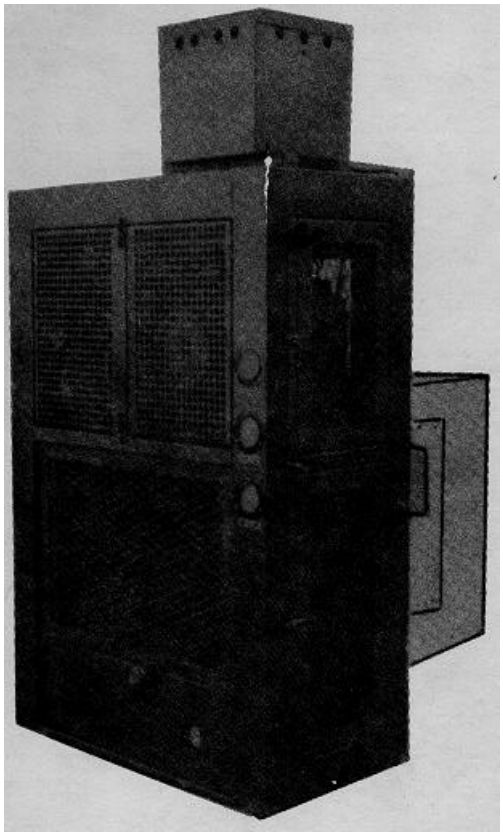
TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

REFRIGERATION UNIT, MECHANICAL: PANEL TYPE; 5000 BTU/ HR. GASOLINE ENGINE DRIVEN (GED) MODEL ER U-5G (NSN 4110-01-076-1991)



OPERATING INSTRUCTIONS

OPERATOR MAINTENANCE INSTRUCTIONS

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

DIRECT SUPPORT & GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

REPAIR OF ENGINE

REFRIGERATION SYSTEM REPAIR

ELECTRIC MOTOR CONVERSION KIT

HEADQUARTERS, DEPARTMENT OF THE ARMY
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CHANGE

NO. 2

HEADQUARTERS
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WASHINGTON D.C., 1 JULY 1992

Operator's, Organizational, Direct Support and General Support
Maintenance Manual

REFRIGERATION UNIT, MECHANICAL: PANEL TYPE;
5000 BTU/HR, GASOLINE ENGINE DRIVEN (GED)
MODEL ERU-5G
(NSN 41101-076-1991)

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Operator's, Organizational, Direct Support, and General Support
Maintenance Manual

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WARNING
FIRE HAZARD

When filling the tank, provide a metal-to-metal contact between fuel tank and container. This will prevent a spark from being generated as fuel flows over the metallic surface. Do not fill fuel tank while engine is in operation. Gasoline spilled on a hot engine may explode and cause serious injury to personnel.

WARNING
DANGEROUS GASES

Do not operate or test-run the refrigeration unit in an enclosed area unless the exhaust gases are piped to the outside. Exhaust gases contain carbon monoxide, a colorless, odorless, and poisonous gas. Refrigerant R-12 decomposes in the presence of flame. Therefore, quantities should not be released where a torch is being used for welding, since the R-12 will decompose into phosgene gas, a lung irritant.

WARNING

Make sure refrigerant charge has been released into the refrigerant system before operating the unit.
Disconnect the power source from the refrigeration unit before performing maintenance on wiring or components. Failure to observe this warning may result in injury to personnel and damage to the equipment.

WARNING

Do not use a lifting device of less than 1500 pounds capacity. Do not allow unit to swing while suspended from lifting device. Failure to observe this precaution may result in injury to personnel and damage to the equipment.

WARNING

Avoid bodily contact with liquid refrigerant, and avoid inhaling of refrigerant gas. When working with or handling refrigerant, always wear approved goggles to prevent possible eye injury. In case of refrigerant leaks, ventilate area at once; high concentration of refrigerant can cause suffocation.

WARNING

Evacuate all gasoline fumes from the unit before soldering or using Halide leak detector on refrigeration components. Do not apply heat to refrigerant cylinder containing refrigerant with a Prestolite torch, blow torch, electric or gas stove, or any other heating device over which there is no temperature control. To apply heat to a refrigerant cylinder, use a shallow vessel containing tap or lukewarm water or apply cloths heated in hot water. Attach a pressure gauge to the cylinder so the pressure is always known.

WARNING

Replace refrigerant cylinder valve cap after using the cylinder. Before breaking any refrigerant connections, loosen slightly to be sure that liquid refrigerant is not present. Do not drop a refrigerant cylinder or allow cylinder to strike another drum violently.

WARNING

Do not spill or allow oil to remain on floor; it may cause personnel to fall or slip and come into contact with a rotating part.

WARNING

The burning of polyurethane foams is dangerous. Due to the chemical composition of polyurethane foam, toxic fumes are released when it is burned or heated. If it is burned or heated indoors, such as during a welding operation in its proximity, precautions should be taken to adequately ventilate the area.

WARNING

An exhaust system equivalent to that of a paint spray booth should be used. Air supplied respirators, approved by the National Institute for Occupational Safety & Health or the U.S. Bureau of Mines, should be used for all welding in confined spaces and when ventilation is inadequate. Individuals who have chronic or recurrent respirator conditions, including allergies and asthma, should not be employed in this type of environment.

WARNING

Liquid refrigerant is used in this equipment. Severe injury may result if personnel fail to observe safety precautions.

WARNING

Do not operate gasoline engine or refrigeration unit in an enclosed area unless exhaust gases are piped outside. Inhalation of the gases could result in serious illness or death.

WARNING

Check engine fuel system for leaks or seeps and repair before soldering or using a Halide leak detector. Further, seal the vent hole in the fuel tank cap with tape and cover with a wet cloth. Then ventilate unit to evacuate gasoline fumes. Failure to follow this procedure could result in a flash or explosion, causing serious injury or death to personnel.

WARNING

Dry cleaning solvent, Fed. Spec. P-D-680 or P-S-661, used to clean parts is potentially dangerous to personnel and property. Do not use near an open flame or excessive heat. The flash point of solvent is 100°F - 138°F (38°C to 59°C).

WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

WARNING

Before starting Preventive Maintenance Checks and Services (PMCS), make sure power switch on control panel is "OFF. "

Technical Manual

No. 5-4110-235-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 1 May 1981

Operator's, Organizational, Direct Support, and General Support Maintenance Manual

REFRIGERATION UNIT, MECHANICAL: PANEL TYPE;
5000 BTU/HR, GASOLINE ENGINE DRIVEN (GED)
MODEL ERU-5G
(NSN 4110-01-076-1991)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MMTS, 4300 Goodfellow Blvd., St. Louis, Missouri 63120-1798. A reply will be furnished directly to you.

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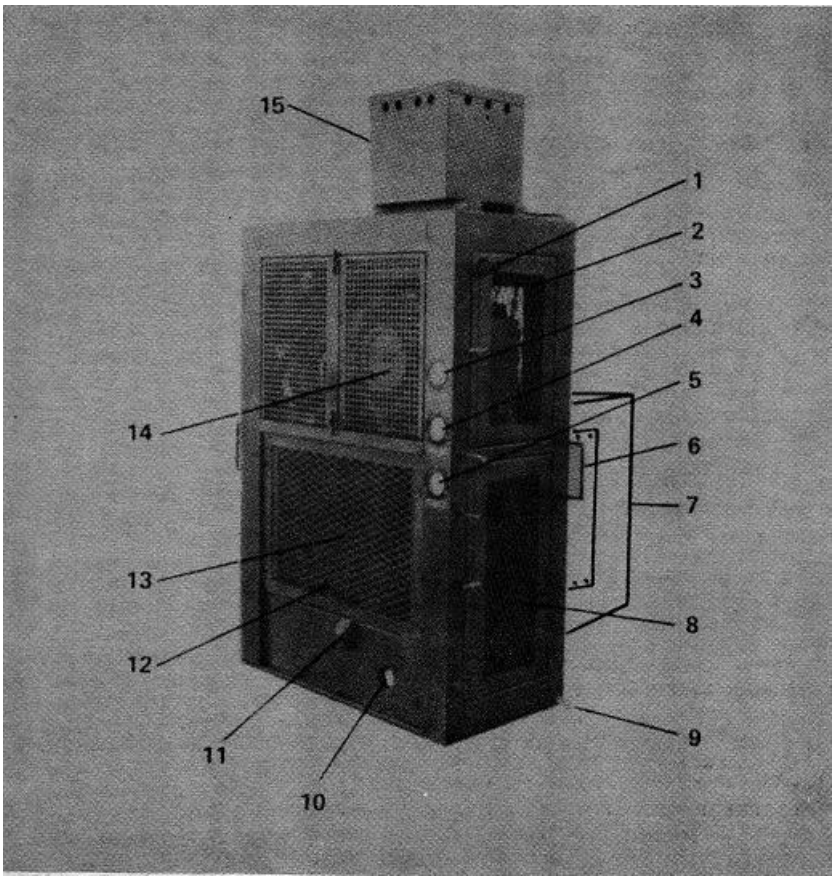
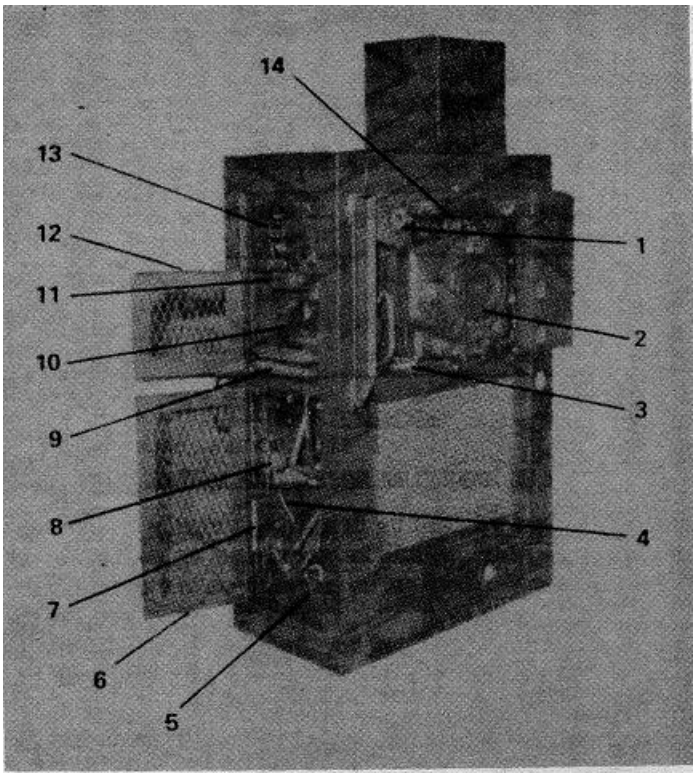


1. Engine Exhaust
2. Top Right Side Access Door
3. Low Pressure Gauge
4. High Pressure Gauge
5. Thermometer
6. Handles
7. Evaporator Housing
8. Bottom Right Side Access Door
9. Evaporator Coil Drain Pipe
10. Fuel Gauge
11. Fuel Tank Cap
12. Condenser Grille
13. Condenser Coil
14. Front Access Door
15. Battery Box

Figure 1-1. Refrigeration Unit, Model ERU-5G, Right Front View



1. Alternator
2. Gasoline Engine
3. Engine Oil Drain Hose
4. Clutch Control Handle
5. Receiver Tank
6. Bottom Left Side Access Door
7. Crankcase Pressure Regulating Valve (HOLD BACK VALVE)
8. Hand Control Valve (HOT GAS SHUT OFF)
9. Vibration Isolators
10. Compressor
11. High Pressure Cutout Switch
12. Top Right Side Access Doors
13. Control Panel
14. Engine Air Cleaner

Figure 1-2. Refrigeration Unit, Model ERU-5G, Left Front View

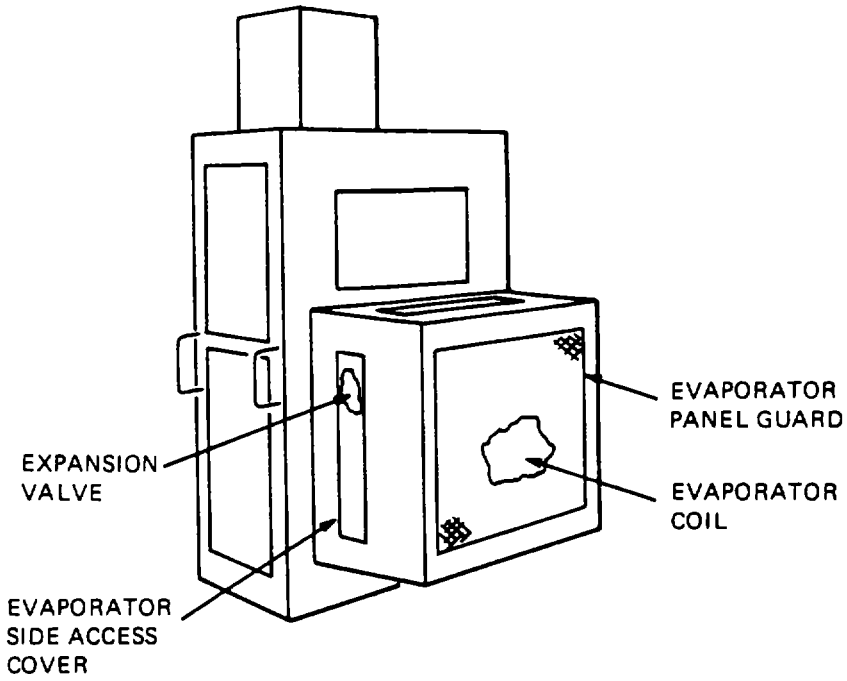


Figure 1-3. Refrigeration Unit, Model ERU-5G, right rear view

1.1. SCOPE

a. Type of Manual. Operator, Organizational, Direct Support and General Support Maintenance Manual.

b. Model Number and Equipment Name.
Model ERU-5G, Refrigeration Unit, Mechanical: Panel type; 5000 BTU/HR, Gasoline Engine Driven (GED).

c. Purpose of Equipment. The refrigeration unit is used to cool air in a portable 150 cubic foot (4. 25 cu meter) field container.

d. Special Limitations. Defrosting of the refrigeration unit is manual.

1-2. MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System (TAMMS).

1-3. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Command decision according to the tactical situation will determine when the destruction of the Refrigeration Unit will be accomplished. A destruction plan will be prepared by the using organization, unless one has been prepared by a higher authority. For general destruction procedures for this equipment, refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use.

1-4. PREPARATION FOR STORAGE OR SHIPMENT

See Chapter 4, Section II for storage and shipment information.

1-5. REPORTING EQUIPMENT RECOMMENDATIONS (EIR)

If your Refrigeration Unit needs improvement, let us know. Send us an EIR. You the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Product Deficienty Report). Mail it to us at Commander, U.S. Army Troops Support Command, ATTN: AMSTR-MOF, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. We'll send a reply.

1-6. NOMENCLATURE CROSS-REFERENCE

Common Name	
Refrigeration Unit	Model ERU-5G, Refrigeration Unit, Mechanical: Panel type; 5000 BTU/HR, Gasoline Engine Driven (GED)

1-7. LIST OF ABBREVIATIONS

ac	alternating current
BTU	British thermal units
amps	amperes
C	celcius
CM	centimeter
cu	cubic
dc	direct current
F	farenheit
fig.	figure
ft	feet
hr	hour
ID	inside diameter
in.	inch
lbs	pounds
no.	number
OD	outside diameter
oz	ounce
para	paragraph
rpm	revolutions per minute
v	volts

Section II. EQUIPMENT DESCRIPTION DATA

1-8. PURPOSE, CAPABILITIES AND FEATURES

a. Purpose. The refrigeration unit is used to cool air in a portable 150 cubic foot (4.25 cu meter) field refrigerator at a capacity of 5000 BTU/HR at 0°F (-17. 78°C).

b. Capabilities and Features.

(1) The unit is a self-contained, package type unit and consists of a condenser section and evaporator section. The evaporator is designed to fit into the wall opening of the refrigerator.

(2) The entire refrigeration unit is attached to the wall of the refrigerated container with four bolts.

(3) The temperature range for , 150 cubic foot (4. 25 cu meter) refrigerator is 0 F to 35°F (-17. 78°C to 1. 670°C).

(4) Defrosting is manual.

(5) Unit contains a manually operated clutch release handle to deactivate fan rotation.

1-9. EQUIPMENT SPECIFICATIONS

REFRIGERATION UNIT:

Type	Air-cooled
Refrigerant	R12
Capacity	5000 BTU/HR cooling @ 0°F (-17.78°C)
Temperature Range	0°F to 35°F (-17. 78°C to 1.67°C)

ENGINE:

Manufacturer	Onan Corporation
Type	Air-cooled, gasoline

ENGINE ACCESSORIES:

Carburetor	Gasoline type
Fuel Filter	Military Std MS51086-1
Air Cleaner	Oil bath type
Fuel Pump	Onan type
Spark Plug	Military Std MS35909-1
Alternator	Motorola RA12N350N-2
Starter	Prestolite MBG4143T
Electric Fuel Pump	12V DC

COMPRESSOR:

Model	Dunham-Bush BP42-1
Type	Reciprocating, 2-cylinder air-cooled

CAPACITIES:

Fuel Tank	9 gallons (34. 1 liters)
Engine Crankcase	3-1/2 quarts (3. 31 liters)
Compressor Oil	3 pints (1.42 liters)
Refrigerant	8 lbs (R12)

DIMENSIONS AND WEIGHT:

Length	35-1/2 Inches
Width	36 Inches
Height	67-1/2 Inches
Weight	730 Lbs

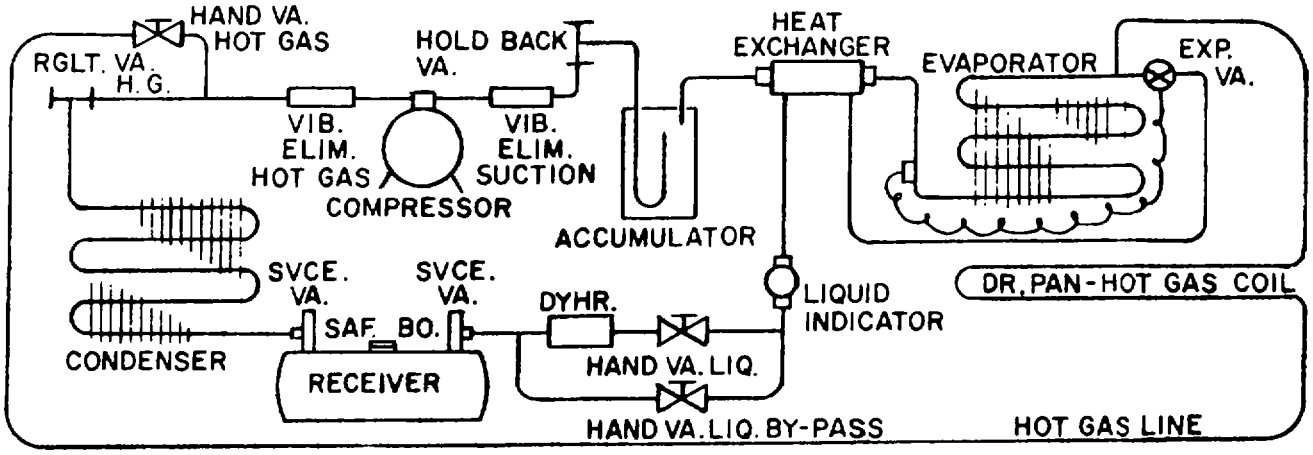
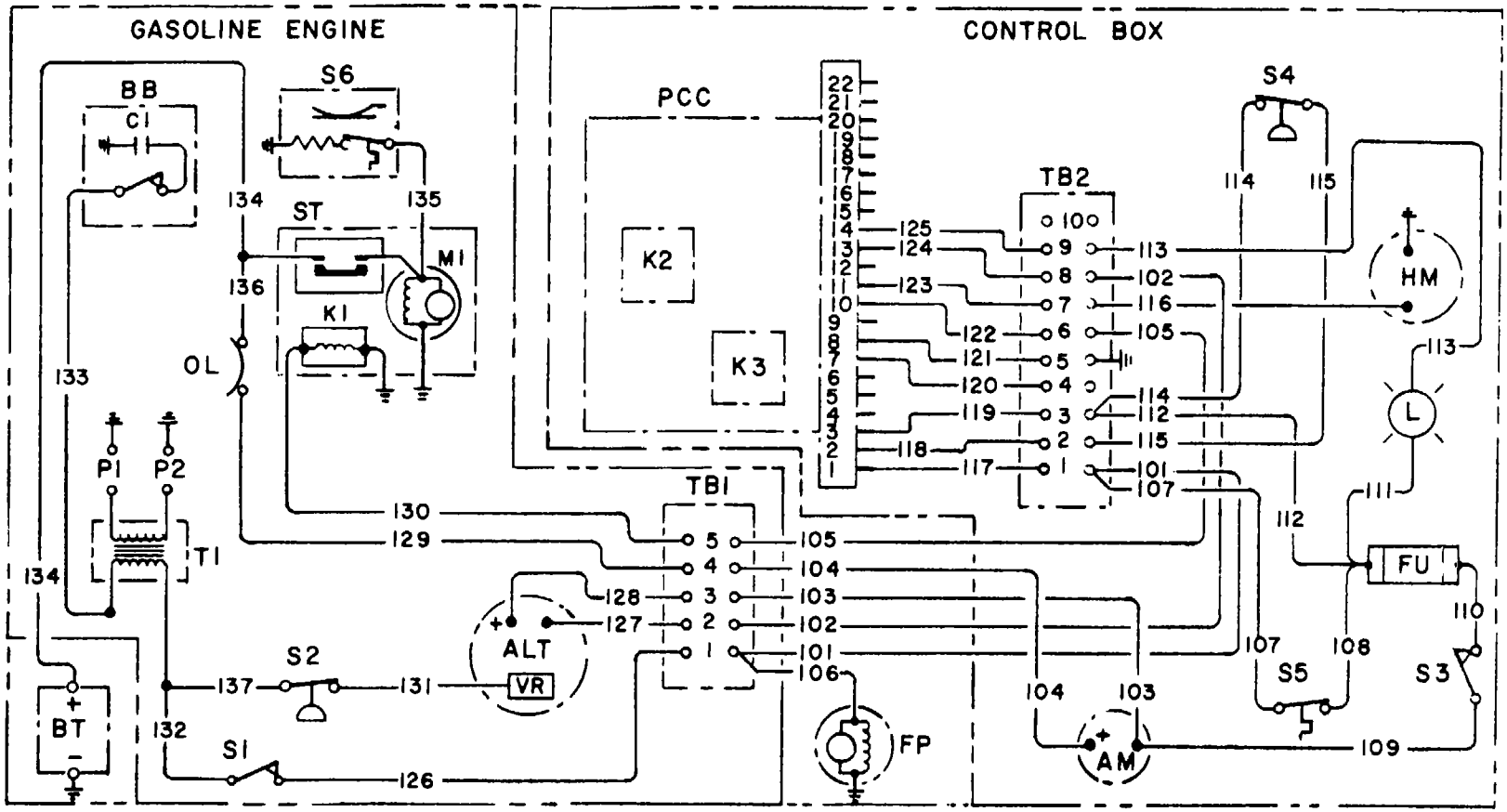


