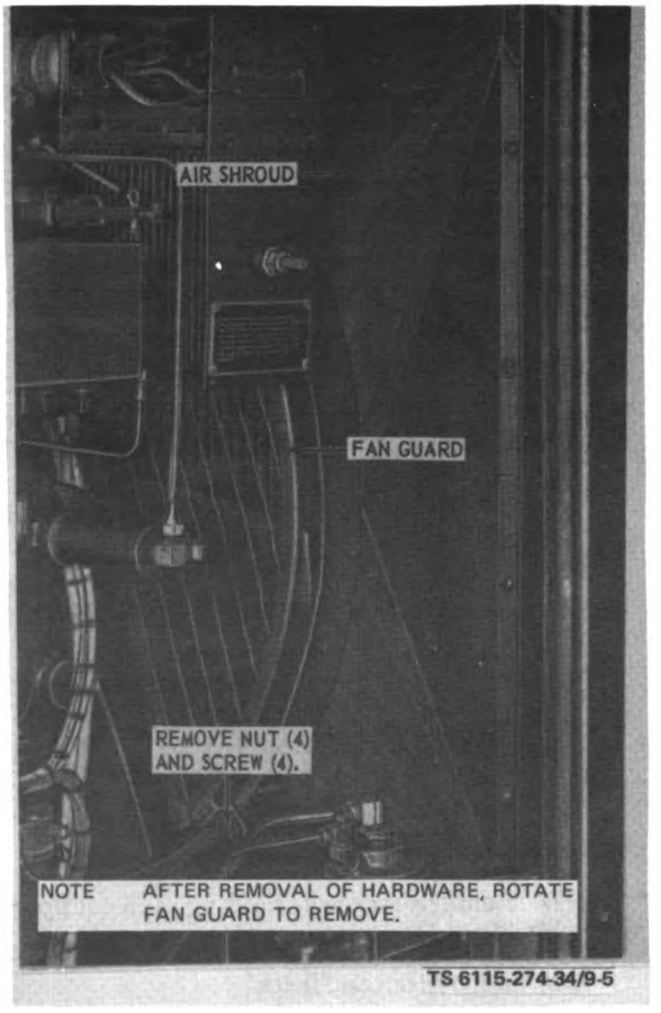


*Figure 9-5. Fan Guard, Removal and Installation*

*(22)* Remove six nuts and remove water manifold. Remove gaskets.

*(23)* Provide suitable container to catch fuel leakage and disconnect fuel line at each end of cooler (fig. 9-10).

*(24)* Remove screws and nuts holding clamps and remove clamps and cooler.

*(25)* Disconnect connectors from rear of rectifier (fig. 9-11).

*(26)* Remove screws holding bracket to engine and remove bracket and rectifier.

*(27)* Attach lifting device to lifting bracket (fig. 9-12).

*(28)* Remove screws and clamp.

*(29)* Remove balance weight cover and gasket.

*b. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean the cover with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the cover for cracks, breaks, and other damage.

*(3)* Replace a damaged or defective balance weight cover.

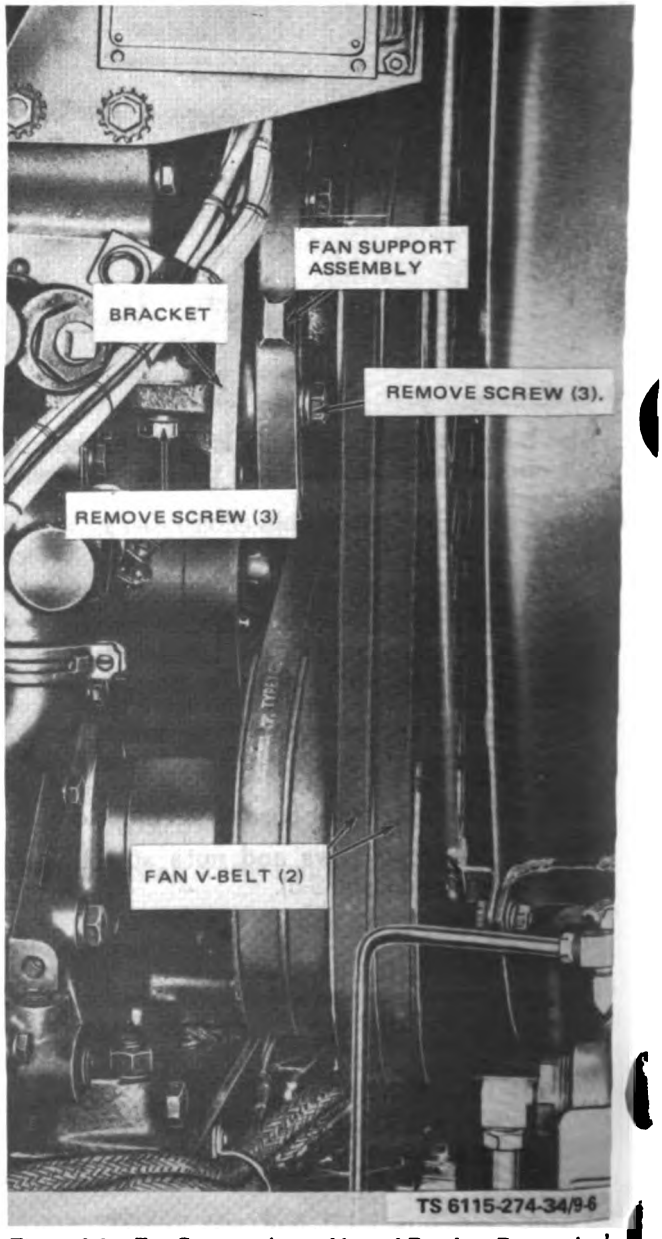


*Figure 9-6. Fan Support Assembly and Bracket, Removal and Installation*

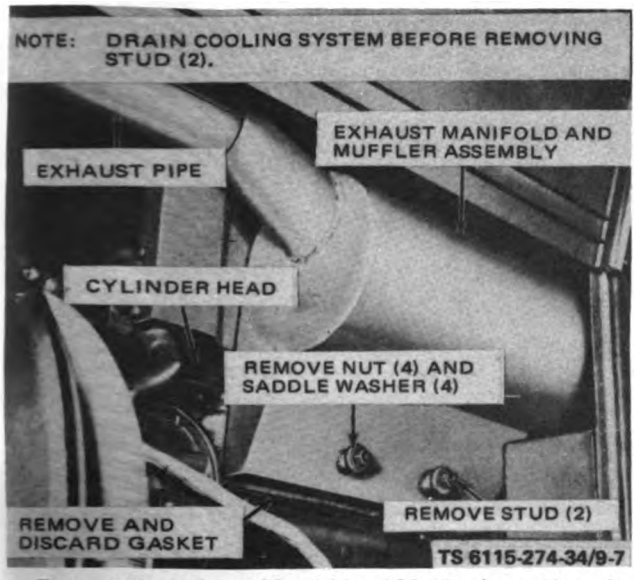


*Figure 9-7. Exhaust Manifold and Muffler Assembly and Exhaust Pipe, Removal and Installation*

c. ***Installation.***

*(1)* Attach lifting device to lifting bracket (refer to fig. 9-12).

*(2)* Install balance weight cover and gasket. Attach with screws.

*(3)* Attach metallic rectifier and brackets to engine (refer to fig. 9-11).

*(4)* Connect electrical connectors at rear of rectifier.

*(5)* Connect fuel lines at each end of fuel oil cooler (refer to fig. 9-10).

*(6)* Attach clamps to cooler and to engine with screws.

*(7)* Install gasket and water manifold (refer to fig. 9-9).

*(8)* Attach with six nuts and torque to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(9)* Install heat indicator sending unit.

*(10)* Install thermostatic switch and heat deflector.

*(11)* Install bypass line assembly and thermostat (refer to fig. 9-8) with screws.

*(12)* Install clamp and screw that secure bypass line to front of balance weight cover.

*(13)* Connect electrical leads to thermostatic switch.

*(14)* Install new gasket (refer to fig. 9-7).

*(15)* Install exhaust manifold and muffler assembly with exhaust pipe.

*(16)* Install nuts and studs.

*(17)* Torque nuts to 30 to 35 ft-lb (4.1 to 4.8 m-kg) and studs to 15 to 30 ft-lb &2.1 to 4.1 m-kg).

*(18)* Install fan bracket and fan support assembly (refer to fig. 9-6).

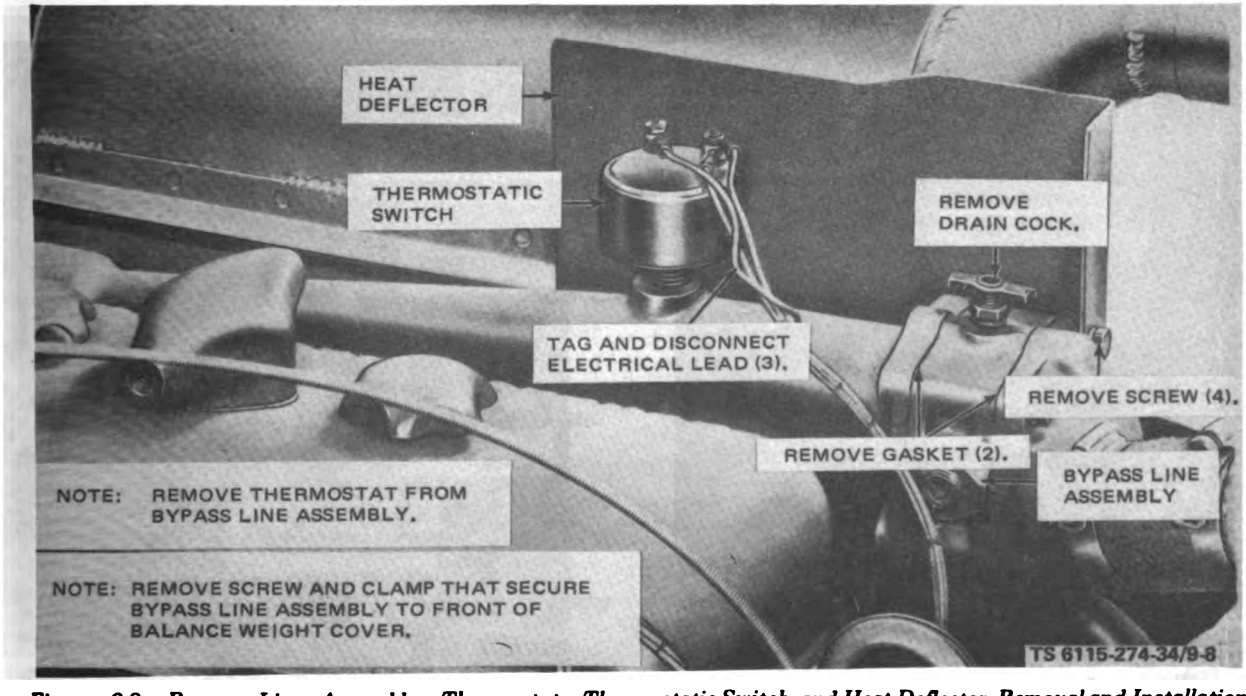


*Figure 9-8. Bypass Line Assembly, Thermostat, Thermostatic Switch, and Heat Deflector, Removal and Installation*

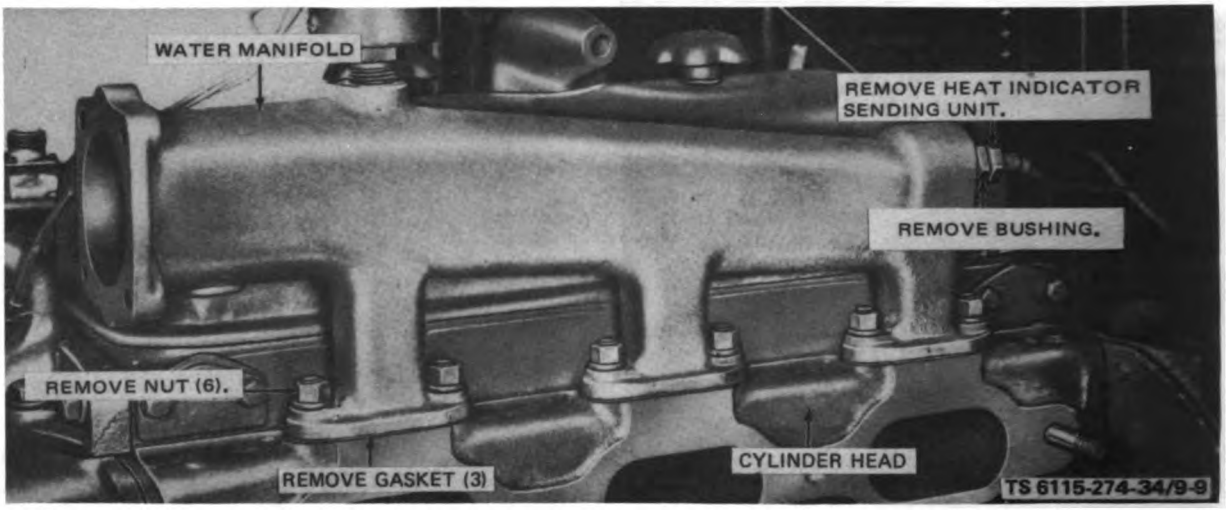


*Figure 9-9. Water Manifold, Removal and Installation*

*(19)* Install fan belts and move adjusting bracket so that the belts deflect 5/8 inch midway between pulleys. Tighten screws.

*(20)* Assemble shutter assembly (9, fig. 7-16) and radiator and air shroud (8) onto front cowl (7).

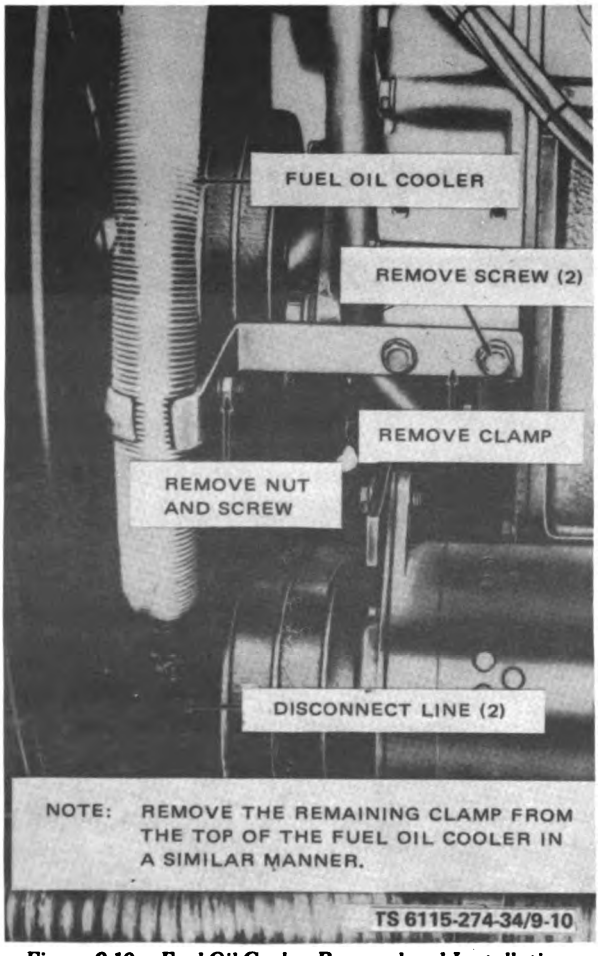


*Figure 9-10. Fuel Oil Cooler, Removal and Installation*

*(21)* Install front cowl assembly and grill guard (6) onto base.

*(22)* Install engine hood (5).

*(23)* Install left-front side panel (4) and LH engine door (3).

*(24)* Install fuel control panel (2) and RH engine door (1).

*(25)* Install fan guard and attach to air shroud.

*(26)* Attach radiator inlet, outlet and overflow hoses to radiator.

*(27)* Install radiator drain plug and service radiator with proper coolant.


*Figure 9-11. Metallic Rectifier and Bracket, Removal and Installation*

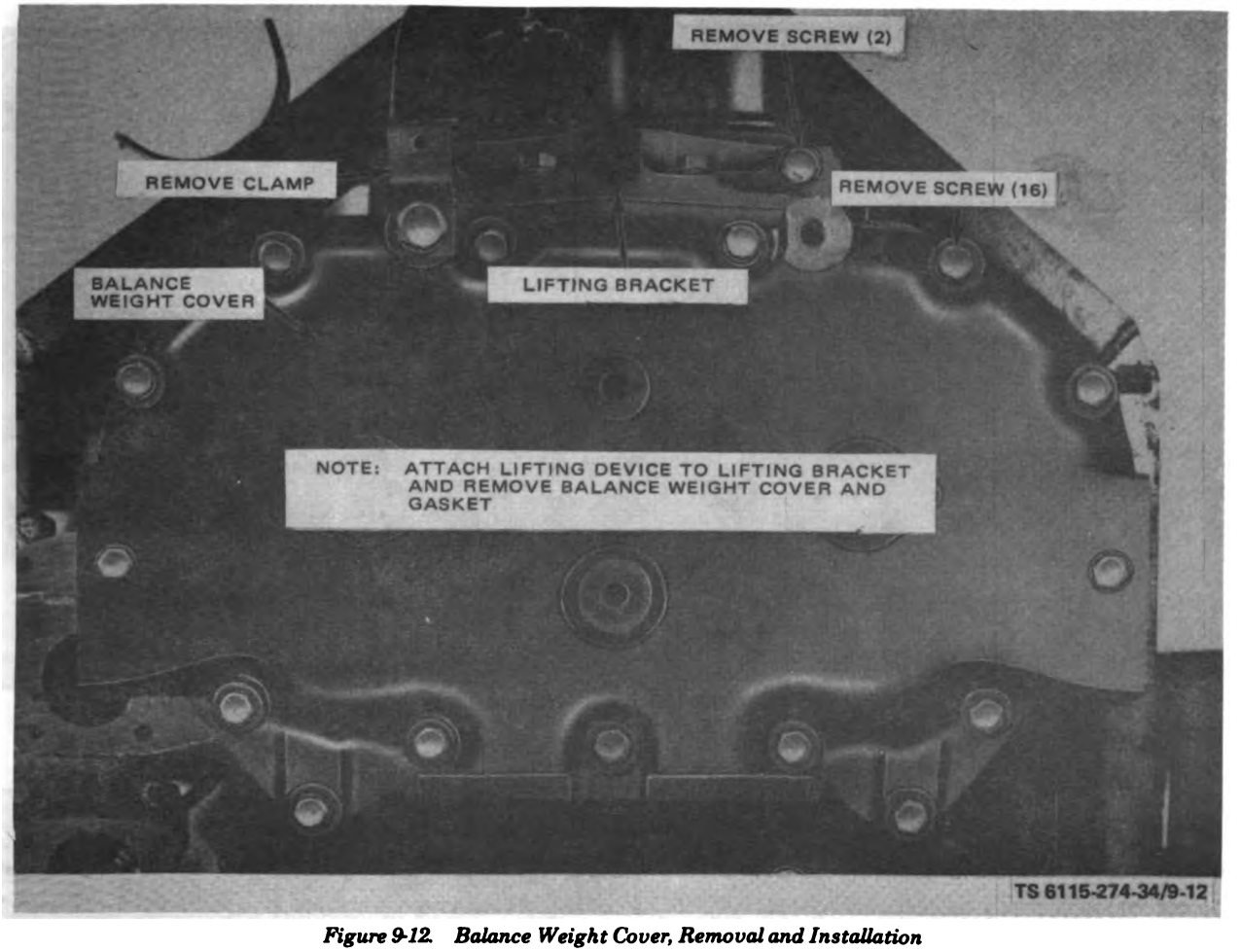


*Figure 9-12. Balance Weight Cover, Removal and Installation*

## Section III. CYLINDER HEAD AND ROCKER ARMS

**9-7. General.**

The cylinder head sits atop the cylinder block and contains the fuel injectors, valves, and rocker arms.

**9-8. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks, or other damage.

**9-9. Cylinder Head and Valves and Rocker Arms.**

*a. Removal.*

*(1)* Remove the RH engine door, LH engine door and the engine hood by removing attaching hardware.

*(2)* Remove radiator drainplug and drain coolant into a suitable container.

*(3)* Remove hose clamps and hoses and remove radiator inlet pipe (fig. 9-13).

*(4)* Open fuel filter draincock and drain fuel sediment into suitable container (refer to fig. 4-3).

*(5)* Tag and disconnect electrical leads.

*(6)* Disconnect fuel lines from fuel filter.

*(7)* Remove screws and fuel filter.

*(8)* Turn fuel oil pressure switch counterclockwise to remove.

*(9)* Remove studs (refer to fig. 9-7).

*(10)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(11)* Remove and discard gasket.

*(12)* Tag and disconnect electrical leads to thermostaic switch (refer to fig. 9-8).

*(13)* Remove four screws that attach bypass line assembly to water manifold.

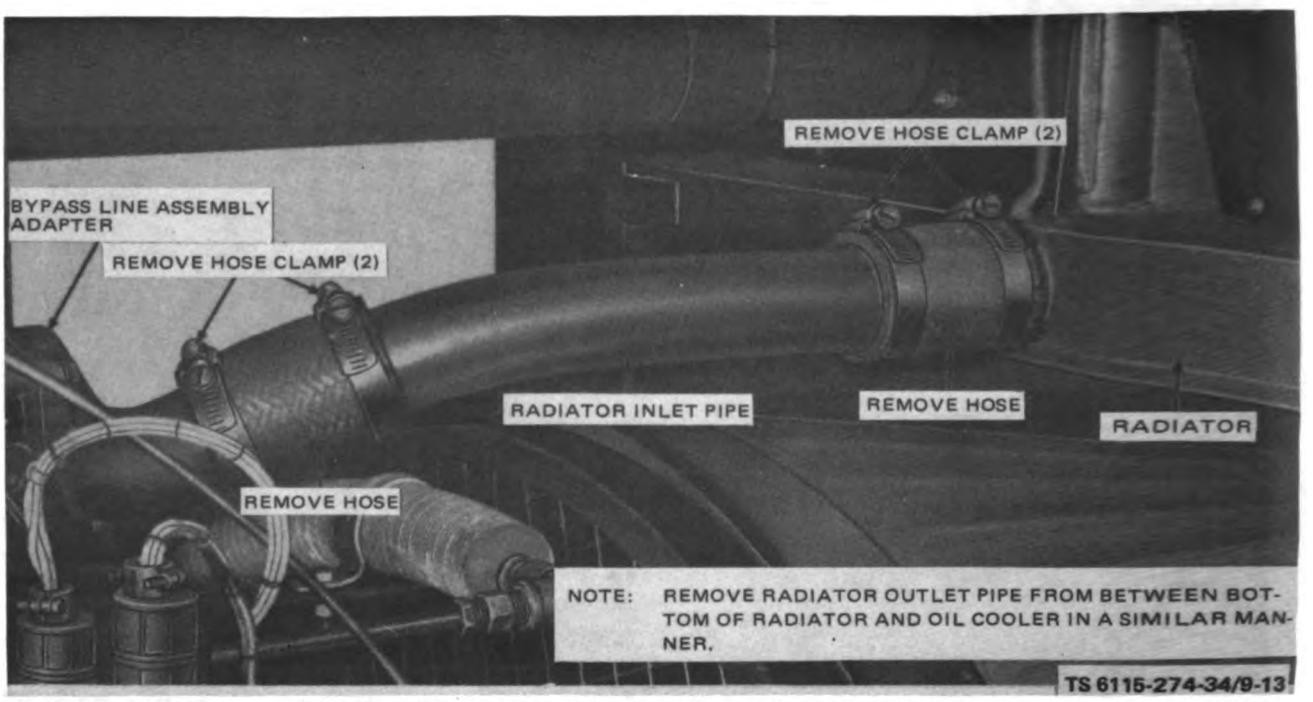


*Figure 9-13. Radiator Inlet Pipe, Removal and Installation*

*(14)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(15)* Remove thermostatic switch and heat deflector.

*(16)* Remove heat indicator sending unit (refer to fig. 9-9).

*(17)* Remove six nuts and remove water manifold. Remove gaskets.

*(18)* Loosen thumbscrews holding rocker arm cover and remove cover (fig. 9-14).

*(19)* Loosen screw and open clamp (fig. 9-15).

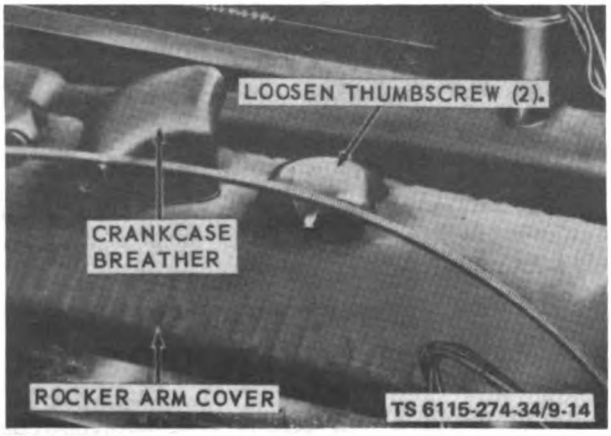


*Figure 9-14. Rocker Arm Cover, Removal and Installation*

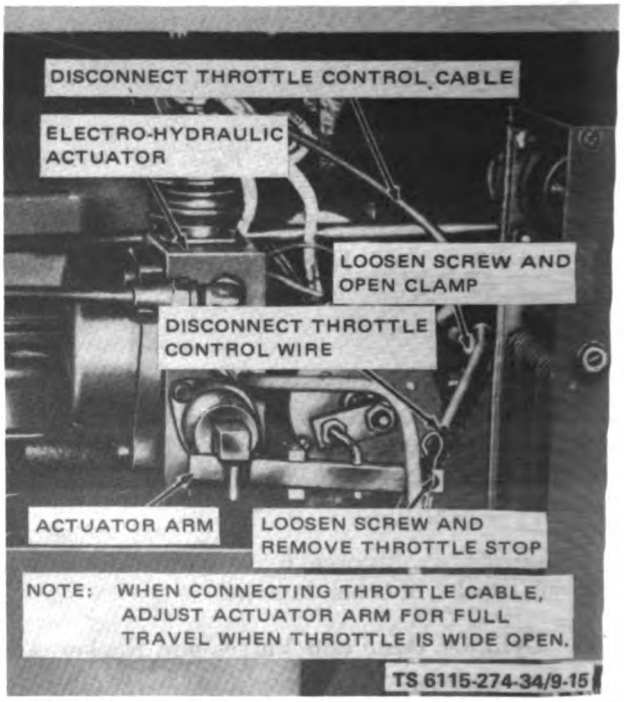


*Figure 9-15. Throttle Control Cable, Disconnect and Reconnect*

*(20)* Loosen screw and remove throttle stop.

*(21)* Disconnect throttle control wire.

*(22)* Tag and disconnect electrical leads to electrohydraulic actuator (refer to fig. 5-3).

*(23)* Disconnect hydraulic lines.

*(24)* Remove elbow and adapter.

*(25)* Remove cotter pin and straight pin and disengage control rod from control tube arm.

*(26)* Remove screws attaching actuator to cylinder head and remove actuator.

*(27)* Remove two nuts and six bolts attaching cylinder head to cylinder block (fig. 9-16).

*(28)* Remove two vertical screws from each lifting bracket.

*(29)* Attach suitable lifting device to front and rear lifting brackets and remove cylinder head.

*(30)* Remove gasket from cylinder block.

*(31)* Cover exposed top of cylinder block to prevent entry of foreign matter.

*(32)* Remove four screws and remove fuel injector control tube (fig. 4-5).

*(33)* Refer to table 2-1 and figure 9-17 for special tools used in removal and timing of fuel injectors.

*(34)* Loosen screws and nuts and remove fuel injector tubes (refer to fig. 4-6).

*(35)* Swing rocker arm assembly to one side and remove screw and special washer.

*(36)* Remove fuel injector clamps.

*(37)* Insert the injector remover under the front of the injector. Turn the injector slightly and disengage the control rack linkage. Remove fuel injectors.

*b. Disassembly.*

*(1)* Remove screws (1, fig. 9-18), washers (2), lifting brackets (3), and gasket (4).

*(2)* Remove injector hole tubes (5), packing (6), valve guides (7), rocker arm extension studs (8), and fuel connectors (9).

*(3)* Remove screws (10), covers (11), and gaskets (12).

*(4)* Remove pipe plugs (13), (14), and (15).

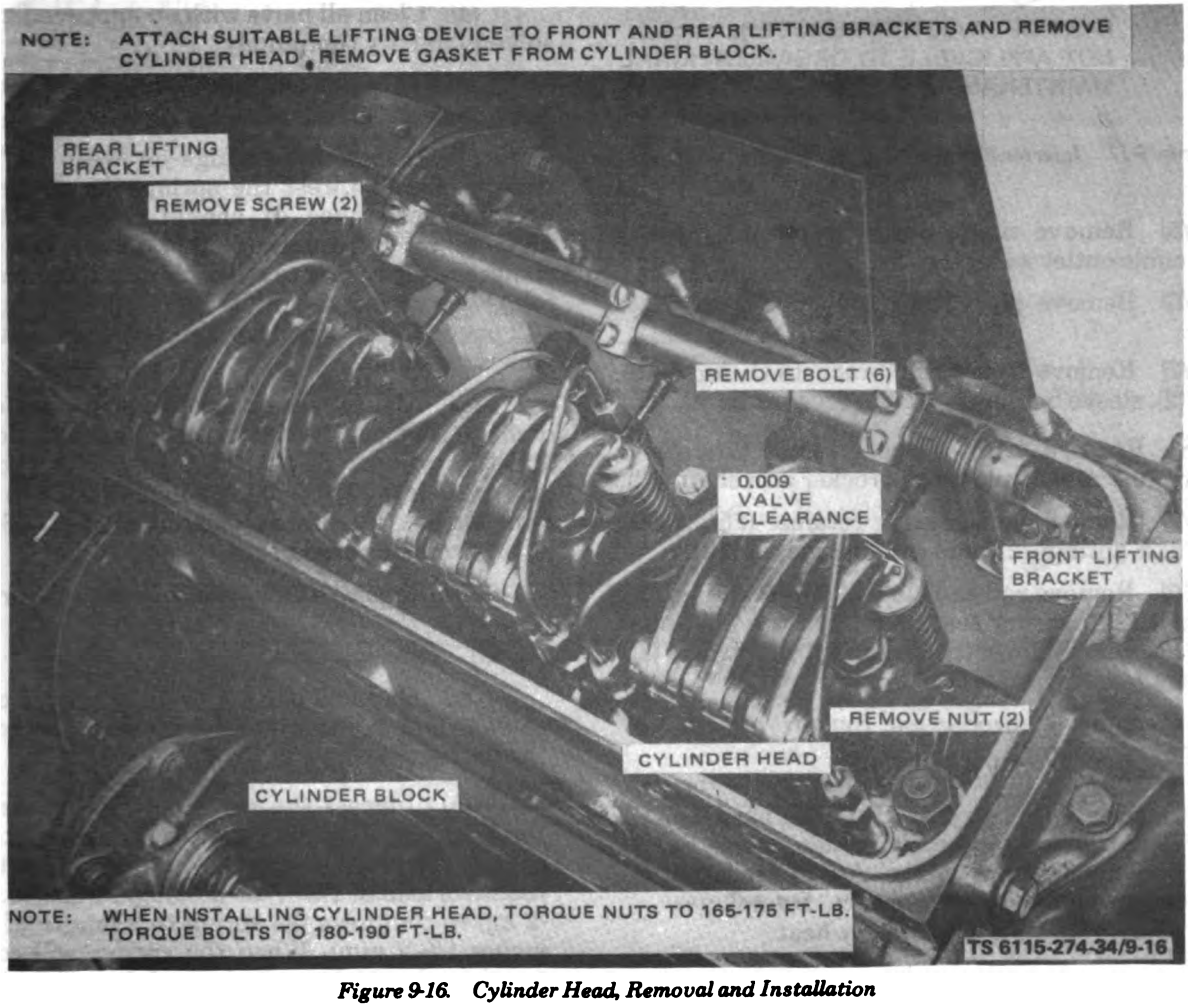


*Figure 9-16. Cylinder Head, Removal and Installation*

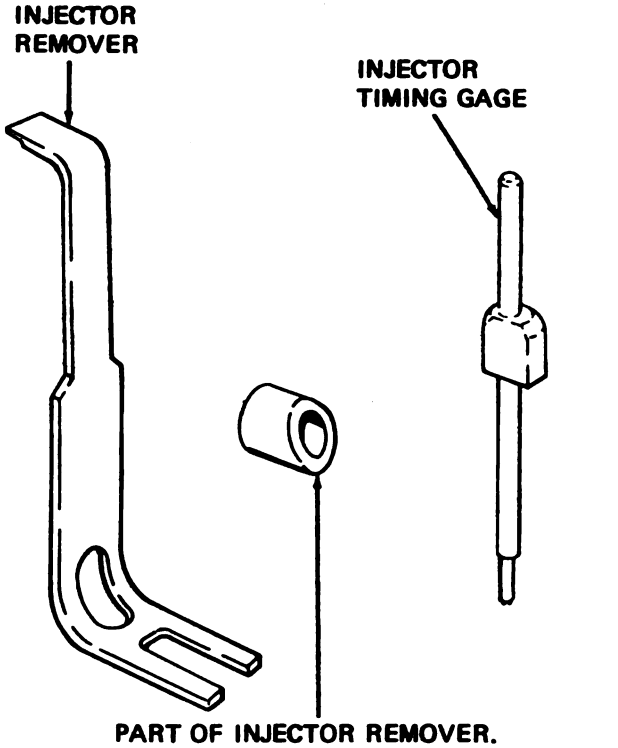


*Figure 9-17. Injector Remover and Injector Timing Gage*

*(5)* Remove single outlet water nozzle (16), and double outlet water nozzle (17).

*(6)* Remove pipe plug (18), and valve seats (19).

*(7)* Remove rocker arm brackets (1, fig. 9-19), bolts (2), sleeve bearings (3) and rocker arms (4).

*(8)* Remove injector rocker arms (5), sleeve bearing (6, 7 and 8), pin (9) and rocker arm shaft (10).

*(9)* Remove valve spring retainer (25), spring seats (22), springs (23) and exhaust valves (12).

*(10)* Remove rod end clevis (24), retaining ring (21), nut (20), spring seats (18), springs (19), push rods (17), cam follower (16), screws (14), washers (15) and cam follower guide (13).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Rocker arms.

*(a)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly with compressed air. Clean out all oil passages with a small wire.

*(b)* Inspect the rocker arm shaft and bushings inside the rocker arms for excessive wear. The diameter of a new shaft is 0.8735 to 0.8740 inch (22.1869 to 22.1996 mm). The inside diameter of a new bushing is 0.8750 to 0.8760 inch (22.225 to 22.2504 mm). The clearance should be 0.001 to 0.0025 inch (0.0254 to 0.0635 mm). Worn parts should not exceed 0.004 inch (0.1016 mm).

*(c)* Inspect the push rod clevis to rocker arm bushing and pin clearance for excessive wear. The clearance between the steel clevis pin bushing and bronze rocker arm bushing is 0.0015 to 0.003 inch (0.0381 to 0.0762 mm). The side clearance between the clevis and rocker arm should be from 0.008 to 0.017 inch (0.203 to 0.432 mm).

*(d)* Replace a damaged or defective part.