Figure 1-4. Refrigeration Diagram



-LEGEND-

ALT.	ALTERNATOR	K2	RELAY, START	S3	SWITCH, POWER ON-OFF
AM	AMPMETER	K3	RELAY, STAND BY RUN	S4	SWITCH, HIGH PRESSURE
BB	BREAKER BOX	L	PILOT LIGHT	S5	THERMOSTAT, ROOM TEMPERATURE
BT	BATTERY	M1	MOTOR, STARTING 12 VOLT	S6	THERMOSTAT, SISSON CHOKE
C1	COIL	OL	OVERLOAD	ST	STARTER. SOLENOID
FP	FUEL PUMP	P1,P2	SPARK PLUG	TB1	TERMINAL BLOCK NO. 1
FU	FUSE	PCC	PRINTED CIRCUIT CARD	TB2	TERMINAL BLOCK NO. 2
HM	HOUR METER	S1	SWITCH, START, STOP	VR	VOLTAGE REGULATOR
K1	RELAY, STARTER SOLENOID	S2	SWITCH, ENGINE OIL PRESSURE		

Figure 1-5. Wiring Diagram

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1. CONTROL PANEL (FIG. 2-1)

1. POWER SWITCH turns on battery or alternator power to equipment. When placed in "ON" position, the unit will run on thermostat demand. "OFF" position turns equipment off.

2. 10 AMP FUSE protects electrical system from overload.

3. OVERCRANK INDICATOR LIGHT indicates an overcrank engine condition. Lights up after cranking engine more than 30 seconds.

4. AMP METER indicates the amount and direction of flow of current in battery circuit.

5. HOURMETER records the hours the unit is in operation. It is non-resetting. Capable of recording a minimum of 9, 999 hours. It is in operation as long as the temperature control switch is closed.

6. TEMPERATURE CONTROL thermostat that controls the operation of refrigeration unit. It automatically starts and stops unit to maintain desired temperature in the box. Selection of refrigerator temperature can be from 0° - 35°F (-17. 78° to 1. 67°C).

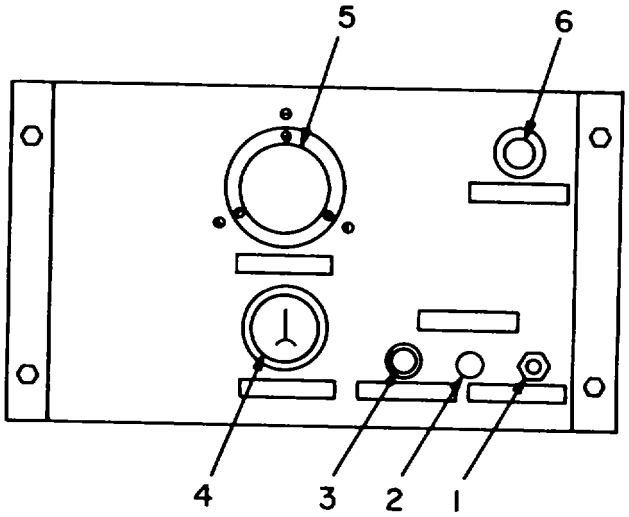


Figure 2-1. Control Panel, front

2-2. HIGH PRESSURE CUTOUT SWITCH (FIG. 2-2)

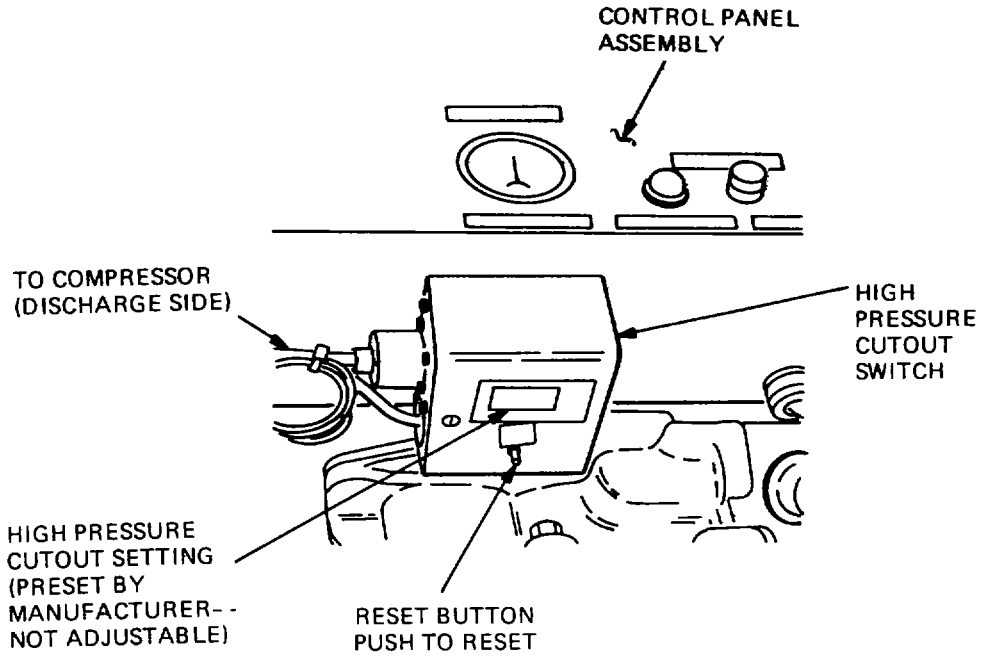


Figure 2-2. High Pressure Cutout Switch

a. General. The high pressure cutout switch consists of an electric switch and a pressure operated bellows. The switch is wired into the control circuit and the bellows is connected by tubing to the discharge side of the compressor. When the pressure of refrigerant rises to a preset limit, the bellows is moved enough to open the electric switch and stop the unit.

b. Operation. Cutout and differential scale settings are preset by the manufacturer before the refrigeration unit is shipped. Those settings are 250 lbs (113. 38 kilograms) for the high pressure side of the scale and must be manually reset if a high pressure condition occurs.

2-3. DIAL CONTROLS (FIG. 2-3)

1. LOW PRESSURE GAUGE (COMPOUND PRESSURE):
   - Indicates pressure on suction side of compressor.
   - Records pressure range from 30-inch vacuum to 150 pound per square inch (1034.25 Kilopascals).
   - Operation automatic.
   - Normal Operating Reading - 4 lbs to 30 lbs

2. HIGH PRESSURE GAUGE:
   - Indicates pressure in discharge side of compressor.
   - Graduated scale reading from 0-300 lbs per square inch (0-2068.5 Kilopascals).
   - Operation automatic.
   - Normal Operating Reading - 125 lbs to 170 lbs.

3. DIAL THERMOMETER:

Indicates air temperatures in refrigerated box.

Range is -20°F to +120°F (-28.88°C to +84.44°C)

4. FUEL TANK GAUGE:
   - Indicates amount of fuel in gasoline tank.

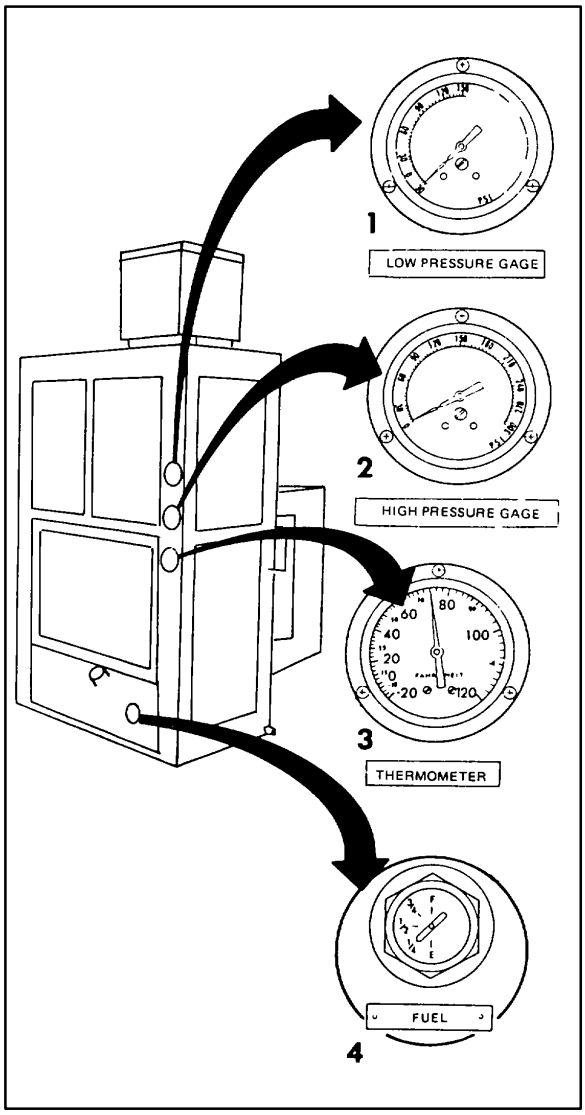


Figure 2-3. Dial Controls

2-4. HAND VALVES AND SIGHT GLASS (FIG. 2-4)

1. "HOT GAS SHUT-OFF" HAND VALVE:
   - Allows selection of low temperature mode of operation.
   - Used for manual defrost.
   - Closed during normal operation.
   - Open during defrost.

2. "LIQUID SHUT-OFF" HAND VALVE:
   - Closed position stops refrigerant from flowing.
   - Used to by-pass dehydrator when filter is contaminated.
   - Open during normal operation.

3. "LIQUID INDICATOR" SIGHT GLASS:
   - Indicates presence of moisture in refrigerant.
   - Indicates shortage of refrigerant.
   - Blue indication - free from moisture.
   - Pink indication - moisture present.
   - Bubbles or foam - refrigerant shortage.

4. HAND VALVE:
   - Liquid shut-off type.
   - Closed position stops refrigerant flowing.
   - Closed during normal operations.

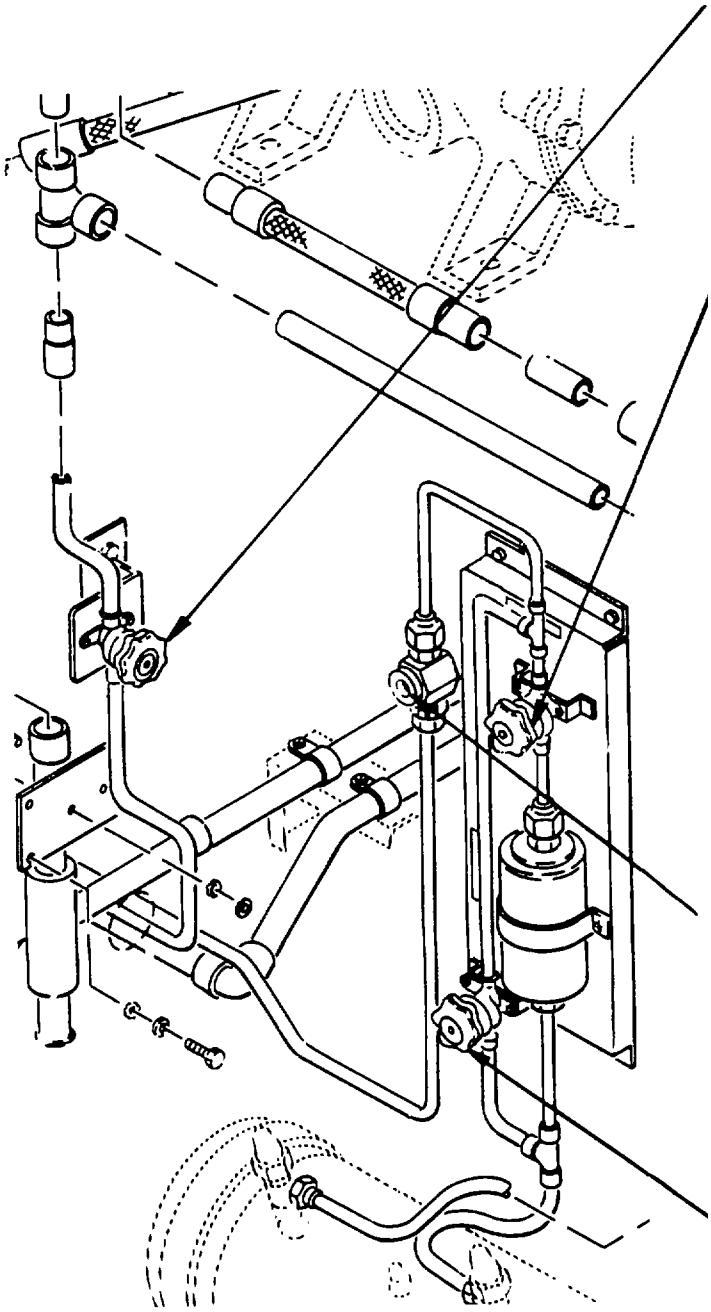
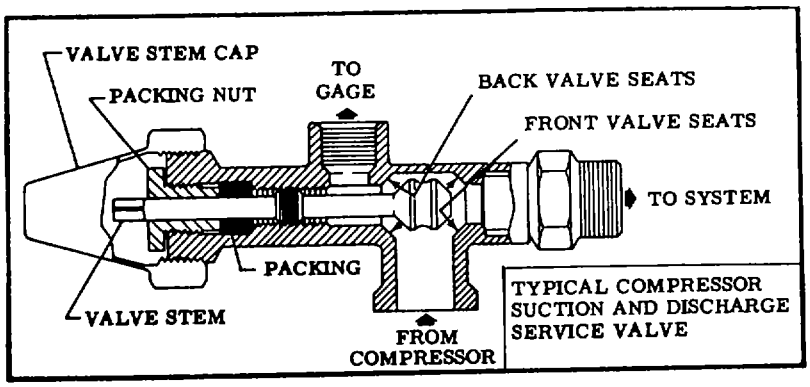


Figure 2-4. Hand Valves and Sight Glass

2-5. SERVICE VALVES (FIG. 2-5)



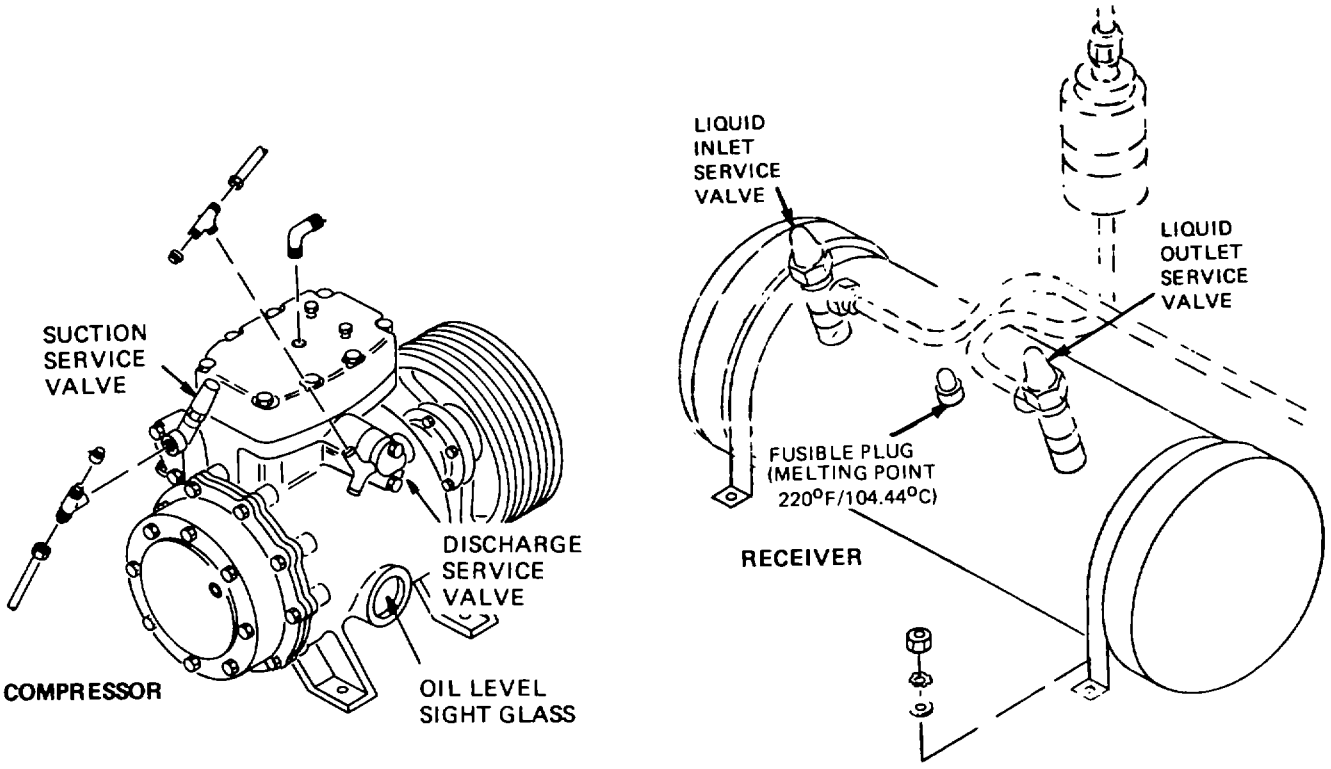


Figure 2-5. Service Valves

2-6. CLUTCH CONTROL HANDLE (FIG. 2-6)

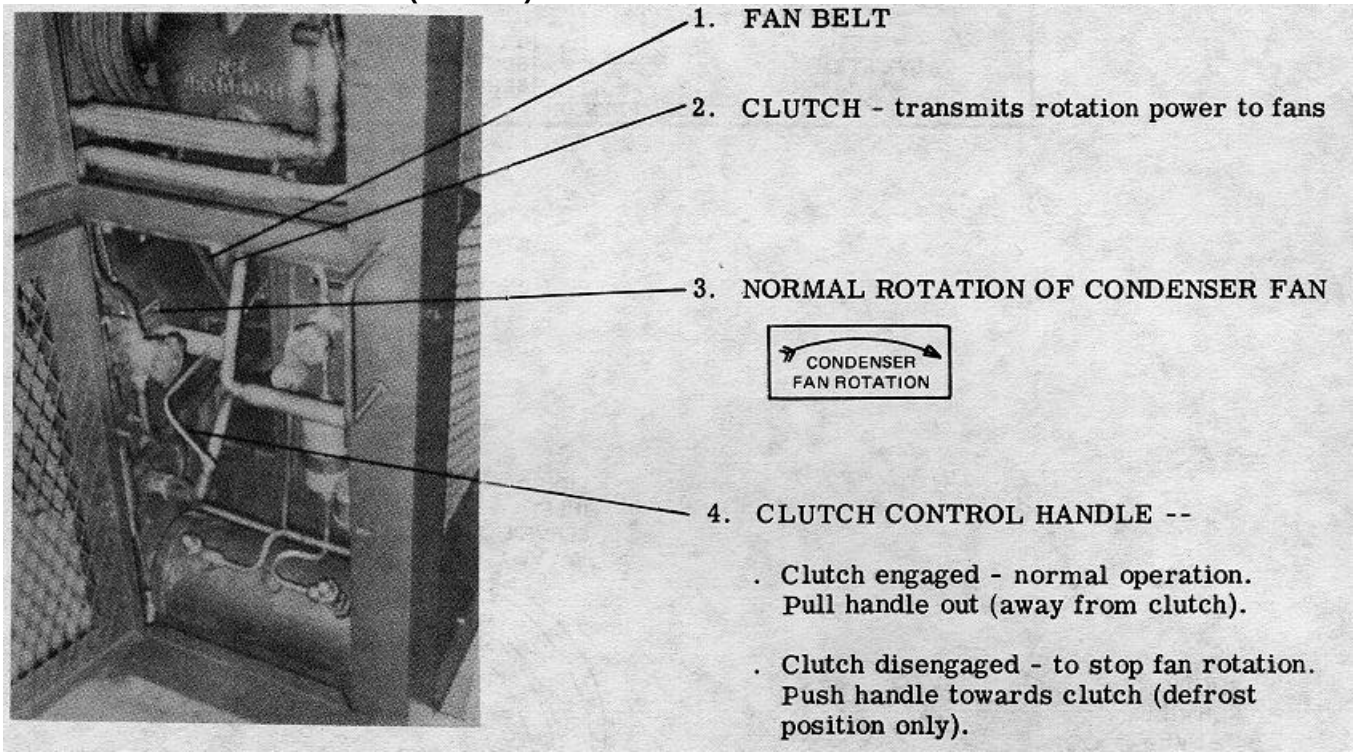


Figure 2-6. Clutch Control Handle

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-7. GENERAL

a. Before You Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS.

b. While You Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS.

c. After You Operate. Be sure to perform your after (A) PMCS.

d. If Your Equipment Fails to Operate. Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See DA PAM 738-750.

NOTE

If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

WARNING

BEFORE STARTING PMCS MAKE SURE POWER SWITCH ON CONTROL PANEL IS "OFF."

2-8. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES TABLE

Table 2-1. Operator Preventive Maintenance Checks and Services

NOTE: Within designated interval, these checks are to be performed in the order listed.

B - Before Operation **D - During Operation** **A - After Operation**

Item No.	INTERVAL B	INTERVAL D	INTERVAL A	Item To Be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment will be reported Not Ready/ (Red) if:
					NOTE: Visually inspect for evidence of lubricant and fuel leaks concurrently with the daily service checks. Lubricate in accordance with current lubrication order. NOTE: The 6TN or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available. Electrolyte (NSNs 6810-00-249-9354 and 681 0-00-843-1640) have a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.	
1	*			Battery	Tighten loose cables and mountings. Remove corrosion. Inspect for cracks and leaks. Fill to 3/8 inch (.9518cm) above plates. Clean vent holes in filler caps before installing. In freezing weather, run engine a minimum of 1 hour after adding water (weekly).	Dead battery; engine will not start.
2	*			Fan Belt	Inspect fan belt for proper tension (weekly).	
3	*			Air Cleaner	Clean as required. This service will vary from a few days of operation in comparatively clean conditions to twice a day in dusty conditions.	

Table 2-1. Operation Preventive Maintenance Checks and Services (Cont)

NOTE: Within designated interval, these checks are to be performed in the order listed.

B - Before Operation **D - During Operation** **A - After Operation**

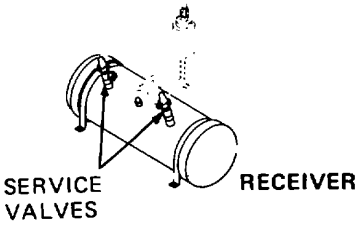
Item No.	INTERVAL B	D	A	Item To Be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment will be reported Not Ready/ (Red) if:
4	*			Engine Oil Level	Add oil as indicated by the engine oil level indicator (dip-stick). Refer to current lubrication order (daily).	
5	*			Compressor Drive Belts and Alternator Belts	Check belts for proper tension (weekly).	
6	*			Compressor Sight Glass	Oil level should be halfway up sight glass. Refer to Direct Support unit for adding oil (daily).	
7	*			Governor Linkage	Inspect and clean governor linkage (daily).	
8	*			Fuel Tank	Add fuel as required (daily).	Lack of fuel; engine will not run
9		*		Operation Noise or Vibration	During operation observe for any unusual noise or vibration (daily).	
10		*		Refrigeration System	Visually check all connections of the refrigeration system for leaks. Check liquid line sight glass for air bubbles or milky appearance. Report deficiencies to Direct Support unit for correction (daily).	

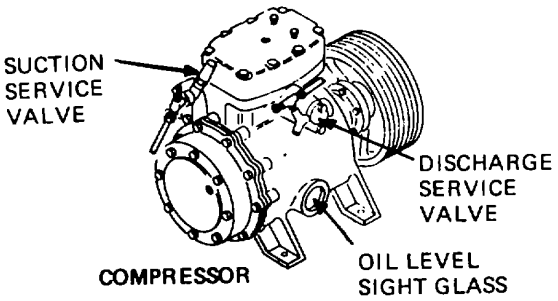
Section III. OPERATION UNDER USUAL CONDITIONS

2-9. STARTING THE EQUIPMENT

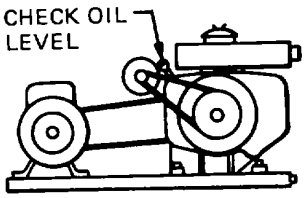
a. Check all service valves on receiver and compressor for operating positions.

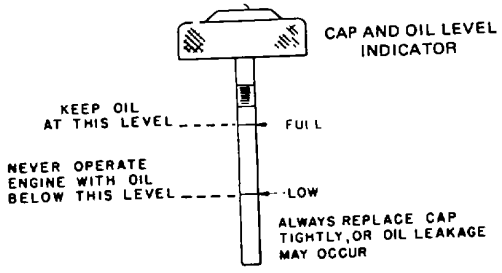
b. Check oil level in compressor sight glass.



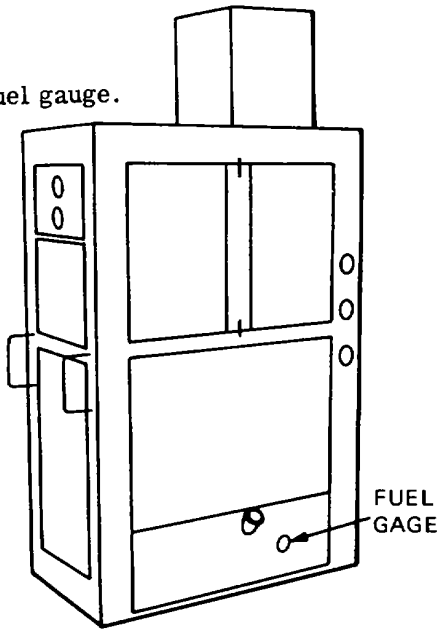


c. Check oil level in engine.



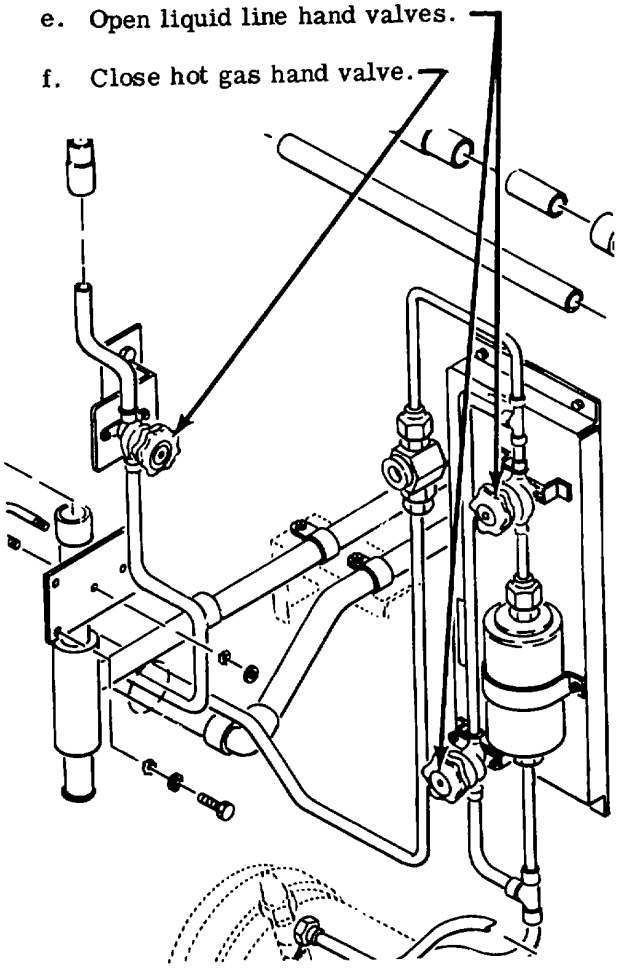


d. Check fuel gauge.



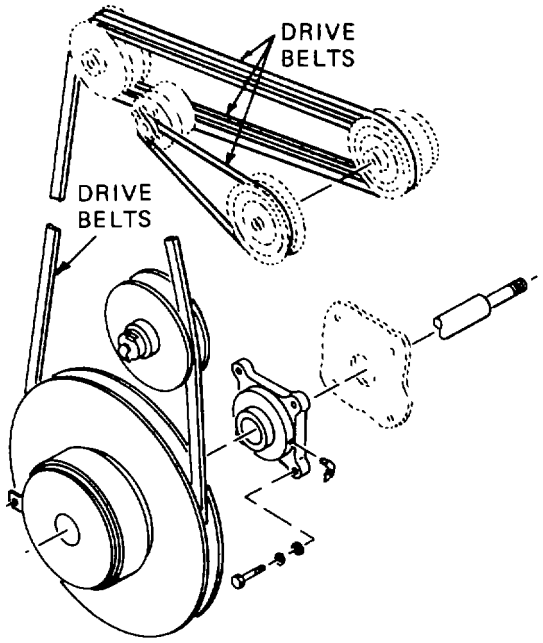
e. Open liquid line hand valves.

f. Close hot gas hand valve.

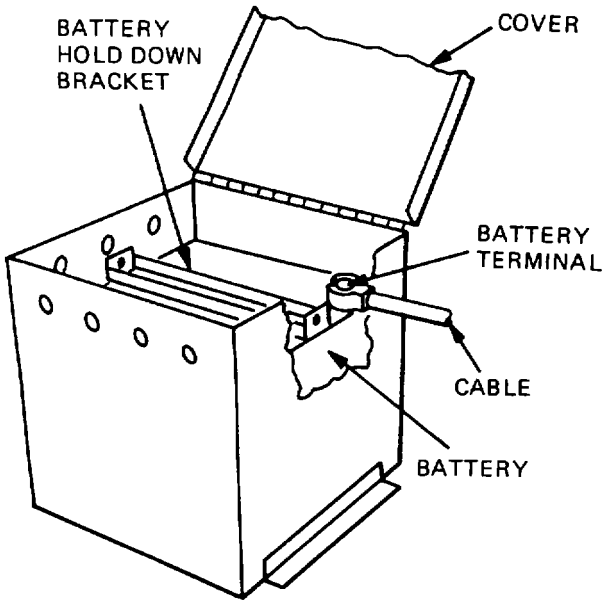


2-9. STARTING THE EQUIPMENT (cont)

g. Check drive belts for tension.

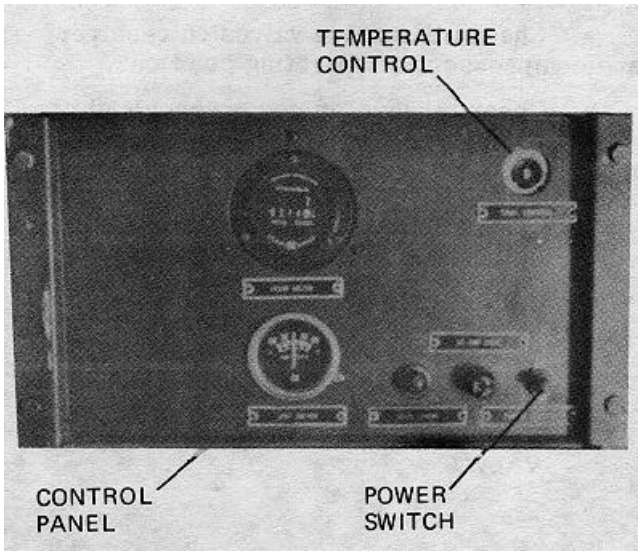


h. Check that battery cables are connected securely.

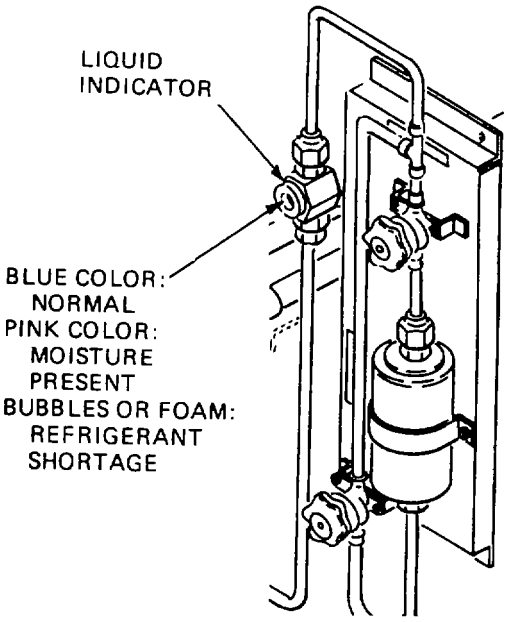


i. Set temperature control on control panel to desired refrigeration temperature (0°F to 35°F/-17.78°C to 1.67°C).

j. Turn on power switch on control panel.



k. Check refrigerant liquid indicator during the first hour of operation. If pink, bubbles, or foam show, report to organizational maintenance. Blue color indicates OK to operate.



1. Keep the refrigerator door closed tight until the temperature is lowered. Don't load the refrigerator until the operating temperature is constant.

2-10. OPERATION UNDER USUAL CONDITIONS

WARNING
WHEN OPERATING GASOLINE ENGINE INDOORS, VENTILATION IS REQUIRED; EXHAUST GAS MUST BE PIPED OUTSIDE.

WARNING
THE UNIT IS GASOLINE OPERATED. USE CAUTION WITH OPEN FLAMES.

WARNING
WHEN WORKING WITH UNIT, USE CAUTION. THE UNIT IS APT TO START AUTOMATICALLY IF IT IS IN STANDBY MODE AND POWER SWITCH IS "ON."

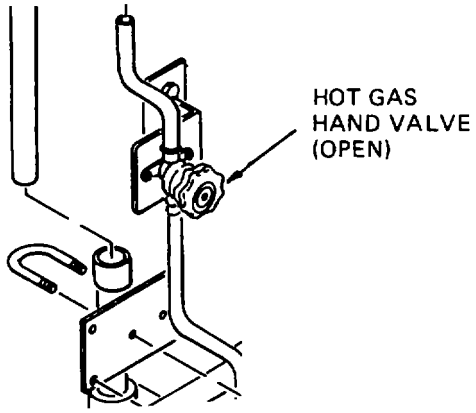
a. For normal operation of the unit, head pressure on the refrigeration unit must not be so high as to trip the high pressure cutout switch (fig. 2-2).

b. Defrosting of the unit is manual.

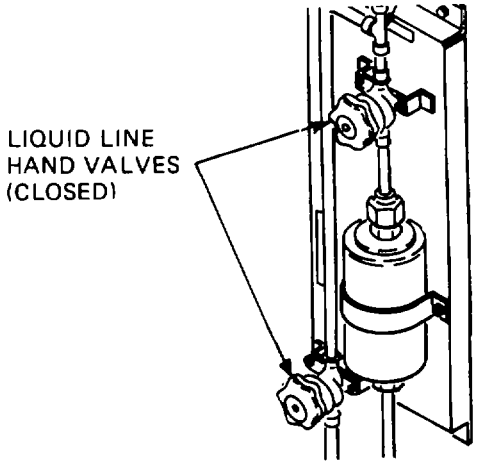
2-11. MANUAL DEFROST

CAUTION
Unit should only be defrosted when unit is operating at 0°F (-17.78°C), and frost has accumulated on evaporator.

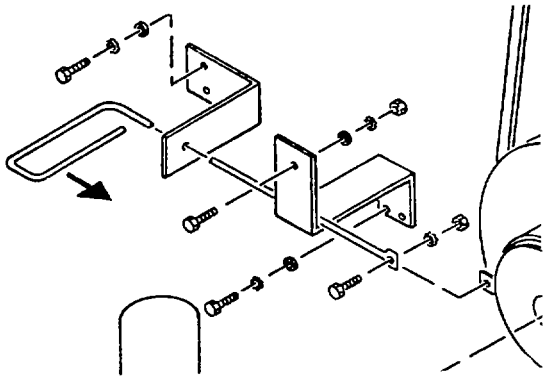
a. Open hot gas hand valve while unit is operating.



b. Close liquid line hand valves.



c. Push fan clutch handle in.



d. Allow unit to operate a sufficient time to defrost coil.

e. With evaporator clear of frost, place hand valves and fan clutch handle in original position.

2-12. STOPPING THE EQUIPMENT

a. Move the ON-OFF power switch (1, figure 2-1) to the OFF position to stop the refrigeration unit.

b. Perform the daily preventive maintenance services (para 2-7).

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-13. OPERATION IN EXTREME COLD (BELOW 0°F/-17.78°C)

a. Keep batteries fully charged.

b. Keep fuel tank full at all times.

c. Drain and service the fuel filter.

d. Lubricate in accordance with the current lubrication chart (fig. 3-2).

2-14. OPERATION IN EXTREME HEAT

a. Lubricate engine in accordance with current lubrication chart (fig. 3-2).

b. If carburetor floods when attempting to start engine, open throttle, close choke and turn engine crankshaft over several times. If vapor lock is evident, do not attempt to start engine for 15 minutes.

c. Check dial thermometer on refrigeration unit frequently to ascertain proper operation of the unit.

d. Increase frequency of periodic inspection and maintenance operations.

2-15. OPERATION IN DUSTY OR SANDY AREAS

a. Clean refrigeration unit frequently.

b. Remove dirt or dust that accumulates on the condenser or evaporator fans and housings.

c. Inspect condenser frequently. Dirt or dust accumulating on condenser tubes or fins causes increased discharge pressure. If tubes and fins are coated, clean with brush, clean cloth or compressed air.

d. Keep covers on all controls and wiring.

e. Check engine oil frequently for cleanliness.

f. Check air filter frequently for cleanliness.

2-16. OPERATION UNDER RAINY OR HUMID CONDITIONS

a. Inspect evaporator coil frequently. In humid areas, the evaporator coil rapidly collects frost. Any steady drop in the compound pressure gauge reading generally indicates that the evaporator needs defrosting.

b. Read dial thermometer frequently to check proper operation of the unit.

c. Increase frequency of periodic inspections and maintenance operations.

d. Check engine oil level frequently.

e. High moisture content in the air will cause difficulty in the electrical system. The spark plug, magneto, and wiring may become unserviceable due to high humidity. Clean and dry the affected parts at frequent intervals.

2-17. OPERATION IN SALT WATER AREAS

a. Salt water corrodes metal rapidly. Avoid contact with salt water as much as possible. When equipment has been exposed to salt water, steam clean or wash exposed areas with clean, fresh water as soon as possible.

b. Inspect fins of condenser and evaporator frequently for clogging due to corrosion, and clean when necessary.

2-18. OPERATION IN HIGH ALTITUDES

a. The air pressure above sea level decreases as altitude is increased. The result is a decrease in air pressure to the carburetor causing a too-rich gasoline-air mixture. If this condition interferes with the operation of refrigeration unit, report to the proper authority.

b. In extremely high altitudes, the conventional type of diaphragm fuel pump used on this equipment may not operate properly. If such a condition exists, report to the proper authority.

c. For each 1000 feet (304.88 meters) altitude above sea-level, there will be a reduction in engine horsepower of 3-1/2%.

2-19. EXTENDED PERIOD SHUTDOWN

a. Turn off power.

b. Disconnect battery cables.

c. Close liquid line hand valve.

d. Drain fuel from fuel tank.