*(2)* Cam followers and push rods.

*(a)* Clean all parts with an approved cleaning solvent and dry thoroughly.

*(b)* Inspect the rods for wear, bending, and damaged threads.

*(c)* Inspect the springs for wear and distortion. If possible, test the springs for proper compression resistance. It should require a load of 184 +8 or -8 pounds (83.5 +3.6 or -3.6 kg) to compress the spring to a length of 2-1/2 inches (63.5 mm). The spring should be replaced when a load of 172 pounds (78 kg) will compress the spring to 2-1/8 inches (54 mm).

*(d)* Inspect the cam follower for evidence of damage. Inspect the clearance between the follower and the cylinder head. The proper clearance with new parts is 0.0010 to 0.0030 inch (0.0254 to 0.0762 mm) with a maximum clearance of 0.0060 inch (0.1524 mm) for used parts.

*(e)* Replace a damaged or defective part.

*(3)* Valves.

*(a)* Clean all parts with an approved cleaning solvent and dry thoroughly. Clean all carbon from the valves.

*(b)* Inspect the valve springs for wear, distortion, and broken coils. If possible, test the springs for proper compression resistance. It should require a load of 140 +4.5 or -4.5 pounds (63.5 +2 or -2 kg) to compress the spring to a length of 1-15/16 inches (49.2 mm). When the spring will compress to a length of 1-51/64 inches (45.6 mm) with a load of 127 pounds (57.6 kg) or less, it must be replaced.

1. Screw, cap hex hd
2. Washer, lock
3. Engine lifting bracket
4. Gasket
5. Injector hole tube
6. Preformed packing
7. Valve guide
8. Rocker arm cover extension stud
9. Fuel connector
10. Screw, cap, hex hd
11. Cover
12. Gasket
13. Plug, pipe
14. Plug, pipe
15. Plug, pipe
16. Single outlet water nozzle
17. Double outlet water nozzle
18. Plug, pipe
19. Valve seat
20. Cylinder head

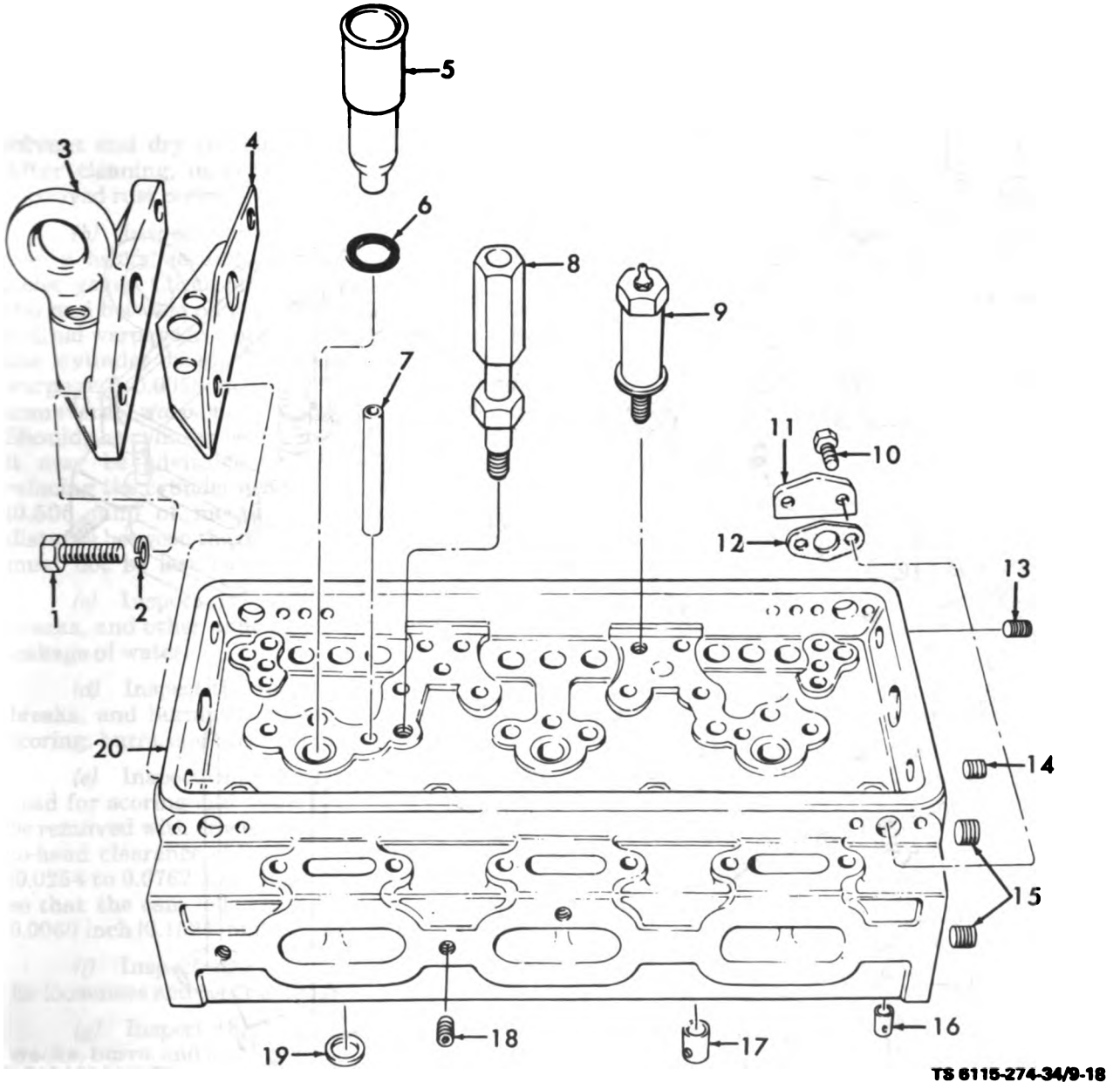


*Figure 9-18. Cylinder Head, Disassembly and Reassembly*

1. Rocker arm shaft bracket
2. Bolt, machine 1/2-13 x 4-$/4 in.
3. Sleeve bearing
4. Rocker arm
5. Injector rocker arm
6. Sleeve bearing
7. Sleeve bearing
8. Sleeve bearing
9. Straight headless pin (spec)
10. Rocker arm shaft
11. Cylinder head assembly
12. Exhaust valve
13. Cam follower guide
14. Screw, cap, hex hd, 1/4-20 x 3/4 in.
15. Washer, lock, 1/4 in.
16. Cam follower
17. Push rod
18. Spring seat
19. Spring
20. Nut, hex, 5/16-20
21. Retaining ring
22. Spring seat
23. Spring
24. Rod end clevis
25. Valve spring retainer

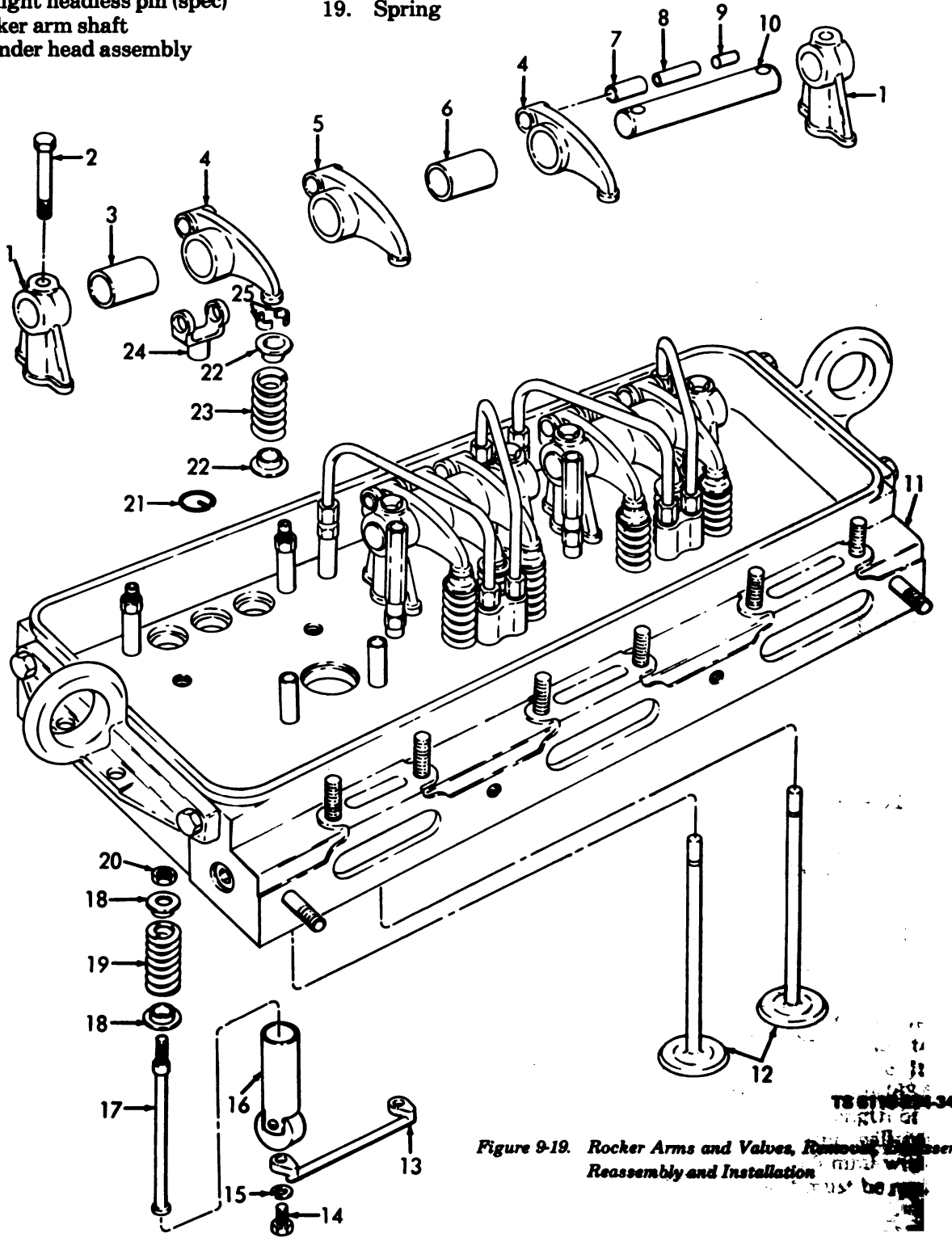


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*Figure 9-19. Rocker Arms and Valves, Removal, Disassembly, Reassembly and Installation*

*(c)* Inspect the valves for wear, pitting, and rough ridges. Inspect to see that the heads are square with the stems and that there is no warpage. Measure the diameter of the valve stem. It should be 0.3415 to 0.3425 inch (8.6741 to 8.6995 mm).

*(d)* Inspect the valve and valve seat insert for proper seating. The correct angle for proper seating face for both valve and the insert is 30 degrees. Should the valve require refacing, be sure the thickness after refacing is not less than 0.020 inch (0.508 mm). The insert may be ground but not past the point where further grinding will allow the grinding wheel to come into contact with the cylinder head.

*(4)* Cylinder Head.

*(a)* Clean all parts with an approved cleaning solvent and dry thoroughly with compressed air. After cleaning, immerse the cylinder head in an approved rust preventive solution (Item 5, App. B).

*(b)* Inspect the cylinder head for warpage. Use a heavy accurate straightedge and accurate feeler gages. Check for transverse warpage at each end and between all cylinders. Also check for longitudinal warpage in 6 places along the bottom face of the cylinder head. The maximum longitudinal warpage is 0.0055 inch (0.1397 mm) and maximum transverse warpage is 0.004 inch (0.1016 mm). Should the cylinder head exceed the warpage limits, it may be advisable to reface the head. When refacing the cylinder head, no more than 0.020 inch (0.508 mm) of metal should be removed. The distance between the top of the head and the bottom must not be less than 3.536 inches (89.814 mm).

*(c)* Inspect the cylinder head for cracks, breaks, and other damage which might permit the leakage of water.

*(d)* Inspect the valve seat inserts for cracks, breaks, and burning. Inspect the valve guides for scoring, burrs, and other damage.

*(e)* Inspect cam follower bores in the cylinder head for scoring and wear. Light score marks may be removed with crocus cloth and fuel oil. Follower-to-head clearance should be 0.0010 to 0.0030 inch (0.0254 to 0.0762 mm). If bores are worn excessively so that the cam follower-to-head clearance exceeds 0.0060 inch (0.1524 mm) the head must be replaced.

*(f)* Inspect the cylinder head water nozzles for looseness and other damage.

*(g)* Inspect the fuel injector hole tubes for cracks, burrs, and leaking seals.

*(h)* Inspect all threaded components for damaged or defective threads.

*(i)* Replace a damaged or defective part.

*d. Reassembly.*

*(1)* Assemble rod end clevis (24, fig. 9-19), retaining ring (21), nut (20), spring seats (18), springs (19), pushrods (17), cam follower (16), screws (14), washers (15) and cam follower guide (13).

*(2)* Assemble valve spring retainer (25), spring seats (22), springs (23) and exhaust valves (12).

*(3)* Install injector rocker arms (5), sleeve bearings (6, 7 and 8), pin (9) and rocker arm shaft (10).

*(4)* Install rocker arms (4), sleeve bearings (3), bolts (2) and rocker arm brackets (1).

*(5)* Install valve seats (19, fig. 9-18) and pipe plugs (18).

*(6)* Install single outlet water nozzle (16) and double outlet water nozzle (17).

*(7)* Install pipe plugs (13, 14 and 15).

*(8)* Install gaskets (12), covers (11) and screws (10).

*(9)* Install fuel connectors (9), rocker arm cover extension studs (8), valve guides (7), preformed packing (6), and injector hole tubes (5).

*(10)* Install gaskets (4), engine lifting brackets (3), lockwashers (2) and screws (1).

*e. Installation.*

*(1)* Install fuel injectors (refer to fig. 4-6).

*(2)* Install fuel injector clamps. Install screws and special washers. Torque screw 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(3)* Install fuel injector tubes and tighten screws and nuts.

*(4)* Install fuel injector control tube (refer to fig. 4-5) and attach with four screws.

*(5)* Remove protective covering from the top of cylinder block and install gasket (fig. 9-16).

*(6)* Attach suitable lifting device to lifting brackets and install cylinder head.

*(7)* Install two vertical screws into lifting brackets.

*(8)* Install two nuts and six bolts attaching cylinder head to cylinder block.

*(9)* Torque nuts to 165 to 175 ft-lb (22.8 to 24.2 m-kg) and bolts to 180 to 190 ft-lb (24.9 to 26.3 m-kg).

*(10)* Attach electrohydraulic actuator to cylinder head (refer to fig. 5-3).

*(11)* Do not attach control rod at this time.

*(12)* Attach elbow and adapter and connect hydraulic lines.

*(13)* Connect electrical leads to actuator.

*(14)* Connect throttle control wire (fig. 9-15).

*(15)* Connect throttle stop and connect throttle control wire. Close clamp.

*(16)* When connecting throttle cable, adjust actuator arm for full travel when throttle is wide open.

*(17)* Loosen all inner and outer adjusting screws (refer to fig. 4-10), and follow the steps given.

*(18)* Connect control rod to control tube arm with cotter pin and straight pin.

*(19)* To adjust control rod, position control rod at full throttle. Position control tube arm at full throttle. Adjust clevis until holes in control tube arm and clevis align, then insert pin.

*(20)* Fuel injector timing can be accomplished during one full revolution of the crankshaft (refer to fig. 4-12). Follow the steps given.

*(21)* Install rocker arm cover (fig. 9-14) and tighten thumbscrews.

*(22)* Install gaskets for water manifold (fig. 9-9).

*(23)* Install water manifold with six nuts. Torque nuts to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(24)* Install heat indicator sending unit.

*(25)* Install thermostatic switch and heat deflector (fig. 9-8).

*(26)* Install bypass line assembly with thermostat. Secure bypass line assembly to front of balance weight cover with clamp and screw.

*(27)* Attach bypass line assembly to water manifold with four screws.

*(28)* Connect electrical leads to thermostatic switch.

*(29)* Install exhaust manifold gasket.

*(30)* Install exhaust manifold and muffler assembly and exhaust pipe with nuts and saddle washers. Install studs.

*(31)* Torque exhaust manifold nuts to 30 to 35 ft-lb (4.1 to 4.8 m-kg) and studs to 15 to 30 ft-lb (2.1 to 4.1 m-kg).

*(32)* Install fuel oil pressure switch by turning clockwise (refer to fig. 4-3).

*(33)* Install fuel filter and connect fuel lines.

*(34)* Connect electrical leads. Close fuel filter draincock.

*(35)* Install radiator inlet pipe with hoses and clamps (refer to fig. 9-13).

*(36)* Install radiator drainplug and service with proper coolant solution.

*(37)* Adjust valve clearance with engine at operating temperature. Crank engine over until the injector on No. 1 cylinder is in the down position. Loosen locknut and place a 0.009 inch (0.229 mm) gage between rocker arm and valve stem. Loosen locknut and turn the pushrod until a steady pull is required to remove the gage. Hold pushrod and secure locknut. Recheck clearance and readjust if necessary. Repeat procedure for all valves in sequence of firing order 1-3-2.

*(38)* Install engine hood, right engine door and left engine door with attaching hardware.

## Section IV. TIMING GEARS AND SHAFTS

### 9-10. General.

The timing gears and shafts are located in the upper cylinder block.

### 9-11. Type of Repairs.

Repairs may involve loose connections, wear, cracks, breaks or other damage.

### 9-12. Timing Gears and Shafts.

*a. Removal.*

*(1)* Remove the radiator drainplug and drain the coolant into a suitable container.

*(2)* Detach radiator hoses from radiator.

*(3)* Refer to figure 9-5 and remove hardware attaching fan guard to air shroud.

*(4)* Rotate fan guard and remove.

*(5)* Remove screws (1, fig. 9-20), washers (2), washers (17) and nuts (7) and remove doors (3, 4 9 and 14) and hoods (5 and 6).

*(6)* Remove panels (10, 15 and 16).

*(7)* Remove canvas boot (11), connector nut (13) and panel (12).

1. Screw, cap, hex hd
2. Washer, flat
3. Generator door, LH
4. Engine door, lh
5. Generator hood
6. Engine hood
7. Nut, hex
8. Front cowl assembly
9. Engine door, RH
10. Fuel control panel
11. Canvas boot
12. Right-rear side panel
13. Connector nut (spec)
14. Generator door, RH
15. Left-rear side panel
16. Left-front side panel
17. Washer, lock

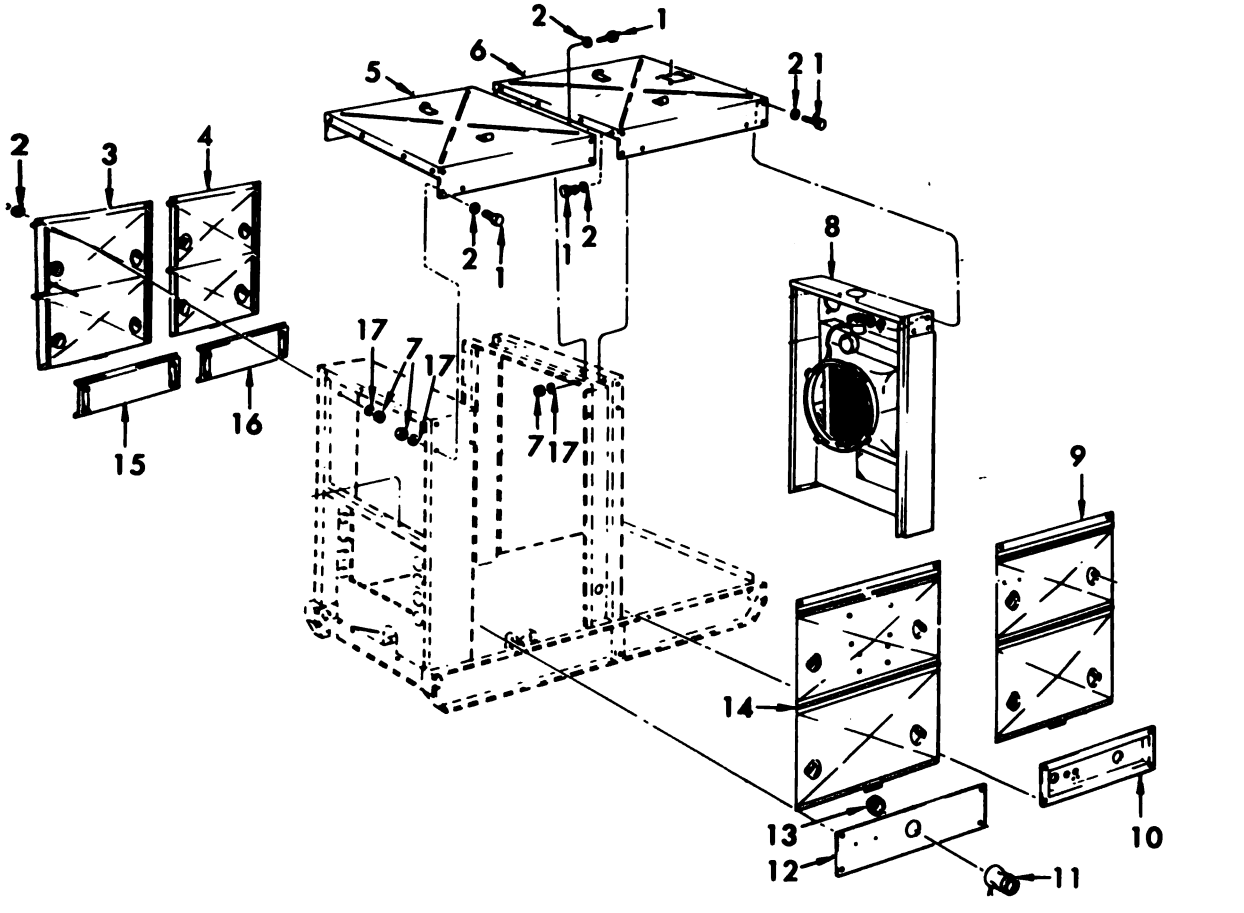


*Figure 9-20. Housing Group and Cowl Assembly, Removal and Installation*

*(8)* Remove front cowl assembly (8) containing radiator, shroud and grill guard.

*(9)* Refer to figure 2-3 to remove the batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(10)* Release latches and remove battery box cover. Loosen nuts, disconnect battery leads and remove jumper lead. Loosen battery holddowns and remove batteries.

*(11)* Refer to figure 2-4 to remove battery box.

*(12)* Loosen clamps and remove heater-to-battery hose.

*(13)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(14)* Remove thermostat. Tag and disconnect electrical leads.

*(15)* Loosen hose clamp and remove drain hose.

*(16)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(17)* Remove nuts and screws holding battery box to frame and remove battery box.

*(18)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(19)* Remove screws and nuts holding generator stator fraine cover and remove cover.

*(20)* Drain the fuel into a suitable container.

*(21)* Refer to figure 2-5 to remove the fuel tank cap and fuel filler.

*(22)* Remove fuel tank cap and strainer.

*(23)* Remove screws securing ring to filler neck and remove ring and gasket.

*(24)* Loosen the clainps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(25)* Remove the heater exhaust pipe at center cowl.

*(26)* Remove screws, washers and nuts holding center cowl to base frame and remove center cowl.

*(27)* Refer to figure 2-6 to remove the engine.

*NOTE*

*Position suitable blocking beneath rear of main generator before removing stator-to-flywheel housing screws.*

*(28)* Remove lockwire and screws holding stator frame to coupling plates.

*(29)* Remove screws holding stator frame to flywheel housing.

*(30)* Remove screws and nuts holding engine to skid base.

*(31)* Attach suitable lifting device to front and rear lifting brackets and remove engine. Place on suitable stand.

*(32)* Tag and disconnect electrical leads to solenoid (refer to fig. 8-2).

*(33)* Remove clevis pin and cotter pin.

*(34)* Remove screws and remove solenoid.

*(35)* Remove screws and spacers and remove solenoid bracket.

*(36)* Remove plug and drain hydraulic tank Disconnect hydraulic fittings and remove tank.

*(37)* Loosen clamp and disconnect air hose.

*(38)* Disconnect ether primer line from air intake housing assembly. Remove screws and remove air intake housing.

*(39)* Remove water pump drainplug (refer to fig. 7-3).

*(40)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(41)* Remove two screws and washers and remove outlet seal retainer.

*(42)* Remove three screws and washers and remove water pump.

*(43)* Disconnect hydraulic lines (refer to fig. 5-1).

*(44)* Remove four screws and remove hydraulic pump.

*(45)* Remove clamp (refer to fig. 7-8).

*(46)* Disconnect fuel lines from main fuel pump.

*(47)* Remove four screws and remove blower.

*(48)* Remove main fuel pump.

*(49)* Remove line (refer to fig. 7-13).

*(50)* Remove two screws. Remove four screws and nuts.

*(51)* Remove gear support and remove gasket from end plate. Remove coupling assembly.

*(52)* Tag and disconnect electrical leads and cables to starting motor and solenoid (refer to fig. 6-1).

*(53)* Remove starting motor mounting screws and remove starter and solenoid.

*(54)* Refer to figure 9-2 and remove lockwire and six bolts.

*(55)* Remove flywheel.

*(56)* Remove screws (1, fig. 9-3).

*(57)* Remove screws (2) and washers (3).

*(58)* Remove screws (4), washers (5), screws (6) and washers (7).

*(59)* Remove cover (8), seal (9) and gasket (10).

*(60)* Remove nuts (11), washers (12) and screws (13).

*(61)* Remove cover (14) and gasket (15).

*(62)* Remove screws (16), washers (17), cover (18) and gasket (19).

*(63)* Remove housing assembly (20) and gasket (21).

*(64)* Remove pipe plugs (22, 23, 24 and 25).

*(65)* Remove screws holding fan support assembly (fig. 9-6).

*(66)* Remove screws and bracket.

*(67)* Remove fan and belts.

*(68)* Remove studs (fig. 9-7).

*(69)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(70)* .Remove and discard gasket.

*(71)* Tag and disconnect electrical leads to thermostatic switch (fig. 9-8).

*(72)* Remove four screws that attach bypass line assembly to water manifold.

*(73)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(74)* Remove thermostatic switch and heat deflector.

*(75)* Remove bushing and heat indicator sending unit (fig. 9-9).

*(76)* Remove six nuts and remove water manifold. Remove gaskets.

*(77)* Provide suitable container to catch fuel leakage and disconnect fuel line at each end of cooler (fig. 9-10).

*(78)* Remove screws and nuts holding clamps and remove clamps and cooler.

*(79)* Disconnect connectors from rear of rectifier (fig. 9-11).

*(80)* Remove screws holding bracket to engine and remove bracket and rectifier.

*(81)* Attach lifting device to lifting bracket (fig. 9-12).

*(82)* Remove screws and clamp.

*(83)* Remove balance weight cover and gasket.

*(84)* Loosen thumbscrews holding rocker arm cover and remove cover (fig. 9-14).

*(85)* Loosen screw and open clamp (fig. 9-15).

*(86)* Loosen screw and remove throttle stop.

*(87)* Disconnect throttle control wire.

*(88)* Tag and disconnect electrical leads to electrohydraulic actuator (fig. 5-3).

*(89)* Disconnect hydraulic lines.

*(90)* Remove elbow and adapter.

*(91)* Remove cotter pins and straight pin and disengage control rod from control tube arm.

*(92)* Remove screws attaching actuator to cylinder head and remove actuator.

*(93)* Remove two nuts and six bolts attaching cylinder head to cylinder block (fig. 9-16).

*(94)* Remove two vertical screws from each lifting bracket.

*(95)* Attach suitable lifting device to lifting brackets and remove cylinder head.

*(96)* Remove gasket from cylinder block.

*(97)* Refer to figure 9-21 and remove components in accordance with steps of procedure.

*(98)* Remove screws from rear sleeve bearings and remove shafts, sleeve bearings, and gears assembled.

*(99)* Remove six screws from plate (fig. 9-22).

*(100)* Remove camshaft and balance shaft sleeve bearings.

*Disassembly.*

*(1)* Remove camshaft plugs (1, fig. 9-23) from camshaft (2).

*(2)* Remove lockrings (3), camshaft intermediate bearings (4) Woodruff keys (5) and rear sleeve bearing (6) from camshaft (2).

*(3)* Remove Woodruff keys (5) and rear sleeve bearing (11) from balance shaft (12).

*(4)* Remove balance weights (7), screws (9), camshaft gear (8) and balance shaft gear (10).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly. Blow out all passages with compressed air.

*(2)* Inspect the shafts and bearings for nicks, burrs, scoring, scratches, and wear.

*(3)* Inspect the bearing thrust washers for scored faces. If not too severely scored, they may be smoothed down with an oilstone.

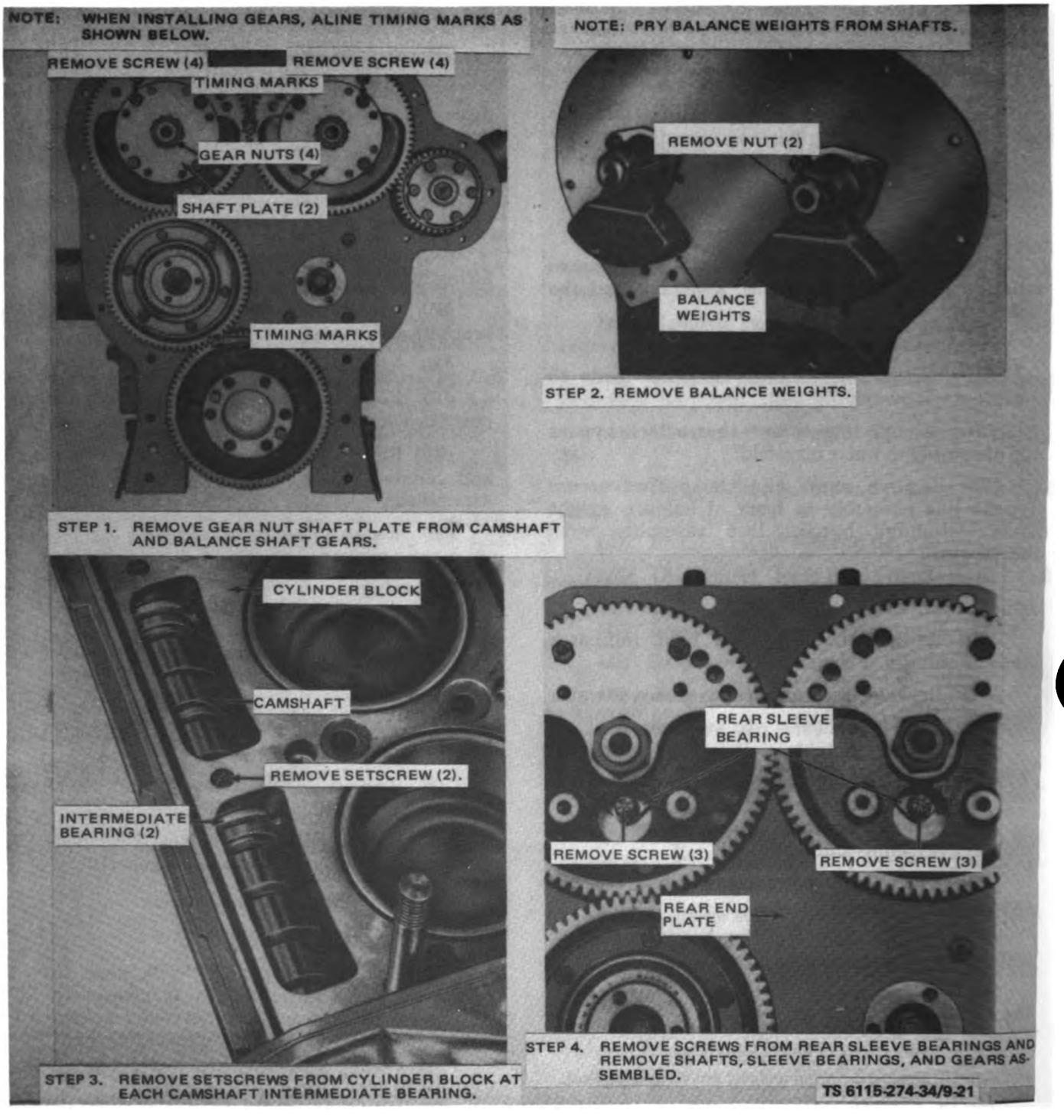


*Figure 9-21. Timing Gears and Shafts, Removal and Installation*

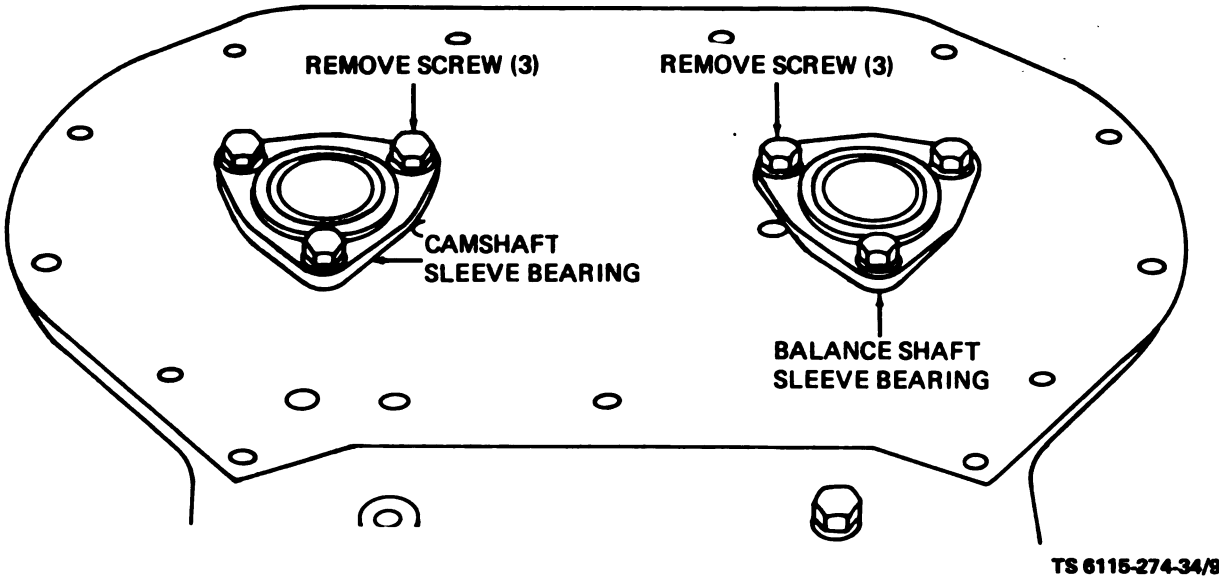


*Figure 9-22. Front Sleeve Bearings, Removal and Installation*

*(4)* Inspect bushings in end bearings for evidence of turning in the bearing cages. If bearings have turned, install new bushings and test for a press fit. A proper press fit is indicated when the bushing will not move when a load of 2,000 pounds (908 kg) is applied.

*(5)* Inspect the gears for scoring, pitting, wear, and burning. If gears are severely damaged or worn, install new gears.

*(6)* Replace a damaged or defective part.

*d. Reassembly.*

*(1)* Assemble balance weights (7, fig. 9-23), screws (9), camshaft gear (8) and balance shaft gear (10).

*(2)* Assemble Woodruff keys (5), rear sleeve bearing (11) and balance shaft (12).