CHAPTER 3

OPERATOR MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

3-1. GENERAL LUBRICATION INFORMATION

a. This section contains the lubrication chart and lubrication instructions which are supplement to, and not specifically covered in the lubrication chart.

b. The lubrication chart, figure 3-2, is the approved lubrication chart for the gasoline engine driven unit Model ERU-5G. Other than the power source, the electric motor driven model conversion kit has the same lubrication. No lubrication is required for the electric motor.

3-2. DETAILED LUBRICATION INFORMATION

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

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

c. Points of Lubrication. Service the lubrication points at proper intervals as illustrated in figure 3-2.

d. Precautions. Before lubricating the equipment, be sure that the starter switch is OFF. Otherwise, automatic controls may start operation of the equipment and cause injury to personnel.

e. Engine Oil.

(1) The crankcase oil level must be checked frequently, as oil consumption may increase.

(2) The oil may require changing more frequently than usual, because contamination by dilution and sludge formation will increase under cold weather operation conditions.

f. Air Cleaner Service.

(1) Remove wing nut and lift off cover and and filter element as indicated in figure 3-1.

(2) Clean bowl, cover and filter element with an approved cleaning agent.

(3) Fill bowl to oil level with same grade of oil used in engine crankcase.

(4) Replace filter element every 200 hours of operation.

(5) Assemble air cleaner as shown in figure 3-1.

NOTE

This service will vary from several days during operation in comparatively clean conditions, to twice a day in dusty conditions.

g. Every 1000 operating hours, lubricate fan shaft and pulley bearings with GAA.

h. Check the compressor oil level, paragraph 7-4.

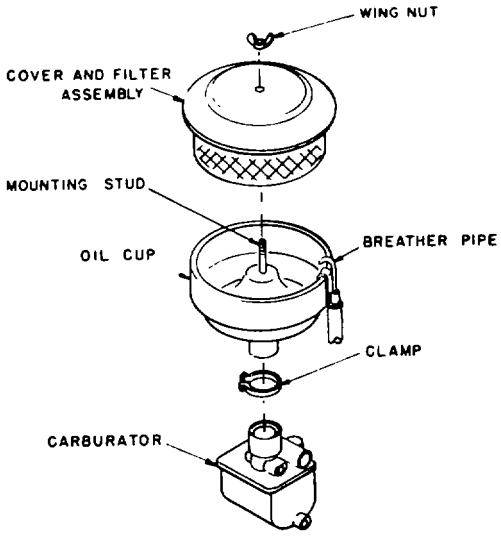


Figure 3-1. Air Cleaner Service

LUBRICATION ORDER

L05-4110-235-12

REFRIGERATION UNIT, MECHANICAL, PANEL TYPE,
5,000 BTU/HR CAPACITY,
FOR PORTABLE 150 CU FT (4.25 CU METER) REFR:GERATOR
MGR EQUIPMENT CORP. MODEL ERU-5G
W/ONAN ENGINE MODEL CCKMS3852J

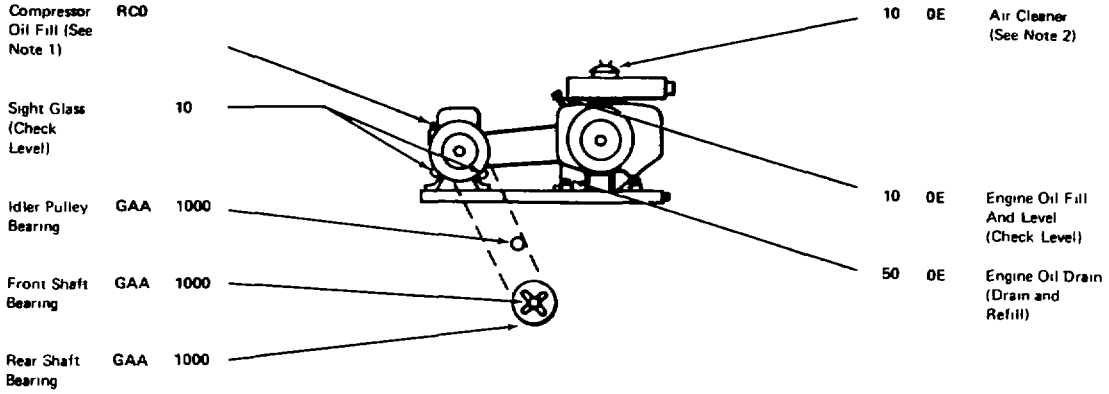
Intervals re based on normal hours operation. Adjust to compensate tor abnormal operation and severe conditions or contaminated lubricants During inactive periods, sufficient lubrication must be performed for adequate preservation Clean fittings before lubricating.

Clean parts with SOLVENT, dry cleaning, or with OIL. fuel.
Diesel Dry before lubricating.

Drain crankcase when hot. Fill and check level.

LUBRICANT • INTERVAL

LUBRICANT • INTERVAL



TOTAL MAN-HR		TOTAL MAN-HR	
INTERVAL	MAN-HR	INTERVAL	MAN.HR
10	0.2	1000	0.2

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

KEY

<table>
<tr><th rowspan="2">LUBRICANTS</th><th rowspan="2">CAPACITY</th><th colspan="3">EXPECTED TEMPERATURES</th><th rowspan="2">TOTAL MAN-HR</th></tr>
<tr><th>Above +32°F (0°C)</th><th>+40°F to -10°F (4.44°C to12.22°C)</th><th>0°F to -65°F (-17.78 to 18.33°C)</th></tr>
<tr><td>GAA-GREASE, Automotive & Artillery</td><td></td><td colspan="3">ALL TEMPERATURES</td><td rowspan="7">Intervals given are in hours of normal operation</td></tr>
<tr><td>OE-OIL, Engine, Heavy Duty</td><td></td><td rowspan="4">0E/HD030</td><td rowspan="4">0E/MD010</td><td rowspan="4">0EA</td></tr>
<tr><td>Crankcase</td><td>3 1/12 qts (3.31 Liter)</td></tr>
<tr><td>Oil Cleaner</td><td>6 ounces (176.47 ml)</td></tr>
<tr><td>OES-OIL, Engine, Sub zero</td><td>S/A Above</td></tr>
<tr><td>RCO-OIL, Lubri cating, Refrigerant, Compressor</td><td>31/2 qts (3.31 Liters)</td><td colspan="3">ALL TEMPERATURES</td></tr>
</table>

NOTES

1. COMPRESSOR UNIT This unit will be serviced by Direct or General Support Personnel only.
2. AIR CLEANER Refill oil reservoir to level mark every 50 hours, disassemble entire unit, re oil and reassemble.

NOTES

1. COMPRESSOR UNIT This unit will be serviced by Direct or General Support Personnel only.
2. AIR CLEANER. Refill oil reservoir to level mark every 50 hours, disassemble entire unit, re oil and reassemble.
3. LUBRICANTS. The following is a list of lubricants with the Military Symbols and applicable Specification numbers.

   OE = MIL L 2104
   RCO = VV G 825
   GAA = MILG 10924
   OES - MILL 10295

4. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW 10°F (23°C). Remove lubricants prescribed In the key for temperatures above 10°F (.12°C). Relubricate with lubricants specified In the key for temperatures below 10°F (.23°C).

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

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

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

Section II. OPERATOR TROUBLESHOOTING

3-3. GENERAL

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the refrigeration unit. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which may help you to determine probable cause and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

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 organizational maintenance.

3-4. TROUBLESHOOTING TABLE

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 3-1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

ENGINE

NOTE

The 6TN and or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available.

Electrolyte (NSNs 6810-00-249-9354 and 6810-00-843-1640) have a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.

1. ENGINE FAILS TO CRANK WHEN POWER SWITCH IS TURNED ON.
   - Step 1. Check to see if electrolyte level in battery cells is above the top of the plates.
     If electrolyte is below top of plates, add distilled or clean water until electrolyte level is three-fourths of an inch above the separators. Recharge battery or replace battery.
   - Step 2. Inspect for loose, corroded, or broken battery cables.
     Clean corroded cables. Tighten loose connections at battery, ground, and starter.
     Request organizational maintenance to replace defective cables.

2. ENGINE CRANKS BUT FAILS TO START.
   - Step 1. Check for empty fuel tank.
     Refill fuel tank if empty or low.
   - Step 2. Check for dirty fuel filter, broken, or clogged fuel line.
     Clean or replace filter. Report clogged line to organizational maintenance.

3. ENGINE MISSES OR RUNS ERRATICALLY.
   - Step 1. Check for water or dirt in gasoline or for improper grade of gasoline.
     Drain and refill tank with proper fuel.

4. ENGINE KNOCKS OR DEVELOPS EXCESSIVE NOISE.
   - Step 1. Check oil level.
     Add oil to crankcase.
   - Step 2. Check to see if oil may be diluted.
     Drain crankcase & refill with proper oil according to current lubrication chart.
   - Step 3. Check for proper grade of gasoline.
     Drain and refill with proper grade.
   - Step 4. Inspect for worn muffler.
     Request organizational maintenance to replace muffler.

Table 3-1. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

5. ENGINE STOPS SUDDENLY.
   - Step 1. Check fuel supply.
     Refill fuel tank with gasoline.
   - Step 2. Check quality of gasoline for possible water, dirt or gum.
     Drain and refill fuel tank with proper quality gasoline.

6. ENGINE WILL NOT IDLE SMOOTHLY.
   Check quality of gasoline for water, dirt or gum.
   Drain and refill with proper gasoline.

7. ENGINE OIL PRESSURE LOW.
   Check oil level and oil quality (too light or diluted).
   Fill crankcase with proper oil according to current lubrication chart.

8. ENGINE OVERHEATS.
   - Step 1. Check for overload on engine.
     Reduce load.
   - Step 2. Check for low crankcase oil supply.
     Replenish oil to proper level.
   - Step 3. Check for correct grade and quality of oil.
     Drain and refill with proper oil.
   - Step 4. Check engine for restricted air cooling circulation.
     Ventilate engine for sufficient supply of fresh air for cooling and combustion.
     Clean dirty or oily cooling fins.
   - Step 5. Check for restricted exhaust.
     Clean or free restriction.

9. EXHAUST SMOKE EXCESSIVE.
   Check for improper grade of engine oil.
   Drain and refill. Refer to current lubrication chart.

10. ENGINE LACKS POWER.
    Inspect air cleaner for clogging.
    Service air cleaner.

11. ENGINE OIL CONSUMPTION EXCESSIVE.
    Check for leaky engine base drain plug.
    Tighten or replace drain plug.

REFRIGERATION SYSTEM

12. REFRIGERATION UNIT WILL NOT OPERATE.
    - Step 1. Inspect thermostat for mis-adjustment.
      Adjust.
    - Step 2. Break or short circuit in wiring.
      Notify organizational maintenance.

Table 3-1. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
REFRIGERATION SYSTEM (Cont)
13. REFRIGERATION UNIT RUNS CONTINUOUSLY.
Step 1. Check for low compressor speed. Inspect drive belts for proper tension. Notify organizational maintenance.
Step 2. Check compressor discharge valve to see if closed too far. Turn valve stem out.
Step 3. Check for possible abnormally warm product load. Remove part of load or allow absorption of heat.
Step 4. Test for leaks through refrigerator walls or joints. Seal all leaks.
Step 5. Check to see if thermostat is set too low. Reset thermostat to desired setting.
Step 6. Inspect thermostat terminal leads for shorting. Notify organizational maintenance.
Step 7. Inspect thermostat for contacts fused in closed position. Notify organizational maintenance.
14. REFRIGERATION UNIT OPERATES TOO LONG.
Step 1. Check for loose compressor belts. Notify organizational maintenance.
Step 2. Check for abnormal heat leakage. Seal cracks. Notify organizational maintenance.
Step 3. Check for excessive product load. Remove part of load or allow more time for absorption of heat.
Step 4. Check for partially closed receiver inlet valve. Open valve as far as it will go.
Step 5. Check for dirty condenser. Clean condenser.
Step 6. Check evaporator coil for excessive frost. Defrost unit.
Step 7. Check for obstruction to air flow through evaporator. Notify general support maintenance.
Step 8. Check thermostat for too low setting. Reset thermostat.
Step 9. Check for shorted thermostat. Notify organizational maintenance.
15. OPERATION OF UNIT NOISY.
Step 1. Check for loose compressor pulley. Notify organizational maintenance.
Step 2. Check bearing lubrication. Lubricate bearings.
Step 3. Inspect for unserviceable bearings. Notify organizational maintenance.
Step 4. Check for loose drive pulley. Notify organizational maintenance.
Step 5. Inspect for worn belts. Notify organizational maintenance.
Step 6. Check for loose evaporator fan or condenser fan. Notify organizational maintenance.
Step 7. Check for fan blades striking housing. Notify organizational maintenance.

Section III. OPERATOR'S MAINTENANCE

3-5. GENERAL

The operator's maintenance is covered in this section.

3-6. FUEL CAP AND STRAINER SERVICE (FIG. 3-3)

Service the fuel cap and strainer after each 500 hours of operation. Clean the cap and strainer in an approved cleaning solvent.

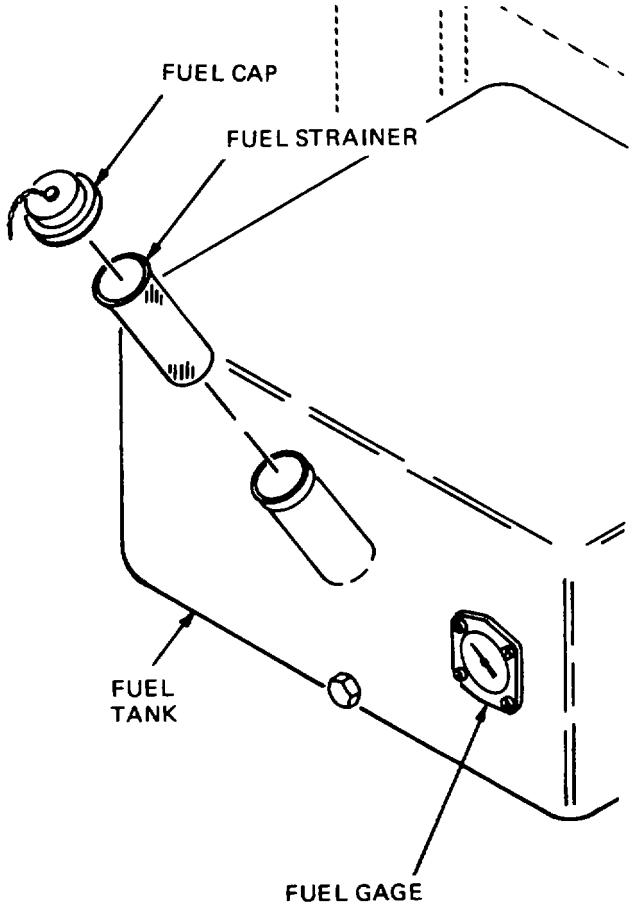


Figure 3-3. Fuel Cap and Strainer Service

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS & EQUIPMENT

4-1. SPECIAL TOOLS AND EQUIPMENT

No special tools or equipment are required for the operator or organizational maintenance personnel for the refrigeration unit.

4-2. ORGANIZATIONAL MAINTENANCE REPAIR PARTS

Organizational Maintenance repair parts are listed and illustrated in TM5-4110-235-24P.

Section II. SERVICE UPON RECEIPT OF MATERIAL AND PREPARATION FOR MOVEMENT

4-3. UNLOADING, UNPACKING AND SERVICING OF EQUIPMENT

a. Unloading. The refrigeration unit is shipped in a crate which has a skid pallet base (fig. 4-1). It should be handled with fork lift equipment, but may be handled by crane and sling. Reasonable precaution should be taken to prevent damage by dropping or bumping.

NOTE
Do not destroy the shipping crate as it is designed for re-use.

b. Unpacking. The refrigeration unit (fig. 4-1) is secured in the shipping crate by two uprights with two horizontal bars and is supported by a skid base. First remove the crate top, then the four side panels. Remove the four bolts securing the uprights to the unit. Refer topara44 for installation and setting up instructions.

c. Inspecting and Servicing.

(1) Inspection.

(a) Visually inspect the unit for physical damage. Make certain all publications and overpack kit parts are on unit and in good condition.
(b) Open all doors and inspect for missing or damaged parts. Report all discrepancies to the proper authority.
(c) Check engine and compressor for oil leakage. Report any leakage to the proper authority.
(d) Check operation of valves, controls and gauges.
(e) Use a halide torch over the entire unit to inspect for refrigerant leakage.

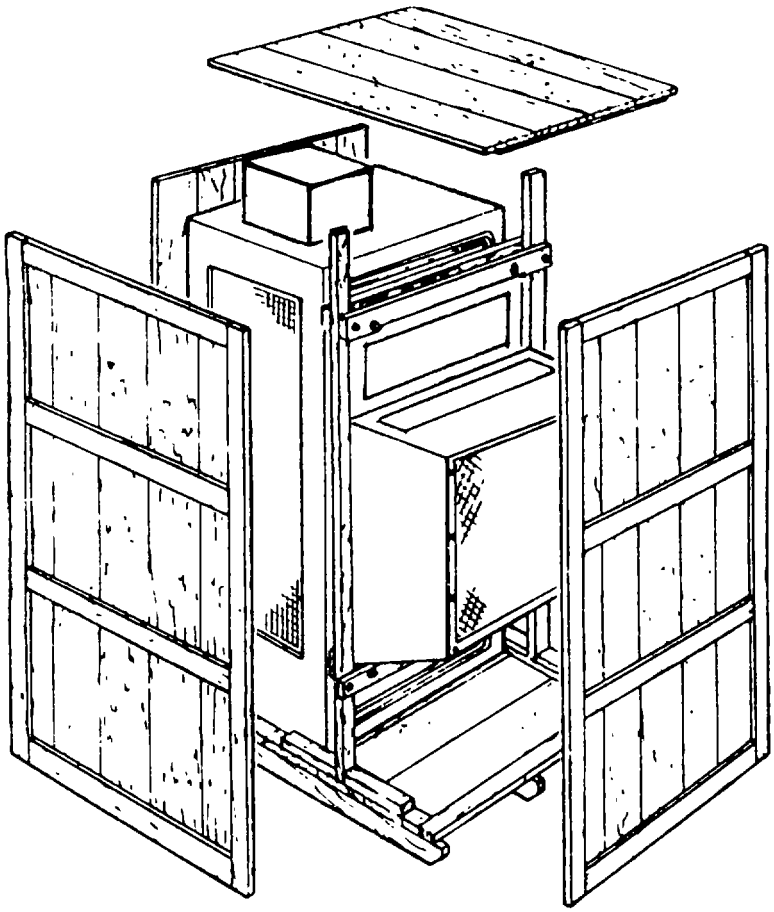


Figure 4-1. Unpacking Refrigeration Unit

(2) Servicing. Refer to table 2-1 for operator preventive maintenance service.

(a) Lubricate the refrigeration unit in accordance with the current lubrication chart.
(b) Lift the gasoline filler cap on the gasoline filler bracket. Fill tank with 16 gallons (60.48 liters) of nonleaded or regular grade gasoline which conforms to MilitarySpecificationMIL-G-3056 orMIL-G-5572.

CAUTION

Do not operate engine on gasoline with an octane rating below 74 (research method). Fuel with a lower octane rating will cause detonation, and if operation is continued under this condition, severe damage will result; cylinder and piston will be scored, head gasket blown out, bearings will be damaged, etc.

(c) Remove oil level gage from engine crankcase. Fill crankcase with 3-1/2 quarts (3.31 liters) engine oil in accordance with current lubrication chart.
(d) Check and service engine carburetor air cleaner. Remove wing nut attaching air cleaner to air cleaner bracket assembly. Remove air cleaner cover and filtering element. Fill air cleaner bowl to oil level line in accordance with current lubrication chart. Install filter element and cover and secure with wing nut.

4-4. INSTALLATION, SETTING UP, DISMANTLING AND REINSTALLATION

a. Installation of Separately Packed Components. Battery acid pack must be used to fill lead acid storage battery before attempting to start refrigeration unit gas engine.

b. Installation or Setting Up Instructions.

(1) Location. The refrigeration unit must be mounted securely in the refrigerator wall. The evaporator air outlet and return must not be restricted by anything inside the refrigerator. The condenser must not be restricted by any type of covers. Adequate space should be provided at the front and sides of the unit for opening the doors in service or maintenance procedures.

(2) Outdoor Installation. Installation consists of positioning the unit in the refrigerator wall and securing the unit with four mounting studs in the unit and four angles (figure 4-1A). Tighten unit to maximum limit of gasket compression provided by wood limit strips.

(3) Indoor Installation. Same as outdoor.

WARNING

DO NOT OPERATE THE GASOLINE ENGINE POWERED REFRIGERATION UNIT IN AN ENCLOSED AREA UNLESS THE EXHAUST GASES ARE PIPED TO THE OUTSIDE. INHALATION OF EXHAUST FUMES WILL RESULT IN SERIOUS ILLNESS OR DEATH.

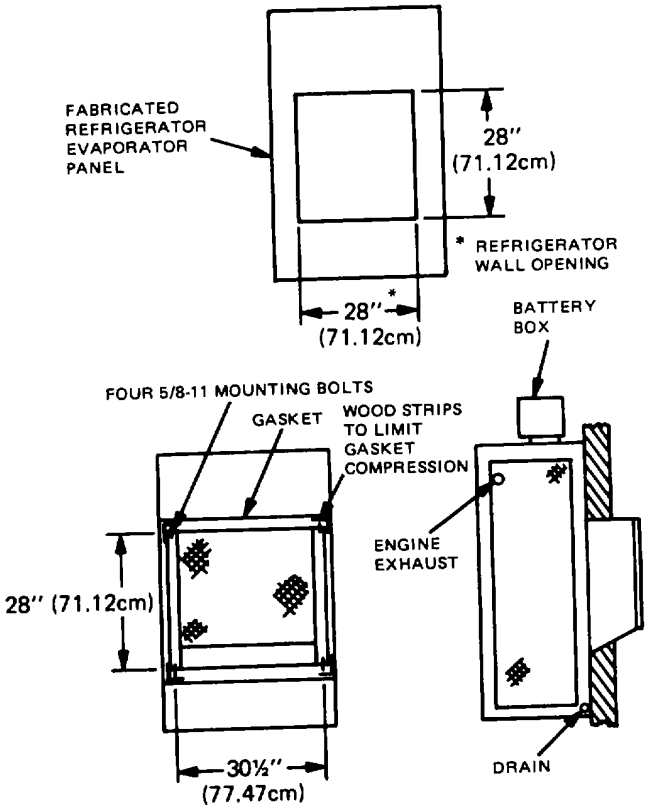


Figure 4-1A. Installation Diagram

4-4. INSTALLATION, SETTING UP, DISMATLING AND REINSTALLATION (cont)

c. Dismantling for Movement.

(1) Limited Movement. For moving a short distance, involving limited handling, it is necessary only to detach the unit from the refrigerator and use forklift equipment to place the unit on a transport vehicle.

(2) Extensive Movement. Pump down refrigerant and close all refrigerant valves. Detach the unit from the refrigerator. Seal all openings in the cabinet with barrier material and sealing tape. Cover entire unit with barrier material. Repack the unit in its original shipping crate, using the reverse of para 4-3b. Use forklift equipment to place the unit in a transport vehicle.

d. Reinstallation After Movement. Refer to paragraph 4-4b, Installation or Setting Up Instructions.

4-4.1. ADMINISTRATIVE STORAGE.

a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.

b. Before placing equipment in administrative storage, current maintenance services and equipment serviceable criteria (ESC) evaluations should be completed, shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

c. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4-5. GENERAL

a. This section contains a tabulated listing of preventive maintenance checks and services which must be performed by organizational maintenance at quarterly intervals. A quarterly interval is equal to 3 calendar months, or 250 hours of operation, whichever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to table 4-1 for quarterly preventive maintenance services.

4-6. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES TABLE

WARNING

BEFORE STARTING PMCS MAKE SURE POWER SWITCH ON CONTROL PANEL IS "OFF." OTHERWISE, AUTOMATIC CONTROLS MAY START OPERATION OF EQUIPMENT AND CAUSE INJURY TO PERSONNEL.

Table 4-1. Organizational Preventive Maintenance Checks and Services Quarterly Schedule

Item No.	Item To Be Inspected	Procedures Check for and have Repaired, Replaced, Adjusted As necessary	For Readiness Reporting, Equipment is Not Ready/Available If:
		NOTE Visually inspect for evidence of lubricant and fuel leaks concurrently with the daily service checks. Lubricate in accordance with current lubrication order. NOTE The 6TN and or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available. Electrolyte (NSNs 6810-00-249-9354 and 6810-00-843-1640) have a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.	
1	Battery	Tighten loose cables and mountings. Remove corrosion. Fill to 3/8 inch (.95cm) above the plates. Clean vent holes in filler caps before installation. in freezing weather, run engine minimum of one hour after adding water. Replace a cracked or leaking battery.	Dead battery.
2	Fan Belt	Adjust belt to proper tension. Replace a worn, frayed or cracked belt.	Belts are cracked.
3	Spark Plug	Replace spark plug that has a cracked insulator or burned electrodes. Clean and set spark plug gap to 0.025 inch (.063cm). Torque spark plugs to 25 to 30 foot pounds (33.9 to 40.68 Newton Meters). Replace lead which is frayed or broken. Clean and tighten lead connections.	Corroded or cracked spark plug.

Table 4-1. Organizational Preventive Maintenance Checks and Services Quarterly Schedule (Cont)

Item No.	Item To Be Inspected	Procedures Check for and have Repaired, Replaced, Adjusted As necessary	For Readiness Reporting, Equipment is Not Ready/Available If:
4	Air Cleaner	Clean as required. This service will vary from a few days operation in comparatively clean conditions to twice a day in dusty conditions.	Dirty air cleaner.
5	Breaker Points	Replace pitted or burned breaker points. Proper point gap adjustment is 0.020 inch (.051cm). Check adjustment every 200 hours of operation.	Pitted or burned points.
6	Engine Oil Level	Add oil as indicated by the engine oil level indicator (dip-stick). Refer to current lubrication order.	Low or no oil.
7	Compressor Drive Belts and Alternator Belt	Adjust belts to proper tension. Replace worn, frayed or cracked belts. If one belt is badly worn, both belts must be replaced.	Cracked belts.
8	Governor Linkage	Inspect and clean governor linkage. Adjust governor system for correct engine speed.	Worn linkage.
9	Fuel Filter	Tighten thumb nut if leaking. Clean a dirty filter element.	Dirty or clogged filter.
10	Compressor Sight Glass	Oil level should be halfway up sight glass. Refer to Direct Support Unit for adding oil.	Cracked or broken sight glass.
11	Fuel Tank	Add fuel as required. Tighten loose mounting. Replace leaking fuel tank. cap gaskets. Clean fuel cap strainer.	Leaking fuel tank. Replace
12	Operation Noise or Vibration	During operation, observe for any unusual noise or vibration.	
13	Refrigeration System	Check visually and check with halide detector all connections of the refrigeration system for leaks. Check liquid line sight glass for air bubbles or milky appearance. Report deficiencies to Direct Support Unit.	Refrigerant leaks.

4-7. FUEL FILTER SERVICE

Disconnect starter cable at starter. Refer to figure 4-2 and service the fuel filter.

NOTE

Be sure fuel shutoff valve is closed before servicing fuel filter. Service fuel filter after each 100 hours of operation. Clean the screen and bowl with an approved cleaning solvent.

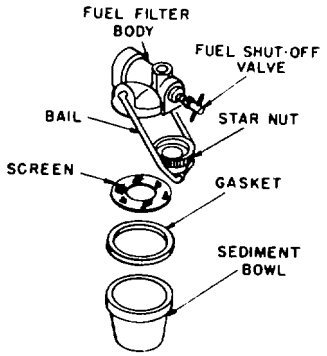
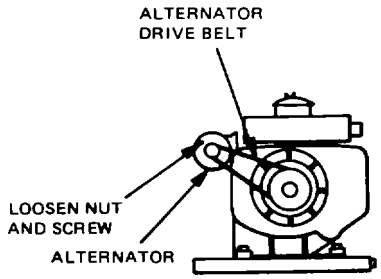


Figure 4-2. Fuel Filter Service

4-8. FAN AND ALTERNATOR V-BELT ADJUSTMENT

Refer to figure in para 2-9g and adjust the fan V-belt to three-fourths inch finger deflection midway between the pulleys. See figure 4-3 for alternator V-belt adjustment.



NOTE: MOVE ALTERNATOR FORWARD TO TIGHTEN BELT, OR AWAY TO LOOSEN. RETIGHTEN NUTS AND SCREWS AFTER OBTAINING PROPER BELT TENSION.

Figure 4-3. Alternator Fan V-Belt Adjustment

4-9. COMPRESSOR DRIVE V-BELT ADJUSTMENT

Refer to figure 4-3A and adjust compressor drive V-belt.

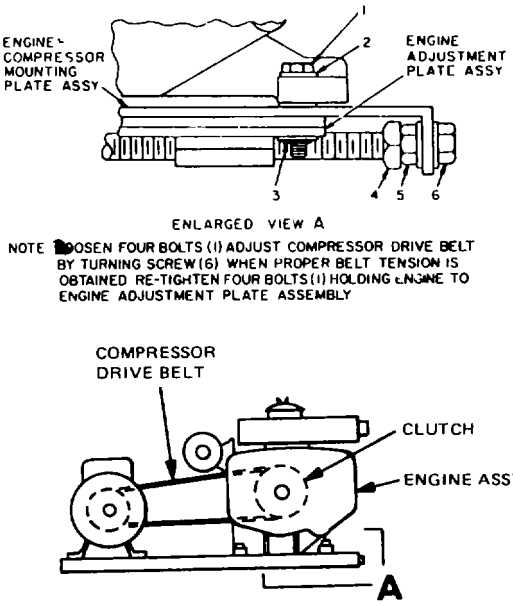


Figure 4-3A. Compressor Drive V-Belt Adjustment and Engine Mounting

4-10. FUSE REPLACEMENT

Refer to figure 4-4 for fuse replacement. Remove fuse cap and fuse. Install new fuse, as necessary, and replace fuse cap.

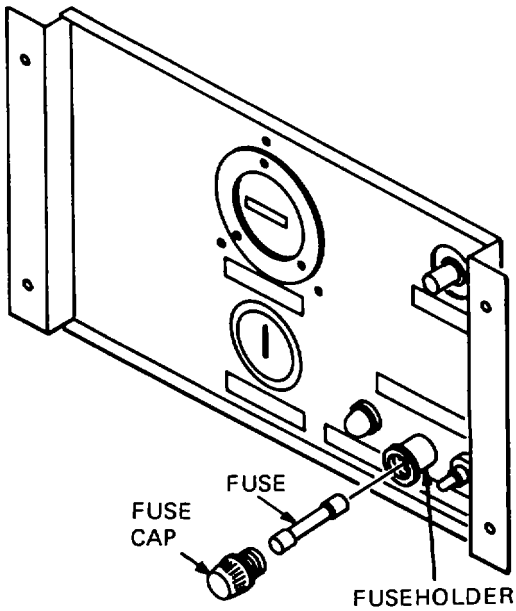


Figure 4-4. Fuse Replacement 4-7

Section IV. ORGANIZATIONAL TROUBLESHOOTING

4-11. GENERAL

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the refrigeration unit. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

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 Direct Support Maintenance.

4-12. TROUBLESHOOTING TABLE

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 4-2. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
NOTE **The 6TN and or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available.** **Electrolyte (NSNs 6810-00-249-9354 and 68 10-00-843-1640) have a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.**
1. ENGINE FAILS TO CRANK WHEN STARTER BUTTON IS DEPRESSED.
Step 1. Check to see if electrolyte level in battery cells is above the top of the plates. If electrolyte is below top of plates, add distilled or clean water until electrolyte level is three-fourths of an inch above the separators. Recharge batteries or replace battery.
Step 2. Inspect for loose, corroded, or broken battery cables. Clean corroded cables. Tighten loose connections at battery, ground, and starter. Replace defective cables.
Step 3. Inspect and test starter assembly. Replace defective starter assembly.
Step 4. Inspect and test starter solenoid. Replace defective starter solenoid.
2. ENGINE CRANKS BUT FAILS TO START.
Step 1. Check for empty fuel tank. Refill fuel tank if empty or low.
Step 2. Check for dirty fuel filter, broken or clogged fuel line. Clean or replace fuel filter and/or fuel line.
Step 3. Check and test ignition system for timing, spark plug gap, worn points, improper gap setting, bad ignition coil or condenser, faulty spark plug wires. Tighten, adjust or replace plugs, points, coil or condenser, spark plug wires.
Step 4. Check for proper functioning of carburetor. Clean and adjust carburetor. Replace defective carburetor.
Step 5. Inspect and test for defective fuel pump. Replace fuel pump.
Step 6. Check for leaky intake manifold. Replace unrepairable gasket or intake manifold.

Table 4-2. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE (Cont)
3. ENGINE MISSES OR RUNS ERRATICALLY.
Step 1. Check for water or dirt in gasoline or for improper grade of gasoline.
Drain and refill tank with proper fuel.
Step 2. Check carburetor for proper functioning.
Adjust carburetor.
Step 3. Inspect for loose or defective spark plug leads.
Tighten, clean or replace spark plug leads.
Step 4. Check for loose or defective spark plugs.
Tighten, clean or replace spark plugs.
Step 5. Check for defective magneto.
Clean, regap, or replace points.
Step 6. Check for defective fuel pump.
Replace fuel pump.
Step 7. Check for leaky manifold.
Replace gasket or manifold.
4. ENGINE KNOCKS OR DEVELOPS EXCESSIVE NOISE.
Step 1. Check oil level.
Add oil to crankcase.
Step 2. Check to see if oil may be diluted.
Drain crankcase and refill with proper oil according to current lubrication chart.
Step 3. Check for proper grade of gasoline.
Drain and refill with proper grade.
Step 4. Check engine for proper timing.
Time engine.
Step 5. Inspect for worn muffler.
Replace muffler.
5. ENGINE STOPS SUDDENLY.
Step 1. Check fuel supply.
Refill fuel tank with gasoline.
Step 2. Check quality of gasoline for possible water, dirt or gum.
Drain and refill fuel tank with proper quality gasoline.
Step 3. Check engine for vapor lock.
Re-start engine after 15 minutes.
Step 4. Check for defective ignition system components.
Clean, adjust, repair or replace defective components.
6. ENGINE WILL NOT IDLE SMOOTHLY.
Step 1. Check setting of carburetor high speed needle valve.
Adjust high speed needle valve.
Step 2. Check quality of gasoline for water, dirt or gum.
Drain and refill with proper gasoline.
Step 3. Inspect fuel lines for restrictions or leaks.
Clean and replace lines.
Step 4. Check for defective ignition system components.
Clean, adjust, repair or replace defective components.

Table 4-2. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE (Cont)
7. ENGINE OIL PRESSURE LOW.
Check oil level and oil quality (too light or dilute).
Fill crankcase with proper oil according to current lubrication chart.
8. ENGINE OVERHEATS.
Step 1. Check for overload on engine.
Reduce load.
Step 2. Check for low crankcase oil supply.
Replenish oil to proper level.
Step 3. Check for correct grade and quality of oil.
Drain and refill with proper oil.
Step 4. Check engine for restricted air cooling circulation.
Ventilate engine for sufficient supply of fresh air for cooling and combustion.
Clean dirty or oily cooling fins.
Step 5. Check for restricted exhaust.
Clean or free restriction.
Step 6. Check for too rich fuel air mixture.
Adjust carburetor high speed needle valve.
Step 7. Check for faulty engine timing.
Time engine.
9. EXHAUST SMOKE EXCESSIVE.
Check for improper grade of engine oil.
Drain and refill. Refer to current lubrication chart.
10. ENGINE LACKS POWER.
Step 1. Inspect air cleaner for clogging.
Service air cleaner.
Step 2. Check for defective governor.
Adjust governor.
11. ENGINE OIL CONSUMPTION EXCESSIVE.
Check for leaky engine base drain plug.
Tighten or replace drain plug.
REFRIGERATION SYSTEM
12. REFRIGERATION UNIT WILL NOT OPERATE.
Step 1. Inspect thermostat for misadjustment.
Adjust or replace.
Step 2. Break or short circuit in wiring.
Trace wiring and repair.
13. REFRIGERATION UNIT RUNS CONTINUOUSLY.
Step 1. Check for low compressor speed.
Adjust engine governor; inspect drive belts for proper tension and adjust.

Table 4-2. Troubleshooting (cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
13. REFRIGERATION UNIT RUNS CONTINUOUSLY (cont).
Step 2. Check compressor discharge valve to see if closed too far. Turn valve stem out.
Step 3. Check for possible abnormally warm product load. Remove part of load or allow absorption of heat.
Step 4. Test for leaks through refrigerator walls or joints. Seal all leaks.
Step 5. Check to see if thermostat is set too low. Reset thermostat to desired setting.
Step 6. Inspect thermostat terminal leads for shorting. Repair leads or wiring.
Step 7. Inspect thermostat for contacts fused in closed position. Replace thermostat.
Step 8. Inspect for loose thermostat bulb. Tighten.
14. REFRIGERATION UNIT OPERATES TOO LONG.
Step 1. Check for loose compressor belts. Adjust drive belt tension.
Step 2. Check for abnormal heat leakage from refrigerator. Seal cracks, replace gaskets.
Step 3. Check for excessive product load. Remove part of load or allow more time for absorption of heat.
Step 4. Check for partially closed receiver inlet valve. Open valve as far as it will go.
Step 5. Check for dirty condenser. Clean condenser.
Step 6. Check evaporator coil for excessive frost. Defrost unit.
Step 7. Check for obstruction to air flow through evaporator. Clean dirt from evaporator or move stored material that restricts air circulation thru coil.
Step 8. Check thermostat for too low setting. Reset thermostat.
Step 9. Check for shorted thermostat. Repair wiring or replace thermostat.
15. OPERATION OF UNIT NOISY.
Step 1. Check for loose compressor pulley. Tighten pulley screws.
Step 2. Check bearing lubrication. Lubricate bearings.
Step 3. Inspect for unserviceable bearings. Replace bearings.
Step 4. Check for loose drive pulley. Tighten pulley screws.
Step 5. Inspect for worn belts. Replace belts.
Step 6. Check for loose evaporator fan or condenser fan. Tighten fan screws or replace fans as necessary.
Step 7. Check for fan blades striking housing. Align blades or orifices; or replace fan.

Section V. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

4-13. GASOLINE ENGINE REMOVAL

a. Remove screw (2, fig. 4-20) holding battery box cover (7,fig. 4-20). Disconnect negative battery cable (4, fig. 4-15).

b. Remove alternator (40, fig. 4-7) from engine by removing screws and washers (41, 42 & 47, fig. 4-7). Disconnect wiring to alternator and control panel.

c. Remove muffler (80, fig. 4-7) by removing four screws and washers (82, 83, fig. 4-7) and loosening screw (65, fig.4-7) to remove choke link (66, fig. 4-7). Disconnect electrical lead wire off sisson choke (67, fig. 4-7).

d. Remove air cleaner (1, fig. 4-7) by loosening screw (3, fig. 4-7).

e. Refer to paragraph 4-9 and loosen and remove compressor drive V-belts from clutch.

f. Close the fuel shutoff valve on fuel filter (7, fig. 4-6). Disconnect fuel pump-to-fuel filter line (3,fig.4-6) from engine.

g. Remove four bolts and washers (6, 7 &8, fig. 4-5) securing engine (20, fig. 4-5) to mounting plate (19, fig. 4-5). Lift engine out through side of unit.

4-14. CLEANING AND INSPECTION

a. Clean engine with an approved cleaning solvent and dry thoroughly.

b. Inspect engine for any external damage. Replace or repair defective parts.

4-15. INSTALLATION OF ENGINE

a. Reinstall engine in unit through side of unit. Secure engine (20, fig. 4-5) to mounting plate (19, fig. 4-5) with four bolts and washers (6, 7 & 8,fig. 4-5).

b. Connect fuel pump-to-fuel filter line (3, fig. 4-6) to engine at fuel filter fitting (6,fig. 4-6). Open fuel shutoff valve on fuel filter (7, fig. 4-6).