*(3)* Assemble lockrings (3), camshaft intermediate bearings (4), Woodruff keys (5), rear sleeve bearing (6) and camshaft (2).

*(4)* Install camshaft plugs (1).

*e. Installation.*

*(1)* Install front sleeve bearings with screws (fig. 9-22).

*(2)* Install assembled shafts, sleeve bearings and gears and attach rear sleeve bearings with screws (fig. 9-21).

*(3)* Install setscrews at each camshaft intermediate bearing.

*(4)* Install balance weights and fasten with nuts.

*(5)* Install gear nuts on shaft.

*NOTE*

*When installing gears, align timing marks.*

*(6)* Fasten camshaft plate and balance shaft weight with screws.

*(7)* Install cylinder block gasket (fig. 9-16).

*(8)* Attach suitable lifting device to lifting brackets and install cylinder head.

*(9)* Install two nuts and six bolts attaching cylinder head to cylinder block.

*(10)* Torque cylinder head nuts to 165 to 175 ft-lb (22.8 to 24.2 m-kg) and screws to 180 to 190 ft-lb (24.9 tc 26.3 m-kg).

*(11)* Attach electrohydraulic actuator to cylinder head with screws (refer to fig. 5-3).

*(12)* Attach control rod to control tube arm with cotter pins and straight pin.

*NOTE*

*To adjust control rod, position control rod at full throttle. Position control tube arm at full throttle. Adjust clevis until holes in control tube arm and clevis align, then insert pin.*

*(13)* Install elbow and adapter and connect hydraulic lines.

*(14)* Connect electrical leads.

1. Camshaft plug
2. Camshaft
3. Lockring
4. Camshaft intermediate bearing
5. Key, Woodruff
6. Rear camshaft sleeve bearing
7. Balance weight
8. Camshaft gear
9. Screw, cap, hex hd
10. Balance shaft gear
11. Rear balance shaft sleeve bearing
12. Balance shaft

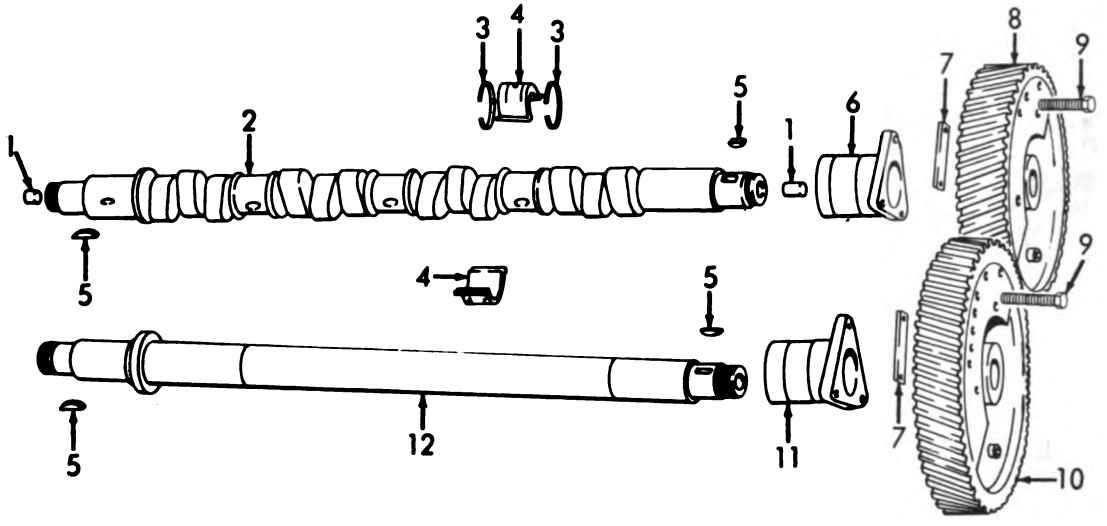


*Figure 9-23. Timing Gears and Shafts, Disassembly and Reassembly*

*(15)* Connect throttle control wire (fig. 9-15).

*(16)* Install throttle stop and tighten screw.

*(17)* Close clamp and tighten screw.

*(18)* Install rocker arm cover and tighten thumbscrews (fig. 9-14).

*(19)* Remove lifting bracket from cylinder head and attach it to balance weight cover (fig. 9-12).

*(20)* Install gasket and balance weight cover.

*(21)* Install clamp.

*(22)* Attach metallic rectifier and bracket to engine (fig. 9-11).

*(23)* Connect electrical connectors to rear of rectifier.

*(24)* Install fuel oil cooler with clamps and screws (fig. 9-10).

*(25)* Connect fuel line at each end of cooler.

*(26)* Install gaskets and water manifold with six nuts (fig. 9-9).

*(27)* Torque nuts to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(28)* Install bushing and heat indicator sending unit.

*(29)* Install heat deflector (fig. 9-8).

*(30)* Install thermostat in bypass line assembly and attach to water manifold.

*(31)* Attach bypass line assembly to front of balance weight cover with clamp and screw.

*(32)* Install thermostatic switch.

*(33)* Connect electrical leads to thermostatic switch.

*(34)* Install new gaskets (fig. 9-7).

*(35)* Install exhaust manifold and muffler assembly and the exhaust pipe with nuts.

*(36)* Install studs.

*(37)* Torque exhaust manifold nuts to 30 to 35 ft-lb (4.1 to 4.8 m-kg) and torque the studs to 15 to 30 ft-lb (2.1 to 4.1 m-kg).

*(38)* Install fan and belts (fig. 9-6).

*(39)* Install bracket and fan support assembly.

*(40)* Adjust the fan assembly so that the belts deflect 5/8 inch midway between pulleys.

*(41)* Install pipe plugs (22, 23, 24 and 25) (fig. 9-3).

*(42)* Install housing assembly (20) and gasket (21).

*(43)* Install gasket (19), cover (18), washers (17) and screws (16).

*(44)* Install gasket (15) and cover (14).

*(45)* Install screws (13), washers (12) and nuts (11).

*(46)* Install gasket (10), seal (9) and cover (8).

*(47)* Install washers (7), screws (6), washers (5) and screws (4).

*(48)* Install washers (3), screws (2) and screws (1).

*(49)* Torque flywheel housing screws in accordance with figure 9-4.

*(50)* Install flywheel (fig. 9-2).

*(51)* Install bolts and torque to 150 to 160 ft-lb (20.7 to 22.1 m-kg).

*(52)* Use a suitable indicator and measure amount of flywheel runout after installation. It should not exceed 0.005 inch (0.127 mm).

*(53)* Install lockwire.

*(54)* Install starter and solenoid with starting motor mounting screws (fig. 6-1).

*(55)* Connect electrical leads and cables to starting motor and solenoid.

*(56)* Install gasket and coupling assembly (fig. 7-13).

*(57)* Install screws and nuts. Install line.

*(58)* Install fuel pump (fig. 7-8).

*(59)* Install blower with screws.

*(60)* Torque screws to 55 to 60 ft-lb (7.6 to 8.3 m-kg).

*(61)* Connect fuel line to main fuel pump.

*(62)* Install clamp.

*(63)* Install hydraulic pump (fig. 9-10).

*(64)* Connect hydraulic lines.

*(65)* Install water pump (refer to fig. 7-3) with washers and screws.

*(66)* Install outlet seal and retainer with screws.

*(67)* Install spacer, clamp and screw.

*(68)* Connect hoses to bypass line and inlet line with clamps and screws.

*(69)* Install water pump drainplug.

*(70)* Attach air intake housing with screws (refer to fig. 7-7).

*(71)* Connect ether primer line to air intake housing assembly.

*(72)* Connect air hose and tighten clamp.

*(73)* Install hydraulic tank and connect hydraulic fittings.

*(74)* Install plug and service tank.

*(75)* Install solenoid bracket with spacers and screws.

*(76)* Install solenoid.

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(77)* Install clevis pin and cotter pin.

*(78)* Connect electrical leads to solenoid.

*(79)* Attach suitable lifting device to engine lifting brackets and install engine (refer to fig. 2-6).

*(80)* Attach engine to skid base with screws and nuts.

*(81)* Attach stator frame to flywheel housing.

*(82)* Attach stator frame to coupling plates with screws and lockwire.

*(83)* Remove blocking from under rear of main generator.

*(84)* Attach center cowl to base frame.

*(85)* Attach heater exhaust pipe to center cowl.

*(86)* Install fuel filler and hose to fuel tank (refer to fig. 2-5). Tighten clamps.

*(87)* Install ring and gasket.

*(88)* Install fuel tank cap and strainer.

*(89)* Install generator stator frame cover.

*(90)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube and starting primer tube to engine.

*(91)* Install battery box (fig. 2-4).

*(92)* Attach battery box support to front engine mount.

*(93)* Install drain hose and tighten clamp.

*(94)* Install thermostat. Connect electrical leads.

*(95)* Attach electrical leads to battery box.

*(96)* Attach heater-to-battery hose and tighten clamps.

*(97)* Install batteries and fasten holddowns (refer to fig. 2-3).

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(98)* Connect battery leads and jumper lead.

*(99)* Install battery box cover.

*(100)* Install front cowl assembly (8, fig. 9-20) containing radiator, shroud and grill guard.

*(101)* Install panel (12), connector nut (13) and canvas boot (11).

*(102)* Install panels (10, 15 and 16).

*(103)* Install hoods (5 and 6) and doors (3, 4, 9 and 14) with screws (1), washers (2), washers (17) and nuts (7).

*(104)* Install fan guard (fig. 9-5).

*(105)* Attach fan guard to air shroud with screws and nuts.

*(106)* Attach radiator hoses to radiator.

*(107)* Install radiator drainplug and fill radiator with proper coolant.

*(108)* Adjust valve clearance with engine at operating temperature. Crank engine over until the injector on No. 1 cylinder is in the down position. Loosen locknut and place a 0.009 inch (0.229 mm) gage between rocker arm and valve stem. Loosen locknut and turn the push rod until a steady pull is require to remove the gage. Hold pushrod and secure locknut. Recheck clearance and readjust if necessary. Repeat procedure for all valves in sequence of firing order 1-3-2.

## Section V. OIL PAN AND OIL PUMP

**9-13. General.**

The oil pan is located beneath the engine and houses the oil pump which circulates the engine oil to the parts needing lubrication.

**9-14. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**9-15. Oil Pan and Oil Pump.**

*a. Removal.*

*(1)* Release latches and remove battery box cover (refer to fig. 2-3).

*(2)* Disconnect battery leads and jumper lead.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(3)* Loosen battery holddowns and remove batteries.

*(4)* Loosen clamps and remove heater-to-battery hose (fig. 2-4).

*(5)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(6)* Remove thermostat. Tag and disconnect electrical leads.

*(7)* Loosen hose clamp and remove drain hose.

*(8)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(9)* Remove nuts and screws holding battery box to frame and remove battery box.

*(10)* Remove pipe plug and drain oil into a suitable container (fig. 9-24).

*(11)* Remove pipe connector.

*(12)* Remove grommet.

*(13)* Remove nipple, elbow and nipple.

*(14)* Disconnect heater exhaust pipe.

*(15)* Remove screws attaching oil pan to cylinder block (fig. 9-25).

*(16)* Remove oil pan and gasket.

*(17)* Remove screws attaching screen support bracket to cylinder block (fig. 9-26).

*(18)* Remove screws attaching oil pressure regulator to cylinder block.

*(19)* Remove four screws attaching oil pump to cylinder block. Remove assembly consisting of oil pump, outlet pipe and oil pressure regulator.

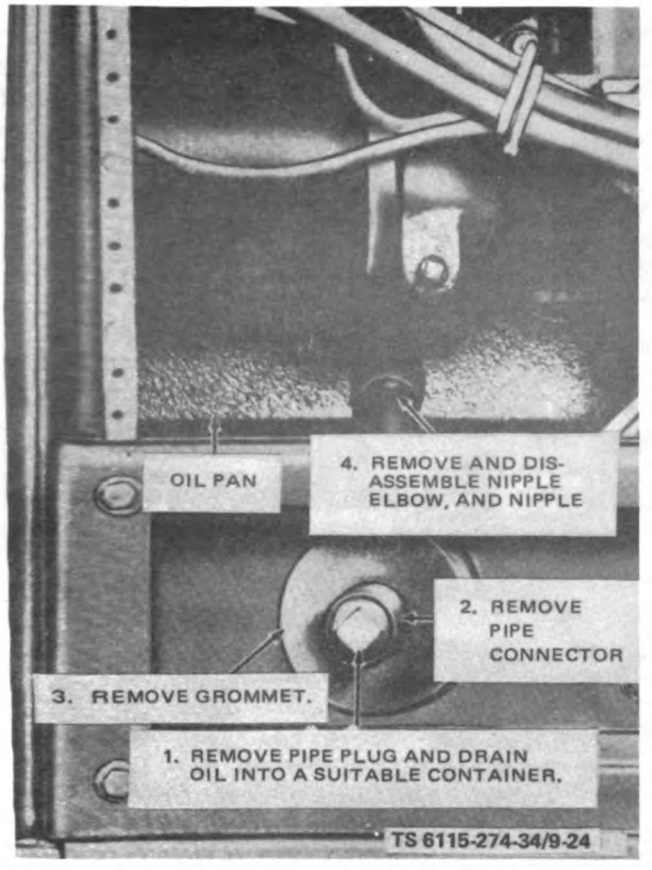


*Figure 9-24. Oil Pan Drainpipe, Removal and Installation*

*NOTE*

*Remove shims from between oil pump and cylinder block. Record number and location of shims to facilitate installation.*

*(20)* Remove screws attaching oil pump outlet pipe to oil pressure regulator.

*b. Disassembly.*

*(1)* Remove screen retainer (34, fig. 9-27) and screen (35).

*(2)* Remove lockwires (36), nuts (37) and screws (1) disassembling support bracket (2), bent pipe (40) and screen cover (39).

*(3)* Remove screws (14) and washers (13) from bent pipe (40) disassembling from gasket (3) and oil pump cover (4).

*(4)* Remove screws (33) and washers (13) from outlet pipe (32) disassembling from gasket (11) and pump body (10).

*(5)* Remove screws (14), washers (13), pad cover (12) and gasket (3) from pump body.

*(6)* Remove screws (14), washers (13), pad cover (12) and gasket (11) from pump body.

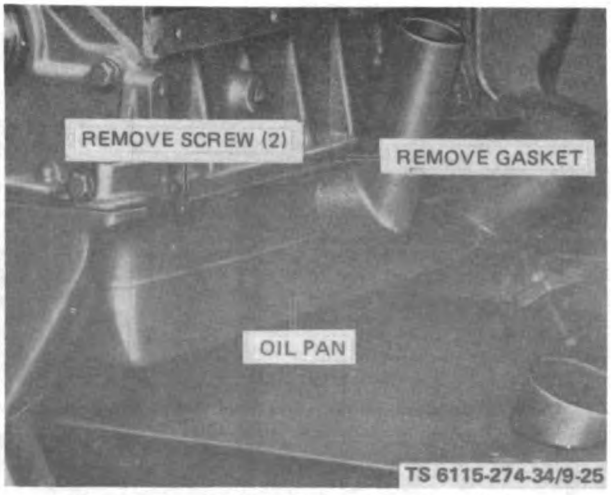


*Figure 9-25. Oil Pan, Removal and Installation*

*(7)* Remove plug (18), gasket (17), spring (16) and relief valve (15) from pump body.

*(8)* Remove screw (27), washers (26 and 25), pin (24), spur gear (23), and bushing (22).

*(9)* Remove plug (18) and gasket (17).

*(10)* Remove screws (38) and washers (13) and disassemble pump cover (4), bushings (5), drive gear (6), driven gear (7), drive shaft (8), bearing (9), body (10), keys (19), sleeve bearing (30), drive shaft (31) and spur gear (28).

*(11)* Remove screw (29), idler gear support (21) and pin(20).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the oil pump body and cover for evidence of damage and wear.

*(3)* Inspect the drive shaft, bushing, and sleeve bearings for cracks, breaks, and excessive wear.

*(4)* Inspect the pump drive and driven gear for a free-running fit in the pump body. Inspect the gears for damaged or worn teeth.

*(5)* Inspect the outlet pipe for evidence of damage and clogging.

*(6)* Inspect the pressure relief valve for a

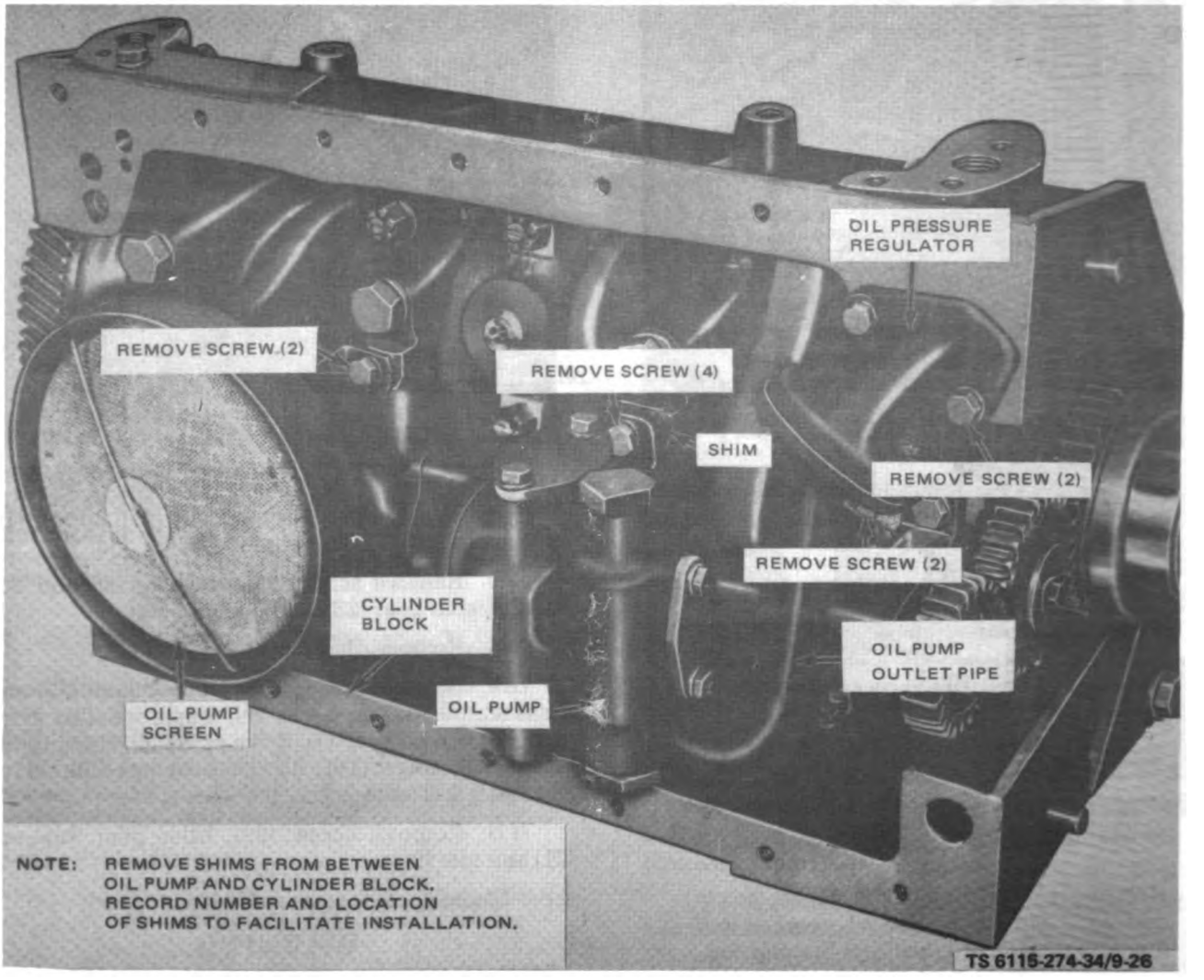


*Figure 9-26. Oil Pump, Removal and Installation*

defective plunger and spring. See that the relief valve makes a good seat in the pump body.

*(7)* Inspect the oil pan for cracks, breaks, dents, and other damage.

*(8)* Weld all cracks and remove all nicks and burrs which might prevent a tight seal between the oil pan and cylinder block.

*(9)* Replace a damaged or defective oil pan.

*(10)* Repair or replace a damaged or defective part.

*(11)* Replace all gaskets.

*d. Reassembly.*

*(1)* Assemble pin (20, fig. 9-27), idler gear support (21) and screw (29) to body (10).

*(2)* Assemble spur gear (28), drive shaft (31), sleeve bearing (30), keys (19), body (10), bearing (9), drive shaft (8), driven gear (7), drive gear (6), bushings (5) and pump cover (4) with washers (13) and screws (38).

*NOTE*

*Press drive gear on shaft so that distance from gear to other end of shaft is 6-5/16 inches (16.03 cm).*

*(3)* Install gasket (17) and plug (18).

*(4)* Install bushing (22), spur gear (23), pin (24), washers (25) and screw (27).

*(5)* Install relief valve (15), spring (16), gasket (17) and plug (18).

*(6)* Install gasket (11), pad cover (12), washers (13) and screws (14).

*(7)* Install gasket (3), cover (12), washers (13), and screws (14).

1. Screw, cap, hex hd
2. Screen support bracket
3. Gasket
4. Oil pump cover
5. Bushing
6. Drive gear
7. Driven gear
8. Drive shaft
9. Sleeve bearing
10. Body
11. Pad cover gasket
12. Pad cover
13. Washer, lock
14. Screw, cap, hex hd
15. Relief valve
16. Spring
17. Gasket
18. Plug, machine thd
19. Key, Woodruff
20. Pin
21. Support, idler gear
22. Bushing
23. Gear, spur
24. Pin
25. Washer
26. Washer, flat
27. Screw, machine, hex hd
28. Gear, spur
29. Screw, machine, hex hd
30. Bearing, sleeve
31. Shaft, drive, oil pump
32. Pipe, outlet
33. Screw, machine, hex hd
34. Retainer
35. Screen, oil pump
36. Wire, lock
37. Nut
38. Screw, machine, hex hd
39. Cover, oil pump screen
40. Bent pipe, steel

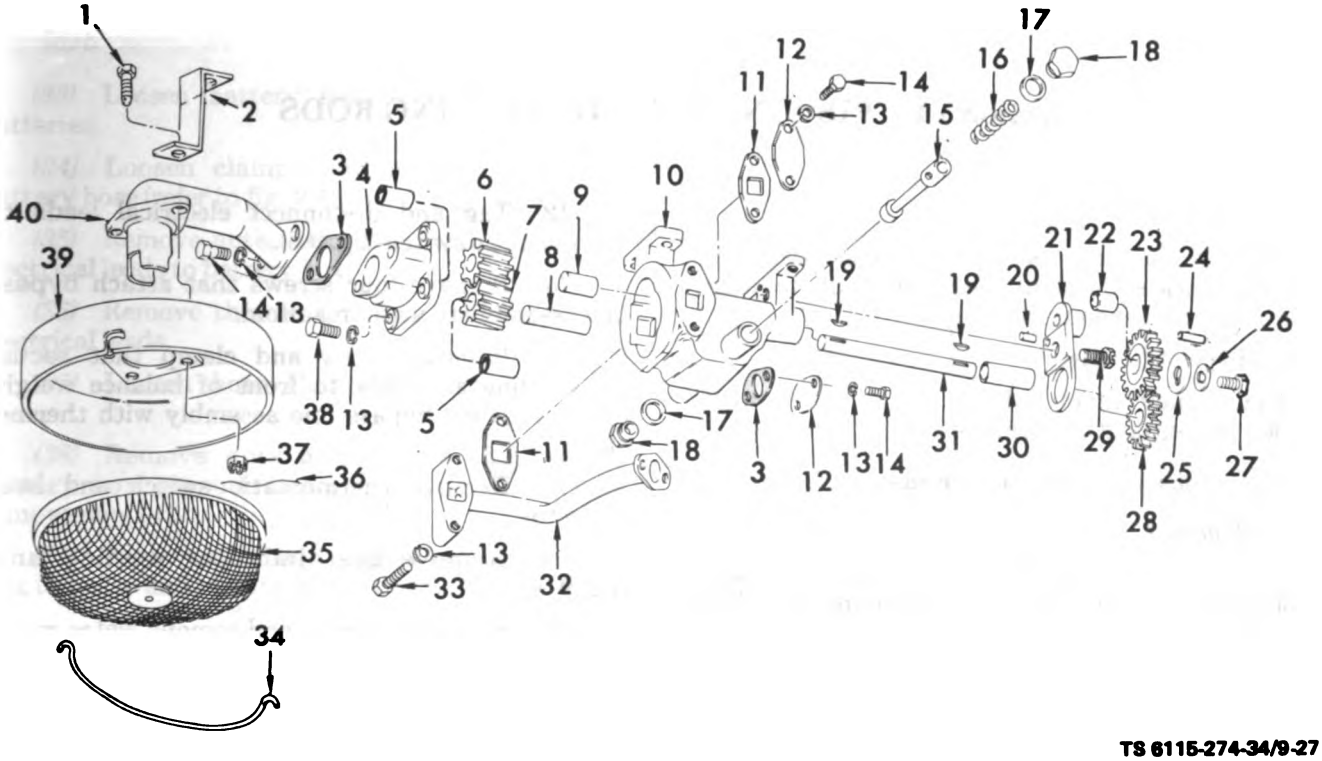


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*Figure 9-27. Oil Pump, Disassembly and Reassembly*

*(8)* Assemble outlet pipe (32) to pump body (10) with gasket (11), washers (13) and screws (33).

*(9)* Assemble bent pipe (40) to oil pump cover (4) with gasket (3), washers (13) and screws (14).

*(10)* Assemble screen cover (39), bent pipe (40) and support bracket (2) with screws (1), nuts (37) and lockwires (36).

*(11)* Install screen (35) and screen retainer (34).

*e. Installation.*

*(1)* Attach oil pressure regulator to oil pump outlet (fig. 9-26).

*(2)* Install oil pump, outlet pipe and oil pressure regulator assembly to block using shims and four screws.

*(3)* Attach oil pressure regulator to block.

*(4)* Attach screen support bracket to cylinder block.

*(5)* Install oil pan and gasket to block with screws (fig. 9-25).

*(6)* Connect heater exhaust pipe.

*(7)* Install nipples and elbow (fig. 9-24).

*(8)* Install grommet and pipe connector.

*(9)* Install pipe plug and service crankcase with proper oil.

*(10)* Install battery box and attach to frame (refer to fig. 2-4).

*(11)* Attach battery box support to front engine mount.

*(12)* Attach drain hose and tighten clamp.

*(13)* Install thermostat. Connect electrical leads.

*(14)* Attach electrical leads to battery box with clamps.

*(15)* Attach heater-to-battery hose and tighten clamps.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(16)* Install batteries and tighten holddowns (refer to fig. 2-3).

*(17)* Connect battery leads and jumper lead.

*(18)* Install battery box cover and fasten latches.

## Section VI. PISTONS AND CONNECTING RODS

**9-16. General.**

The pistons and connecting rods are located in the cylinder block and operate the crankshaft by alternate intake and exhaust strokes.

**9-17. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**9-18. Pistons and Connecting Rods.**

*a. Removal.*

*(1)* Remove the RH engine door, LH engine door and the engine hood by removing attaching hardware.

*(2)* Remove radiator drainplug and drain coolant into a suitable container.

*(3)* Remove hose clamps and hoses and remove radiator inlet pipe (fig. 9-13).

*(4)* Open fuel filter draincock and drain fuel sediment into suitable container (refer to fig. 4-3).

*(5)* Tag and disconnect electrical leads.

*(6)* Disconnect fuel lines from fuel filter.

*(7)* Remove screws and fuel filter.

*(8)* Turn fuel oil pressure switch counterclockwise to remove.

*(9)* Remove studs (fig. 9-7).

*(10)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(11)* Remove and discard gasket.

*(12)* Tag and disconnect electrical leads to thermostatic switch (fig. 9-8).

*(13)* Remove four screws that attach bypass line assembly to water manifold.

*(14)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(15)* Remove thermostatic switch and heat deflector.

*(16)* Remove heat indicator sending unit (fig. 9-9).

*(17)* Remove six nuts and remove water manifold. Remove gaskets.

*(18)* Loosen thumbscrews holding rocker arm cover and remove cover (fig. 9-14).

*(19)* Loosen screw and open clamp (fig. 9-15).

*(20)* Loosen screw and remove throttle stop.

*(21)* Disconnect throttle control wire.

*(22)* Tag and disconnect electrical leads to electrohydraulic actuator (refer to fig. 5-3).

*(23)* Disconnect hydraulic lines.

*(24)* Remove elbow and adapter.

*(25)* Remove cotter pin and straight pin and disengage control rod from control tube arm.

*(26)* Remove screws attaching actuator to cylinder head and remove actuator.

*(27)* Remove two nuts and six bolts attaching cylinder head to cylinder block (fig. 9-16).

(28) Remove two vertical screws from each lifting bracket.

(29) Attach suitable lifting device to front and rear lifting brackets and remove cylinder head.

(30) Remove gasket from cylinder block.

(31) Release latches and remove battery box cover (refer to fig. 2-3).

(32) Disconnect battery leads and jumper lead.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

(33) Loosen battery holddowns and remove batteries.

(34) Loosen clamps and remove heater-to-battery hose (refer to fig. 2-4).

(35) Remove nuts, screws and clamps holding electrical leads to battery box.

(36) Remove thermostat. Tag and disconnect electrical leads.

(37) Loosen hose clamp and remove drain hose.

(38) Remove nuts and screws that secure battery box support to front engine mount and remove support.

(39) Remove nuts and screws holding battery box to frame and remove battery box.

(40) Remove pipe plug and drain oil into a suitable container (fig. 9-24).

(41) Remove pipe connector.

(42) Remove grommet.

(43) Remove nipple, elbow and nipple.

(44) Disconnect heater exhaust pipe.

(45) Remove screws attaching oil pan to cylinder block (fig. 9-25).

(46) Remove oil pan and gasket.

(47) Remove screws attaching screen support bracket to cylinder block (fig. 9-26).

(48) Remove screws attaching oil pressure regulator to cylinder block.

(49) Remove four screws attaching oil pump to cylinder block. Remove assembly consisting of oil pump, outlet pipe and oil pressure regulator.

*NOTE*

*Remove shims from between oil pump and cylinder block. Record number and location of shims to facilitate installation.*

(50) Remove screws attaching oil pump outlet pipe to oil pressure regulator.

(51) Remove cotter pins and nuts from lower end of connecting rods (fig. 9-28).

(52) Remove connecting rod caps.

(53) Using a wooden stick of suitable proportions, push the piston and connecting rod assemblies out the top of the cylinder block.

*NOTE*

*Remove carbon or ridge ring from inside of cylinder sleeve before removing pistons.*

*b. Disassembly.*

(1) Cotter pins (13, fig. 9-29), nuts (12) and connecting rod caps (14) have already been removed to extract pistons.

(2) Remove connecting rod bolts (3), sleeve beaings (15) and orifice (16).

(3) Remove rings (8, 9, 10 and 11).

(4) Remove piston pin retainers (4).

(5) Heat pistons (7) and press out piston pins (5) and bushings (6).

*NOTE*

*Bushings (1) are not removed from connecting rods (2) unless wear limits are exceeded. If necessary, these bushings are pressed out of the connecting rods.*

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1) Pistons.*

*(a)* Clean the pistons with cleaning solvent (Item 4, App. B) and dry thoroughly. Clean all carbon deposits from the pistons.

*(b)* Inspect the pistons for cracks, breaks, scoring, and wear. If pistons are slightly scored, remove the score with a fine stone or emery cloth.

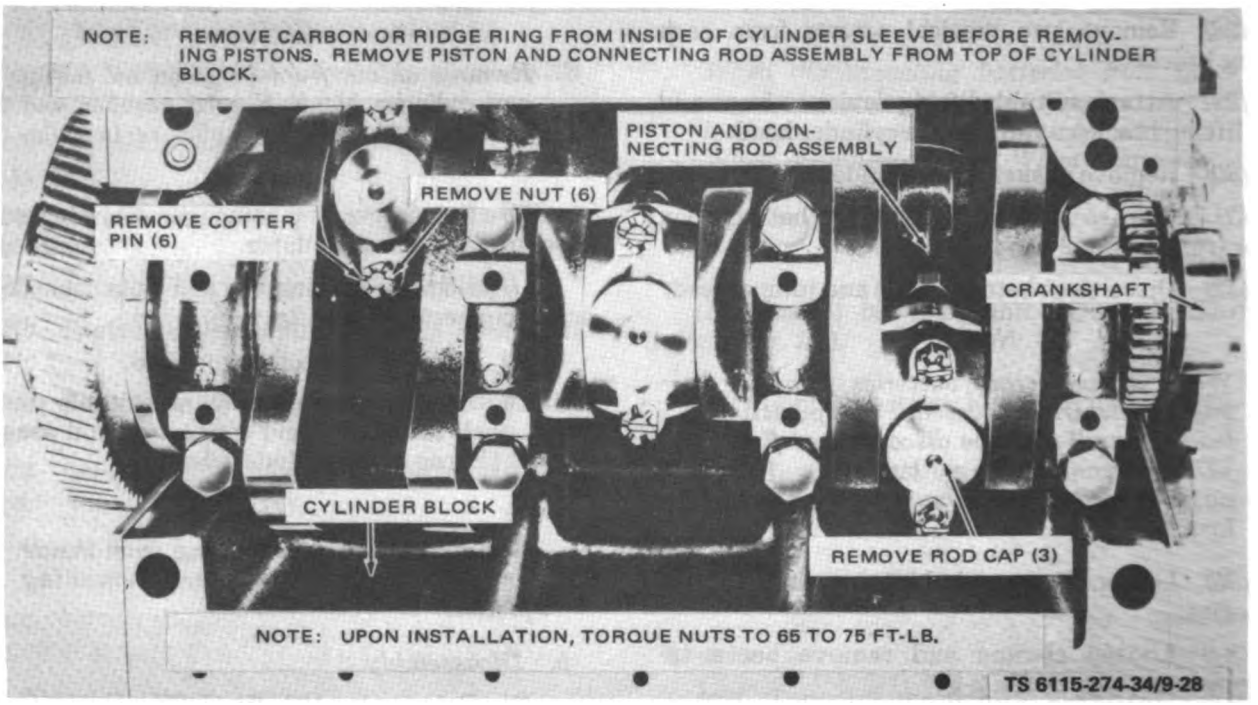



*Figure 9-28. Pistons, Rings and Connecting Rods, Removal and Installation*

*(c)* Inspect and measure the inside diameter of the piston pin bushings in each piston and, if worn, replace the bushings. Refer to table 1-1 for wear limits.

*(d)* Inspect the ring-to-piston clearance as in (2) below.

*(e)* Replace a damaged or defective piston.

*(2) Rings.*

*(a)* Inspect the rings for free fit in the piston grooves, for inside clearance and wear. Refer to table 1-1 for correct clearance and wear.

*(b)* If new piston rings are used, measure the rings for proper gap by inserting one ring at a time inside the cylinder sleeve, far enough down in the bore to be in the ring wiping surface. Measure the ring gap. If the ring gap is below the limits in table 1-1, increase the gap by filing across the butt ends of the ring to attain the proper gap.

*(3) Connecting rods and piston pins.*

*(a)* Clean all parts with an approved cleaning solvent and dry thoroughly. Blow out all oil passages.