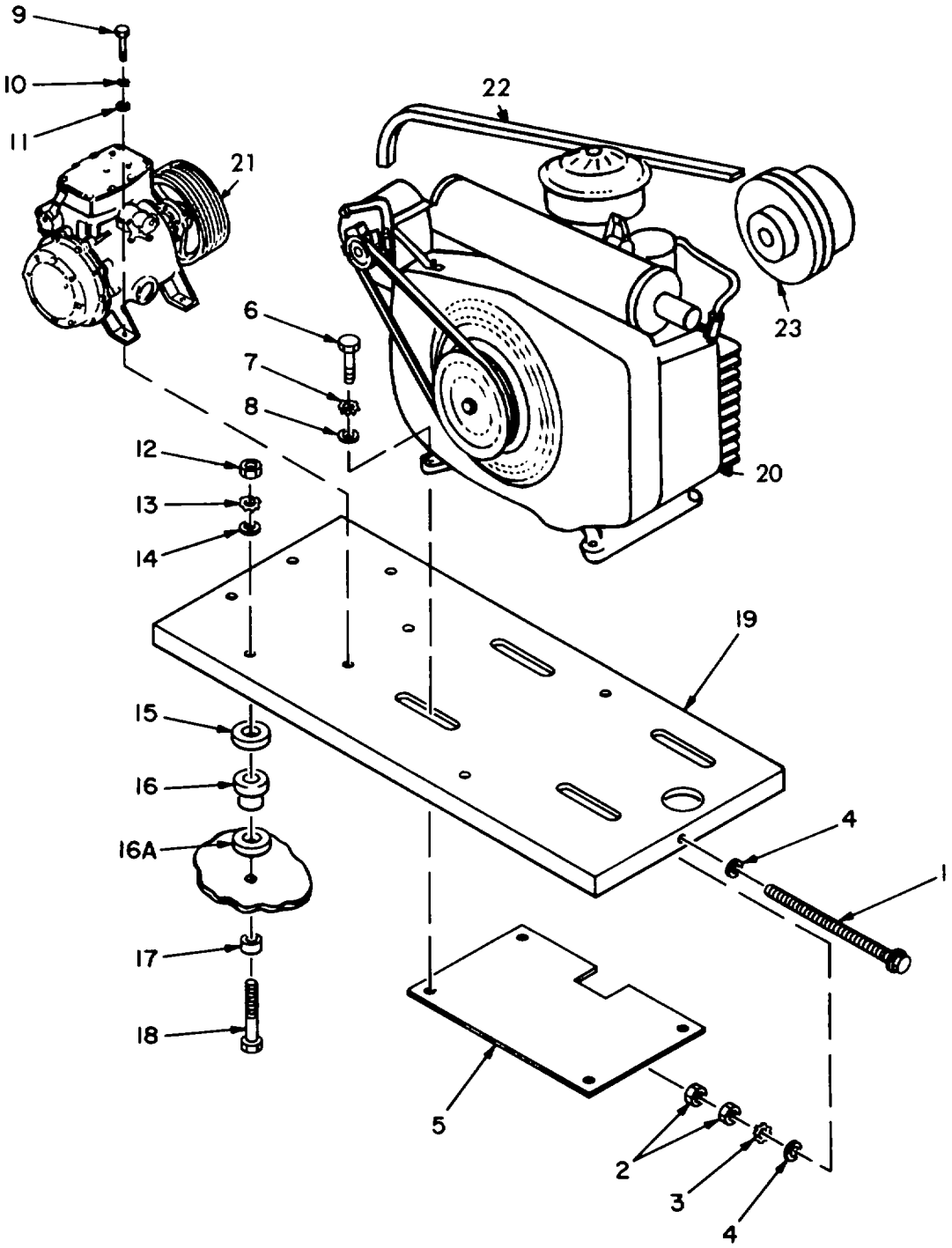
c. Replace compressor drive V-belts on to clutch and adjust belts. Refer to paragraph 4-9.

d. Install air cleaner (1, fig. 4-7). Tighten screw (3, fig. 4-7).

e. Install muffler (80, fig. 4-7) with four screws and washers (82, 83, fig. 4-7). Install choke link (66, fig. 4-7) into swivel choke (65A, fig. 4-7) and tighten screw (65, fig. 4-7). Connect electrical lead wire to sisson choke (67, fig. 4-7).

f. Replace alternator (40, fig. 4-7) on to engine with screws and washers (41, 42 & 47, fig. 4-7).

g. Connect negative battery cable (4, fig. 5). Close and secure battery cover with screw (2, fig. 4-20).



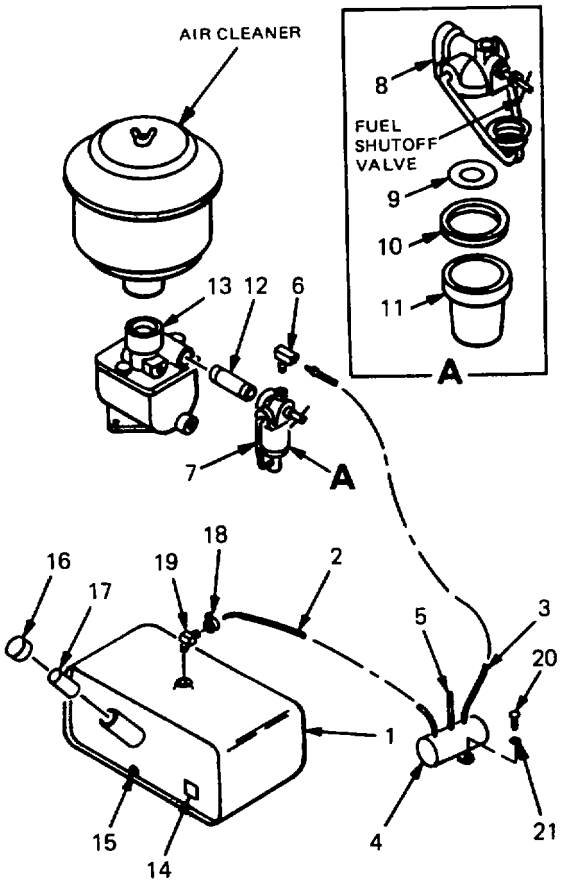
1. Screw
2. Nut, hex
3. Spacer
4. Washer, nylon
5. Plate
6. Screw
7. Washer, lock
8. Washer, flat
9. Screw
10. Washer, lock
11. Washer, flat
12. Nut, hex
13. Washer, lock
14. Washer, flat
15. Washer
16. Shock Mount
16A. Shim
17. Washer
18. Screw
19. Plate
20. Engine
21. Compressor
22. Compressor V-Belt
23. Clutch, centrifugal

Figure 4-5. Engine Removal

Section VI. FUEL SYSTEM

4-16. GENERAL

The fuel system (fig. 4-6) stores, cleans, pumps, carries and mixes with air, the gasoline needed to operate the engine. The fuel system consists of a 16-gallon gasoline storage tank, gasoline filter, fuel pumps, carburetor, carburetor air cleaner, governor, fuel lines and fittings and fuel shutoff valve.



1. Tank, gasoline
2. Line, fuel tank-to-fuel pump
3. Line, fuel pump-to-fuel filter
4. Fuel Pump
5. Wire, electrical
6. Fitting
7. Fuel Filter Assy
8. Head, fuel filter
9. Screen, filter
10. Gasket
11. Bowl, sediment
12. Nipple
13. Carburetor
14. Gauge, fuel
15. Plug, drain
16. Cap, fuel tank
17. Strainer
18. Clamp
19. Fitting
20. Screw
21. Washer

Figure 4-6. Fuel Filter, Lines, and Fittings

4-17. AIR CLEANER

a. Removal and Disassembly (fig. 3 1).

(1) Unscrew wing nut from mounting stud. Lift off cover and filter assembly.

(2) Loosen clamp under oil cup.

(3) Remove oil cup, with breather pipe off carburetor.

b. Cleaning and Inspection.

(1) Empty oil from oil cup.

(2) Wash cover and filter assembly and oil cup and breather pipe in an approved cleaning solvent. Dry parts thoroughly with clean, lint-free cloth.

c. Reassembly and Installation.

(1) Install oil cup with breather pipe on carburetor.

(2) Tighten oil cup clamp.

(3) Fill oil cup in accordance with current lubrication chart.

(4) Install cover and filter assembly over stud.

(5) Screw wing nut on stud finger-tight to secure air cleaner assembly.

4-18. FUEL FILTER

a. Removal and Disassembly (fig. 4-6).

(1) Disconnect battery cable at starter.

(2) Screw fuel shutoff valve on fuel filter (7) clockwise to full closed position.

(3) Disconnect fuel pump-to-fuel filter line (3) at filter (7).

(4) Loosen star nut on bail (fig. 4-1) to remove bowl (11) from head casting (8). Swing bail to one side. Remove filter screen (9) and gasket (10) from head casting.

(5) Unscrew head casting (8) from carburetor nipple (12).

b. Cleaning and Inspection.

(1) Empty sediment and gasoline from bowl. Dry bowl with clean, lint-free cloth.

(2) Blow all sludge from filter screen and fuel passages in head casting.

(3) Inspect all components for damage or deterioration. Check bail and bowl for dents or cracks. Inspect star nut for damaged threads. Replace defective parts with new items during reassembly.

c. Reassembly and Installation.

(1) Screw head casting (8) on carburetor nipple (12).

(2) Place gasket (10), filter screen (9), and bowl (11) in place. Swing bail in place and tighten star nut.

(3) Connect fuel pump-to-fuel filter line (3) at fuel filter (7).

(4) Turn fuel shutoff valve on fuel filter (7) counterclockwise to full open position.

4-19. CARBURETOR a. Removal (fig. 4-7).

(1) Remove air cleaner (para 4-17), fuel filter (para 4-18) and breaker mechanism box (para 4-36).

(2) Loosen screw (65) to release choke control link (66) at sisson choke lever.

(3) Remove clip (76) to release throttle link (75) at carburetor (52).

(4) Remove two screws (53) and lockwashers (54) that attach carburetor (52) to intake manifold (110).

(5) Remove carburetor and carburetor mounting gasket (52A). Remove choke control link from carburetor.

b. Installation (fig. 4-7).

(1) Align holes in carburetor mounting gasket (52A) and throttle body with holes in intake manifold (110). Attach carburetor (52) to intake manifold with two screws (53) and lockwashers (54).

(2) Assemble clip to throttle link (75) at carburetor.

(3) Insert end of choke control link (66) in hole of carburetor choke lever.

(4) Put choke control link (66) straight end in sisson choke lever hole and secure with screw (65).

(5) Assemble breaker box (95), fuel filter (56) and air cleaner (1) (para 4-17, 4-18 and 4-36).

c. Carburetor Main Adjustment Needle.

(1) If the engine runs unevenly at half or full load due to faulty carburetion, the main adjusting needle needs adjusting.

(2) Make the adjustment while the engine is running at normal operating temperature and with almost a full load connected to the engine.

(3) Turn the main adjusting needle out about two full turns. Then turn it slowly in until the engine begins to lose power and speed. Then turn it out very slowly until the engine runs smoothly at full power and speed.

d. Idle Needle Adjustment.

(1) When adjusting the idle jet needle, the engine should be running at normal operating temperature and without a load connected.

(2) Turn the idle adjusting needle in until the engine loses considerable speed. Then turn it out until the engine runs smoothly. A hunting condition at no load can sometimes be corrected by an idle adjustment.

4-20. FUEL PUMP

a. Removal (fig. 4-6).

(1) Disconnect fuel lines (2 and 3) from fuel pump (4).

(2) Disconnect electrical wire (5) from fuel pump (4).

(3) Remove two screws and washers (20 and 21) attaching fuel pump (4) to floor of unit. Remove fuel pump.

b. Installation(fig. 4-6).

(1) Align holes of fuel pump (4) with holes in floor of unit. Fasten fuel pump with two screws and washers (20 and 21).

(2) Connect fuel pump-to-fuel filter line (3) at fuel pump (4).

(3) Connect fuel tank-to-fuel filter line (2) at fuel pump (4).

(4) Connect electrical wire (5) to fuel pump (4).

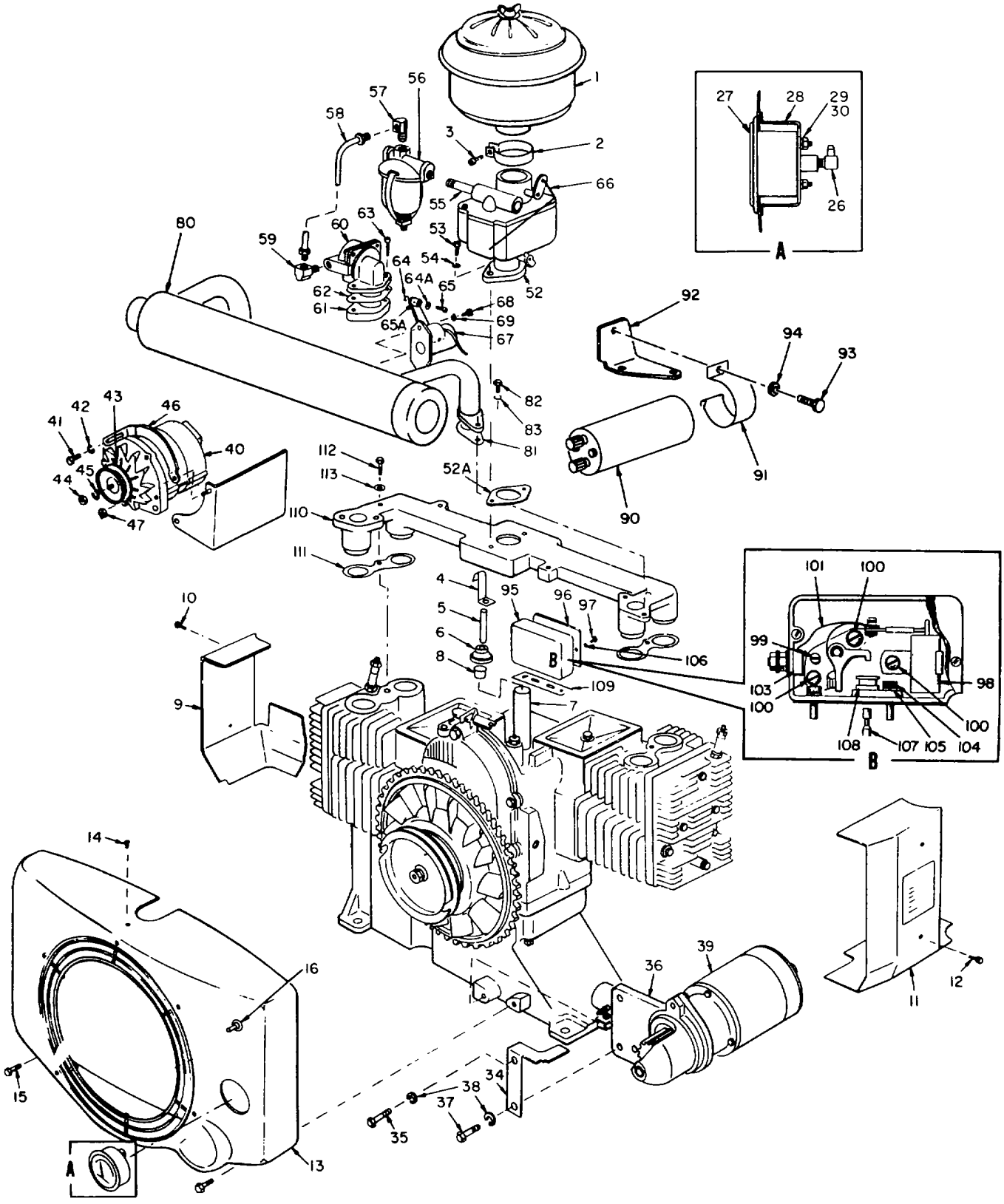


Figure 4-7. Engine Exploded View (Sheet 1 of 4)

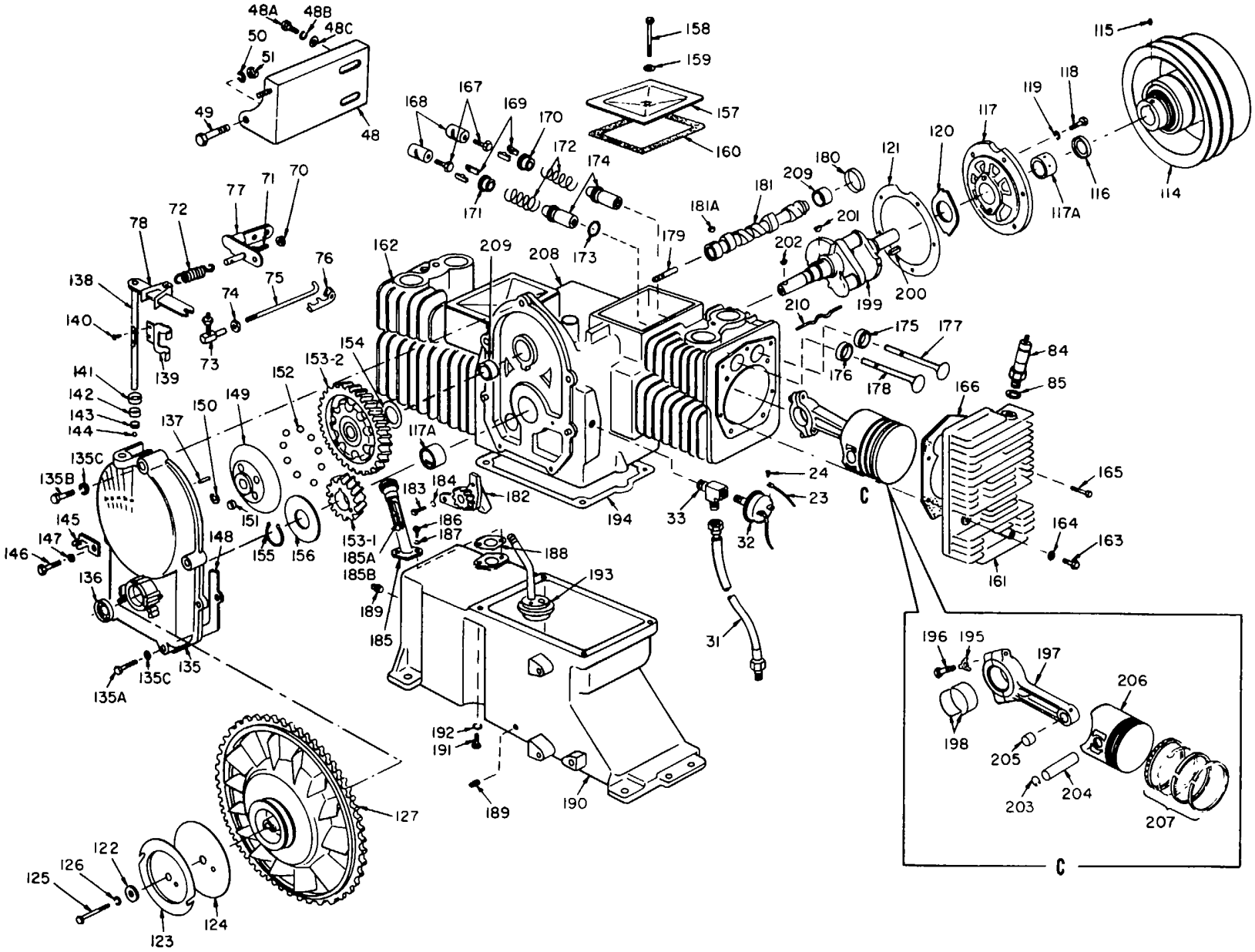


Figure 4-7. Engine Exploded View (Sheet 2 of 4)

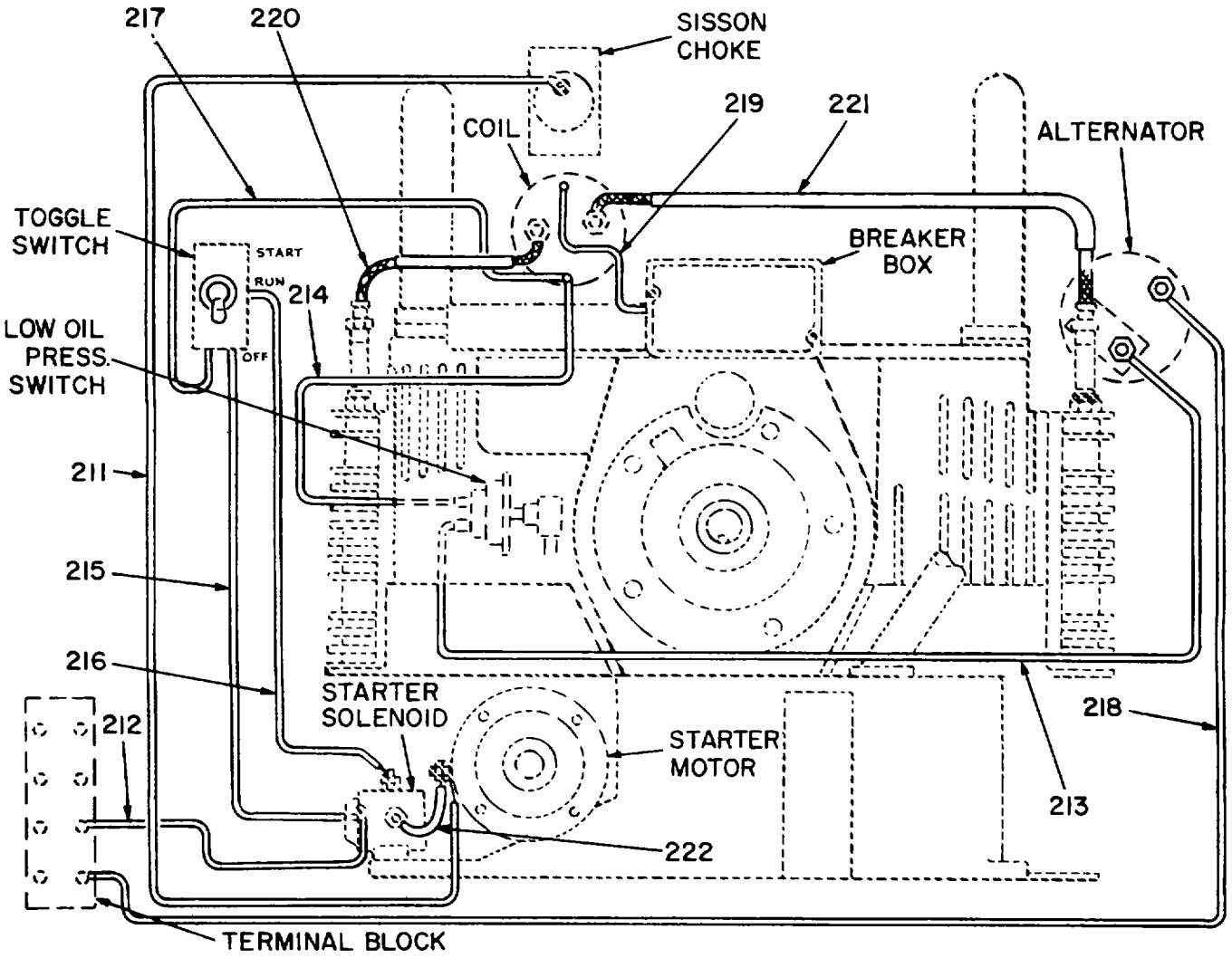


Figure 4-7. Engine Exploded View (Sheet 3 of 4)

LEGEND FOR FIGURE 4-7

1. Cleaner, air
2. Clamp
3. Screw Incl. w/Item 2
4. Bracket
5. Pipe, breather
6. Cap, breather tube
7. Breather tube assy
8. Baffle, breather tube
9. Housing, air cylinder (LH)
10. Screw
11. Housing, air cylinder (RH)
12. Screw
13. Housing, blower
14. Screw
15. Screw
16. Switch, toggle
17. Not Used
18. Not Used
19. Not Used
20. Not Used
21. Not Used
22. Not Used
23. Not Used
24. Screw
25. Terminal
26. Fitting
27. Gauge, oil pressure
28. Bracket
29. Washer, lock
30. Nut
31. Line, oil gauge
32. Switch, low oil press.
33. Tee, low oil pressure
34. Baffle, air
35. Screw
36. Flange, starter
37. Screw
38. Washer
39. Motor, starter
40. Alternator
41. Screw
42. Washer, lock
43. Pulley
44. Nut, pulley
45. Washer, lock
46. Bracket, alternator adj.
47. Nut
48. Bracket, alternator mtg
48A. Screw
48B. Washer, lock
48C. Washer, flat
49. Screw
50. Washer
51. Nut
52. Carburetor
52A. Gasket, carburetor mtg
53. Screw, hex cap
54. Washer, lock
55. Nipple, carburetor-to-fuel filter
56. Fuel filter
57. Fitting, fuel filter
58. Line, fuel pump-to-filter
59. Not Used
60. Not Used
61. Not Used
62. Not Used
63. Not Used
64. Pin, cotter
64A. Washer, flat
65. Screw
65A. Swivel, choke
66. Link, choke
67. Sisson choke
68. Screw
69. Washer
70. Nut, speed adj
71. Stud, speed adj
72. Spring, governor
73. Joint, ball
74. Nut, hex, throttle-to-ball-joint
75. Link, throttle
76. Clip, link end
77. Bracket, speed stud
78. Clip, governor sensitivity
79. Not Used
80. Muffler
81. Gasket, muffler
82. Screw, cap, self-locking
83. Washer
84. Plug, spark
85. Washer
86. Cable, ignition, 8 in.
87. Cable, ignition, 17 in.
88. Cable
89. Cable
90. Coil
91. Clamp, coil mtg
92. Bracket, coil mtg.
93. Screw, coil bracket
94. Washer
95. Ignition Breaker Box Assy
96. Cover, breaker box
97. Screw, breaker box cover
98. Condenser, .3 mfd
99. Pivot, breaker arm cam
100. Screw
101. Strap
102. Points, breaker
103. Terminal block
104. Screw
105. Washer, lock
106. Washer, lock
107. Plunger, breaker box
108. Guide, breaker box
109. Gasket, breaker box mtg
110. Manifold, intake
111. Gasket, intake manifold
112. Screw, intake manifold mtg
113. Washer, lock
114. Clutch, centrifugal
115. Setscrew
116. Seal, bearing plate
117. Plate, bearing
117A. Bearing, crankshaft
118. Screw
119. Washer, lock
120. Washer, crankshaft brg
121. Gasket, bearing plate
122. Washer, wheel mtg
123. Sheave, rope
124. Backplate, rope sheave
125. Screw, wheel mtg
126. Washer, lock flywheel mtg
127. Flywheel
128. Not Used
129. Not Used
130. Not Used
131. Not Used
132. Not Used
133. Not Used
134. Not Used
135. Gear Cover Assembly
135A. Screw
1358. Screw
135C. Washer, lock
136. Seal, gear cover
137. Pin, roll
138. Shaft and Arm Assembly
139. Yoke, governor shaft
140. Screw, yoke mtg
141. Seal, oil, governor shaft
142. Bearing, gov. shaft, upper
143. Bearing, gov. shaft, lower
144. Ball
144A. Gasket, gear cover
145. Clip
146. Screw
147. Washer
148. Gasket, gear cover
149. Cup, governor
150. Ring, camshaft center pin
151. Liner, plastic
152. Ball, flygovernor
153. Gear Set
154. Washer, thrust, camshaft
155. Ring, retainer
156. Plate (washer)
157. Cover, valve compartment
158. Screw, valve cover
159. Washer, valve cover
160. Gasket, valve cover
161. Head, cylinder, right No.2
162. Head, cylinder, left, No.1
163. Screw
164. Washer, flat
165. Screw
166. Gasket, cylinder head
167. Screw, valve adj
168. Tappet, valve
169. Lock, valve & spring retainer
170. Rotacap, exhaust valve
171. Rotacap, intake valve
172. Spring, valve
173. O-Ring
174. Guide valve
175. Insert, valve seat, exhaust
176. Insert, valve seat intake
177. Valve, exhaust
178. Valve, intake
179. Pin, camshaft, center
180. Plug, camshaft expansion
181. Camshaft
181A. Key, camshaft gear mtg
182. Pump, oil
183. Screw, oil pump
184. Washer, lock
185. Tube, oil fill
185A. Cap and Indicator, oil fill
185B. Gasket, oil fill cap
186. Screw, oil fill tube mtg
187. Washer, lock
188. Gasket, oil fill tube mtg
189. Plug, oil drain
190. Base, oil
191. Screw, oil base mtg
192. Washer, lock
193. Intake, oil pump
194. Gasket, oil base mtg
195. Washer, connecting rod screw lock
196. Screw, connecting rod
197. Rod, connecting
198. Bearing, connecting rod
199. Crankshaft
200. Key, clutch mounting
201. Key, crankshaft gear mtg
202. Key, wheel mtg
203. Ring, piston pin retainer
204. Pin, piston
205. Bushing, piston pin
206. Piston
207. Ring set
208. Block, crankcase
209. Bearing, camshaft
210. Tube, crankcase oil
211. Lead, choke to starter motor
212. Lead, terminal block to solenoid
213. Lead, switch to alternator
214. Lead, switch to coil
215. Lead, start switch to solenoid
216. Lead, start switch to solenoid
217. Lead, start switch to coil
218. Lead, terminal block to alternator
219. Lead, breaker box to coil
220. Lead, spark plug wire
221. Lead, Spark plug wire
222. Lead, solenoid to starter motor

4-21. FUEL LINES AND FITTINGS

a. Removal (fig. 4-6).

(1) Remove drain plug (15) and drain gasoline tank (1) of fuel.

(2) Disconnect and remove fuel tank-to-fuel pump line (2).

(3) Disconnect and remove fuel pump-to-fuel filter line (3). Unscrew fittings (6) and (19) and nipple (12).

(4) Unscrew filter sediment bowl (11) from fuel filter assembly.

b. Cleaning and Inspection

(1) Clean all lines and fittings and filter sediment bowl in an approved cleaning solvent. Use compressed air to blow all dirt and sludge from fuel passages. Dry external surfaces with clean, lint-free cloth.

(2) Inspect fuel lines for cracks, dents, and other damage. Pay particular attention to root of flare. Check fittings and shut-off valve for damaged threads and other defects. Check operation of fuel shut-off valve on fuel filter assembly. Replace all defective parts.

c. Installation (fig. 4-6).

(1) Install filter sediment bowl (11) to fuel filter assembly (7).

(2) Screw fitting (6) to fuel filter assy (7).

(3) Install nipple (12) between fuel filter assembly (7) and carburetor (13).

(4) Connect fuel pump-to-fuel filter line (3).

(5) Connect fuel tank-to-fuel pump line (2).

(6) Screw in drain plug (15) to gasoline tank (1).

4-22. SISSON CHOKE (FIG. 4-8)

a. The sisson choke should not require any seasonal adjustment. If adjustment becomes necessary, pull choke lever up and insert a 1/16-inch diameter rod through shaft hole (opposite end from lever) and engage rod in notch of mounting flange to lock shaft in place.

b. Loosen the choke lever clamp screw. With air inlet removed, adjust choke lever so carburetor choke plate is completely closed, or not more than 5/16-inch open. Tighten choke lever clamp screw and remove locking rod from shaft.

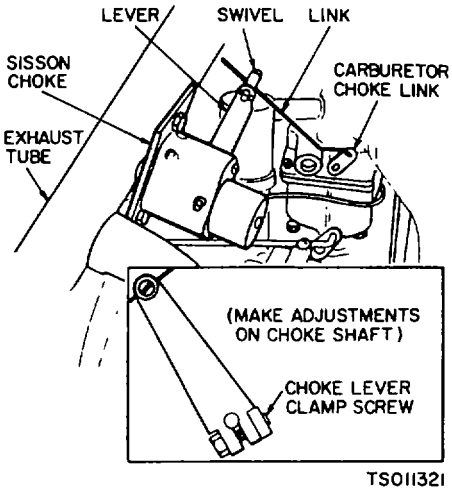


Figure 4-8. Sisson Choke

4-23. GOVERNOR AND THROTTLE CONTROLS

a. Cleaning and Inspection.

(1) Clean all parts in an approved cleaning solvent. Dry parts with clean lint-free cloth.

(2) Inspect all parts for cracks, breaks, and signs of wear. Examine spring for set or out-of-round. Refer to Direct Support Unit for repair or replacement.

b. Governor System Adjustments (fig. 4-9 and fig. 4-10).

(1) Adjust carburetor for best operation. Refer to paragraphs 4-19c and 4-19d.

(2) Governor linkage adjustment.

(a) The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft is adjusted by rotating the ball joint in or out. The locknut sets the distance.

(b) Adjust this length so that with the engine stopped and with tension on the governor spring, the stop on the carburetor throttle shaft just contacts the underside of the carburetor bowl.

(3) Linkage check.

(a) Check the governor arm and linkage, throttle shaft and lever for binding or excessive slack and wear at connecting points. A binding condition will cause the governor to act slowly and regulation will be poor. Excessive looseness will cause a hunting condition and regulation will be erratic. Work the arm back and forth several times by hand while the engine is idle.

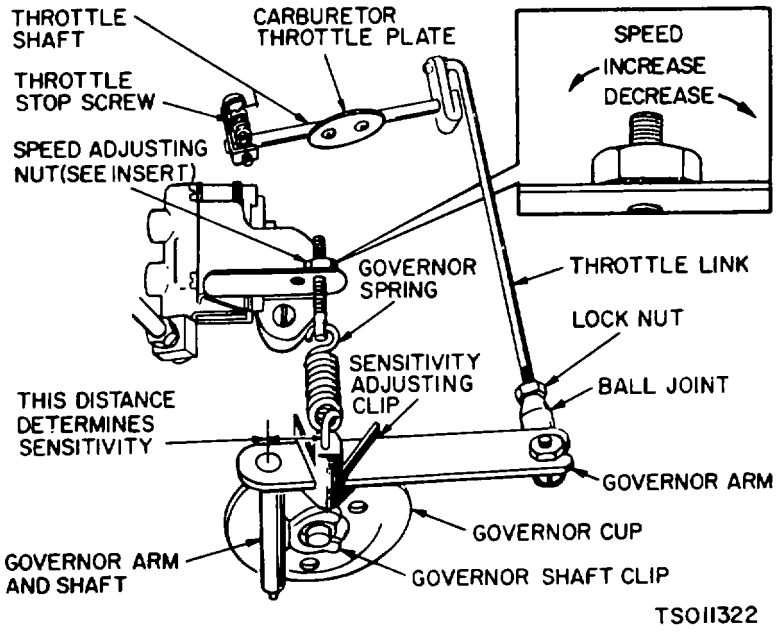


Figure 4-9. Governor System Adjustments

(b) If engine binding still occurs or excessive looseness causes hunting, refer to Direct Support Unit.

(4) Speed adjustment.

(a) The speed at which the engine operates is determined by the tension applied to the governor spring. Increasing spring tension increases engine speed. Decreasing spring tension decreases engine speed. The no-load speed of the engine should be slightly higher than the speed requirements of the connected load.

(b) Adjust the engine speed by turning the speed adjusting nut clockwise or counterclockwise (fig. 4-9) to increase or decrease speed. Set the no-load speed of the engine at about 1800 rpm. Check speed with a tachometer.

(5) Sensitivity adjustment.

(a) Governor sensitivity depends upon the position of the arm end of the governor spring. A sliding clip provides for adjustment. To increase sensitivity, shift the adjusting clip toward the governor shaft. To decrease sensitivity shift the adjusting clip toward the linkage end of the governor arm.

(b) Too sensitive a setting will result in a surging speed (hunting) condition (alternate increase and decrease in engine speed). An opposite setting will result in too much speed variation between no-load and full-load conditions. Thus the correct position of the clip will result in the most stable speed regulation without causing a surge condition.

(c) Always check the speed adjustment after a sensitivity adjustment. Increasing sensitivity will cause a slight decrease in speed and will require a slight increase in the governor spring tension.

(6) Throttle stop screw adjustment (fig. 4-10). Set the throttle stop screw at 1/32-inch (.080cm) from the manifold when the engine is operating with no load connected.

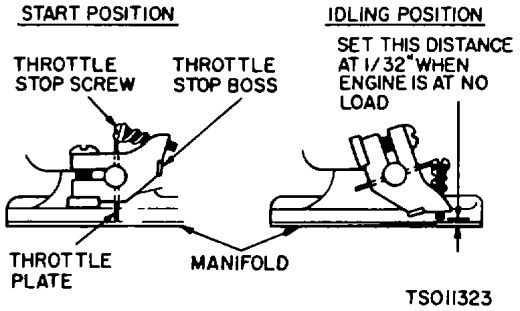


Figure 4-10. Throttle Screw Adjustment

Section VII. ENGINE LUBRICATION SYSTEM

4-24. GENERAL

The engine has pressure lubrication to all working parts. The oil system includes the oil intake cup, gear type oil pump, oil pressure gauge, oil filter, and oil passages to deliver oil throughout the engine. An oil pressure gauge (27, fig. 4-7) is mounted on the engine blower housing. Normal oil pressure should be 30 psi (206.85 kilopascals) or higher when the engine is at operating temperature. If pressure drops below 30 psi (206. 85 kilopascals) at governed speed, refer to Direct Support Unit.

4-25. OIL FILLER AND OIL LEVEL INDICATOR

The oil fill tube is capped with a cap and oil level indicator dip-stick. Refer to figure 4-11 for correct oil level indication. Always replace cap tightly to prevent dirt from entering the crankcase.

4-26. CRANKCASE BREATHER TUBE

The engine uses a crankcase breather valve for maintaining crankcase vacuum. Maintenance is generally not required. However, if the crankcase becomes pressurized as evidenced by oil leaks at the seals, refer to Direct Support Unit.

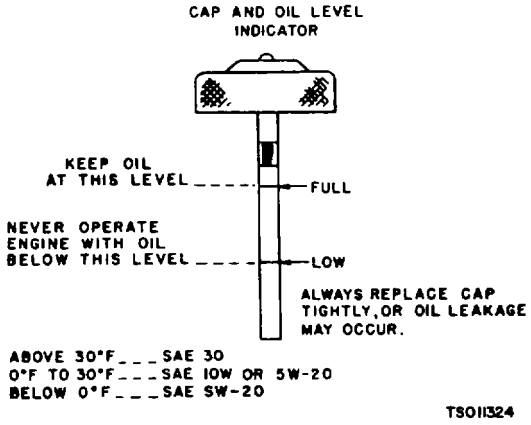


Figure 4-11. Cap and Oil Level Indicator

Section VIII. ENGINE ROPE STARTING SYSTEM

4-27. GENERAL

This system consists of a starting rope, sheave, and rope sheave backplate.

4-28. ROPE AND ROPE SHEAVE (FIG. 4-7)

a. Removal.

(1) Unscrew the wheel mounting screw (125) with a wrench .

(2) Remove screw (125), lockwasher (126), wheel mounting washer (122), rope sheave (123), and rope sheave backplate (124).

b. Cleaning and Inspection.

(1) Clean all removed parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect sheave and backplate for cracks, breaks and other damage. Inspect rope for excessive wear or cuts. Replace all defective parts.

c. Installation.

(1) Install backplate (124) and sheave (123) on flywheel (127) using guide pin on flywheel.

(2) Assemble with washer (122), lockwasher (126) and screw (125).

Section IX. EXHAUST SYSTEM

4-29. GENERAL

The exhaust system consists of a muffler with tube which carries the exhaust fumes out the top of the unit.

4-30. MUFFLER (FIG. 4-7)

a. Removal.

(1) Loosen screw (65) that secures choke link (66) at sisson choke's (67) lever. Remove choke link off choke lever.

(2) Remove four cap screws (82) that secure muffler (80) to intake manifold (110).

(3) Remove muffler (80) and gasket (81).

b. Cleaning and Inspection.

(1) Use wire brush or scraper to clean all parts. Blow all dirt from parts. Repoint cleaned bored areas.

(2) Inspect all threads. Check all parts for cracks, bends, dents or other visible damage. Replace defective parts.

c. Installation.

(1) Make sure all threaded areas are clean. Apply graphite paste to all male pipe threads.

(2) Mount muffler (80) and gasket (81) on intake manifold (110). Align holes and replace cap screws (82).

(3) Replace choke link (66) and adjust sisson choke (67) per paragraph 4-22.

Section X. INTAKE MANIFOLD

4-31. GENERAL

The intake manifold is an iron casting installed between the muffler and cylinder block.

4-32. INTAKE MANIFOLD (FIG. 4-7)

a. Removal.

(1) Remove air cleaner (para 4-17a).

(2) Remove fuel filter (para 4-18a).

(3) Remove carburetor (para 4-19a).

(4) Remove fuel pump (para 4-20a) and fuel lines (para 4-21a).

(5) Remove two hex head cap screws (112) and two washers (113) attaching intake manifold (110) to engine block (208).

(6) Remove intake manifold and two intake manifold gaskets (111) from block.

b. Clean and Inspect.

(1) Clean all parts except gaskets (111) in approved cleaning solvent. Dry parts thoroughly with clean lint-free cloth.

(2) Inspect manifold for cracks, chips, and other damage. Check screws for damaged threads. Inspect tapped holes in crankcase and manifold for damaged threads. Retap holes if necessary. Inspect gasket for deterioration. Replace all repairable defective parts.

c. Installation.

(1) Position gaskets (111) between engine block (208) and intake manifold (110) to engine block with two cap screws (112) and washers (113).

(2) Reassemble fuel pump (para 4-20c), carburetor (para 4-19c), fuel filter (para 4-18c) and air cleaner (para 4-17c).

Section XI. ENGINE ELECTRICAL SYSTEM

4-33. GENERAL

The engine electrical system consists of a starter motor, starter solenoid, breaker mechanism, alternator, voltage regulator and battery.

4-34. STARTER SOLENOID

a. Removal (fig. 4-12).

(1) Disconnect battery cable (4, fig. 4-15).

(2) Disconnect starter cable (17). Disconnect harness wiring at solenoid (1).

(3) Remove two nuts (2) and washer (3) that attach solenoid to engine frame.

b. Clean and Inspect.

(1) Clean solenoid with an approved cleaning solvent and dry thoroughly.

(2) Inspect for cracks, dents and other damage. Replace if defective.

c. Installation (fig. 4-12).

(1) Align holes of starter solenoid (1)with holes on engine frame and attach with two nuts (2) and washers (3).

(2) Connect starter cable (17) and wires (A from harness to solenoid.