*(b)* Inspect the rods for improper alignment, scoring, and wear. Inspect the bearing surface for damage.

*(c)* Inspect the piston pins for nicks, burrs, scoring, and wear. Measure the outside diameter of the pins. Refer to table 1-1 for correct measurements.

*(d)* Inspect the connecting rod piston pin bushing for nicks, burrs, scoring, and wear. Measure the inside diameter of the bushing. Refer to table 1-1 for correct measurement.

*(e)* Measure the clearance between the pin and the bushing. Refer to table 1-1 for correct clearance and maximum allowable wear.

*(f)* Replace a damaged or defective connecting rod and piston pin.

*(4)* Connecting rod bearings.

*(a)* Clean the bearings with an approved cleaning solvent and dry thoroughly.

*(b)* Inspect the bearings for nicks, burrs, scoring, and wear. Inspect the bearings for bright spots that are evidence of slipping or shifting. If such spots are present, discard the bearings.

*(c)* Measure the thickness of the bearing to determine the wear. Refer to table 1-1 for correct measurement and maximum allowable wear.

*(d)* Position the bearings in the respective rods and install the rod caps. Measure the inside diameter of the bearings while installed. Refer to table 1-1 for the correct measurement.

*(e)* Measure the clearance between the bearings and the crankshaft journals. Refer to table

1-1 for the correct clearance and maximum allowable wear.

*(f)* Replace a damaged or defective connecting rod bearing.

*d. Reassembly.*

*(1)* Press bushings (1, fig. 9-29) into connecting rods (2) if it is necessary to replace them.

*(2)* Assemble connecting rod, bushings (6) and piston (7) by heating piston and inserting piston pin (5).

*(3)* Attach piston pin retainers (4).

*(4)* Install rings (8, 9, 10 and 11) on pistons in their proper place according to figure 9-29.

*(5)* Install orifice (16) and sleeve bearings (15). Insert bolts (3).

*(6)* Using a piston ring compressor install the pistons in the cylinder block.

*e. Installation.*

*(1)* Install connecting rod caps (fig. 9-28).

*(2)* Install nuts and torque to 65 to 75 ft-lb (9 to 10.4 m-kg). Install cotter pins.

*(3)* Attach oil pump outlet pie to oil pressure regulator (fig. 9-26).

*(4)* Install assembly consisting of oil pump, outlet pie and oil pressure regulator replacing shims in same position from which removed. Install screws.

*(5)* Attach oil pressure regulator to cylinder block.

*(6)* Attach screen support bracket to cylinder bracket.

*(7)* Install gasket and oil pan (fig. 9-25).

*(8)* Install screws around oil pan.

*(9)* Connect heater exhaust pipe.

*(10)* Install nipples and elbow (fig. 9-24).

*(11)* Install grommet.

*(12)* Install pipe connector.

*(13)* Install pipe plug and service crankcase.

*(14)* Install battery box, fastening it to frame (refer to fig. 2-4).

*(15)* Attach battery box support to front engine mount.

*(15)* Attach battery box support to front engine mount.

*(16)* Install drain hose and tighten clamp.

*(17)* Install thermostat. Connect electrical leads.

*(18)* Attach electrical leads to battery box with clamps and screws.

*(19)* Install heater-to-battery hose and tighten clamps.

*(20)* Install batteries and fasten holddowns (refer to fig. 2-3).

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(21)* Connect battery leads and jumper lead.

*(22)* Install battery box cover and fasten latches.

*(23)* Install gasket on cylinder block (fig. 9-16).

*(24)* Attach suitable lifting device to lifting brackets and install cylinder head.

*(25)* Install vertical screws into each lifting bracket.

*(26)* Install two nuts and six bolts attaching head to cylinder block.

*(27)* Torque nuts to 165 to 175 ft-lb (22.8 to 24.2 m-kg) and bolts to 180 to 190 ft-lb (24.9 to 26.3 m-kg).

*(28)* Attach electrohydraulic actuator to cylinder head (refer to fig. 5-3).

*(29)* Connect control rod to control tube arm with cotter pin and straight pin.

*(30)* Adjust control rod by positioning control rod at full throttle. Position control tube arm at full throttle. Adjust clevis until holes in control tube arm and clevis align, then insert pin.

*(31)* Install elbow and adapter.

*(32)* Connect hydraulic lines.

*(33)* Connect electrical leads to actuator.

*(34)* Connect throttle control wire (fig. 9-15).

*(35)* Install throttle stop. Close clamp and tighten screw.

*(36)* Install rocker arm cover with thumbscrews (fig. 9-14).

*(37)* Install gaskets (fig. 9-9).

*(38)* Install manifold with six nuts.

*(39)* Torque nuts to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

1. Bushing
2. Connecting rod
3. Connecting rod bolt
4. Piston pin retainer
5. Piston pin
6. Bushing
7. Piston
8. Chrome plate compression ring
9. Plain compression ring
10. Oil ring
11. Expander ring
12. Nut, slotted, hex
13. Pin, cotter
14. Connecting rod cap
15. Sleeve bearing
16. Orifice

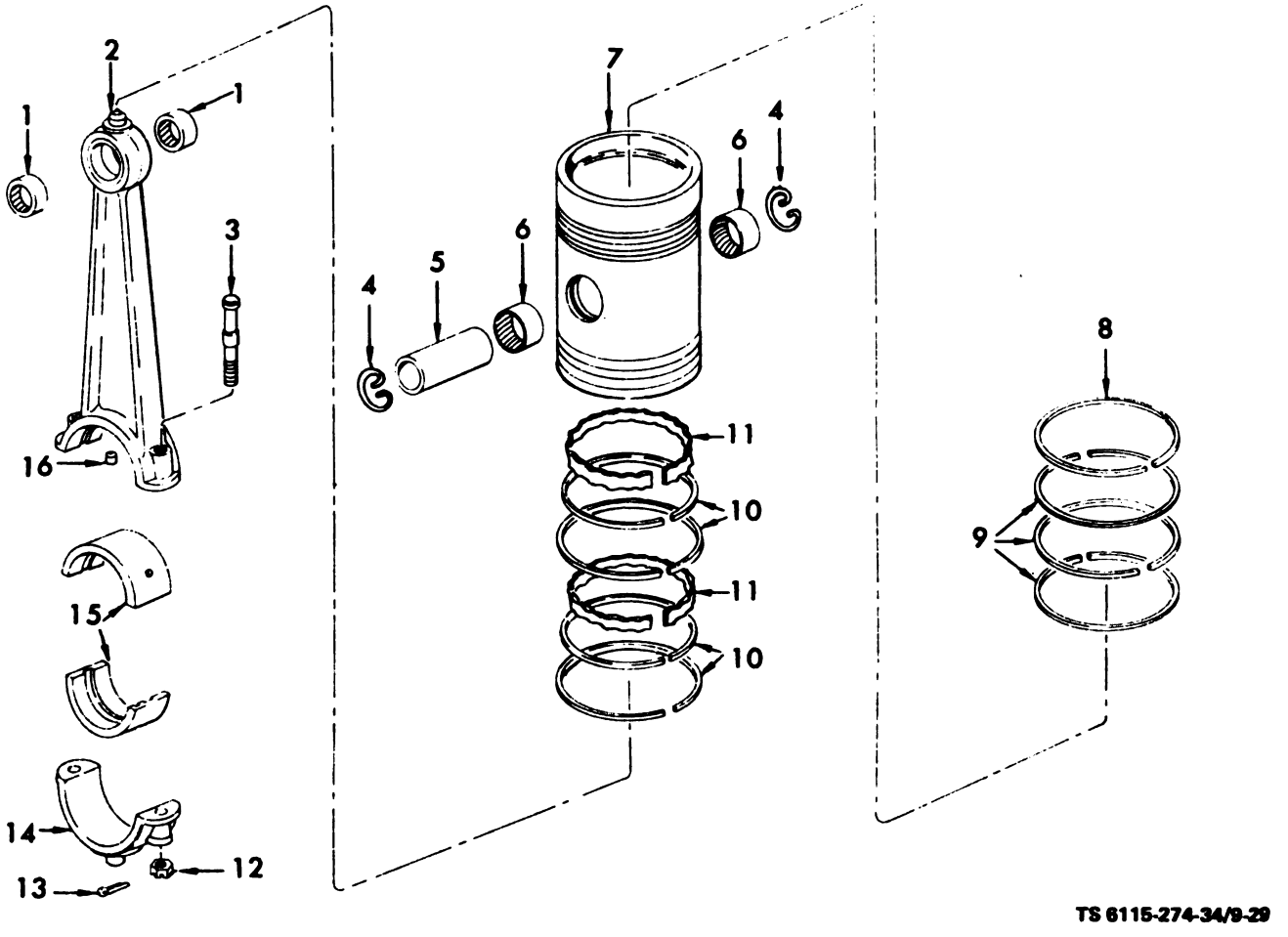



*Figure 9-29. Pistons, Rings and Connecting Rods, Disassembly and Reassembly*

*(40)* Install heat indicator sending unit.

*(41)* Attach bypass line assembly to water manifold (fig. 9-8).

*(42)* Attach bypass line assembly to front of balance weight cover with clamp.

*(43)* Install thermostatic switch and heat deflector.

*(44)* Connect electrical leads to switch.

*(45)* Install new gasket (fig. 9-7).

*(46)* Install exhaust manifold and muffler assembly and exhaust pipe with nuts.

*(47)* Install studs.

*(48)* Torque nuts to 30-35 ft-lb (4.1-4.8 m kg) and studs to 15-30 ft-lb (2.1-4.1 m kg).

*(49)* Install fuel oil pressure switch by turning clockwise (refer to fig. 4-3).

*(50)* Install fuel filter.

*(51)* Connect fuel lines to fuel filter.

*(52)* Connect electrical leads.

*(53)* Close fuel filter draincock.

*(54)* Install radiator inlet pipe with hoses and tighten clamps (fig. 9-13).

*(55)* Install radiator drainplug and service radiator with proper coolant.

*(56)* Adjust valve clearance with engine at operating temperature. Crank engine over until the injector on No. 1 cylinder is in the down position. Loosen locknut and place a 0.009 inch (0.229 mm) gage between rocker arm and valve stem. Loosen locknut and turn the push rod until a steady pull is required to remove the gage. Hold push rod and secure locknut. Recheck clearance and readjust if necessary. Repeat procedure for all valves in sequence of firing order 1-3-2.

*(57)* Install engine hood, right engine door and left engine door with attaching hardware.

## Section VII. CRANKSHAFT

**9-19. General.**

The crankshaft is operated by the action of the pistons and in turn operates the main generator.

**9-20. Type of Repairs.**

Repairs may involve loose connections, wear, cracks, breaks or other damage.

**9-21. Crankshaft.**

*a. Removal.*

*(1)* Remove radiator drainplug and drain coolant into a suitable container.

*(2)* Remove screws (1, fig. 9-1), washers (2), washers (18) and nuts (7) in the order necessary to remove engine doors (4 and 10), engine hood (6), generator doors (3 and 15), generator hood (5), left-side panels (16 and 17), fuel control panel (11) and right rear panel (13) with canvas boot (12) and connector nut (14).

*(3)* Remove muffler rain cap and retainer (9).

*(4)* Remove screws attaching fan guard to shroud and remove fan guard.

*(5)* Remove radiator hose connections.

*(6)* Remove front cowl assembly (8).

*(7)* Refer to figure 2-3 to remove the batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(8)* Release latches and remove battery box cover. Loosen nuts, disconnect battery leads and remove jumper lead. Loosen battery holddowns and remove batteries.

*(9)* Refer to figure 2-4 to remove the battery box.

*(10)* Loosen clamps and remove heater-to-battery hose.

*(11)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(12)* Remove thermostat. Tag and disconnect electrical leads.

*(13)* Loosen hose clamp and remove drain hose.

*(14)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(15)* Remove nuts and screws holding battery box to frame and remove battery box.

*(16)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(17)* Remove screws and nuts holding generator stator frame cover and remove cover.

*(18)* Drain the fuel into a suitable container.

*(19)* Refer to figure 2-5 to remove the fuel tank cap and fuel filter.

*(20)* Remove fuel tank cap and strainer.

*(21)* Remove screws securing ring to filler neck and remove ring and gasket.

*(22)* Loosen the clamps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(23)* Remove the heater exhaust pipe at center cowl.

*(24)* Remove screws, washers and nuts holding center cowl to base frame and remove center cowl.

*(25)* Refer to figure 2-6 to remove the engine.

*NOTE*

*Position suitable blocking beneath rear of main generator before removing stator-to-flywheel housing screws.*

*(26)* Remove lockwire and screws holding stator frame to coupling plates.

*(27)* Remove screws holding stator frame to flywheel housing.

*(28)* Remove screws and nuts holding engine to skid base.

*(29)* Attach suitable lifting device to front and rear lifting brackets and remove engine. Place on suitable stand.

*(30)* Tag and disconnect electrical leads to solenoid (refer to fig. 7-7).

*(31)* Remove clevis pin and cotter pin.

*(32)* Remove screws and remove solenoid.

*(33)* Remove screws and spacers and remove solenoid bracket.

*(34)* Remove plug and drain hydraulic tank. Disconnect hydraulic fittings and remove tank.

*(35)* Loosen clamp and disconnect air hose.

*(36)* Disconnect ether primer line from air intake housing assembly. Remove screws and remove air intake housing.

*(37)* Remove water pump drainplug (refer to fig. 7-3).

*(38)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(39)* Remove two screws and washers and remove outlet seal and retainer.

*(40)* Remove three screws and washers and remove water pump.

*(41)* Disconnect hydraulic pump lines (refer to fig. 5-1).

*(42)* Remove four screws and remove hydraulic pump.

*(43)* Remove clamp (refer to fig. 7-8).

*(44)* Disconnect fuel lines from main fuel pump.

*(45)* Remove four screws and remove blower.

*(46)* Remove main fuel pump.

*(47)* Remove line (refer to fig. 7-13).

*(48)* Remove two screws. Remove four screws and nuts.

*(49)* Remove gear support and remove gasket from end plate. Remove coupling assembly.

*(50)* Tag and disconnect electrical leads and cables to starting motor and solenoid (refer to fig. 6-1).

*(51)* Remove starting motor mounting screws and remove starter and solenoid.

*(52)* Refer to figure 9-2 and remove lockwire and six bolts.

*(53)* Remove flywheel.

*(54)* Remove screws (1, fig. 9-3).

*(55)* Remove screws (2) and washers (3).

*(56)* Remove screws (4), washers (5), screws (6) and washers (7).

*(57)* Remove cover (8), seal (9) and gasket (10).

*(58)* Remove nuts (11), washers (12) and screws (13).

*(59)* Remove cover (14) and gasket (15).

*(60)* Remove screws (16), washers (17), cover (18) and gasket (19).

*(61)* Remove housing assembly (20) and gasket (21).

*(62)* Remove pipe plugs (22, 23, 24 and 25).

*(63)* Remove six screws on crankshaft gear (fig. 9-30). Remove crankshaft gear.

*(64)* Remove screws holding idler gear and remove gear. Remove bearing retainer.

*(65)* Remove screw holding dummy hub and remove hub.

*(66)* Remove screws holding fan support assembly (fig. 9-6).

*(67)* Remove screws and bracket.

*(68)* Remove fan and belts.

*(69)* Disconnect wiring harness (refer to fig. 6-8).

*(70)* Remove screws and remove mounting bracket and adjusting strap.

*(71)* Remove belts.

*(72)* Remove screws and generator.

*(73)* Remove studs (fig. 9-7).

*(74)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(75)* Remove and discard gasket.

*(76)* Tag and disconnect electrical leads to thermostatic switch (fig. 9-8).

*(77)* Remove four screws that attach bypass line assembly to water manifold.

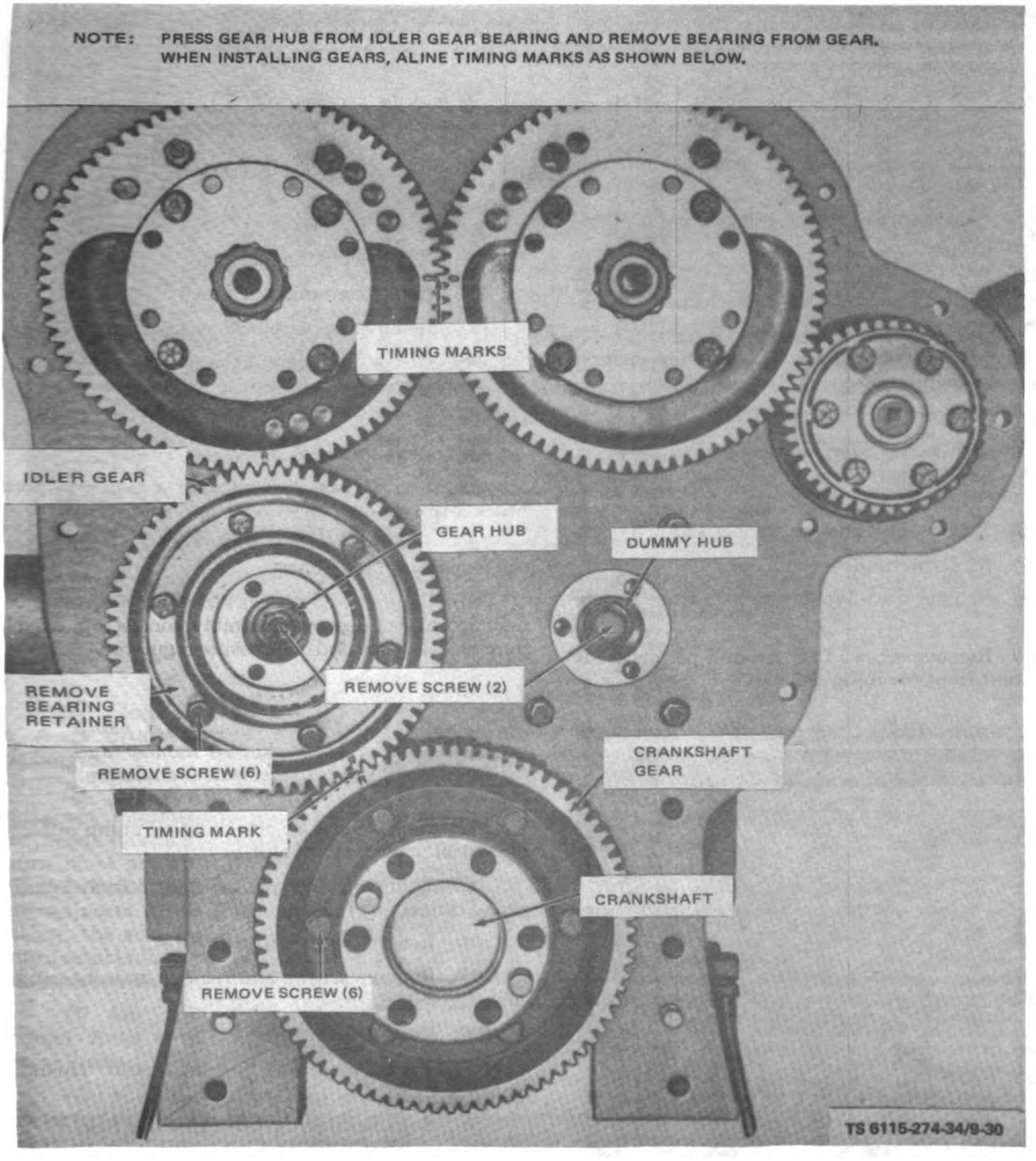



*Figure 9-30. Crankshaft Gear, Idler Gear, and Dummy Hub, Removal and Installation*

*(78)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(79)* Remove thermostatic switch and heat deflector.

*(80)* Remove heat indicator sending unit (fig. 9-9).

*(81)* Remove six nuts and remove water manifold. Remove gaskets.

*(82)* Provide suitable container to catch fuel leakage and disconnect fuel line at each end of cooler (fig. 9-10).

*(83)* Remove screws and nuts holding clamps and remove clamps and cooler.

*(84)* Disconnect connectors from rear of rectifier (fig. 9-11).

*(85)* Remove screws holding bracket to engine and remove bracket and rectifier.

(86) Remove bolt and flat washer (fig. 9-31).

*(87)* Remove crankshaft pulley.

*(88)* Remove two Woodruff keys from crankshaft.

*(89)* Remove screws from around perimeter of crankshaft front cover (fig. 9-32).

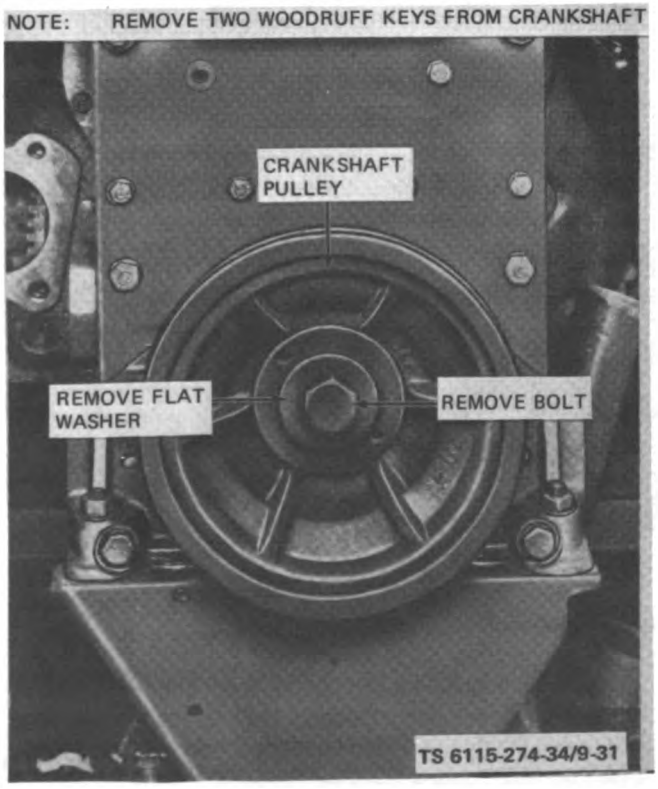



*Figure 9-31. Crankshaft Pulley, Removal and Installation*

*(90)* Remove front cover.

*NOTE*

*It may be necessary to drive front cover from end plate dowels.*

*(91)* Remove oil seal from cover.

*(92)* Remove pipe plug and drain oil into a suitable container (fig. 9-24).

*(93)* Remove pipe connector.

*(94)* Remove grommet.

*(95)* Remove nipple, elbow and nipple.

*(96)* Disconnect heater exhaust pipe.

*(97)* Remove screws attaching oil pan to cylinder block (fig. 9-25).

*(98)* Remove oil pan and gasket.

*(99)* Remove screws attaching screen support bracket to cylinder block (fig. 9-26).

*(100)* Remove screws attaching oil pressure regulator to cylinder block.

*(101)* Remove four screws attaching oil pump to cylinder block. Remove assembly consisting of oil pump, outlet pipe and oil pressure regulator.

*NOTE*

*Remove shims from between oil pump and cylinder block. Record number and location of shims to facilitate installation.*

*(102)* Remove screws attaching oil pump outlet pipe to oil pressure regulator.

*(103)* Remove cotter pins and nuts from lower end of connecting rods (fig. 9-28).

*(104)* Remove connecting rod caps.

*(105)* Remove screws and remove main bearing caps (fig. 9-33).

*(106)* Remove crankshafts.

*(107)* Remove main bearings and thrust washers.

*(108)* Remove oil pump drive gear and key.

*b. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

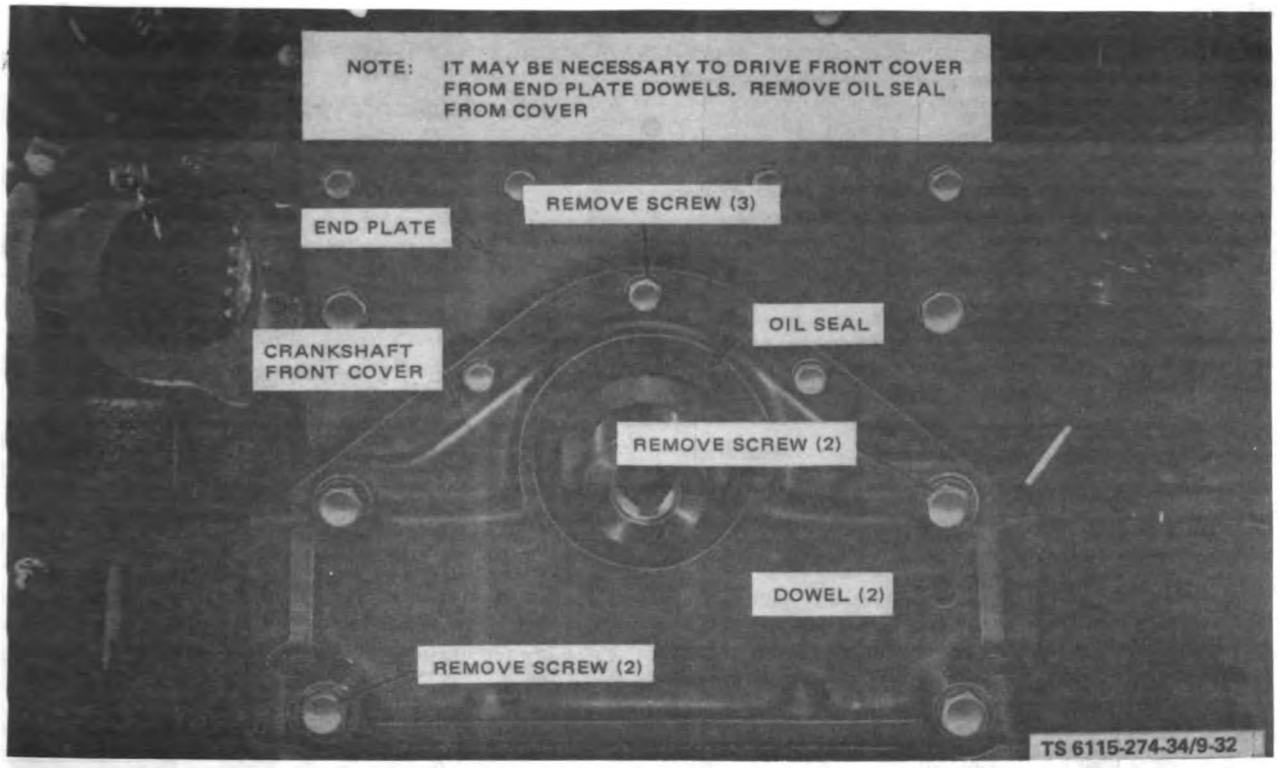



*Figure 9-32. Crankshaft Front Cover, Removal and Installation*

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly. Blow out all oil passages.

*(2)* Inspect the crankshaft for alignment at adjacent intermediate journals. When runout on adjacent journals is in the opposite direction, the sum must not exceed a total of 0.003 inch (0.076 mm) indicator reading. When high spots of runout on adjacent journals are at right angles to each other, the sum must not exceed 0.004 inch (0.102 mm) total indicator reading or 0.002 inch (0.051 mm) on each journal.

*(3)* Measure the bearing journals for out-of-round. Refer to table 1-1 for maximum allowable wear limits.

*(4)* Measure the bearing journals for taper. Refer to table 1-1 for wear limits.

*(5)* Inspect the crankshaft main bearing journals for ridges. A ridge exceeding 0.002 inch (0.051 mm) must be removed before new main bearings are installed. If the ridges are greater than 0.001 inch (0.025 mm), the crankshaft will have to be reground.

*(6)* Inspect the crankshaft for cracks, pitting, and rough bearing surfaces. Inspect the keyways for wear. Slight pitting and roughness may be removed with crocus cloth wet with fuel oil.

*(7)* Inspect the oil pump drive gear for cracked or broken teeth and evidence of wear.

*(8)* Inspect the main bearings for scoring, pitting, flaking, chipping, cracking, and overheating. Replace a defective main bearing.

*(9)* Inspect the bearings for bright spots which indicate bearings are slipping. Discard these bearings.

*(10)* Measure the thickness of the bearings to determine wear. Refer to table 1-1 for wear limits.

*(11)* Measure the clearance between the bearing and the crankshaft journal. Refer to table 1-1 for correct clearance and maximum allowable wear.

*(12)* With the crankshaft removed, install the bearings in the cylinder block with the main bearing caps installed and measure the inside diameter of the main bearings. Refer to table 1-1 for correct measurement and clearance.

*(13)* Inspect the crankshaft thrust washer for damage. Measure the thrust washer to determine wear. Refer to table 1-1 for wear limits.

*(14)* Replace a damaged or defective part.

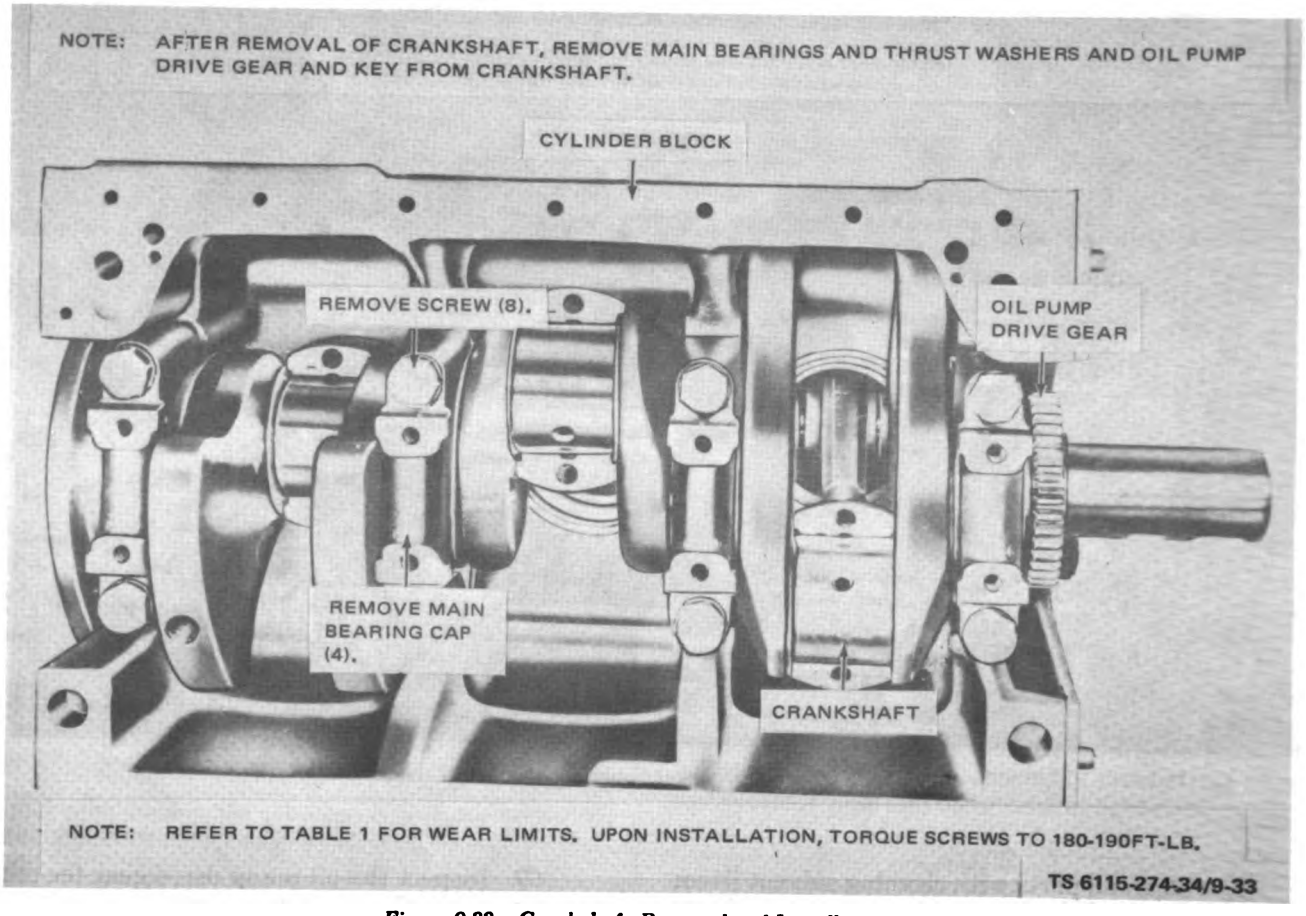



*Figure 9-33. Crankshaft, Removal and Installation*

*NOTE*

***Main bearing halves should not be replaced separately. If bearings require replacement, new halves, both upper and lower, must be replaced.***

*c. Installation.*

*(1)* Install oil pump drive gear and key (fig. 9-33).

*(2)* Install main bearings and thrust washers.

*(3)* Install crankshaft.

*(4)* Install main bearing caps. Torque screws to 180 to 190 ft-lb (24.9 to 26.3 m-kg).

*(5)* Install connecting rod caps (fig. 9-28).

*(6)* Install nuts and torque to 65 to 75 ft-lb (9 to 10.4 m-kg). Install cotter pins.

*(7)* Attach oil pump outlet pipe to oil pressure regulator (fig. 9-26).

*(8)* Install shims between oil pump and cylinder block in proper location as removed.

*(9)* Install oil pump assembly and attach with screws.

*(10)* Attach screen support bracket to cylinder block.

*(11)* Install gasket and oil pan (fig. 9-25).

*(12)* Connect heater exhaust pipe (fig. 9-24).

*(13)* Install nipples, elbow and grommet.

*(14)* Install pipe connector.

*(15)* Install pipe plug and service crankcase with proper oil.

*(16)* Attach oil seal to crankshaft front cover (fig. 9-32).

*(17)* Install front cover and attach with screws.

*(18)* Install Woodruff keys and pulley onto crankshaft (fig. 9-31).

*(19)* Install flat washer and bolt.

*(20)* Install metallic rectifier and bracket to engine (fig. 9-11).

*(21)* Attach connectors to rear of rectifier.

*(22)* Attach clamps and fuel oil cooler (fig. 9-10).

*(23)* Connect fuel line at each end of cooler.

*(24)* Install gaskets and water manifold (fig. 9-9).

*(25)* Attach with nuts and torque to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(26)* Install heat indicator sending unit.

*(27)* Install thermostatic switch and heat deflector (fig. 9-8).

*(28)* Install bypass line assembly with thermostat. Attach line to balance weight cover with clamp. Attach bypass line to water manifold.

*(29)* Attach electrical leads to thermostatic switch.

*(30)* Install new gasket (fig. 9-7).

*(31)* Install exhaust manifold and muffler assembly and the exhaust pipe with nuts and studs.

*(32)* Torque nuts to 30 to 35 ft-lb (4.1 to 4.8 m-kg) and studs to 15 to 30 ft-lb (2.1 to 4.1 m-kg).

*(33)* Install engine accessory generator with nuts and screws (refer to fig. 6-8).

*(34)* Install belts.

*(35)* Install bracket and adjusting strap.

*(36)* Connect wiring harness.

*(37)* Position generator so that the belts deflect 5/8 inch midway between pulleys. Tighten adjusting screw.

*(38)* Install fan with fan support assembly and bracket (fig. 9-6).

*(39)* Install fan belts and position fan assembly so that the belts deflect 5/8 inch midway between pulleys. Tighten adjusting bracket.

*(40)* Install dummy hub (fig. 9-30).

*(41)* Install bearing retainer and idler gear.

*(42)* Install crankshaft gear.

*NOTE*

*When installing gears, align timing marks.*

*(43)* Install pipe plugs (22, 23, 24 and 25) in flywheel housing (fig. 9-3).

*(44)* Install gasket (21) and housing assembly (20).

*(45)* Install gasket (19), cover (18), washers (17) and screws (16).

*(46)* Install gasket (15) and cover (14).

*(47)* Install screws (13), washers (12) and nuts (11).

*(48)* Install gasket (10), seal (9) and cover (8).

*(49)* Install washers (7), screws (6), washers (5), screws (4), washers (3), screws (2) and screws (1).

*(50)* Refer to figure 9-4 and tighten flywheel housing nuts in sequence shown and to torque values shown.

*(51)* Install flywheel (fig. 9-2).

*(52)* Install six bolts and torque to 150 to 160 ft-lb (20.7 to 22.1 m-kg). Install lockwire.

*NOTE*

*Use a suitable indicator and measure amount of flywheel runout after installation. It should not exceed 0.005 inch (0.127 mm).*

*(53)* Install starter and solenoid with mounting screws (fig. 6-1).

*(54)* Connect electrical leads and cables to starter and solenoid.

*(55)* Install gasket and blower drive coupling (refer to fig. 7-13).

*(56)* Install screws and nuts.

*(57)* Install line.

*(58)* Install main fuel pump (fig. 7-8).

*(59)* Attach blower to cylinder block with four screws and torque to 55 to 60 ft-lb (7.6 to 8.3 m-kg).

*(60)* Connect fuel lines to main fuel pump.

*(61)* Install clamp on blower drive coupling.

*(62)* Install hydraulic pump (refer to fig. 5-1).

*(63)* Connect hydraulic lines.

*(64)* Install water pump (refer to fig. 7-3).

*(65)* Install outlet seal and retainer.

*(66)* Install spacer, clamp and screw.

*(67)* Connect hoses to bypass line and inlet line with clamps. Tighten screws.

*(68)* Install water pump drainplug.

*(69)* Install air intake housing (refer to fig. 7-7).

*(70)* Attach ether primer line to air intake housing assembly.

*(71)* Connect air hose and tighten clamp.

*(72)* Install hydraulic tank and connect hydraulic fittings.

*(73)* Install hydraulic tank drain plug. Service hydraulic tank.

*(74)* Install solenoid bracket with spacers and screws.

*(75)* Install solenoid.

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(76)* Install clevis pin and cotter pin.

*(77)* Connect electrical leads to solenoid.

*(78)* Attach suitable lifting device to lifting brackets and install engine (refer to fig. 2-6).

*(79)* Attach engine to skid base with screws and nuts.

*(80)* Attach stator frame to flywheel housing.

*(81)* Attach stator frame to coupling plates with screws and lockwire.

*(82)* Install stator-to-flywheel housing screws. Remove blocking from beneath rear of main generator.

*(83)* Attach center cowl to base frame with screws, washers and nuts.

*(84)* Install heater exhaust pipe at center cowl.

*(85)* Install the fuel filter and hose to fuel tank and tighten clamps (refer to fig. 2-5).

*(86)* Install ring and gasket to filler neck.

*(87)* Install strainer and fuel tank cap. Service fuel tank.

*(88)* Attach generator stator frame cover.

*(89)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube and starting primer tube to the engine.

*(90)* Install battery box (refer to fig. 2-4).

*(91)* Attach battery box support to front engine mount.

*(92)* Install drain hose and tighten clamp.

*(93)* Install thermostat. Connect electrical leads.

*(94)* Attach electrical leads to battery box with clamps, screws and nuts.

*(95)* Install heater-to-battery hose and tighten clamps.

*(96)* Install batteries and fasten holddowns (refer to fig. 2-3).

*(97)* Connect battery leads and jumper lead.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(98)* Install battery box cover and fasten latches.

*(99)* Install front cowl assembly (8, fig. 9-1).

*(100)* Attach radiator hose connections.

*(101)* Attach fan guard to shroud with screws.

*(102)* Install muffler rain cap and retainer (9).

*(103)* Install connector nut (14), canvas boot (12), right rear panel (13), fuel control panel (11), left-side panels (16 and 17), generator hood (5), generator doors (3 and 15), engine hood (6), and engine doors (4 and 10) with nuts (7), washers (18), washers (2) and screws (1).

*(104)* Install radiator drainplug and service radiator with proper coolant.

## Section VIII. CRANKCASE

**9-22. General.**

The crankcase consists of the cylinder block, end plates and sleeves, and attaching hardware.

**9-23. Type of Repair.**

Repairs may involve cracks, breaks, damaged threads, and other damage.

**9-24. Crankcase.**

*a. Removal.*

*(1)* Remove radiator drainplug and drain coolant into a suitable container.

*(2)* Remove screws (1, fig. 9-1), washers (2), washers (18) and nuts (7) in the order necessary to remove engine doors (4 and 10), engine hood (6), generator doors (3 and 15), generator hood (5), left-side panels (16 and 17), fuel control panel (11) and right-rear panel (13) with canvas boot (12) and connector nut (14).

*(3)* Remove muffler rain cap and retainer (9).

*(4)* Remove screws attaching fan guard to shroud and remove fan guard.

*(5)* Remove radiator hose connections.

*(6)* Remove front cowl assembly (8).

*(7)* Refer to figure 2-3 to remove the batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(8)* Release latches and remove battery box cover. Loosen nuts, disconnect battery leads and remove jumper lead. Loosen battery holddowns and remove batteries.

*(9)* Refer to figure 2-4 to remove the battery box.

*(10)* Loosen clamps and remove heater-to-battery hose.

*(11)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(12)* Remove thermostat. Tag and disconnect electrical leads.

*(13)* Loosen hose clamp and remove drain hose.

*(14)* Remove nuts and screws that secure battery box support to dront engine mount and remove support.

*(15)* Remove nuts and screws holding battery box to fraine and remove battery box.

*(16)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(17)* Remove screws and nuts holding generator stator frame cover and remove cover.

*(18)* Drain the fuel into a suitable container.

*(19)* Refer to figure 2-5 to remove the fuel tank cap and fuel filler.

*(20)* Remove fuel tank cap and strainer.

*(21)* Remove screws securing ring to filler neck and remove ring and gasket.

*(22)* Loosen the clamps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(23)* Remove the heater exhaust pipe at center cowl.

*(24)* Remove screws, washers and nuts holding center cowl to base frame and remove center cowl.

*(25)* See figure 2-6 to remove the engine.

*NOTE*

*Position suitable blocking beneath rear of main generator before removing stator-to-flywheel housing screw.*

*(26)* Remove lockwire and screws holding stator frame to coupling plates.

*(27)* Remove screws nolding stator frame to flywheel housing.

*(28)* Remove screws and nuts holding engine to skid base.

*(29)* Attach suitable lifting device to front and rear lifting brackets and remove engine. Place on suitable stand.

*(30)* Tag and disconnect electrical leads to solenoid (refer to fig. 7-7).

*(31)* Remove clevis pin and cotter pin.

*(32)* Remove screws and remove solenoid.

*(33)* Remove screws and spacers and remove solenoid bracket.

*(34)* Remove plug and drain hydraulic tank. Disconnect hydraulic fittings and remove tank.

*(35)* Loosen clamp and disconnect air hose.

*(36)* Disconnect ether primer line from air intake housing assembly. Remove screws and remove air intake housing.

*(37)* Remove water pump drainplug (refer to fig. 7-3).

*(38)* Loosen screws and clamps and disconnect hoses to bypass line and inlet line. Remove screw, clamp and spacer.

*(39)* Remove two screws and washers and remove outlet seal and retainer.

*(40)* Remove three screws and washers and remove water pump.

*(41)* Disconnect hydraulic lines (refer to fig. 5-1).

*(42)* Remove four screws and remove hydraulic pump.

*(43)* Remove clamp (refer to fig. 7-8).

*(44)* Disconnect fuel lines from main fuel pump.

*(45)* Remove four screws and remove blower.

*(46)* Remove main fuel pump.

*(47)* Remove line (refer to fig. 7-13).

*(48)* Remove two screws. Remove four screws and nuts.

*(49)* Remove gear support and remove gasket from end plate. Remove coupling assembly.

*(50)* Tag and disconnect electrical leads and cables to starting motor and solenoid (refer to fig. 6-1).

*(51)* Remove starting motor mounting screws and remove starter and solenoid.

*(52)* Refer to figure 9-2 and remove lockwire and six bolts.

*(53)* Remove flywheel.

*(54)* Remove screws (1, fig. 9-3).

*(55)* Remove screws (2) and washers (3).

*(56)* Remove screws (4), washers (5), screws (6) and washers (7).

*(57)* Remove cover (8), seal (9) and gasket (10).

*(58)* Remove nuts (11), washers (12) and screws (13).

*(59)* Remove cover (14) and gasket (15).

*(60)* Remove screws (16), washers (17), cover (18) and gasket (19).

*(61)* Remove housing assembly (20) and gasket (21).

*(62)* Remove pipe plugs (22, 23, 24 and 25).

*(63)* Remove six screws on crankshaft gear (fig. 9-30). Remove crankshaft gear.

*(64)* Remove screws holding idler gear and remove gear. Remove bearing retainer.

*(65)* Remove screw holding dummy hub and remove hub.

*(66)* Remove screws holding fan support assembly (fig. 9-6).

*(67)* Remove screws and bracket.

*(68)* Remove fan and belts.

*(69)* Disconnect wiring harness (fig. 6-8).

*(70)* Remove screws and remove mounting bracket and adjusting strap.

*(71)* Remove belts.

*(72)* Remove screws and generator.

*(73)* Remove studs (fig. 9-7).

*(74)* Remove nuts and washers and remove exhaust manifold and muffler assembly and the exhaust pipe.

*(75)* Remove and discard gasket.

*(76)* Tag and disconnect electrical leads to thermostatic switch (fig. 9-8).

*(77)* Remove four screws that attach bypass line assembly to water manifold.

*(78)* Remove screw and clamp that secure bypass line assembly to front of balance weight cover. Remove bypass line assembly with thermostat.

*(79)* Remove thermostatic switch and heat deflector.

*(80)* Remove heat indicator sending unit (fig. 9-9).

*(81)* Remove six nuts and remove water manifold. Remove gaskets.

*(82)* Provide a suitable container to catch fuel leakage and disconnect fuel line at each end of cooler (fig. 9-10).

*(83)* Remove screws and nuts holding clamps and remove clamps and cooler.

*(84)* Disconnect connectors from rear of rectifier (fig. 9-11).

*(85)* Remove screws holding bracket to engine and remove bracket and rectifier.

*(86)* Remove bolt and flat washer (fit. 9-31).

*(87)* Remove crankshaft pulley.

(88) Remove two Woodruff keys from crankshaft.

(89) Remove screws from around perimeter of crankshaft front cover (fig. 9-32).

(90) Remove front cover and oil seal.

*NOTE*

*It may be necessary to drive front cover from end plate dowels.*

(91) Remove clamp and horizontal screws through lifting bracket (fig. 9-12).

*NOTE*

*Attach lifting device to lifting bracket and remove balance weight cover and gasket.*

(92) Remove pipe plug and drain oil into a suitable container (fig. 9-24).

(93) Remove pipe connector.

(94) Remove grommet.

(95) Remove nipple, elbow and nipple.

(96) Disconnect heater exhaust pipe.

(97) Remove screws attaching oil pan to cylinder block (fig. 9-25).

(98) Remove oil pan and gasket.

*NOTE*

*Engine must be on a stand that fastens to lower edge of block and that allows access to both top and bottom of engine.*

(99) Loosen thumbscrews holding rocker arm cover and remove cover (fig. 9-14).

(100) Loosen screw and open clamp (fig. 9-15).

(101) Loosen screw and remove throttle stop.

(102) Disconnect throttle control wire.

(103) Tag and disconnect electrical leads to electrohydraulic actuator (fig. 5-3).

(104) Disconnect hydraulic lines.

(105) Remove elbow and adapter.

(106) Remove cotter pin and straight pin and disengage control rod from control tube arm.

(107) Remove screws attaching actuator to cylinder head and remove actuator.

(108) Remove two nuts and six bolts attaching cylinder head to cylinder block (fig. 9-16).

(109) Remove two vertical screws from each lifting bracket.

(110) Attach suitable lifting device to front and rear lifting brackets and remove cylinder head.

(111) Remove gasket from cylinder block.

(112) Remove four screws on camshaft plate (fig. 9-21).

(113) Remove screws on balance shaft plate.

(114) Remove gear nuts from shafts.

(115) Remove nuts and pry balance weights from shafts.

(116) Remove setscrews from cylinder block at each camshaft intermediate bearing.

(117) Remove screws from rear sleeve bearings and remove shafts, sleeve bearings, and gears assembled.

(118) Remove screws (fig. 9-22).

(119) Remove front sleeve bearings.

(120) Remove screws attaching screen support bracket to cylinder block (fig. 9-26).

(121) Remove screws attaching oil pressure regulator to cylinder block.

(122) Remove four screws attaching oil pump to cylinder block. Remove assembly consisting of oil pump, outlet pipe and oil pressure regulator.

*NOTE*

*Remove shims from between oil pump and cylinder block. Record number and location of shims to facilitate installation.*

(123) Remove screws attaching oil pump outlet pipe to oil pressure regulator.

(124) Remove cotter pins and nuts from lower end of connecting rods (fig. 9-28).

(125) Remove connecting rod caps.

(126) Using a wooden stick of suitable proportions push the piston and connecting rod assemblies out the top of the cylinder block and remove them.

*NOTE*

*Remove carbon or ridge ring from inside of cylinder sleeve before removing pistons.*

(127) Remove screws and remove main bearing caps (fig. 9-33).

(128) Remove crankshaft.

(129) Remove main bearings and thrust washers.

(130) Remove oil pump drive gear and key.

*b. Disassembly.*

*(1)* Remove rear plate (1, fig. 9-34) and gasket (2).

*(2)* Remove water and oil gaskets (3), waterhole gasket (7), studs (8), waterhole seal ring (9) and cylinder head oil seal (10).

*(3)* Remove cylinder sleeve insert (4), cylinder sleeve (5) and cylinder sleeve compression gasket (6).

*NOTE*

*Use extreme care in driving sleeve from block bore so as not to damage lands.*

*(4)* Remove pipe plugs (11, 12 and 13), expansion plug (14), screws (27), washers (28), cover (29) and gasket (30).

*(5)* Remove screws (18 and 19), washers (17 and 20), front end plate (16) and gasket (15).

*(6)* Remove expansion plugs (21), plugs (22), gaskets (23) and pins (24 and 25) from block (26).

*c. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Cylinder block.

*(a)* Clean all parts with an approved cleaning solvent (Item 4, App B) and dry thoroughly. Dip the block in rust preventive (Item 5, App B). Remove excessive rust preventive before reassembly.

*(b)* Inspect the block for cracks, breaks, damaged threads, and other damage.

*(c)* Use an accurate straightedge and feeler gage and check the block face for flatness. Smooth down all nicks and burrs and check both transversely and longitudinally. The top face of the block must not vary over 0.003 inch (0.076 mm) transversely and 0.006 inch (0.152 mm) longitudinally. If it is necessary to machine the top of the block, do not remove over 0.008 inch (0.203 mm) of metal. The distance from the centerline of the crankshaft to the top of the block must not be less than 16.176 inches (41.087 cm). If it is necessary to machine the top of the block, it will also be necessary to deepen the grooves and counterbores for the water and oil seals by the same amount. Undersize cylinder sleeves are available for adjusting liner position.

*(d)* Hone out the cylinder bores with a suitable honing device and measure the block bores. Refer to table 1-1 for the correct measurements.

*(e)* Measure the clearance between the sleeve and the bore. Refer to table 1-1 for correct clearance.

*(f)* Measure the cylinder bores for out-of-round and taper. Refer to table 1-1 for correct measurements.

*(g)* Inspect the main bearing bore for cracks, nicks, burrs, and wear.

*(h)* Replace a damaged or defective part.

*(2)* End plates.

*(a)* Clean the end plates with an approved cleaning solvent and dry thoroughly. Remove all old gasket material.

*(b)* Inspect both surfaces of each end plate for nicks, dents, scratches, and score marks. Plates that are scratched or scored may be cleaned up with emery cloth and diesel fuel.

*(c)* Replace a damaged or defective part.

*(3)* Sleeves.

*(a)* Clean the sleeves with an approved cleaning solvent and dry thoroughly.

*(b)* Inspect the sleeves for cracks, breaks, nicks, burrs, and other damage.

*(c)* Measure the clearance between the cylinder block and sleeve. Refer to table 1-1 for correct clearance.

*(d)* Measure the sleeves for improper taper and out-of-round. Refer to table 1-1 for correct measurements and wear limits.

*(e)* Replace a damaged or defective sleeve.

*d. Assembly.*

*(1)* Install expansion plugs (21, fig. 9-34), plugs (22), gaskets (23) and pins (24 and 25) into block (26).

*(2)* Install gasket (15), front end plate (16), washers (17 and 20) and screws (18 and 19).

*(3)* Install gasket (30), cover (29), washers (28), screws (27), expansion plug (14), and pipe plugs (11, 12 and 13).

*(4)* Install cylinder sleeve compression gasket (6), cylinder sleeve (5) and cylinder sleeve insert (4).

*(5)* Install cylinder head oil seal (10), waterhole seal ring (9), studs (8), waterhole gasket (7), and water and oil gaskets (3).

*(6)* Install gasket (2) and rear plate (1).

1. Rear plate
2. Gasket
3. Water and oil gasket
4. Cylinder sleeve insert
5. Cylinder sleeve
6. Cylinder sleeve compression gasket
7. Waterhole gasket
8. Stud, plain
9. Waterhole seal ring
10. Cylinder head oil seal
11. Plug, pipe
12. Plug, pipe
13. Plug, pipe
14. Expansion plug
15. Gasket
16. Front end plate
17. Washer, lock
18. Screw, cap, hex hd
19. Screw, cap, hex hd
20. Washer, lock
21. Expansion plug
22. Plug, machine thd
23. Gasket
24. Pin, straight headless
25. Pin, straight headless
26. Cylinder block
27. Screw, cap, hex hd
28. Washer, lock
29. Cover
30. Gasket

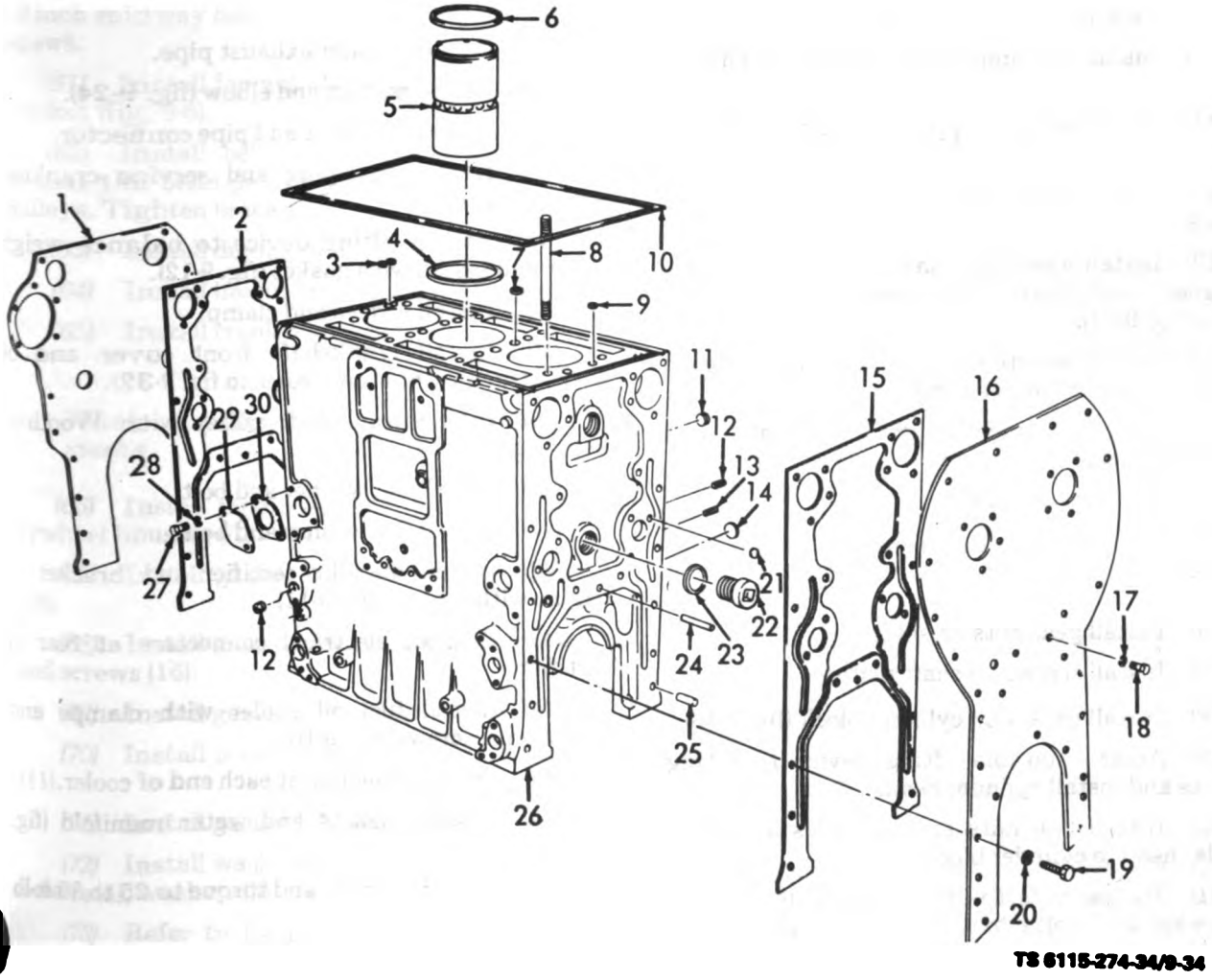



*Figure 9-34. Crankcase, Disassembly and Reassembly*

*e. Installation.*

*(1)* Install oil pump drive gear and key onto crankshaft (fig. 9-33).

*(2)* Install main bearings and thrust washers.

*(3)* Install crankshaft.

*(4)* Install main bearing caps and torque screws to 180 to 190 ft-lb (24.9 to 26.3 m-kg).

*(5)* Using a piston ring compressor install the pistons in the cylinder block (fig. 9-28).

*(6)* Install connecting rod caps.

*(7)* Install nuts and torque to 65 to 75 ft-lb (9 to 10.4 m-kg). Install cotter pins.

*(8)* Attach oil pump outlet pipe to oil pressure regulator (fig. 9-26).

*(9)* Install shims between oil pump and cylinder block in proper location as removed.

*(10)* Install oil pump assembly and attach with screws.

*(11)* Attach screen support bracket to cylinder block.

*(12)* Install front sleeve bearings with screws (fig. 9-22).

*(13)* Install assembled shafts, sleeve bearings, and gears and fasten rear sleeve bearings with screws (fig. 9-21).

*(14)* Install setscrews in cylinder block at each camshaft intermediate bearing.

*(15)* Install balance weights on shafts and fasten with nuts.

*NOTE*

*When installing gears align timing marks.*

*(16)* Install gear nuts on shafts.

*(17)* Install screws on shaft plates.

*(18)* Install gasket on cylinder block (fig. 9-16).

*(19)* Attach suitable lifting device to lifting brackets and install cylinder head.

*(20)* Install two nuts and six bolts attaching cylinder head to cylinder block.

*(21)* Torque nuts to 165 to 175 ft-lb (22.8 to 24.2 m-kg) and bolts to 180 to 190 ft-lb (24.9 to 26.3 m-kg).

*(22)* Attach electrohydraulic actuator to cylinder head (refer to fig. 5-3).

*(23)* Attach control rod to control tube arm with cotter pin and straight pin.

*(24)* Adjust control rod by positioning control rod and control tube arm at full throttle. Adjust clevis until holes in control tube arm and clevis align, then insert pin.

*(25)* Install elbow and adapter and connect hydraulic lines.

*(26)* Connect electrical leads to electro-hydraulic actuator.

*(27)* Connect throttle control wire (fig. 9-15).

*(28)* Install throttle stop and tighten screw.

*(29)* Close clamp and tighten screw.

*(30)* Install rocker arm cover and tighten thumbscrews (fig. 9-14).

*(31)* Install gasket and oil pan (fig. 9-25).

*(32)* Install screws attaching oil pan to cylinder block.

*(33)* Connect heater exhaust pipe.

*(34)* Install nipples and elbow (fig. 9-24).

*(35)* Install grommet and pipe connector.

*(36)* Install pipe plug and service crankcase with proper oil.

*(37)* Attach lifting device to balance weight cover and install with gasket (fig. 9-12).

*(38)* Install screws and clamp.

*(39)* Install crankshaft front cover and oil seal. Attach with screws (refer to fig. 9-32).

*(40)* Install crankshaft pulley with Woodruff keys (fig. 9-31).

*(41)* Install flat washer and bolt.

*(41)* Install flat washer and bolt.

*(42)* Install metallic rectifier and bracket to engine with screws (fig. 9-11).

*(43)* Connect electrical connectors at rear of rectifier.

*(44)* Install fuel oil cooler with clamps and fasten with screws (fig. 9-10).

*(45)* Connect fuel line at each end of cooler.

*(46)* Install gaskets and water manifold (fig. 9-9).

*(47)* Install six nuts and torque to 25 to 30 ft-lb (3.5 to 4.1 m-kg).

*(48)* Install heat indicator sending unit.

*(49)* Secure bypass line assembly to front of balance weight cover with clamp and screw (fig. 9-8).

*(50)* Install bypass line assembly with thermostat to water manifold.

*(51)* Install thermostatic switch and heat deflector.

*(52)* Connect electrical leads to switch.

*(53)* Install gasket and exhaust manifold and muffler assembly and exhaust pipe (fig. 9-7).

*(54)* Attach assembly with washers, nuts and studs.

*(55)* Torque nuts to 30 to 35 ft-lb (4.1 to 4.8 m-kg) and studs to 15 to 30 ft-lb (2.1 to 4.1 m-kg).

*(56)* Attach generator with screws (refer to fig. 6-8).

*(57)* Install belts.

*(58)* Install bracket and adjusting strap.

*(59)* Connect wiring harness.

*(60)* Position generator so that the belts deflect 5/8 inch midway between pulleys. Tighten adjusting screws.

*(61)* Install fan with fan support assembly and bracket (fig. 9-6).

*(62)* Install belts and position fan assembly so that the belts deflect 5/8 inch midway between pulleys. Tighten bracket.

*(63)* Install dummy hub (fig. 9-30).

*(64)* Install bearing retainer and idler gear.

*(65)* Install crankshaft gear.

*NOTE*

*When installing gears align timing marks.*

*(66)* Install pipe plugs (22, 23, 24 and 25) in flywheel housing (fig. 9-3).

*(67)* Install gasket (21) and housing assembly (20).

*(68)* Install gasket (19), cover (18), washers (17) and screws (16).

*(69)* Install gasket (15) and cover (14).

*(70)* Install screws (13), washers (12) and nuts (11).

*(71)* Install gasket (10), seal (9) and cover (8).

*(72)* Install washers (7), screws (6), washers (5), screws (4), washers (3), screws (2) and screws (1).

*(73)* Refer to figure 9-4 and tighten flywheel housing nuts in sequence shown and to torque values shown.

*(74)* Install flywheel (fig. 9-2).

*(75)* Install six bolts and torque to 150 to 160 ft-lb (20.7 to 22.1 m-kg). Install lockwire.

*NOTE*

*Use a suitable indicator and measure amount of flywheel runout after installation. It should not exceed 0.005 inch (0.127 mm).*

*(76)* Install starter and solenoid with mounting screws (refer to fig. 6-1).

*(77)* Connect electrical leads and cables to starter and solenoid.

*(78)* Install gasket and blower drive coupling (refer to fig. 7-13).

*(79)* Install screws and nuts.

*(80)* Install line.

*(81)* Install main fuel pump (refer to fig. 7-8).

*(82)* Attach blower to cylinder block with four screws and torque to 55 to 60 ft-lb (7.6 to 8.3 m-kg).

*(83)* Connect fuel lines to main fuel pump.

*(84)* Install clamp on blower drive coupling.

*(85)* Install hydraulic pump (refer to fig. 5-1).

*(86)* Connect hydraulic lines.

*(87)* Install water pump (refer to fig. 7-3).

*(88)* Install outlet seal and retainer.

*(89)* Install spacer, clamp and screw.

*(90)* Connect hoses to bypass line and inlet line with clamps. Tighten screws.

*(92)* Install air intake housing (refer to fig. 7-7).

*(93)* Attach ether primer line to air intake housing assembly.

*(94)* Connect air hose and tighten clamp.

*(95)* Install hydraulic tank and connect hydraulic fittings.

*(96)* Install hydraulic tank drain plug. Service hydraulic tank.

*(97)* Install solenoid bracket with spacers and screws.

*(98)* Install solenoid.

*NOTE*

*When installing solenoid, loosen locking nut and adjust yoke so that yoke fits to shaft when the shaft is in the up position.*

*(99)* Install clevis pin and cotter pin.

*(100)* Connect electrical leads to solenoid.

*(101)* Attach suitable lifting device to lifting brackets and install engine (refer to fig. 2-6).

*(102)* Attach engine to skid base with screws and nuts.

*(103)* Attach stator frame to flywheel housing.

*(104)* Attach stator frame to coupling plates with screws and lockwire.

*(105)* Install stator-to-flywheel housing screws. Remove blocking from beneath rear of main generator.

*(106)* Attach center cowl to base frame with screws, washers and nuts.

*(107)* Install heater exhaust pipe at center cowl.

*(108)* Install the fuel filler and hose to fuel tank and tighten clamps (refer to fig. 2-5).

*(109)* Install ring and gasket to filler neck.

*(110)* Install strainer and fuel tank cap. Service fuel tank.

*(111)* Attach generator stator frame cover.

*(112)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube and starting primer tube to the engine.

*(113)* Install battery box (refer to fig. 2-4).

*(114)* Attach battery box support to front engine mount.

*(115)* Install drain hose and tighten clamp.

*(116)* Install thermostat. Connect electrical leads.

*(117)* Attach electrical leads to battery box with clamps, screws and nuts.

*(118)* Install heater-to-battery hose and tighten clamps.

*(119)* Install batteries and fasten holddown (refer to fig. 2-3).

*(120)* Connect battery leads and jumper lead.

*(121)* Install battery box cover and fasten latches.

*(122)* Install front cowl assembly (8, fig. 9-1).

*(123)* Attach radiator hose connections.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(124)* Attach fan guard to shroud with screws.

*(125)* Install muffler rain cap and retainer (9).

*(126)* Install connector nut (14), canvas boot (12), right rear panel (13), fuel control panel (11), left-side panels (16 and 17), generator hood (5), generator doors (3 and 15), engine hood (6) and engine doors (4 and 10) with nuts (7), washers (8), washers (2) and screws (1).

*(127)* Install radiator drainplug and service radiator with proper coolant.

*(128)* Adjust valve clearance with engine at operating temperature. Crank engine over until the injector on No. 1 cylinder is in the down position. Loosen locknut and place a 0.009 inch (0.229 mm) gage between rocker arm and valve stem. Loosen locknut and turn the push rod until a steady pull is required to remove the gage. Hold push rod and secure locknut. Recheck clearance and readjust if necessary. Repeat procedure for all valves in sequence of firing order 1-3-2.

# CHAPTER 10

# REPAIR OF CONTROLS AND INSTRUMENTS

## Section I. CONTROL BOX

**10-1. General.**

The controls and instruments for the main generator are located on the instrument panel and in the control box.

**10-2. Type of Repairs.**

Inspect for cracks, breaks, loose terminals and other damage. Damaged instruments are replaced rather than repaired.

**10-3. Control Box Controls and Instruments (Except Main Generator Voltage Regulator).**

*a. Removal.*

*(1)* Remove the adjustment knobs from the frequency and voltage control variable resistors (fig. 10-1).

*(2)* Remove thermal watt converter:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(3)* Remove frequency converter:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(4)* Remove battery relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(5)* Remove shutdown relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(6)* Remove governor parallel relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(7)* Remove paralleling resistors:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(8)* Remove reactance droop adjustable resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(9)* Remove remote-local control relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(10)* Remove electrical receptacles:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(11)* Remove field flash resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(12)* Remove air box solenoid resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(13)* Remove overvoltage-underfrequency relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(14)* Remove undervoltage trip coil terminal board:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(15)* Disconnect receptacle connector.

*(16)* Remove voltage control adjustable resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(17)* Remove droop adjusting adjustable resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(18)* Remove frequency control adjustable resistor:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(19)* Remove main circuit breaker:

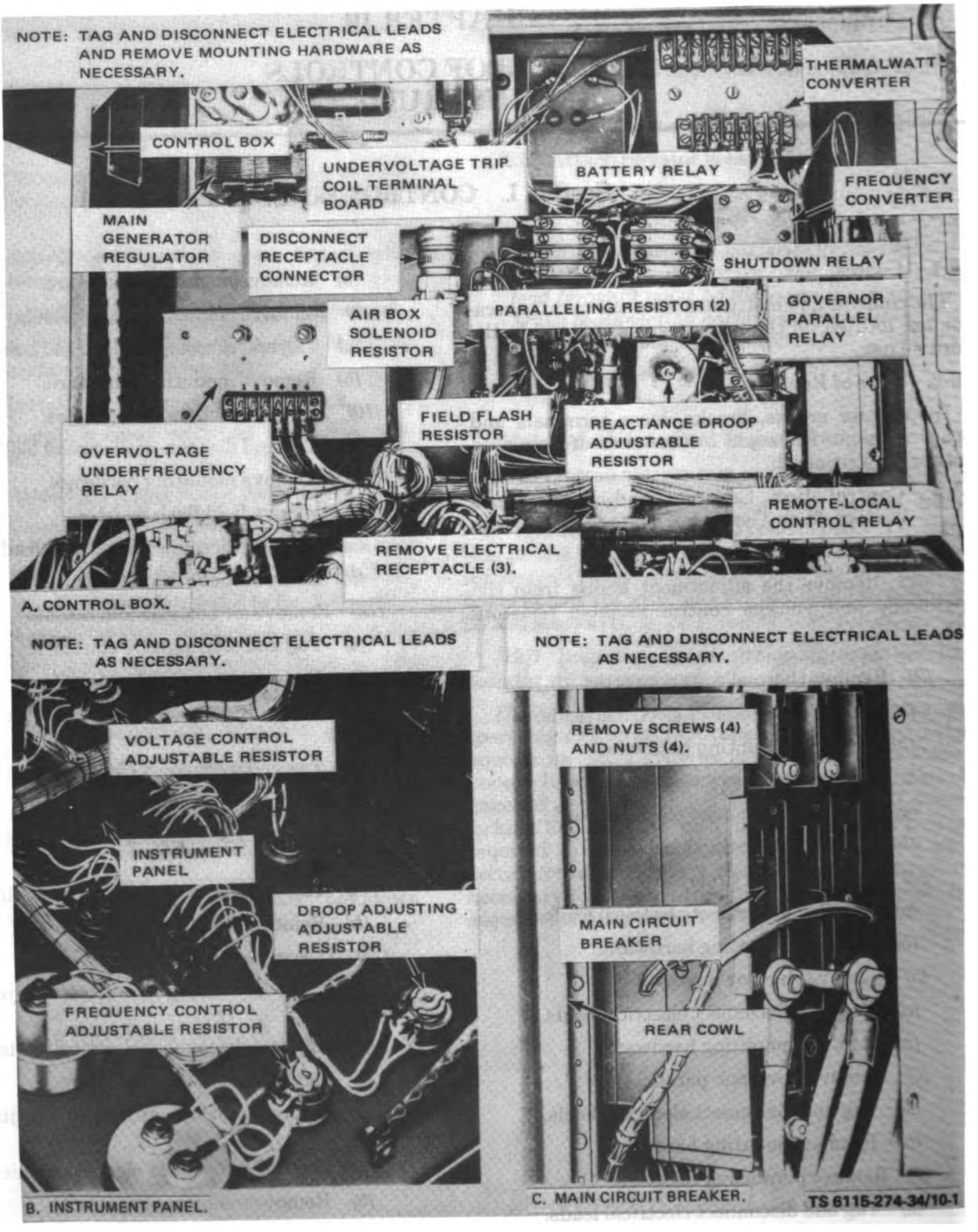



*Figure 10-1. Controls and Instruments, Removal and Installation*

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*b. Cleaning and Inspection.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all controls and instruments with a cloth dampened with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect for cracks, breaks, loose terminals, cracked or broken glass, and other damage.