(3) Connect battery cable (4, fig. 4-15).

4-35. STARTER MOTOR

a. Removal (fig. 4-12).

(1) Remove blower housing (13, fig. 4-7) by removing three cap screws (15, fig. 4-7) and screw (14, fig. 4-7).

(2) Remove solenoid starter per paragraph 4-34a.

(3) Remove three cap screws (32) and washers (33) attaching starter mounting flange (31) to engine.

(4) Remove two cap screws (36) and lockwashers (35) attaching starter motor (34) to flange.

b. Clean and Inspect.

(1) Clean starter with a clean lint-free cloth.

(2) Inspect starter for cracks, chips, worn drive, and worn brushes. Refer to Direct Support unit for repairs.

c. Installation (fig. 4-12).

(1) Assemble starter mounting flange (31) to starter motor (34) using two cap screws (36) and lockwashers (35).

(2) Attach starter mounting flange with starter motor to engine with three cap screws (32) and washers (33).

NOTE

When installing starter to engine oil base, do not draw the mounting bolts up tight. The gears should have 0.004 inch (.010cm) to 0.007 inch (.018cm) backlash. Tap the starter in or out from the oil base to adjust. Then tighten bolts securely.

(3) Install solenoid starter per paragraph 4-34c.

(4) Install blower housing with screws (14, 15, fig. 4-7).

4-36. BREAKER POINT SERVICING

a. Remove two screws and cover on the breaker mechanism box 96, 97, fig. 4-7).

b. Remove both spark plugs (84, fig.4-7) so engine can be easily rotated by hand.

c. Remove two mounting screws (A, fig. 413) and pull points out of box just far enough so screw (B) can be removed. Replace points with a new set but do not completely tighten mounting screws (A).

NOTE

Each time new breaker points are installed, place a drop of oil on the point's pivot point.

d. Rotate engine clockwise (facing flywheel) by hand until points are fully open. Turn screw (C) until point gap measures 0. 020 inch (. 05cm) using flat thickness measuring gauge.

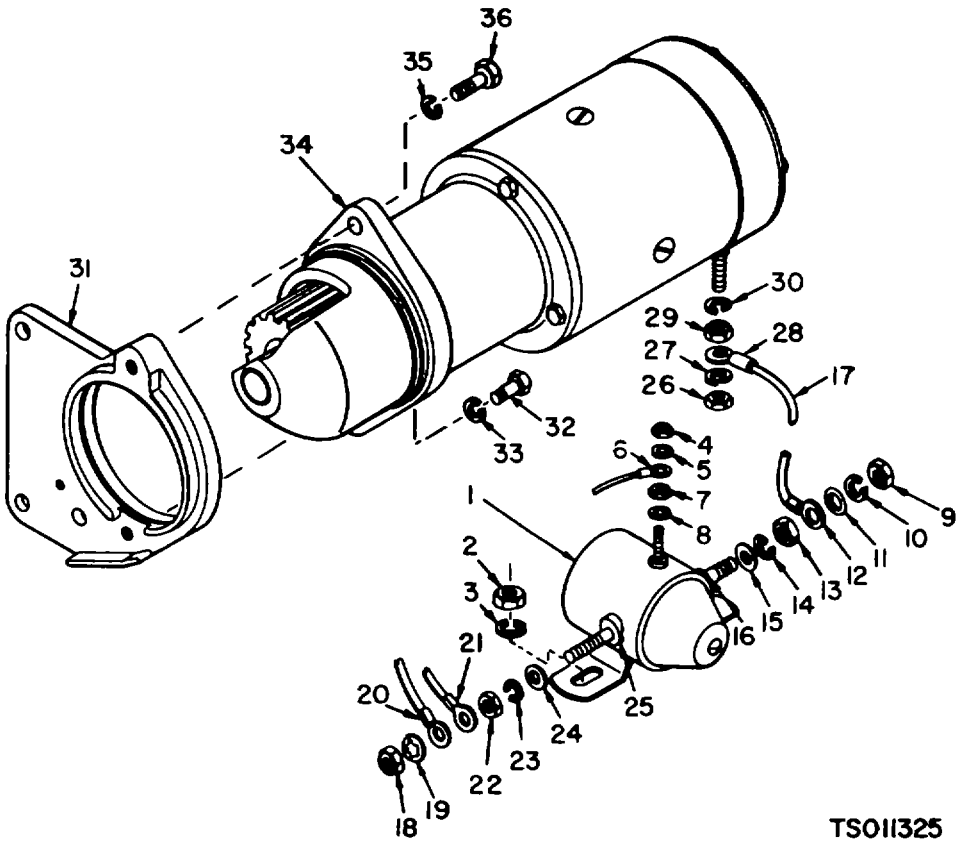
e. Tighten mounting screws and recheck gap.

f. Replace both spark plugs.

NOTE

If spark plugs have not been changed within 200 hours of operation, replace them with new ones after setting breaker points.

g. Proceed to ignition timing.



1. Solenoid, starter
2. Nut
3. Washer
4. Nut
5. Washer
6. Terminal
7. Nut
8. Washer
9. Nut
10. Washer, lock
11. Washer, flat
12. Terminal
13. Nut
14. Washer, lock
15. Washer, flat
16. Grommet
17. Cable, starter-to-solenoid
18. Nut
19. Washer, lock
20. Terminal
21. Terminal
22. Nut
23. Washer, lock
24. Washer, flat
25. Grommet
26. Nut
27. Washer, lock
28. Terminal
29. Nut
30. Washer, lock
31. Flange, starter mounting
32. Screw, cap
33. Washer, lock
34. Starter, motor
35. Washer, lock
36. Screw, cap
37. Terminal

Figure 4-12. Starter Motor and Starter Solenoid

4-37. IGNITION TIMING (FIG. 4-13)

a. Engine Running Timing. Always check timing after replacing ignition points or if noticing poor engine performance. Proceed as follows:

(1) To accurately check the ignition timing, use a timing light when engine is running. Connect the timing light according to manufacturer's instructions. Either spark plug can be used as they fire simultaneously.

(2) Place a white chalk or paint mark on the timing mark.

(3) Start the engine and check the timing.

(4) If timing needs adjustment, loosen the mounting screws on breaker box and move it left to advance or right to retard the timing.

(5) Tighten the screws on the breaker box and recheck timing.

(6) Replace breaker box cover and any other hardware removed.

b. Engine Not Running.

(1) Connect a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.

(2) Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).

(3) The lamp should go out just as the points break.

(4) If timing needs adjustment, loosen the mounting screws on breaker box and move it left to advance or right to retard the timing.

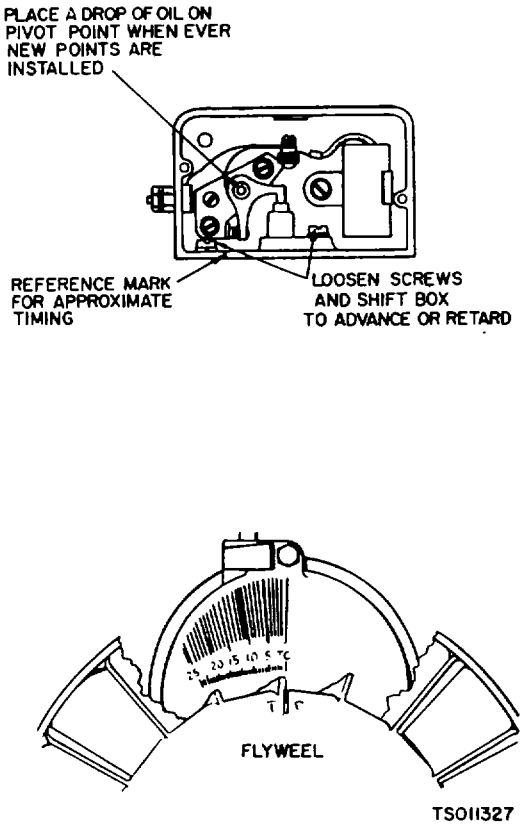


Figure 4-13. Ignition Timing

4-38. ALTERNATOR

The alternator (fig. 4-14) covered in this paragraph is designed for 12-volt negative ground electrical systems. The mechanical construction of the alternator differs from the DC generator in that the field rotates and the generating windings (armature) are stationary. The field current necessary to control the output of the alternator is supplied from the alternator. The regulator controls the current fed to the field via the brushes and rotor slip rings.

a. Testing Precautions.

(1) When making the "Alternator System Test, " the battery must be in good condition and fully charged so that the alternator output current can be completely controlled with an external load.

(2) DO NOT under any circumstances, short FIELD terminal of alternator to ground.

(3) DO NOT disconnect voltage regulator while alternator is operating.

(4) DO NOT disconnect load (alternator output lead) from alternator while the alternator is operating.

(5) DO NOT remove alternator from unit without first disconnecting the negative ( ) battery cable. If battery must be removed, disconnect negative cable first.

CAUTION

If a battery is being installed, make certain that the negative terminal is connected to ground. Reverse polarity will destroy rectifier diodes in the alternator.

b. Test Equipment Required.

(1) Volt-ampere tester such as the Sun Electric Model VAT-20 or equivalent with meter ranges shown below:

DC ammeter	0-60 ampere
DC ammeter	0-5 ampere
DC voltmeter	0-16 volt
Rheostat	40 ohm, capable of handling 3 amps
Carbon pile	45 ampere

(2) In-circuit diode tester (Sun Electric Model RDT or equivalent).

(3) Test lamp--12 volt DC.

(4) Ohmmeter-Any commercial type; not absolutely necessary, but can be helpful.

c. Isolation Diode Test. If it is suspected that the battery is being discharged with the ignition switch OFF, the cause could be a shorted isolation diode.

(1) Make sure that the regulator is connected to the alternator.

(2) Measure the voltage appearing at the auxiliary terminal. With the ignition switch OFF, the voltage should not exceed 0.1 volts. A voltage in excess of 0.1 volts indicates excessive leakage, and the diode should be replaced. Refer to direct support unit for replacement of the diode.

d. Alternator System Test. This test checks the current output of the alternator to determine if the system (alternator and voltage regulator) is functioning properly.

(1) With the engine off, disconnect output cable from alternator output terminal and connect an ammeter with a range of 0-60 amperes in series with output terminal and output cable (negative terminal of meter to positive terminal of battery).

(2) Connect a carbon pile load to the negative side of ammeter and negative battery terminals.

(3) Connect a voltmeter to alternator output terminal and negative ( ) battery terminal.

(4) Start engine (allow about 5 minutes for temperature stabilization), slowly increase load with carbon pile until minimum is reached (10 amperes). The voltage at the output terminal should be at least 13 volts but not more than 15 volts.

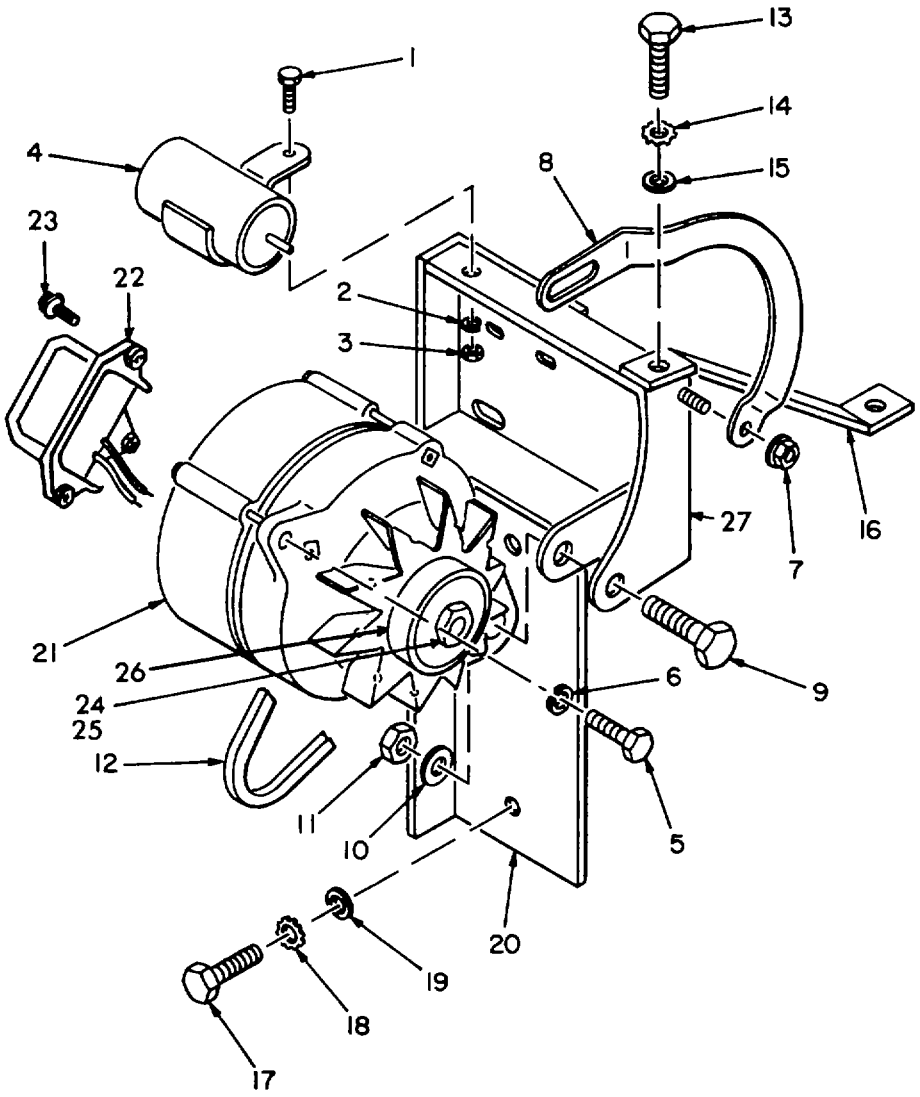
(5) If voltage exceeds 15 volts at rated current output (35 amperes), replace or check voltage regulator (para 4-39).

(6) If the rated output cannot be obtained at proper engine speed, check fan belt for proper tension.

NOTE

Remove carbon pile immediately after engine is stopped to avoid discharging battery when alternator is not operating. The alternator system is functioning properly if the output current is 25 amperes at alternator temperature of 75°F (23. 89°C).

(7) If the current output is below normal and the output terminal voltage exceeds 13 volts, replace alternator and/or regulator or refer to direct support unit for further testing.



1. Screw
2 Washer, lock
3. Nut, hex
4. Capacitor W/Clip
5. Screw
6. Washer, lock
7. Nut
8. Bracket
9. Screw
10. Washer, lock
11. Nut, hex
12. Belt
13. Screw
14. Washer, lock
15. Washer, flat
16. Alternator Plate
17. Screw
18. Washer, lock
19. Washer, flat
20. Alternator Plate
21. Alternator
22. Regulator, voltage
23. Screw
24. Nut, hex
25. Washer, lock
26. Pulley
27. Bracket, mounting

Figure 4-14. Alternator and Brackets

4-38. ALTERNATOR (cont)

d. (8) If output is below the minimum rated or the output terminal voltage is below 12 volts, proceed to "Alternator Test."

e. Alternator Test. This test excludes the regulator from the alternator system, thereby isolating the problem to either the regulator or alternator.

(1) With engine off, connect carbon pile load across battery (carbon pile in "OFF" position) and place 0-5 ampere meter in series with output terminal and (+) battery (positive meter to positive battery).

(2) Remove regulator screws. Place a folded wiping cloth over the isolation diode to prevent the regulator body from touching the sink on the output terminal stud.

(3) Disconnect regulator field wire from brush terminal.

(4) Connect field rheostat with knob set to maximum resistance, between the positive output terminal and the brush terminal.

(5) Connect voltmeter between the brush terminal (±) and the negative output terminal of alternator.

(6) Slowly reduce resistance of rheostat. If rheostat resistance can be fully eliminated with the test ammeter indicating 3.0 amperes or less, the rotor (field) circuit is correct.

(7) With rheostat eliminated, note reading on voltmeter and test ammeter. Slowly apply carbin pile load to the battery until voltmeter indicates reference voltage of 10.0 volts. The field current should be 1.95 to 2.55 amperes at 70° to 80°F (21. 1° to 26. 67°C).

(8) A slight variation in current may be noted if the rotor is moved during test, indicating slip rings and brushes require cleaning.

(9) Return carbon pile to "OFF" immediately after test to avoid discharging battery.

(10) Reconnect regulator and field wire.

f. Removal (fig. 4-14).

(1) Disconnect negative (-) battery cable (4, fig. 4-15) from battery.

(2) Disconnect cable from alternator to voltage regulator and all other wires. Carefully label each cable, wire and terminal.

(3) Remove screw (5) and lockwasher (6) from alternator (21).

(4) Remove nut (7) and adjusting bracket (8).

(5) Swing up alternator and detach belt (12).

(6) Remove screw (9), lockwasher (10) and nut (11) to release alternator (21) from unit.

(7) If alternator is to be replaced, remove nut (24), lockwasher (25) and pulley (26).

g. Cleaning and Inspection.

(1) Clean alternator with a clean lint-free cloth.

(2) Inspect alternator for dents, cracks, chips or other damage. Replace if defective or refer to direct support unit for repairs.

h. Installation (fig. 4-14).

(1) Install pulley (26) on alternator (21) using nut (24) and lockwasher (25).

(2) Place alternator in unit as in original configuration and secure with screw (9), lockwasher (10) and nut (11).

(3) Place alternator drive belt (12) on pulley.

(4) Assemble adjusting bracket (8) to mounting bracket (27) with nut (7).

(5) Fasten adjusting bracket (8) to alternator (21) with screw (5) and lockwasher (6). Adjust belt to proper tension before tightening (para 4-8).

(6) Connect cable from alternator voltage regulator and all other wires as in original configuration.

4-39. VOLTAGE REGULATOR

The voltage regulator (fig.4-14) is an all electronic, transistorized device. No mechanical contacts or relays are used to perform the voltage regulation of the alternator system. The electronic circuitry should never require adjustment and the solid state active elements used have proved reliable enough to warrant a sealed unit. The system is temperature compensated to permit the ideal charging rate at all temperatures.

4-39. VOLTAGE REGULATOR (cont)

a. Test. The regulator should be checked with an alternator that is functioning properly (para 4-28).

(1) Connect a 60 amp ammeter and a carbon pile load per paragraph 4-38d.

(2) Connect a DC voltmeter (16-volt range) with an accuracy of ± 0.1 volts to output terminal and negative (-) battery terminal.

(3) Start engine, increase load with carbon pile, if necessary, to obtain 10 amperes to output current. Operate for 15 minutes to stabilize temperature.

(4) Output terminal voltage must be 14.4 ± 0.4 volt at regulator ambient temperature of 75 ± 5°F (23.89° ± 1.59°C). Measure ambient temperature of regulator by placing a reliable thermometer I inch (2.54 cm) away from regulator case.

(5) If the ambient temperature is other than 75°F (23.89°C), see table 4-3 for correct voltage output.

(6) If voltage is not within limits specified, replace regulator and repeat test.

(7) Increase load with carbon pile until minimum rated current output is reached. Voltage at output terminal should be at least 13 volts but should not exceed maximum limits in table 4-3.

b. Removal(fig. 4-14).

(1) Disconnect cable from alternator at connector.

(2) Remove three screws (23) securing voltage regulator (22) to alternator.

c. Cleaning and Inspection.

(1) Clean voltage regulator with a clean lintfree cloth.

(2) Inspect voltage regulator for cracks, chips, dents and other damage. Replace if defective.

d. Installation (fig. 4-14).

(1) Align holes in voltage regulator (22) with holes in alternator as in original configuration and attach with three screws (23).

(2) Connect cable from alternator.

4-40. BATTERY

a. Charging.

(1) Use any commercial type battery charger for charging the battery. Refer to charger manufacturer's instructions for proper use of charger.

CAUTION

As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator. Possible damage to regulator may occur if the battery is charged without disconnecting the positive battery terminal. Most commercial charges contain a high AC ripple voltage which can be 4 or 5 volts in excess of the DC voltage indicated on charger. This voltage may exceed the maximum rating of rectifier diodes and regulator.

NOTE

The 6TN and or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available.

Electrolyte (NSNs 6810-00-249-9354 and 6810-00-843-1640) have a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.

b. Removal (fig. 4-15).

(1) Remove screw (l 1) securing battery cover. Open cover.

(2) Remove battery cables (4) and (5) from battery terminals.

(3) Remove battery hold-down bracket (7) by removing two screws, nuts and washers (8, 9 and 10).

(4) Lift battery (6) from battery box.

c. Cleaning and Inspection.

(1) Clean battery with an approved cleaning solvent and dry thoroughly.

(2) Inspect battery for cracks, chips, and other damage. Replace if defective.

d. Installation (fig. 4-15).

CAUTION

Observe proper polarity when installing battery; negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator.