*(3)* Replace a damaged or defective control and instrument.

*c. Testing and Adjustment.*

*(1)* Paralleling circuit fixed resistors. Touch the probes of a multimeter to the terminals of the resistors. A 6,000 ohm resistance should be indicated.

*(2)* Field flash resistor. Touch the probes of a multimeter to the terminals of the resistor. A 5 ohm resistance should be indicated.

*(3)* Air box solenoid resistor. Touch the probes of a multimeter to the end terminals of the resistor. A reading of 25 ohms should be indicated. Test between the center tab and one end tab; a resistance of 25 ohms should be indicated.

*(4)* Shutdown, battery, and protection bypass relays.

*(a)* Touch the probes of an ohmmeter to relay terminals A2 and A3; continuity should be indicated. Perform the same test on terminals B2 and B3; continuity should be indicated. Test between A2 and A1, B2 and B1; continuity should not be indicated.

*(b)* Apply a source of 24 volts, direct current, to terminals X1 and X2 and perform a continuity test between A2 and A1 and B2 and B1; continuity should be indicated. Test between A2 and A3 and B2 and B3; continuity should not be indicated.

*(5)* Remote-local control relay.

*(a)* Use an ohmmeter and test between terminals 1 and 2. Resistance should be indicated. Reverse the test leads; an open circuit should be indicated.

*(b)* Test between terminals 3 and 4 and 6 and 7. Continuity should be indicated.

*(c)* Test between terminals 3 and 5. An open circuit should be indicated.

*(d)* Apply a source of 110 volts, alternating current to terminals 1 and 2. Continuity should exist between terminals 3 and 5. Test between terminals 3 and 4 and 6 and 7. An open circuit should be indicated on both tests.

*(6)* Variable resistors.

*(a)* Reactance droop adjusting variable resistor. Test the total resistance of the droop resistor by connecting an ohmmeter to the outside terminals. Resistance should be 35 ohms. Touch one probe to the center terminal and rotate the resistor throughout its entire range. The resistance should vary smoothly as the knob is turned.

*(b)* Voltage adjusting variable resistor. Disconnect the jumper lead from one tab and test the resistor as described in (a) above. The proper resistance is 150 ohms.

*(c)* Frequency droop adjusting variable resistor. Test the resistor as described in (a) above. The proper resistance is 2,500 ohms.

*(d)* Frequency adjusting variable resistor. Test the resistor as described in (a) above. The proper resistance is 1,000 ohms.

*(7) Overvoltage - underfrequency relay.*

*(a)* Place the relay assembly on a test stand having a variable source of voltage and frequency. Bring the test circuit frequency to 400 Hz and the voltage to 156 volts. The overvoltage relay should trip, if not, adjust the resistor marked V until the overvoltage relay does trip at 156 volts. Return voltage source to 120 volts. With the test circuit voltage at 120 volts, lower the frequency to 365 Hz. The underfrequency relay should trip, if not, adjust the resistor marked F until the underfrequency relay does trip at 365 Hz.

*(b)* Testing relay while attached to the generator set, same as test and adjustment, paragraph c(7)(a), except voltage and frequency control rheostats on control panel will be used to vary the voltage and frequency.

*d. Installation.*

*(1)* Install main circuit breaker (fig. 10-1).

*(a)* Install mounting hardware.

*(b)* Connect electrical leads.

*(2)* Install frequency control adjustable resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(3) Install droop adjusting adjustable resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(4) Install voltage control adjustable resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(5) Connect receptacle connector.

(6) Install undervoltage trip coil terminal board:

(a) Install mounting hardware.

(b) Connect electrical leads.

(7) Install overvoltage-underfrequency relay:

(a) Install mounting hardware.

(b) Connect electrical leads.

(8) Install air box solenoid resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(9) Install field flash resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(10) Install electrical receptacles:

(a) Install mounting hardware.

(b) Connect electrical leads.

(11) Install remote-local control relay:

(a) Install mounting hardware.

(b) Connect electrical leads.

(12) Install reactance droop adjustable resistor:

(a) Install mounting hardware.

(b) Connect electrical leads.

(13) Install paralleling resistors:

(a) Install mounting hardware.

(b) Connect electrical leads.

(14) Install governor parallel relay:

(a) Install mounting hardware.

(b) Connect electrical leads.

(15) Install shutdown relay:

(a) Install mounting hardware.

(b) Connect electrical leads.

(16) Install battery relay:

(a) Install mounting hardware.

(b) Connect electrical leads.

(17) Install frequency converter:

(a) Install mounting hardware.

(b) Connect electrical leads.

(18) Install thermal watt converter:

(a) Install mounting hardware.

(b) Connect electrical leads.

(19) Install adjustment knobs on frequency and voltage control variable resistor.

**10-4. Main Generator Voltage Regulator.**

*a. Adjustment.*

(1) With unit parallel switch in OFF position, loosen locknut and adjust rheostat on regulator until no load generator voltage and full load generator voltage are equal.

(2) Maximum voltage fluctuation at constant load should not exceed 1/2 percent from average voltage.

*b. Removal.*

(1) Tag and disconnect electrical leads.

(2) Remove mounting hardware.

*c. Disassembly.*

(1) Disassemble only to the point where inspection and repair can be made. Unsolder leads as necessary.

(2) Remove screws (24, fig. 10-2) and washers (25) around perimeter of mounting board (9) allowing mounting board to separate from chassis (1).

1. Regulator chassis
2. Nut, hex
3. Washer, lock ET
4. Rheostat
5. Screw, cap, hex hd
6. Washer, flat
7. Washer, lock IT (spec)
8. Hex nut (spec)
9. Regulator mounting board
10. Transformer
11. Washer, lock, IT
12. Nut, hex
13. Fixed resistor, 5 ohm, 25 watt
14. Dished washer (spec)
15. Insulating washer
16. Adjustable resistor, 500 ohm, 25 watt
17. Capacitor
18. Clamp
19. Fixed resistor, 1,000 ohm, 10 watt
20. Choke
21. Washer, lock, IT
22. Nut, hex
23. Reactor Assembly
24. Screw, machine
25. Washer, lock, IT
26. Tube shield
27. Tube
28. Screw, machine
29. Washer, lock, IT
30. Shield base
31. Washer, flat
32. Screw, cap, hex hd
33. Plastic clamp
34. Screw, machine
35. Fixed resistor, 5,440 ohm, 10 watt
36. Electrical receptacle
37. Screw, machine
38. Screw, machine
39. Rectifier
40. Silicon diode
41. Fixed resistor, 4,700 ohm, 2 watt, 5%

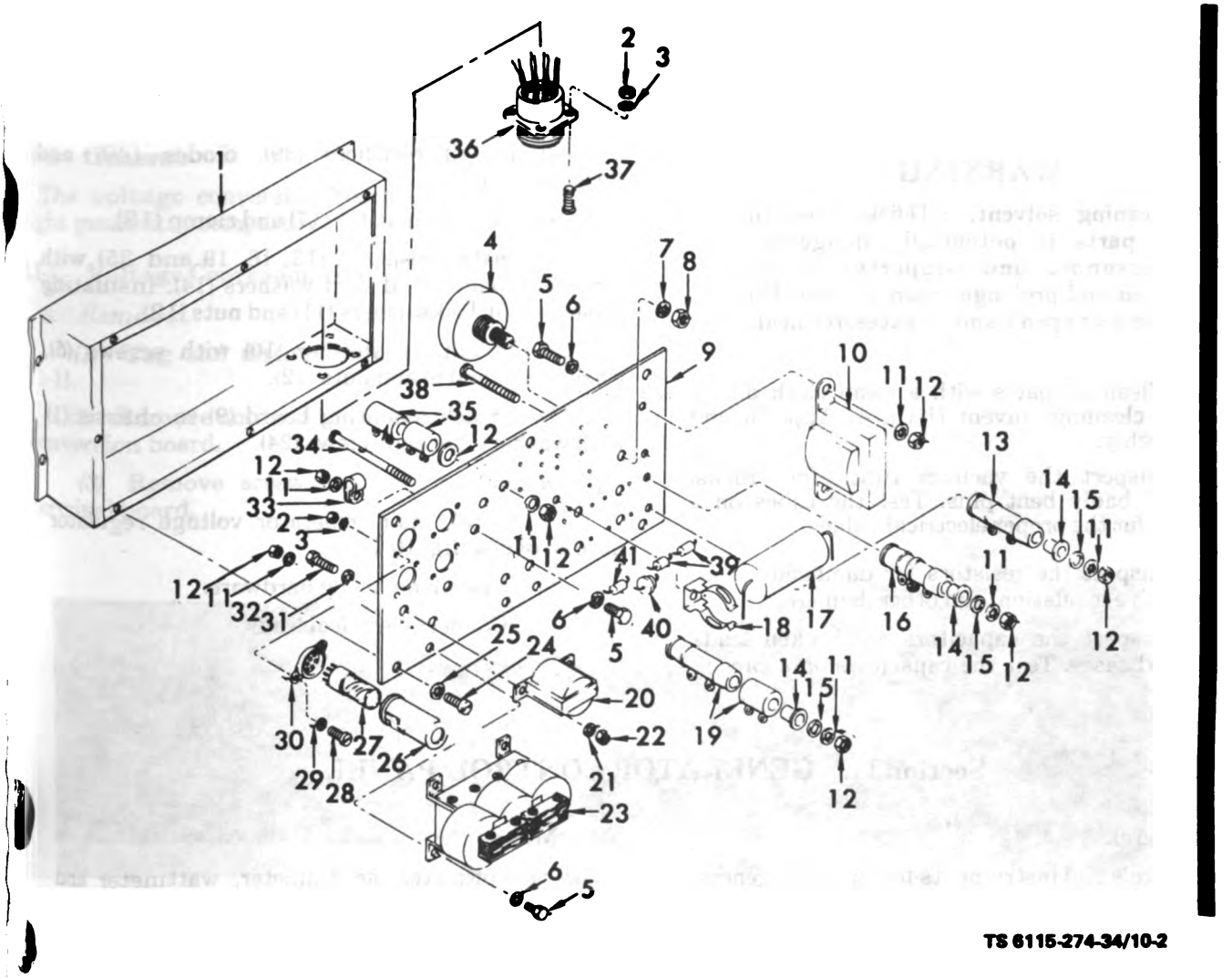



*Figure 10-2. Main Generator Voltage Regulator, Disassembly and Reassembly*

*(3)* Remove nuts (12), washers (11 and 6), screws (5) and transformer (10).

*(4)* Remove nuts (12), lockwashers (11), insulating washers (15), dished washers (14), resistors (13, 16, 19 and 35) and screws (34 and 38).

*(5)* Remove capacitor (17) and clamp (18).

*(6)* Remove rectifiers (39), diodes (40) and resistors (41).

*(7)* Remove nuts (22), lockwashers (21), washers (31), screws (32) and choke (20).

*(8)* Remove screws (5), washers (6), lockwashers (11), nuts (12) and reactor assembly (23).

*(9)* Remove tube shields (26), tubes (27), screws (28), lockwashers (29 and 3), nuts (2) and shield bases (30).

*(10)* Remove screw (5), washer (6), washer (11), nut (12) and plastic clamp (33).

*(11)* Remove nut (8), washer (7) and rheostat (4).

*(12)* Remove nuts (2), washers (3), screws (37) and electrical receptacle (36).

*d. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with a clean cloth dampened with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the vacuum tubes for cracks, breaks and badly bent pins. Test the tubes on a tube tester for the proper electrical values.

*(3)* Inspect the resistors for damaged terminals, defective insulation, and other damage.

*(4)* Inspect the capacitors for broken leads and cracked cases. Test the capacitors on a capacitor tester.

*(5)* Inspect the chassis for cracks, breaks, and other damage.

*(6)* Inspect the magnetic amplifier for broken terminals and defective insulation.

*(7)* Inspect the transformer and chokes for cracks, breaks, broken terminals and evidence of overheating.

*(8)* Replace a damaged or defective part.

*e. Reassembly.*

*(1)* Install receptacle (36, fig. 10-2) with screws (37), washers (3) and nuts (2).

*(2)* Install rheostat (4) with washer (7) and nut (8).

*(3)* Install plastic clamp (33) with screw (5), washer (6), washer (11) and nut (12).

*(4)* Install shield bases (30) with screws (28), lockwashers (29 and 3) and nuts (2). Install tubes (27) and tube shields (26).

*(5)* Install reactor assembly (23) with screws (5), washers (6), lockwashers (11) and nuts (12).

*(6)* Install choke (20) with screws (32), washers (31), lockwashers (21) and nuts (22).

*(7)* Install rectifiers (39), diodes (40) and resistors (41).

*(8)* Install capacitor (17) and clamp (18).

*(9)* Install resistors (13, 16, 19 and 35) with screws (34 and 38), dished washers (14), insulating washers (15), lockwashers (11) and nuts (12).

*(10)* Install transformer (10) with screws (5), washers (11 and 6) and nuts (12).

*(11)* Attach mounting board (9) to chassis (1) with washers (25) and screws (24).

*f. Installation.*

*(1)* Install main generator voltage regulator in control box (fig. 10-1).

*(a)* Install mounting hardware.

*(b)* Connect electrical leads.

## Section II. GENERATOR CONTROL PANEL

### 10-5. General.

The controls and instruments for the main generator are located on the instrument panel and in the control box.

### 10-6 Meters.

The ac voltmeter, ac ammeter, wattmeter and frequency meter are tested by Direct Support Maintenance for the accuracy of their readings. If found defective they are replaced by Organizational Maintenance.

# CHAPTER 11
# REPAIR OF AC GENERATOR

## Section I. RECEPTACLES AND TERMINAL STRIPS, CABLE ASSEMBLY

**11-1. General.**

The load receptacles with cable assemblies and terminal strips are located at the lower portion of the rear cowl.

**11-2. Receptacles, Terminal Strips, Cable Assemblies.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads.

*(2)* Remove attaching hardware.

*b. Inspection and Test.*

*(1)* Inspect for cracks, breaks, corrosion and defective insulation.

*(2)* Test for electrical continuity.

*(3)* Repair or replace defective part.

*c. Installation.*

*(1)* Install with attaching hardware.

*(2)* Connect electrical leads.

## Section II. VOLTAGE CONVERSION BOARD

**11-3. General.**

The voltage conversion board is located in the right generator compartment.

**11-4. Voltage Conversion Board.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads (fig. 11-1).

*(2)* Remove nuts and studs and remove voltage conversion board.

*(3)* Remove screws and nuts and remove terminal board.

*b. Inspection and Test.*

*(1)* Inspect for cracks, breaks, corrosion and defective insulation.

*(2)* Test for electrical continuity.

*(3)* Repair or replace defective parts.

*c. Installation.*

*(1)* Install terminal board.

*(2)* Install voltage conversion board.

*(3)* Connect electrical leads.

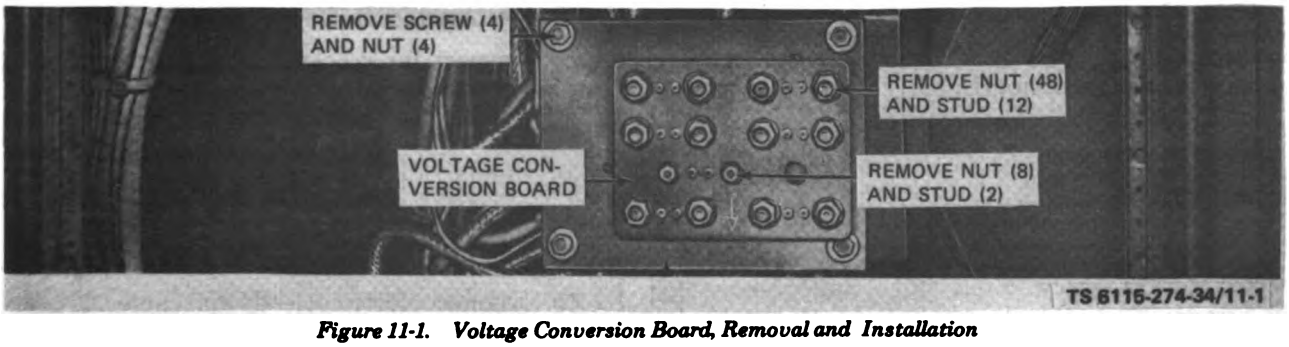



*Figure 11-1. Voltage Conversion Board, Removal and Installation*

## Section III. POWER SUPPLY STATIC EXCITER

**11-5. General.**

The static exciter is located on the right rear of the main generator compartment.

**11-6. Static Exciter.**

Test the exciter before removal as follows:

*a. On-Equipment Testing.*

*(1)* Disconnect the receptacle connector from the exciter.

*(2)* Remove the cover from the exciter assembly.

*(3)* Disconnect all external electrical wiring.

*(4)* Use an ohmmeter and measure the resistance between terminals T7 and T12, T8 and T12, and T9 and T12. A value of 0.1 ohm should be obtained. An open reading indicates an open linear reactor or transformer primary winding.

*(5)* Measure the resistance of all transformer windings to ground. All should read 1 megohm or more.

*(6)* Measure the resistance across all terminals of the current transformer. A reading of 0.5 ohm should be obtained.

*(7)* Measure the resistance between terminals C and D of the receptacle. A reading of 12 to 15 ohms should be obtained. An open reading indicates an open control winding in one of the excitation transformers.

*b. Removal.*

*(1)* Remove screws and remove cover (fig. 11-2).

*(2)* Disconnect receptacle connector.

*(3)* Tag and disconnect electrical leads.

*(4)* Remove screws and nuts and remove exciter assembly.

*c. Cleaning, Inspection and Repair.*

*(1)* Clean all parts with a clean, dry, lint-free cloth and compressed air.

*(2)* Inspect transformers and reactors for damaged insulation, terminals and windings.

*(3)* Inspect the transformers and reactors for discoloration and other signs of overheating.

*(4)* Check for continuity between windings 1 and 2, 3 and 4, and 7 and 8 of the excitation transformers. Check the continuity of the reactor winding.

*(5)* Inspect the receptacle connector for damaged threads and terminals.

*(6)* Replace or repair a damaged or defective part.

*d. Installation.*

*(1)* Attach exciter assembly with hardware.

*(2)* Connect electrical leads.

*(3)* Connect receptacle connector.

*(4)* Install cover.

## Section IV. CIRCUIT BREAKER AND CABLES

**11-7. General.**

The circuit breaker is located on the right rear of the main generator compartment.

**11-8. Circuit Breaker and Cables.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads and cables.

*(2)* Remove screws and nuts and remove circuit breaker.

*b. Inspection and Test.*

*(1)* Inspect for cracks, breaks, corrosion and defective insulation.

*(2)* Test for electrical continuity.

*(3)* Replace defective parts.

*c. Installation.*

*(1)* Install circuit breaker.

*(2)* Connect electrical leads and cables.

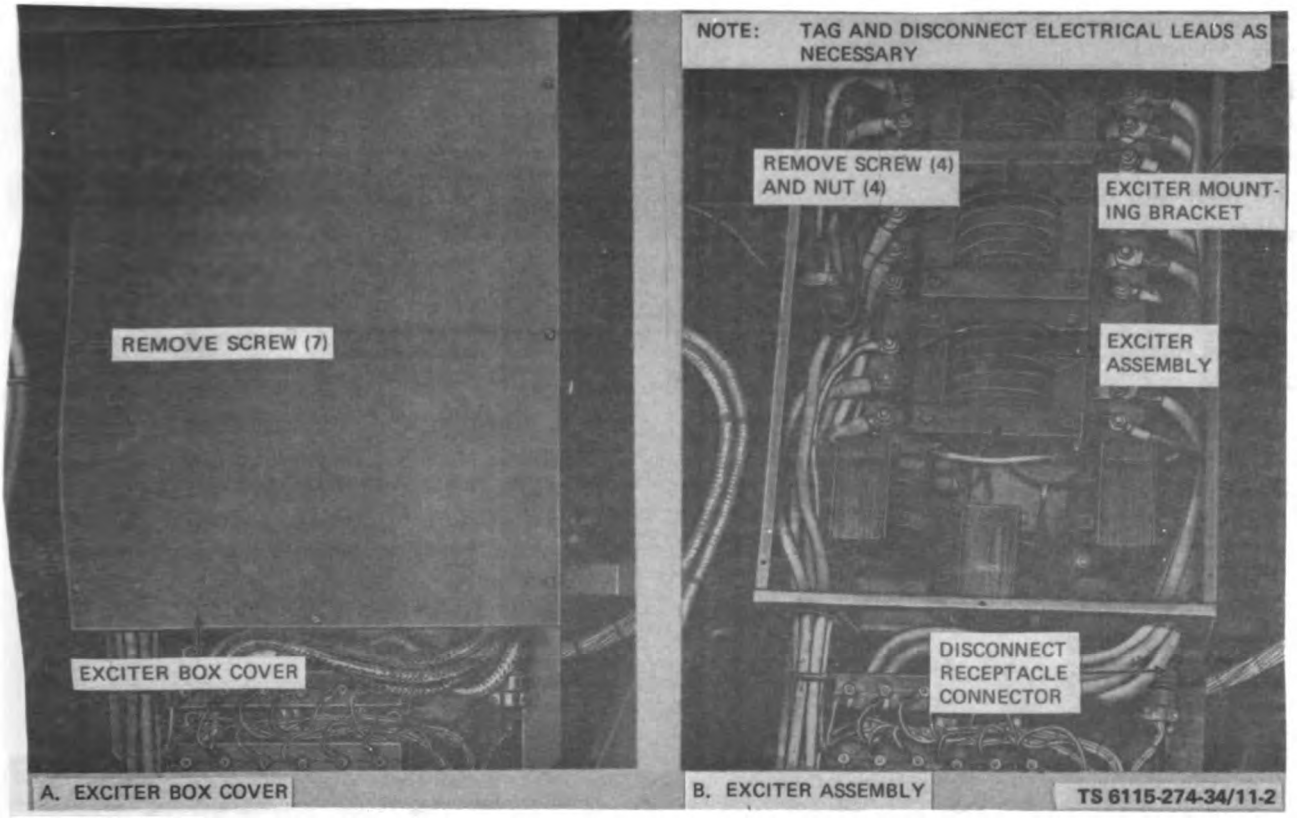



*Figure 11-2. Static Exciter, Removal and Installation*

## Section V. LOAD TERMINAL BOARD

**11-9. General.**

The load terminal board is located in the right generator compartment.

**11-10. Load Terminal Board.**

*a. Removal.*

*(1)* Tag and disconnect electrical leads (fig. 11-3).

*(2)* Remove attaching hardware.

*(3)* To remove terminal post from load terminal board, remove two nuts from rear of terminal post.

*b. Test.*

*(1)* Test for electrical continuity.

*(2)* Replace defective parts.

*c. Installation.*

*(1)* Attach terminal posts to rear of load terminal board.

*(2)* Install with attaching hardware.

*(3)* Connect electrical leads.


*Figure 11-3. Load Terminal Board, Removal and Installation*

## Section VI. RECTIFIER AND WIRING

**11-11. General.**

The rectifiers are mounted on the main generator and convert the ac voltage to dc voltage to excite the revolving field.

**11-12. Rectifier and Wiring.**

*a. Removal.*

*(1)* Remove the main generator end cover (fig. 11-4).

*(2)* Loosen winged fasteners and remove louvered doors.

*(3)* Loosen wingnuts and remove end cover.

*(4)* Tag and disconnect electrical leads (fig. 11-5).

*(5)* Remove screws and nuts and remove insulators.

*(6)* Remove screws and nuts and remove brackets and rectifiers.

**WARNING**

**When a malfunction of the selenium rectifier occurs, thoroughly ventilate the area to prevent inhalation of poisonous fumes. Do not handle the damaged selenium rectifier. Selenium oxide may be absorbed through the skin, especially when the rectifier is hot. Failure to observe this warning may result in serious injury or death.**

*b. Cleaning and Inspection.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

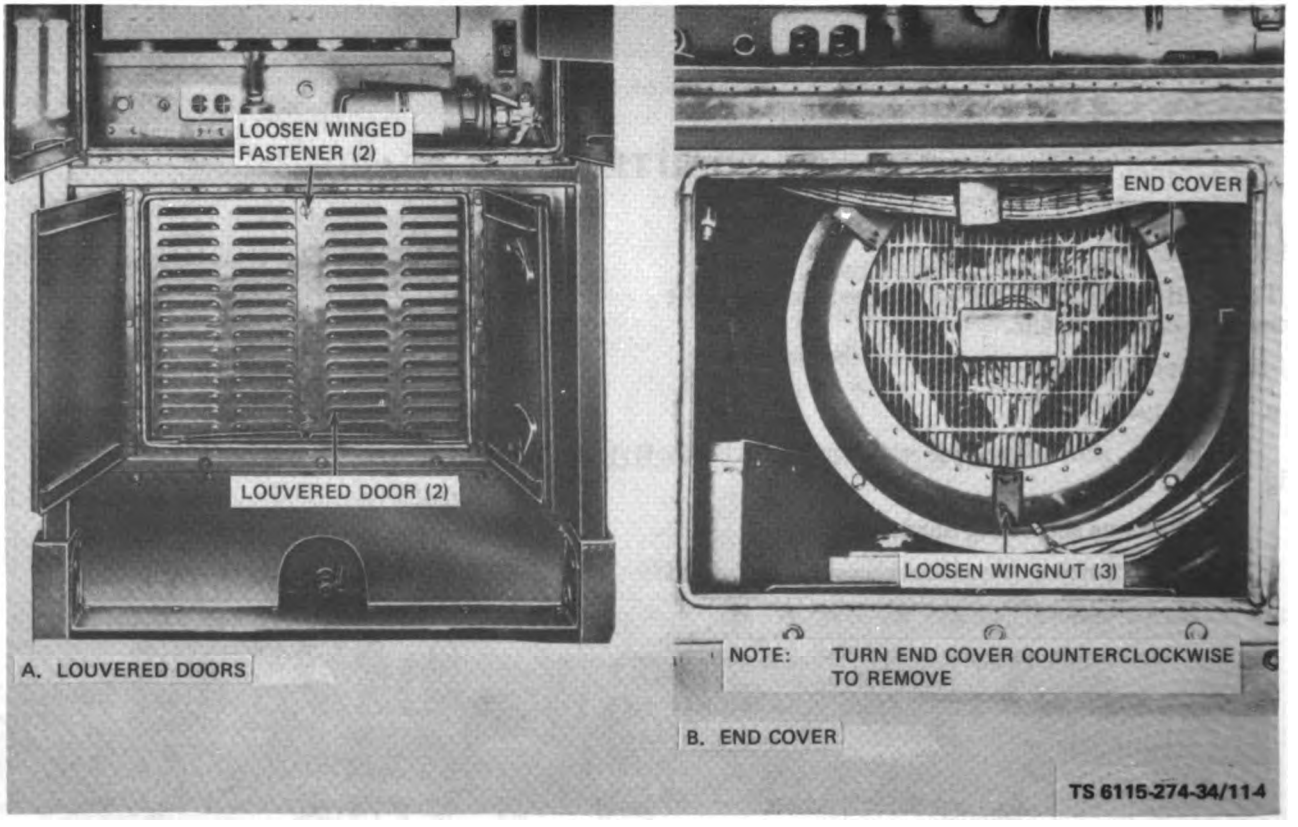



*Figure 11-4. End Cover, Removal and Installation*

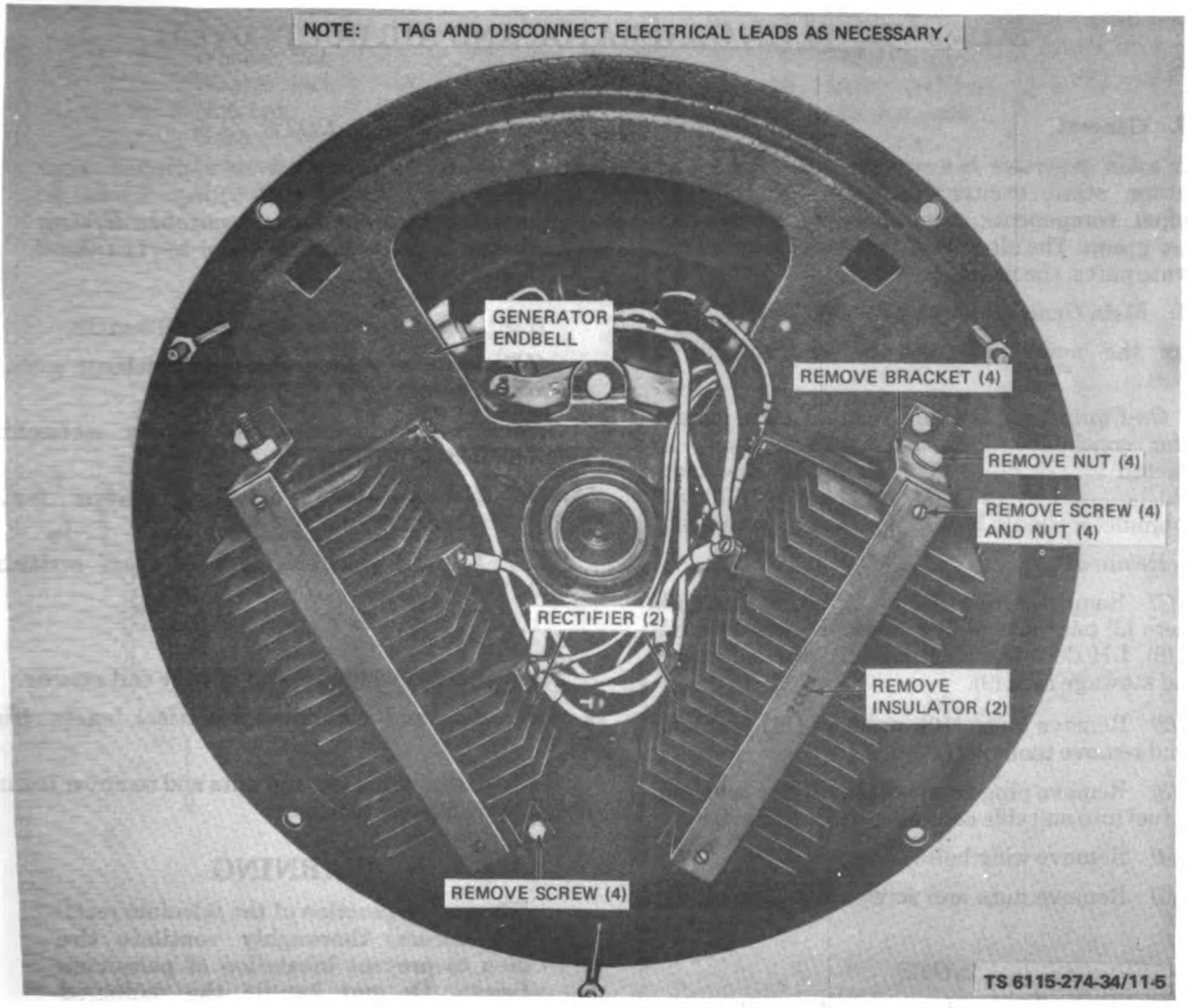



*Figure 11-5. Static Exciter Rectifiers, Removal and Installation*

*(1)* Clean all parts with a cloth dampened with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect the brackets for breaks and distortion. Inspect the insulation pieces for damage.

*(3)* Test the rectifier using a multimeter to determine if it is operational.

*(4)* Replace a damaged rectifier.

*c. Installation.*

*(1)* Install brackets (fig. 11-5).

*(2)* Install insulators.

*(3)* Connect electrical leads.

*(4)* Install end cover (fig. 11-4) and tighten wingnuts.

*(5)* Install louvered doors and tighten winged fasteners.

## Section VII. MAIN GENERATOR AND AIR DUCT COVER

### 11-13. General.

The main generator is a rotating field, stationary armature, static exciter type, consisting of two principal components, the alternator and static exciter group. The alternator is subdivided into two separate parts, the rotor and the stator.

### 11-14. Main Generator and Air Duct Cover.

Test the main generator before removal as follows:

*a. On-Equipment Testing.* Test the main generator for continuity and insulation resistance as instructed in TM 5-764. The insulation resistance should be not less than 0.4 megohm. A 500 volt megohmmeter should be used for the measurement.

*b. Removal.*

*(1)* Remove screws (1, fig. 11-6), washers (2), washers (3) and nuts (4) and remove generator RH door (6), LH door (7), hood (5), left rear side panel (8) and stowage rack (9).

*(2)* Remove bolts (10), washers (11) and nuts (12) and remove toolbox (13).

*(3)* Remove plug from bottom of day tank and drain fuel into suitable container (refer to fig. 2-8).

*(4)* Remove wing bolts and cover.

*(5)* Remove nuts and screws and remove day tank.

*NOTE*

*The fuel day tank or Serial Numbers 52300-593 through 52300-3339 contains two float valves and a microswitch and is mounted horizontally rather than vertically as in figure 2-8. This day tank is removed by disconnecting 6 lines, 2 electrical leads, and removing 3 nuts and screws.*

*(6)* Loosen clamps and remove air hose from top of air cleaner (refer to fig. 2-9).

*(7)* Remove nuts and screws and remove straps.

*(8)* Remove nuts and screws and remove saddle bracket and air cleaner bracket.

*(9)* Remove air cleaner.

*(10)* Remove fuel line and primer cable (refer to fig. 2-10).

*(11)* Remove screws and nuts and remove stator frame cover (air duct cover).

*NOTE*

*Position jacking bolts to support rear of engine. Install two lifting eyes in main generator and attach suitable lifting device before removing stator-to-flywheel housing screws.*

*(12)* Tag and disconnect electrical leads.

*(13)* Remove screws and nuts holding generator to skid base.

*(14)* Remove lockwire and screws attaching coupling plates.

*(15)* Remove screws attaching stator frame to flywheel housing.

*(16)* Lift the generator and place on suitable stand.

*c. Disassembly.*

*(1)* Loosen wingnuts and remove end cover.

*(2)* Tag and disconnect electrical leads (fig. 11-5).

*(3)* Remove screws and nuts and remove insulators, brackets and rectifiers.

**WARNING**

**When a malfunction of the selenium rectifier occurs, thoroughly ventilate the area to prevent inhalation of poisonous fumes. Do not handle the damaged selenium rectifier. Selenium oxide may be absorbed through the skin, especially when the rectifier is hot. Failure to observe this warning may result in serious injury or death.**

*(4)* Remove bolts (1, fig. 11-7), lockplates (2) and coupling plates (3).

*(5)* Remove screws (8), washers (9) and remove end plate (11) and air deflector (12).

*(6)* Remove studs (10), washers (13) and nuts (14) and separate end plate from air deflector.

*(7)* Remove bearing (21), slipring assembly (22) and rotor (7) from frame (4).

*(8)* Remove grommets (5 and 6).

*(9)* Disassemble brush holder stem (15), tension arm (16), pins (17), brush holder (18), brush springs (19), washers (20), lockwashers (23), setscrews (24), nuts (25) and cotter pins (26).

1. Screw, cap, hex hd
2. Washer, flat
3. Washer, lock
4. Nut, hex
5. Generator hood
6. Generator door, RH
7. Generator door, LH
8. Left rear side panel
9. Stowage rack
10. Bolt, machine
11. Washer, lock
12. Nut, hex
13. Toolbox

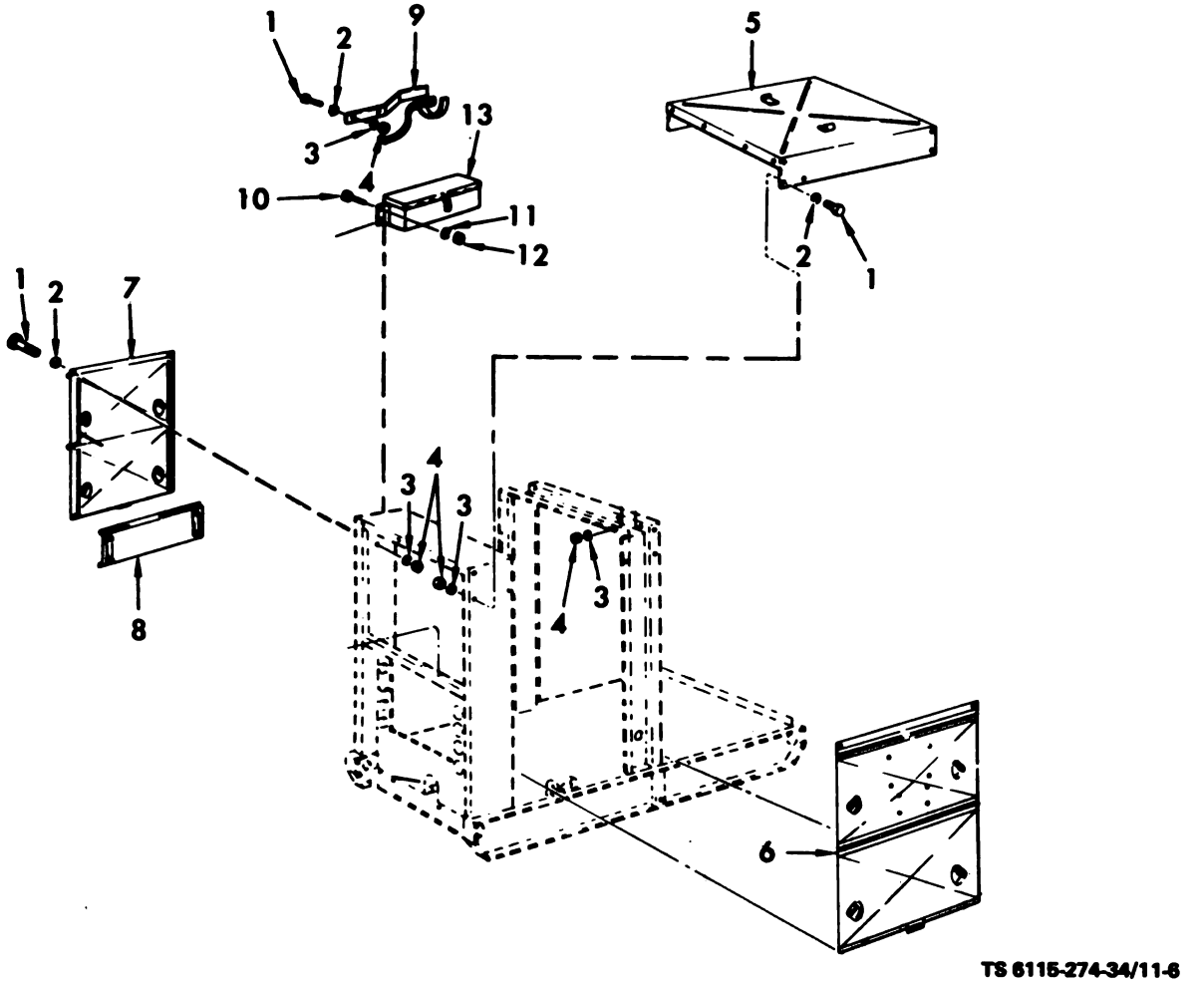



*Figure 11-6. Generator Top and Side Covers, Removal and Installation*

*d. Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all metal parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Clean all nonmetal parts with a clean, dry cloth. Remove all dust and dirt from inaccessible locations with compressed air.

*(3)* Inspect all threaded components for damaged threads.

*(4)* Inspect the endbell for cracks, burred or rough mating surfaces, and other damage.

*(5)* Inspect the brush holders and springs for cracks, breaks, distortion, and other damage.

*(6)* Inspect the housing for cracks, breaks, burred mating surfaces, and other damage.

*(7)* Inspect the stator for loose or frayed windings. Inspect for scoring on the stator core, which is evidence of contact with the rotor.

1. Bolt, machine
2. Lockplate
3. Coupling plate
4. Stator frame
5. Grommet
6. Grommet
7. Rotor
8. Screw, cap
9. Washer, lock
10. Stud
11. End plate
12. Air deflector
13. Washer, lock
14. Nut, hex
15. Brush holder stem
16. Tension arm
17. Pin (spec)
18. Brush holder
19. Brush spring
20. Washer, flat
21. Bearing
22. Slipring assembly
23. Washer, lock, IT
24. Setscrew
25. Nut, hex
26. Pin, cotter

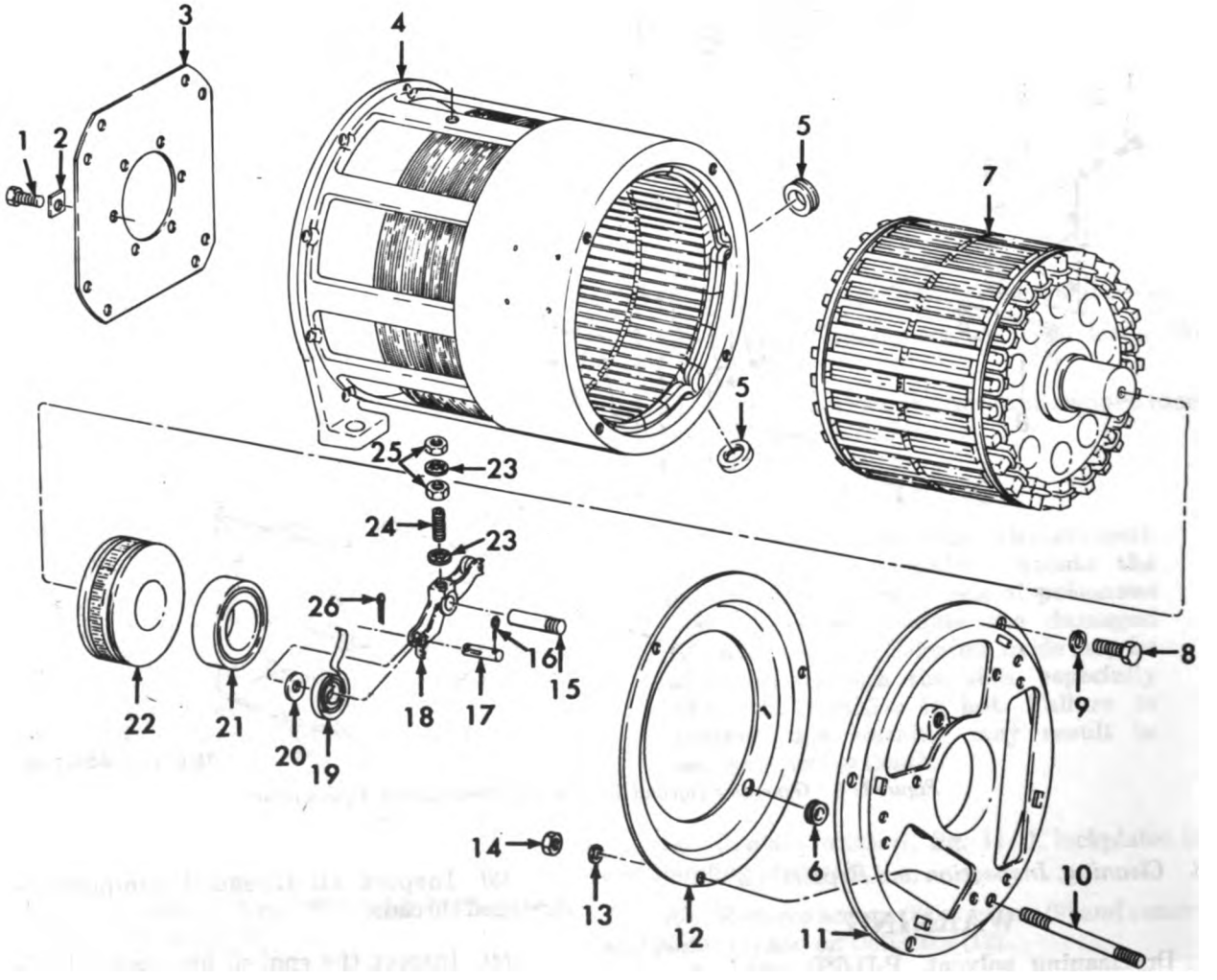



*Figure 11-7. Main Generator, Disassembly and Reassembly*

*(8)* Inspect the rotor for loose or frayed windings. Inspect for scoring of field poles, caused by rubbing on the stator core. Inspect the shaft for evidence of wear.

*(9)* Inspect the slipring assembly for wear, scoring, and pits. If the slipring assembly is scored or pitted, it may be dressed with a fine stone or turned down on a lathe.

*(10)* Inspect the drive disk for cracks, breaks, and distortion.

*(11)* Replace damaged or defective parts.

*e. Testing After Disassembly.*

*(1)* Test the generator stator for short circuits on an inside growler as instructed in TM 5-764.

*(2)* Test the revolving field windings for resistance and insulation resistance as instructed in TM 5-764. The insulation resistance should measure not less than 0.5 megohm. A 500 volt megohmmeter should be used.

*(3)* Use a megohmmeter and test between one slipring and the rotor shaft. Test between the other slipring and the rotor shaft. If a reading of less than 0.5 megohm is indicated, disconnect the rotor electrical leads from the sliprings and repeat the test. Should a reading of less than 0.5 megohm be obtained, the slipring assembly is defective and must be replaced.

*(4)* Use a megohmmeter and test between each brush holder and the endbell. A reading of less than 0.5 megohm indicates faulty insulation. Replace the insulation material.

*f. Reassembly.*

*(1)* Assemble in necessary order the brush holder stem (15, fig. 11-7), tension arm (16), pins (17), brush holder (18), brush springs (19), washers (20), lockwashers (23), setscrews (24), nuts (25) and cotter pins (26).

*(2)* Install grommets (5 and 6).

*(3)* Install bearing (21), slipring assembly (22), and rotor (7) into frame (4).

*(4)* Attach end plate (11) to air deflector (12) with studs (10), washers (13) and nuts (14).

*(5)* Attach end plate to stator frame with screws (8) and washers (9).

*(6)* Install coupling plates (3), lockplates (2) and bolts (1).

*(7)* Install insulators, brackets and rectifiers with screws and nuts (fig. 11-5).

*(8)* Connect electrical leads.

*(9)* Install end cover and tighten wingnuts.

*g. Installation.*

*(1)* Using suitable lifting device plate generator onto base (refer to fig. 2-10).

*(2)* Attach stator frame to flywheel housing. Loosen jacking bolts.

*(3)* Attach coupling plates with screws and lockwires.

*(4)* Fasten generator to skid base with screws.

*(5)* Connect electrical leads.

*(6)* Attach stator frame cover with screws and nuts.

*(7)* Attach fuel line and primer cable.

*(8)* Install air cleaner (refer to fig. 2-9).

*(9)* Install saddle bracket and air cleaner bracket with nuts and screws.

*(10)* Install straps with nuts and screws.

*(11)* Attach hose to top of air cleaner and tighten clamps.

*(12)* Install day tank with nuts and screws (refer to fig. 2-8).

*(13)* Install cover with wingbolts.

*(14)* Install drainplug in tank.

*(15)* Install toolbox (13, fig. 11-6) with bolts (10), washers (11) and nuts (12).

*(16)* Install stowage rack (9), left rear side panel (8), hood (5), LH door (7) and RH door (6) with screws (1), washers (2 and 3), and nuts (4).

# CHAPTER 12

# REPAIR OF WINTERIZATION SYSTEM

## 12-1. General.

The generator set is equipped with diesel fuel burning, fresh air heater used to preheat the engine during cold weather operation at temperatures down to -65 degress F (-54 degrees C).

## 12-2. Overhaul Heater Assembly.

*a. Removal.*

*(1)* Disconnect fuel lines (fig. 12-1).

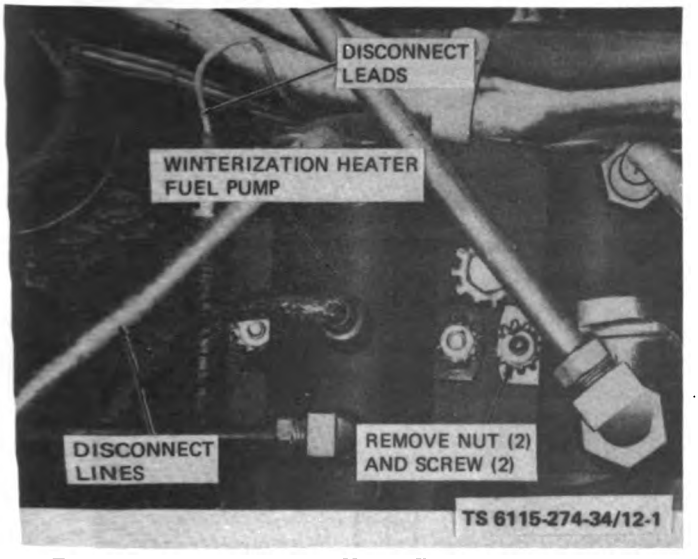



*Figure 12-1. Winterization Heater Fuel Pump, Removal and Installation*

*(2)* Disconnect electrical leads.

*(3)* Remove screws and nuts and remove winterization heater fuel pump.

*(4)* Remove plug and chain (refer to fig. 3-2).

*(5)* Remove screw and handle.

*(6)* Remove screws and plate.

*(7)* Remove all necessary lines and fittings.

*(8)* Remove fuel control valve.

*(9)* Pull exhaust pipe and cap assembly from right side of oil pan at center cowl (fig. 12-2).

*(10)* Disconnect receptacle plug.

*(11)* Loosen screw on top of cover and remove cover.

*(12)* Loosen clamps and remove air ducts.

*(13)* Remove fuel line.

*(14)* Remove clamps and air duct.

*(15)* Remove screws and nuts and remove heater assembly.

*b. Disassembly.*

*(1)* Remove screws (2, fig. 12-3) washers (3), limit switch (32) and bracket (33).

*(2)* Remove screws (17) and washers (3) and separate combustion chamber casing (31) from combustion chamber (45).

*(3)* Tag and disconnect electrical leads and remove screws (34), washers (44), data plate (43) and resistor (42).

*(4)* Tag and disconnect electrical leads and remove screws (34), washers (35) and electrical receptacle (36).

*(5)* Remove screws (37), terminal block (40) and grommet (41).

*(6)* Remove screws (2 and 38), washers (3 and 39) and bracket (4).

*(7)* Tag and disconnect electrical leads and remove regulator valve (5), grommet (6) and solenoid coil (7).

*(8)* Remove screws (12), washers (11), mounting brackets (13), plain support (10) and notched support (9) from burner casing (8).

*(9)* Remove combustion chamber switch (30), nut (29), igniter (28) and gasket (27) from burner (24).

*(10)* Remove screw (12), washer (11), vaporizer retainer (26) and ceramic vaporizer (25).

*(11)* Remove screws (17) and washers (3) separating air inlet cover (16) from burner casing.

*(12)* Remove screws (34), and washers (44) separating combustion air inlet (21) from burner.

*(13)* Remove setscrews (14) from combustion fan (23) and fresh air fan (15).

*(14)* Remove inlet plate (22).

*(15)* Remove nuts (20) and washers (19) and disassemble combustion air inlet from blower motor (18).

c. *Cleaning, Inspection and Repair.*

**WARNING**

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect all threaded parts for damaged or defective threads.

*(3)* Inspect all parts for cracks, breaks, distortion, wear, and other damage.

*(4)* Inspect the condition of the solenoid coil electrical leads and coil insulation. Use an ohmmeter and test the coil for continuity.

*(5)* Inspect the combustion chamber and casing for leaks due to burning. Inspect for distortion and other possible damage.

*(6)* Repair or replace all damaged or defective parts.

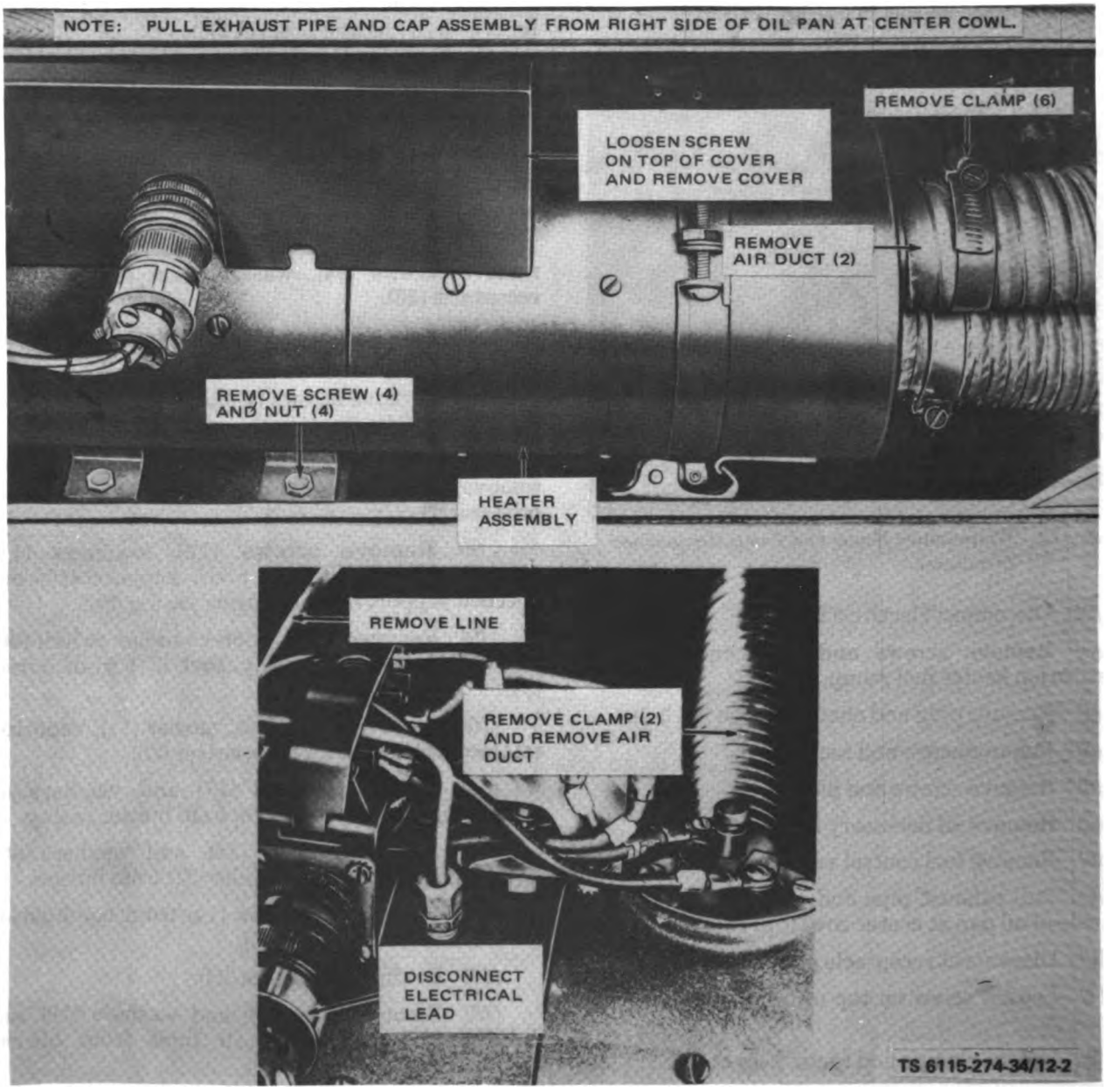



*Figure 12-2. Heater Assembly, Removal and Installation*

1. Cover
2. Screw, machine
3. Washer, lock
4. Bracket
5. Regulator valve
6. Grommet
7. Solenoid coil
8. Burner casing
9. Notched support
10. Plain support
11. Washer, lock
12. Screw, cap, hex hd
13. Mounting bracket
14. Setscrew
15. Fresh air fan
16. Air inlet cover
17. Screw, self-tapping
18. Blower motor
19. Washer, lock
20. Nut, hex
21. Combustion air inlet
22. Inlet plate
23. Combustion fan
24. Burner
25. Ceramic vaporizer
26. Vaporizer retainer
27. Gasket
28. Igniter
29. Nut (spec)
30. Combustion chamber switch
31. Combustion chamber casing
32. Limit switch
33. Bracket
34. Screw, machine
35. Washer, lock
36. Electrical receptacle
37. Screw, machine
38. Screw, machine
39. Washer, lock
40. Terminal block
41. Grommet
42. Resistor
43. Data plate
44. Washer, lock
45. Combustion chamber

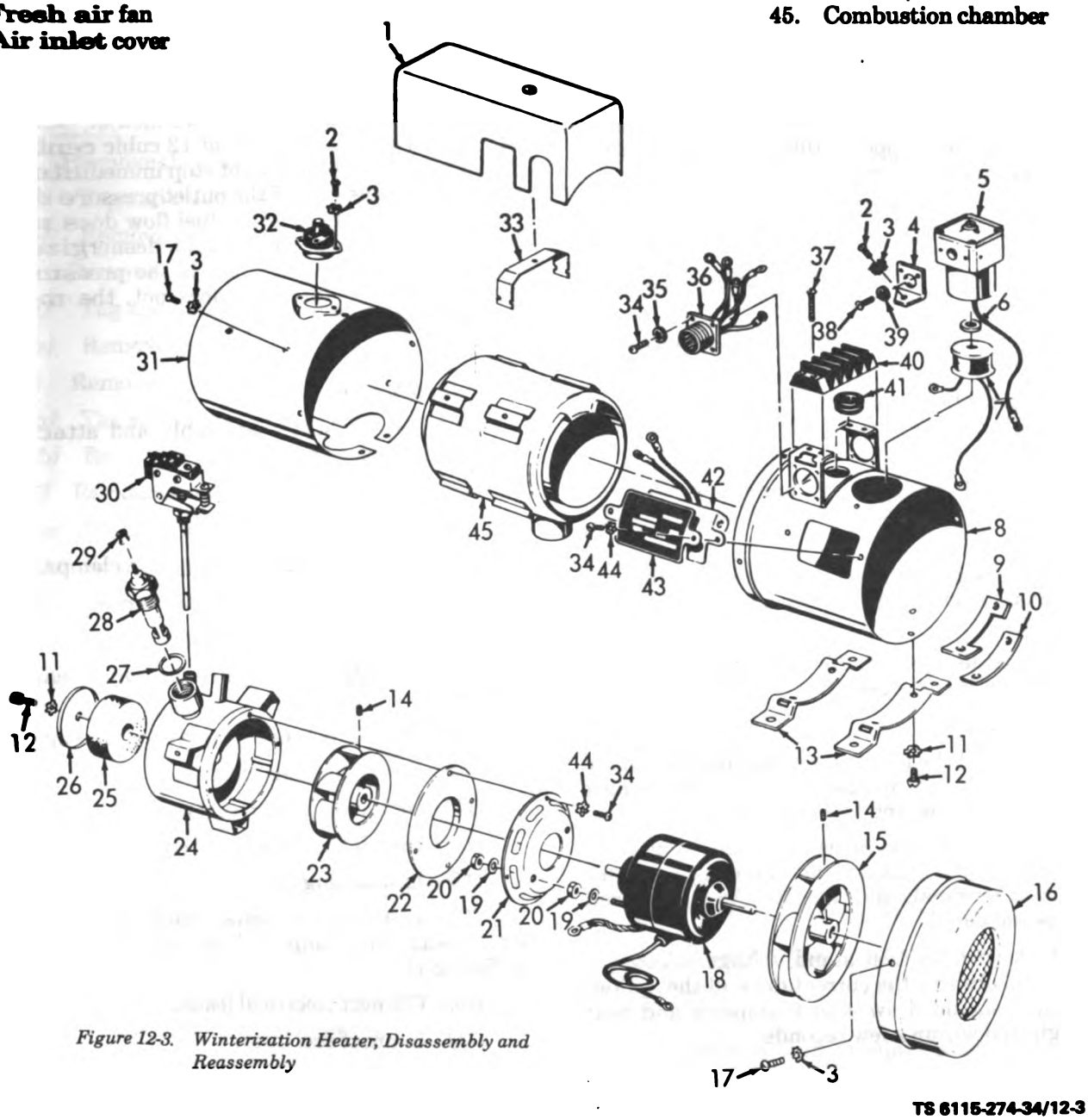



*Figure 12-3. Winterization Heater, Disassembly and Reassembly*

*d. Reassembly.*

*(1)* Assemble combustion air inlet to blower motor (18, fig. 12-3) with washers (19) and nuts (20).

*(2)* Install inlet plate (22).

*(3)* Install combustion fan (23) and fresh air fan (15) and tighten setscrews (14).

*(4)* Attach combustion air inlet (21) to burner with screws (34) and washers (44).

*(5)* Attach air inlet cover (16) to burner casing with screws (17) and washers (3).

*(6)* Install ceramic vaporizer (25), vaporizer retainer (26), washer (11) and screw (12).

*(7)* Install combustion chamber switch (30), nut (29), igniter (28) and gasket (27) into burner (24).

*(8)* Assemble burner casing (8), notched support (9), plain support (10), mounting brackets (13), washers (11) and screws (12).

*(9)* Install solenoid coil (7), grommet (6) and regulator valve (5) and connect electrical leads.

*(10)* Install bracket (4) with washers (3 and 39), and screws (2 and 38).

*(11)* Install grommet (41), terminal block (40) and screws (37).

*(12)* Install electrical receptacle (36) with washers (35) and screws (34) and connect electrical leads.

*(13)* Install resistor (42) and data plate (43) with washers (44) and screw (34) and connect electrical leads.

*(14)* Attach combustion chamber casing (31) to combustion chamber (45) with washers (3) and screws (17).

*(15)* Install bracket (33) and limit switch (32) with washers (3) and screws (2).

*e. Bench Test.*

*(1)* Install the heater assembly in a test stand equipped to measure voltage, amperage, resistance continuity, fuel flow, and fuel pressure.

*(2)* Test the resistor assembly for continuity and grounds by connecting an ohmmeter between the resistor terminals and the case. An open circuit should be indicated.

*(3)* Adjust the test stand voltage selector to 12 volts and observe the current draw of the igniter. The igniter should draw 4 to 6 amperes and heat to a bright red within a few seconds.

*(4)* Test the resistor assembly as in (2) above for the correct current draw. The resistor assembly should draw 4 to 6 amperes after 10 seconds.

*(5)* Position the test stand voltage selector to 24 volts and test the fan motor. The motor should operate at 7,600 revolutions per minute with a current draw of 2.8 amperes.

*(6)* To test the regulator valve and metering orifice, remove them from the heater and insert a tee in the place of the elbow located on the regulator valve. Connect a pressure gage to the inlet side of the regulator at 4 to 5 pounds per square inch. Connect the regulator to the 24 volt electrical supply and energize the shutoff coil. Bleed the system until the fuel flows freely through the metering orifice. Test the fuel flow and pressure for one minute. The pressure gage should read a pressure of 2 pounds per square inch or 4.1 inches of mercury with a fuel flow of 12 cubic centimeters per minute. Fuel flow should stop immediately upon deenergizing the coil. If the outlet pressure does not meet specifications or if the fuel flow does not stop immediately when the coil is deenergized, the regulator valve is defective. If the pressure does conform but the fuel flow does not, the metering orifice is defective.

*f. Installation.*

*(1)* Install heater assembly and attach with screws and nuts (fig. 12-2).

*(2)* Install clamps and air ducts.

*(3)* Install fuel line.

*(4)* Install air ducts and tighten clamps.

*(5)* Install cover and tighten screw.

*(6)* Connect receptacle plug.

*(7)* Attach exhaust pipe and cap assembly to oil pan.

*(8)* Install fuel control valve (refer to fig. 3-2).

*(9)* Install lines and fittings.

*(10)* Install plate with screws.

*(11)* Install handle with screw.

*(12)* Install plug and chain.

*(13)* Install fuel transfer pumps and winterization heater fuel pump with screws and nuts (refer to fig. 12-1).

*(14)* Connect electrical leads.

*(15)* Connect fuel lines.

# CHAPTER 13

# REPAIR OF FRAME AND ATTACHING PARTS

## 13-1. General.

The generator set is completely enclosed by a sheet metal housing, with doors and panels provided for easy access to all components. The unit is also equipped with a one-piece skid base of welded steel construction.

## 13-2. Frame and Attaching Parts.

*a. Removal.*

*(1)* Remove the adjustment knobs from the frequency and voltage control variable resistors (refer to fig. 10-1).

*(2)* Remove thermal watt converter:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(3)* Remove frequency converter:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(4)* Remove battery relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(5)* Remove shutdown relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(6)* Remove governor parallel relay:

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(7)* Remove paralleling resistors.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(8)* Remove reactance droop adjustable resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(9)* Remove remote-local control relay.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*10)* Remove electrical receptacles.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(11)* Remove field flash resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(12)* Remove air box solenoid resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(13)* Remove overvoltage-underfrequency relay.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(14)* Remove undervoltage trip coil terminal board.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(15)* Disconnect receptacle connector.

*(16)* Remove voltage control adjustable resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(17)* Remove droop adjusting adjustable resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(18)* Remove frequency control adjustable resistor.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(19)* Remove main circuit breaker.

*(a)* Tag and disconnect electrical leads.

*(b)* Remove mounting hardware.

*(20)* Remove load receptacles (fig. 13-1).

*(a)* Tag and disconnect electrical leads.

*(b)* Remove attaching hardware.

*(21)* Remove load terminal board (refer to fig. 11-3), voltage conversion board (refer to fig. 11-1), and current transformers (fig. 13-2).

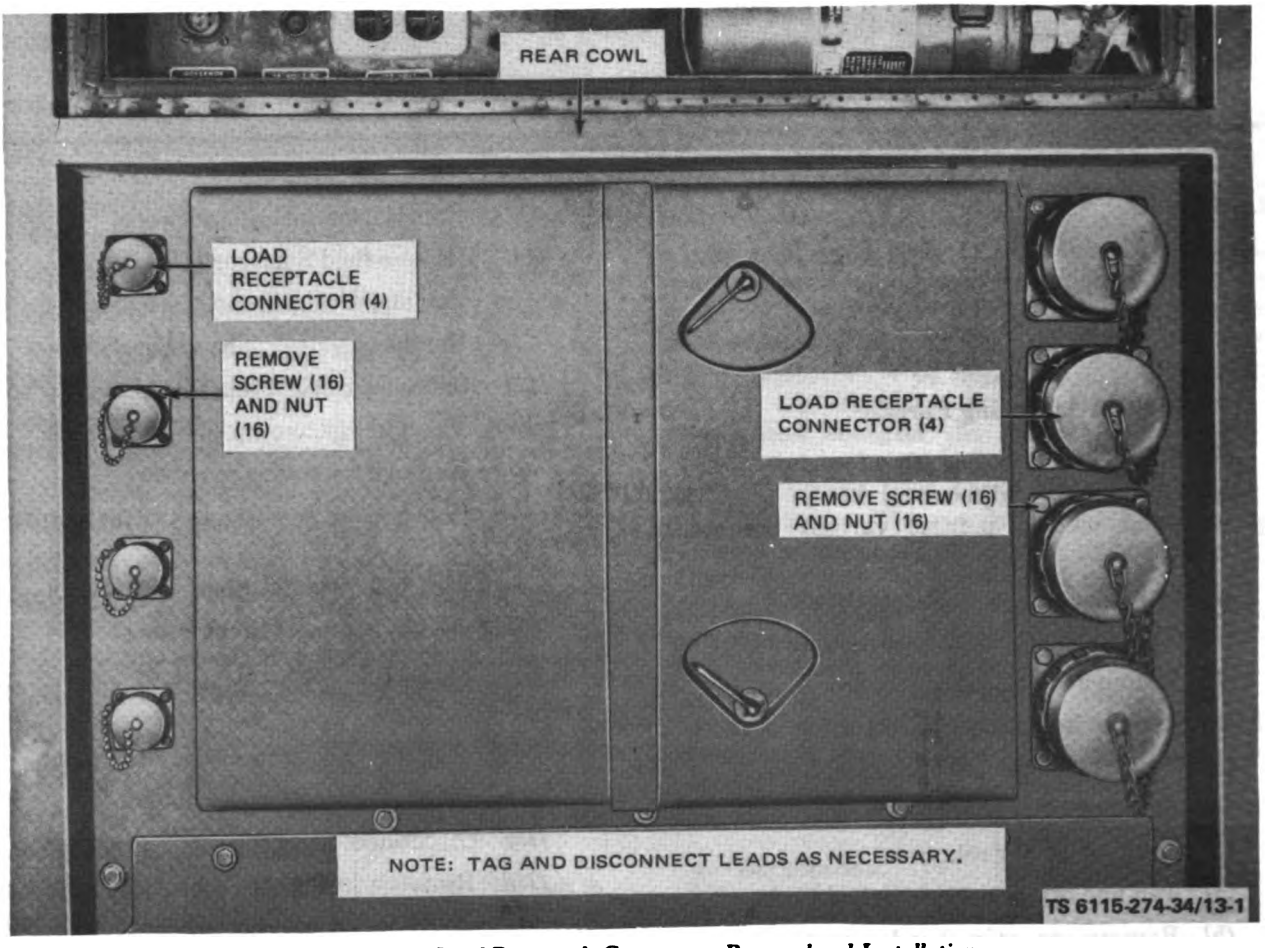



*Figure 13-1. Load Receptacle Connectors, Removal and Installation*

*(a)* Tag and disconnect electrical leads.

*(b)* Remove attaching hardware.

*(22)* Remove static exciter (fig. 11-2).

*(a)* Remove screws and cover.

*(b)* Disconnect receptacle connector.

*(c)* Tag and disconnect electrical leads.

*(d)* Remove attaching hardware.

*(23)* Remove circuit breaker (refer to fig. 10-1).

*(a)* Tag and disconnect electrical leads.

*(b)* Remove attaching hardware.

*(24)* Remove screws (1, fig. 13-3), washer (2), washers (3) and nuts (4) and remove generator RH door (6), LH door (7), hood (5), left rear side panel (8) and stowage rack (9).

*(25)* Remove bolts (10), washers (11) and nuts (12) and remove toolbox (13).

*(26)* Remove plug from bottom of day tank and drain fuel into suitable container (refer to fig. 2-8).

*(27)* Remove wingbolts and cover.

*(28)* Remove nuts and screws and remove day tank.

*NOTE*

*The fuel day tank or Serial Numbers 52300-593 through 52300-3339 contains two float valves and a microswitch and is mounted horizontally rather than vertically as in figure 2-8. This day tank is removed by disocnnecting six lines, two electrical leads, and removing three nuts and screws.*

*(29)* Loosen clamps and remove air hose from top of air cleaner (refer to fig. 2-9).

*(30)* Remove nuts and screws and remove straps.

*(31)* Remove nuts and screws and remove saddle bracket and air cleaner bracket.

*(32)* Remove air cleaner.

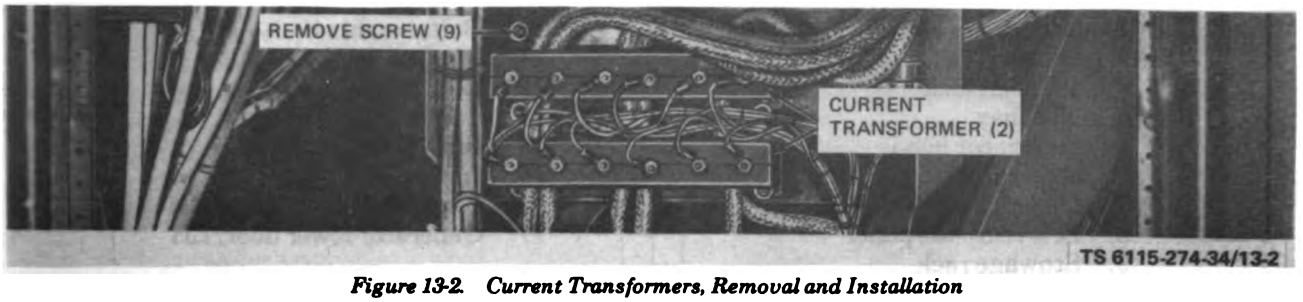



*Figure 13-2. Current Transformers, Removal and Installation*

*(33)* Remove fuel line and primer cable (refer to fig. 2-10).

*(34)* Remove screws and nuts and remove stator frame cover (air duct cover).

*NOTE*

*Position jacking bolts to support rear of engine. Install two lifting eyes in main generator and attach suitable lifting device before removing stator-to-flywheel housing screws.*

*(35)* Tag and disconnect electrical leads.

*(36)* Remove screws and nuts holding generator to skid base.

*(37)* Remove lockwire and screws attaching coupling plates.

*(38)* Remove screws attaching stator frame to flywheel housing.

*(39)* Lift the generator and place on suitable stand.

*(40)* Remove radiator drainplug and drain coolant into a suitable container.

*(41)* Remove screws (1, fig. 13-4), washers (2), washer (11) and nuts (5) in the order necessary to remove engine doors (3, 8), engine hood (4), left side panel (10), and fuel control panel (9).

*(42)* Remove muffler rain cap and retainer (7).

*(43)* Remove screws attaching fan guard to shroud and remove fan guard.

*(44)* Remove radiator hose connections.

*(45)* Remove front cowl assembly (6).

*(46)* Refer to figure 2-3 to remove the batteries.

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(47)* Release latches and remove battery box cover. Loosen nuts, disconnect battery leads and remove jumper lead. Loosen battery holddowns and remove batteries.

*(48)* Refer to figure 2-4 to remove the battery box.

*(49)* Loosen clamps and remove heater-to-battery hose.

*(50)* Remove nuts, screws and clamps holding electrical leads to battery box.

*(51)* Remove thermostat. Tag and disconnect electrical leads.

*(52)* Loosen hose clamp and remove drain hose.

*(53)* Remove nuts and screws that secure battery box support to front engine mount and remove support.

*(54)* Remove nuts and screws holding battery box to frame and remove battery box.

*(55)* Disconnect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube from the engine.

*(56)* Drain the fuel into a suitable container.

*(57)* Refer to figure 2-5 to remove the fuel tank cap and fuel filler.

*(58)* Remove fuel tank cap and strainer.

*(59)* Remove screws securing ring to filler neck and remove ring and gasket.

*(60)* Loosen the clamps that secure the fuel filler hose, connecting the filler neck to the fuel tank, and remove the fuel filler and hose from the tank.

*(61)* Remove the heater exhaust pipe at center cowl.

*(62)* Remove screw, washers and nuts holding center cowl to base frame and remove center cowl (12, fig. 13-4).

*(63)* See to figure 2-6 to remove the engine.

1. Screw, cap hex hd
2. Washer, flat
3. Washer, lock
4. Nut, hex
5. Generator hood
6. Generator door, RH
7. Generator door, LH
8. Left rear side panel
9. Stowage rack
10. Bolt, machine
11. Washer, lock
12. Nut, hex
13. Toolbox
14. Instrument door, RH
15. Instrument door, LH
16. Generator lower door, RH
17. Generator lower door, LH

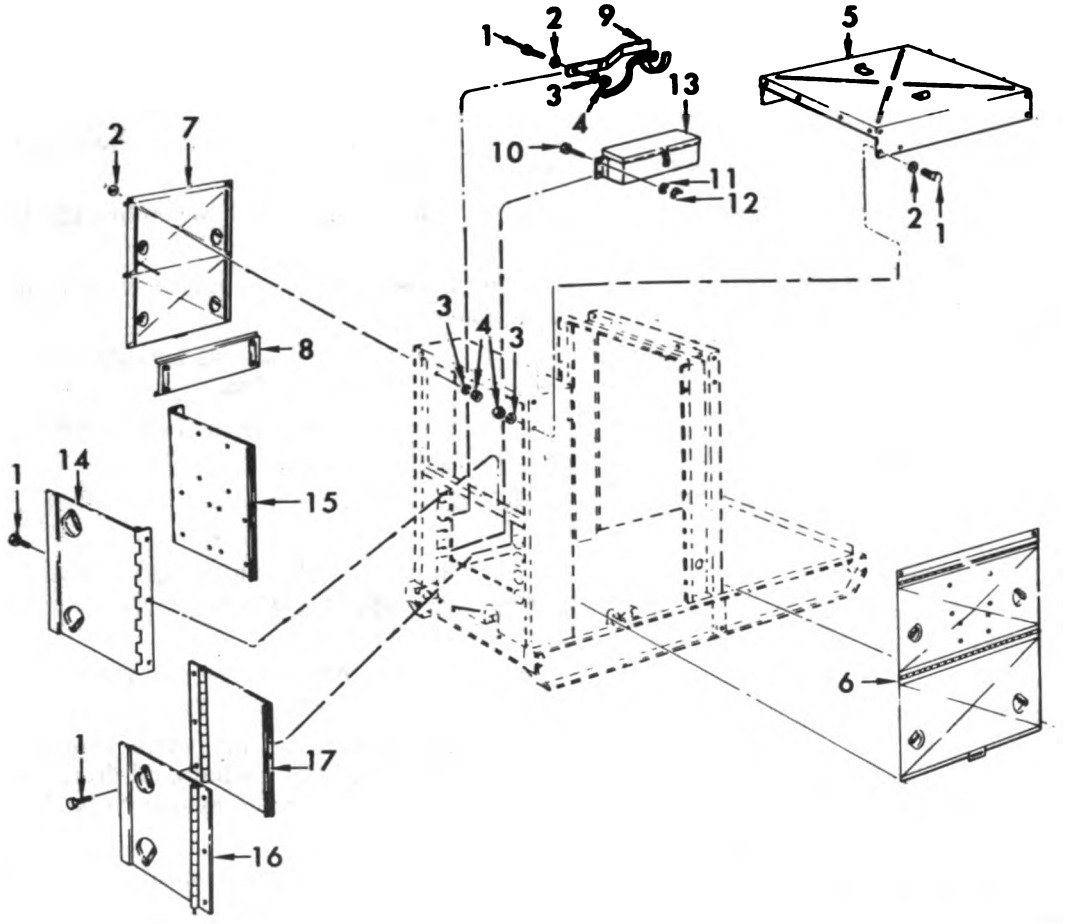



*Figure 13-3. Generator Doors and Hood, Removal and Installation*

*(64)* Remove screws and nuts holding engine to skid base.

*(65)* Attach suitable lifting device to front and rear lifting brackets and remove engine. Place on suitable stand. This leaves the skid base and attaching parts to be disassembled.

*b. Disassembly.*

*(1)* Remove screws (32, fig. 13-5), washers (3, 9) and nuts (26) and remove control panel (1).

*(2)* Remove screws (4), washers (3, 9) and nuts (26) and remove control box (5).

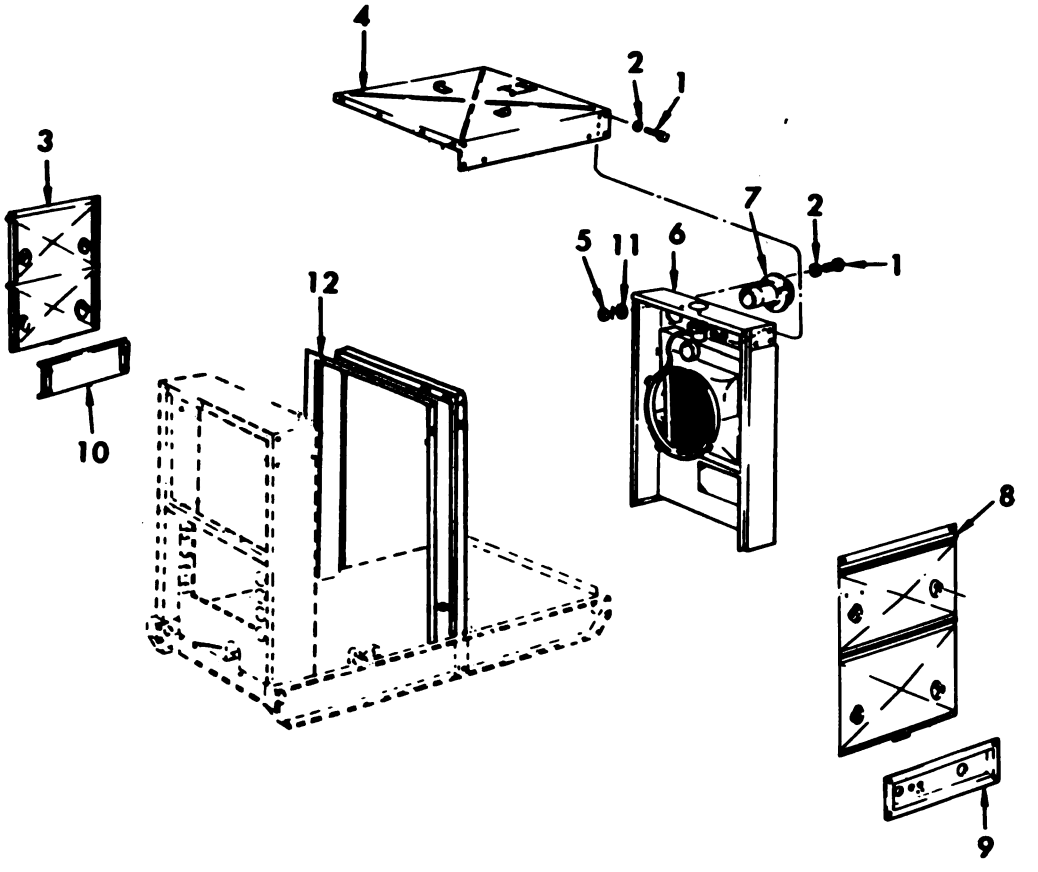
*(3)* Remove screws (2), washers (35) and nuts (34) and remove vibration mounts (33).

*(4)* Remove screw (7), washers (3, 9) and nut (26) and remove control box bracket (8), and insulation (10, 11).

*(5)* Remove screw (40), washer (13, 39) and nut (12) disengaging bracket support (38) from rear cowl (6).

*(6)* Remove screws (40), washers (13, 39) and nuts (12) and remove bracket supports (38) and exciter mounting bracket (14).

1. Screw, cap, hex hd
2. Washer, flat
3. Engine door, lh
4. Engine hood
5. Nut, hex
6. Front cowl
7. Muffler rain cap and retainer
8. Engine door, rh
9. Fuel control panel
10. Left front side panel
11. Washer, lock
12. Center cowl




TS 6115-274-34/13-4

*Figure 13-4. Engine Doors, Hood and Cowls, Removal and Installation*

*(7)* Remove screws (36), washers (37), wedges (19), washers (16) and nuts (15) and remove rear cowl (6).

*(8)* Remove bolt (20), washers (21, 22) and nut (41) and remove engine support (23).

*(9)* Remove screws (30), washers (16), nuts (15) and clamps (42).

*(10)* Remove screws (31), washers (3, 9), nuts (26) and brackets (17, 18).

*(11)* Remove screws (30), washers (16), nuts (15), rear plate (29), insulation (28) and fuel tank (27).

*(12)* Remove screws (31), washers (9) and nuts (26) and separate gravel pan (25) from skid base (24).

*c. Cleaning, Inspection and Repair.*

## WARNING

**Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat.**

1. Control panel
2. Screw, machine
3. Washer, flat, 1/4 in.
4. Screw, cap, hex hd
5. Control box
6. Rear cowl
7. Screw, cap, hex hd
8. Control box bracket
9. Washer, lock
10. Vibration insulation
11. Vibration insulation
12. Nut, hex
13. Washer, lock, IT
14. Exciter mounting bracket
15. Nut, hex
16. Washer, lock
17. Bracket
18. Bracket
19. Wedge
20. Bolt, machine
21. Washer, lock
22. Washer, flat
23. Engine support
24. Skid base
25. Gravel pan
26. Nut, hex
27. Fuel tank
28. Insulation
29. Rear plate
30. Screw, cap, hex hd
31. Screw cap, hex hd
32. Screw, cap, hex hd
33. Vibration mount
34. Nut, hex
35. Washer, lock
36. Screw, cap, hex hd
37. Washer, flat, 3/8 in.
38. Exciter bracket support
39. Washer, flat
40. Screw, cap, hex hd
41. Nut, hex
42. Clamp

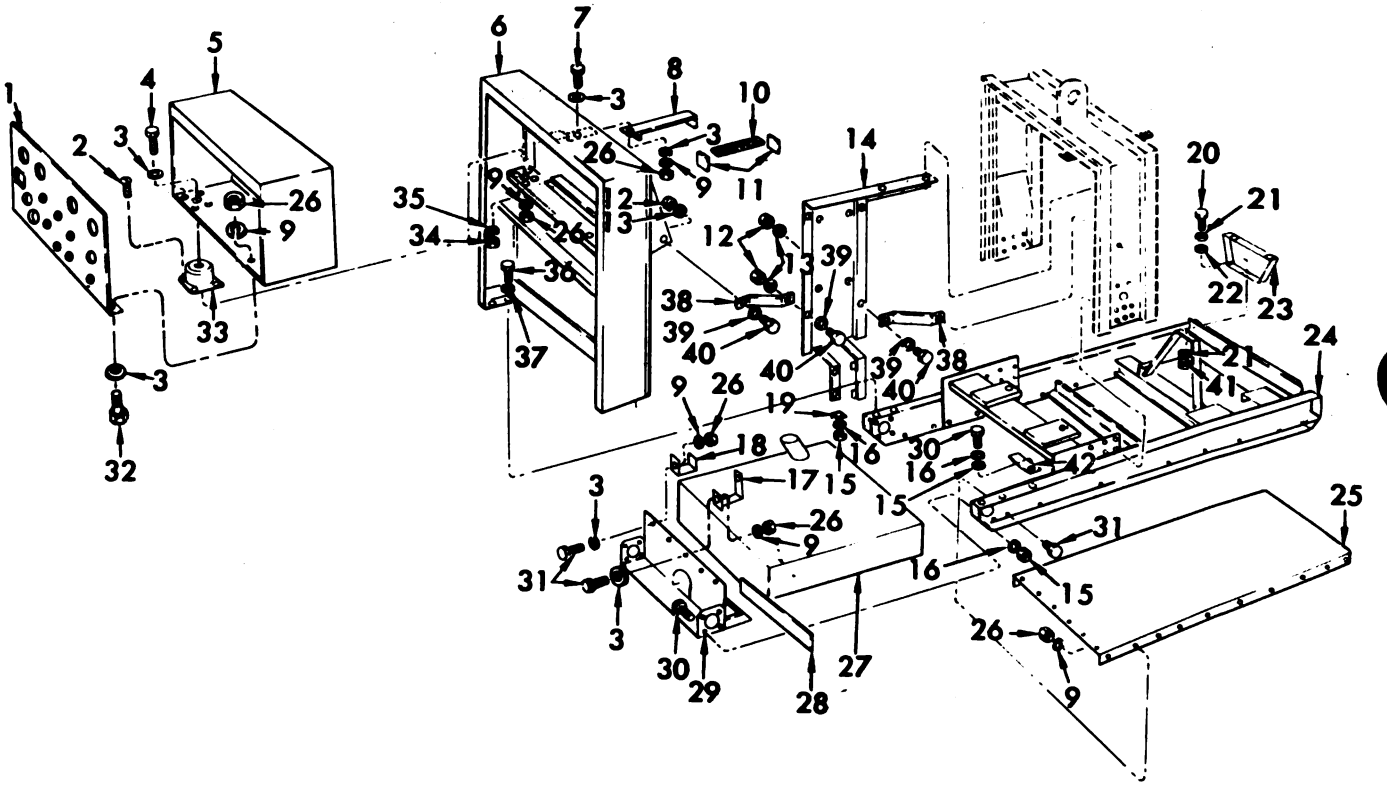


*Figure 13-5. Skid Base and Attaching Parts, Removal and Installation*

TS 6115-274-34/13-5

*(1)* Clean all parts with cleaning solvent (Item 4, App. B) and dry thoroughly.

*(2)* Inspect for cracks, breaks, and other damage.

*(3)* Repair or replace all damaged or defective parts as necessary.

*d. Assembly.*

*(1)* Attach gravel pan (25, fig. 13-5) to skid base (24) with screws (31), washers (9) and nuts (26).

*(2)* Install fuel tank (27), insulation (28), and rear plate (29) with screws (30), washers (16) and nuts (15).

*(3)* Install brackets (17, 18) with screws (31), washers (3, 9) and nuts (26).

*(4)* Install clamps (42) with screws (30), washers (16) and nuts (15).

*(5)* Attach engine support (23) with bolt (20), washers (21, 22) and nut (41).

*(6)* Install rear cowl (6) with screws (36), washers (37), wedges (19), washers (16) and nuts (15).

*(7)* Attach exciter mounting bracket (14) and bracket supports (38) with screws (40), washers (13, 39) and nuts (12).

*(8)* Attach bracket support (38) to rear cowl with screw (40), washers (13, 39) and nut (12).

*(9)* Install control box bracket (8) and insulation (10, 11) with screw (7), washers (3, 9) and nut (26).

*(10)* Install vibration mounts (33) with screws (2), washers (35) and nuts (34).

*(11)* Install control box (5) with screws (4), washers (3, 9) and nuts (26).

*(12)* Install control panel (1) with screws (32), washers (3, 9) and nuts (26).

*e. Installation.*

*(1)* Attach suitable lifting device to front and rear lifting brackets and install engine (refer to figure 2-6).

*(2)* Attach engine to skid base.

*(3)* Install center cowl (12, fig. 13-4) to base frame with screws, washers and nuts.

*(4)* Install heater exhaust pipe at center cowl.

*(5)* Install fuel filler hose to fuel tank and tighten clamps (refer to fig. 2-5).

*(6)* Install ring and gasket and fasten with screws.

*(7)* Install fuel tank cap and strainer.

*(8)* Connect the air valve control cable, throttle cable, temperature bulb, oil drain line, fuel primer tube, and starting primer tube to the engine.

*(9)* Install battery box and fasten to frame (refer to fig. 2-4).

*(10)* Install battery box support and secure to front engine mount.

*(11)* Install drain hose and tighten clamp.

*(12)* Install thermostat. Connect electrical leads.

*(13)* Attach electrical leads to battery box with clamps.

*(14)* Install heater-to-battery hose and tighten clamps.

*(15)* Install batteries and tighten holddowns. Install battery leads and jumper lead (refer to fig. 2-3).

*NOTE*

*When disconnecting batteries from the engine electrical system, the positive lead (ground) must be disconnected first. When reconnecting batteries, the positive lead (ground) must be connected last.*

*(16)* Install battery box cover and fasten latches.

*(17)* Install front cowl assembly (6, fig. 13-4).

*(18)* Connect radiator hoses and tighten clamps.

*(19)* Install fan guard and attach to shroud.

*(20)* Install muffler rain cap and retainer (7).

*(21)* Install fuel control panel (9), left side panel (10), engine hood (4) and engine doors (3, 8) with attaching hardware.

*(22)* Install radiator drain plug and service radiator with coolant.

*(23)* Attach lifting device to generator and lift into place (refer to fig. 2-10).

*(24)* Install screws attaching stator frame to flywheel housing.

*(25)* Install screws attaching coupling plates and fasten with lockwire.

*(26)* Fasten generator to skid base with screws.

*(27)* Connect electrical leads.

*(28)* Loosen jacking bolts under rear of engine.

*(29)* Install stator frame cover.

*(30)* Install fuel line and primer cable.

*(31)* Install air cleaner (refer to fig. 2-9).

*(32)* Install saddle bracket and air cleaner bracket.

*(33)* Install straps and tighten screws.

*(34)* Install air hose to top of air cleaner and tighten clamps.

*(35)* Install day tank and gasten screws (refer to fig. 2-8).

*(36)* Install cover and fasten wingbolts.

*(37)* Install plug into bottom of day tank.

*(38)* Install toolbox (13, fig. 13-3), with bolts (10), washers (11) and nuts (12).

*(39)* Using screws (1), washers (2, 3) and nuts (4) install generator RH door (6), LH door (7), hood (5), left rear side panel (8) and stowage rack (9).

*(40)* Install circuit breaker with attaching hardware (fig. 10-1).

*(41)* Connect electrical leads.

*(42)* Install static exciter with attaching hardware (fig. 11-2).

*(43)* Connect electrical leads.

*(44)* Connect receptacle connector.

*(45)* Install cover.

*(46)* Install load terminal board, voltage conversion board and current transformers with attaching hardware &fig. 13-2).

*(47)* Connect electrical leads.

*(48)* Install load receptacles with attaching hardware (fig. 13-1).

*(49)* Connect electrical leads.

*(50)* Install main circuit breaker with attaching hardware (refer to fig. 10-1).

*(51)* Connect electrical leads.

*(52)* Install frequency control adjustable resistor with attaching hardware.

*(53)* Connect electrical leads.

*(54)* Install droop adjusting adjustable resistor with attaching hardware.

*(55)* Connect electrical leads.

*(56)* Install voltage control adjustable resistor with attaching hardware and connect electrical leads.

*(57)* Connect receptacle connector.

*(58)* Install undervoltage trip coil terminal board with mounting hardware and connect electrical leads.

*(59)* Install overvoltage-underfrequency relay with mounting hardware and connect electrical leads.

*(60)* Install air box solenoid resistor with mounting hardware and connect electrical leads.

*(61)* Install field flash resistor with mounting hardware and connect electrical leads.

*(62)* Install electrical receptacles with mounting hardware and connect electrical leads.

*(63)* Install remote-local control relay with mounting hardware and connect electrical leads.

*(64)* Install reactance droop adjustable resistor with mounting hardware and connect electrical leads.

*(65)* Install paralleling resistors with mounting hardware and connect electrical leads.

*(66)* Install governor parallel relay with mounting hardware and connect electrical leads.

*(67)* Install shutdown relay with mounting hardware and connect electrical leads.

*(68)* Install battery relay with mounting hardware and connect electrical leads.

*(69)* Install frequency converter with mounting hardware and connect electrical leads.

*(70)* Install thermal watt converter with mounting hardware and connect electrical leads.

*(71)* Install the adjustment knobs on the frequency and voltage control variable resistors.

# APPENDIX A

# REFERENCES

**A-1. Fire Protection.**

| | |
|---|---|
| TB 5-4200-200-10 | Hand Portable Fire Extinguisher for Army Users |

**A-2. Lubrication.**

| | |
|---|---|
| C9100IL | Fuels, Lubricants, and Waxes |
| LO 5-6115-274-12 | Lubrication Order |

**A-3. Maintenance.**

| | |
|---|---|
| TM 5-764 | Electric Motor and Generator Repair |
| TM 5-6115-274-12 | Operator and Organizational Maintenance Manual |
| TM 5-6115-274-20P | Organizational Maintenance Repair Parts and Special Tools Lists |
| TM 5-6115-274-34P | Direct and General Support and Depot Maintenance Repair Parts and Special Tools Lists |
| TM 38-750 | The Army Maintenance Management System |

**A-4. Painting.**

| | |
|---|---|
| TM 43-0139 | Painting Instructions for Field Use |

# APPENDIX B

# EXPENDABLE SUPPLIES AND MATERIALS LIST

## Section I. INTRODUCTION

**B-1. Scope.**

This appendix lists expendable supplies and materials you will need to operate and maintain the generator. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

**B-2. Explanation of Columns.**

*a. Column 1 - Item Number.* This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, Item 5, App. B").

*Column 2 - Level.* This column identifies the lowest level of maintenance that requires the listed item.

F - Direct Support Maintenance
H - General Support Maintenance

*c. Column 3 - National Stock Number.* This is the National stock number assigned to the item; use it to request or requisition the item.

*d. Column 4 - Description.* Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

*e. Column 5 - Unit of Measure (U/M).* Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

| (1) Item Number | (2) Level | (3) National Stock Number | (4) Description | (5) U/M |
|---|---|---|---|---|
| 1 | F | 6810-00-250-6808 | Alcohol, ethyl (Specification MIL-A-6091, Type I) | |
| 2 | F | | Bond paper (hard surface) | |
| 3 | F | | Cleaner for electrical contacts | |
| 4 | F | 6950-00-281-1985 | Cleaning solvent (Specification P-D-680) | |
| 5 | F | 8030-00-664-4017 | Corrosion preventive (Specification MIL-C-15074) | |
| 6 | F | | Crocus cloth | |
| 7 | F | | Solder, tin lead (50/50) (resin flux core) | |
| 8 | F | 8010-00-840-7494 | Varnish (Specification MIL-V-173) | |

# INDEX

**By Order of the Secretary of the Army:**

**BERNARD W. ROGERS**
***General, United States Army***
***Chief of Staff***

**Official:**

**J. C. PENNINGTON**
***Major General, United States Army***
***The Adjutant General***

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To be distributed in accordance with DA Form 12-25D, Direct and General Support maintenance requirements for Generator Sets, Engine Driven: 45 KW, 400 HZ.

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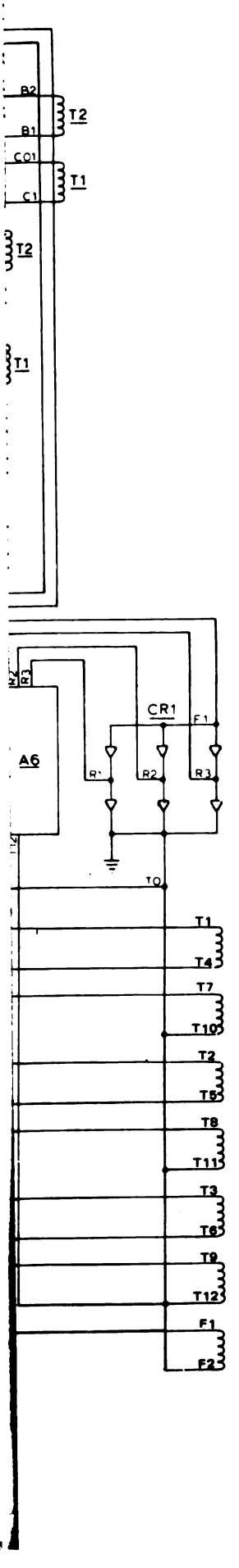


| | |
|---|---|
| A1 | FREQUENCY METER CONVERTER |
| A2 | WATTMETER CONVERTER |
| A3 | GOVERNOR CONTROL UNIT |
| A4 | RACK POSITION TRANSDUCER |
| A5 | RACK POSITION ACTUATOR |
| A6 | STATIC EXCITER |
| A7 | BENMAR HEATER |
| B1 | ENGINE STARTING MOTOR |
| B2 | HEATER FUEL PUMP |
| B3 | FUEL PUMP |
| B4 | FUEL PUMP |
| BT1 | 12 VOLT BATTERY |
| BT2 | 12 VOLT BATTERY |
| CB1 | A. C. CIRCUIT BREAKER |
| CR1 | GENERATOR FIELD RECTIFIER |
| CR2 | BATTERY CHARGING RECTIFIER |
| DS1 | PANEL LIGHT |
| DS2 | PANEL LIGHT |
| DS3 | PARALLEL LIGHT |
| DS4 | PARALLEL LIGHT |
| DS5 | OVERVOLTAGE INDICATING LIGHT |
| DS6 | HEATER PILOT LIGHT |
| F1 | REMOTE BATTERY FUSE |
| F2 | TROUBLE LIGHT RECEPTACLE FUSE |
| F3 | 120 VOLT RECEPTACLE FUSE |
| G1 | A. C. GENERATOR |
| G2 | BATTERY CHARGING ALTERNATOR |
| J1 | TELEPHONE JACK |
| J2 | GOVERNOR PARALLEL RECEPTACLE |
| J3 | TROUBLE LIGHT RECEPTACLE |
| J4 | BATTERY CHARGING RECEPTACLES |
| J5 | 120 VOLT RECEPTACLE |
| J6 | REMOTE RECEPTACLE |
| J7 | REMOTE RECEPTACLE |
| J8 | REMOTE RECEPTACLE |
| J9 | REMOTE RECEPTACLE |
| J10 | POWER TAKEOFF RECEPTACLE |
| J12 | POWER TAKEOFF RECEPTACLE |
| J13 | POWER TAKEOFF RECEPTACLE |
| K1 | OVERVOLTAGE-UNDERFREQUENCY RELAY |
| K2 | STARTING MOTOR CONTACTOR |
| K3 | BATTERY RELAY |
| K4 | SHUTDOWN RELAY |
| K5 | PROTECTION BYPASS RELAY |
| K6 | REMOTE-LOCAL VOLTAGE CONTROL RELAY |
| K7 | AUX, START CONTACTOR |
| L1 | UNDERVOLTAGE TRIP COIL |
| L2 | AIR BOX SOLENOID |
| L3 | GOVERNOR RACK SOLENOID |
| L4 | ETHER PRIMER SOLENOID |
| M1 | ENGINE HOUR METER |
| M2 | BATTERY CHARGING AMMETER |
| M3 | A. C. VOLTMETER |
| M4 | A. C. AMMETER |
| M5 | WATTMETER |
| M6 | FREQUENCY METER |
| R1 | AIR BOX SOLENOID RESISTOR |
| R2 | FIELD FLASH RESISTOR |
| R3 | PARALLEL LIGHT RESISTOR |
| R4 | PARALLEL LIGHT RESISTOR |
| R5 | REACTANCE DROOP RHEOSTAT |
| R6 | VOLTAGE ADJUSTING RHEOSTAT |
| R7 | FREQUENCY ADJUSTING RHEOSTAT |
| R8 | FREQUENCY DROOP RHEOSTAT |
| R9 | AMMETER SHUNT |
| S1 | PERMISSIVE START SWITCH |
| S2 | ENGINE STARTING SWITCH |
| S3 | EMERGENCY SWITCH |
| S4 | PHASE SELECTOR SWITCH |
| S5 | REMOTE-LOCAL VOLTAGE CONTROL SWITCH |
| S6 | PARALLEL SWITCH |
| S7 | FIELD FLASH SWITCH |
| S8 | OVERVOLTAGE RESET SWITCH |
| S9 | CIRCUIT BREAKER AUXILIARY SWITCH |
| S10 | CIRCUIT BREAKER AUXILIARY SWITCH |
| S11 | HEATER CONTROL SWITCH |
| S12 | BATTERY BOX THERMOSTAT |
| S13 | FUEL PRESSURE SWITCH |
| S14 | OIL PRESSURE SWITCH |
| S15 | COOLANT TEMPERATURE SWITCH |
| S16 | OVERSPEED SWITCH |
| S17 | PANEL LIGHT SWITCH |
| S18 | GOVERNOR ON-OFF SWITCH |
| S19 | COOLANT TEMPERATURE THERMOSTAT |
| S20 | FUEL LEVEL SWITCH |
| S21 | ETHER PRIMER SWITCH |
| T1 | METERING CURRENT TRANSFORMER |
| T2 | GOVERNOR CURRENT TRANSFORMER |
| TB1 | LOAD TERMINAL BOARD |
| TB2 | VOLTAGE CHANGEOVER BOARD |
| VR1 | A. C. VOLTAGE REGULATOR |
| VR2 | BATTERY CHARGING REGULATOR |

TS 6115-274-34/FO-1

# The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = . 39 inch
1 decimenter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = . 15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = . 035 ounce
1 dekagram = 10 grams = . 35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliters = . 34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 38.82 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = . 155 sq. inch
1 sq. decimenter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = . 386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = . 06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu meter = 1000 cu. decimeters = 35.31 cu. feet

# Approximate Conversion Factors

| *To change* | *To* | *Multiply by* | *To change* | *To* | *Multiply by* |
|---|---|---|---|---|---|
| inches | centimeters | 2.540 | ounce-inches | newton-meters | .007062 |
| feet | meters | .305 | centimeters | inches | .394 |
| yards | meters | .914 | meters | feet | 3.280 |
| miles | kilometers | 1.609 | meters | yards | 1.094 |
| square inches | square centimeters | 6.451 | kilometers | miles | .621 |
| square feet | square meters | .093 | square centimeters | square inches | .155 |
| square yards | square meters | .836 | square meters | square feet | 10.764 |
| square miles | square kilometers | 2.590 | square meters | square yards | 1.196 |
| acres | square hectometers | .405 | square kilometers | square miles | .386 |
| cubic feet | cubic meters | .028 | square hectometers | acres | 2.471 |
| cubic yards | cubic meters | .765 | cubic meters | cubic feet | 35.315 |
| fluid ounces | milliliters | 29,573 | cubic meters | cubic yards | 1.308 |
| pints | liters | .473 | milliliters | fluid ounces | .034 |
| quarts | liters | .946 | liters | pints | 2.113 |
| gallons | liters | 3.785 | liters | quarts | 1.057 |
| ounces | grams | 28.349 | liters | gallons | .264 |
| pounds | kilograms | .454 | grams | ounces | .035 |
| short tons | metric tons | .907 | kilograms | pounds | 2.205 |
| pound-feet | newton-meters | 1.365 | metric tons | short tons | 1.102 |
| pound-inches | newton-meters | .11375 | | | |

# Temperature (Exact)

| | | | | |
|---|---|---|---|---|
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |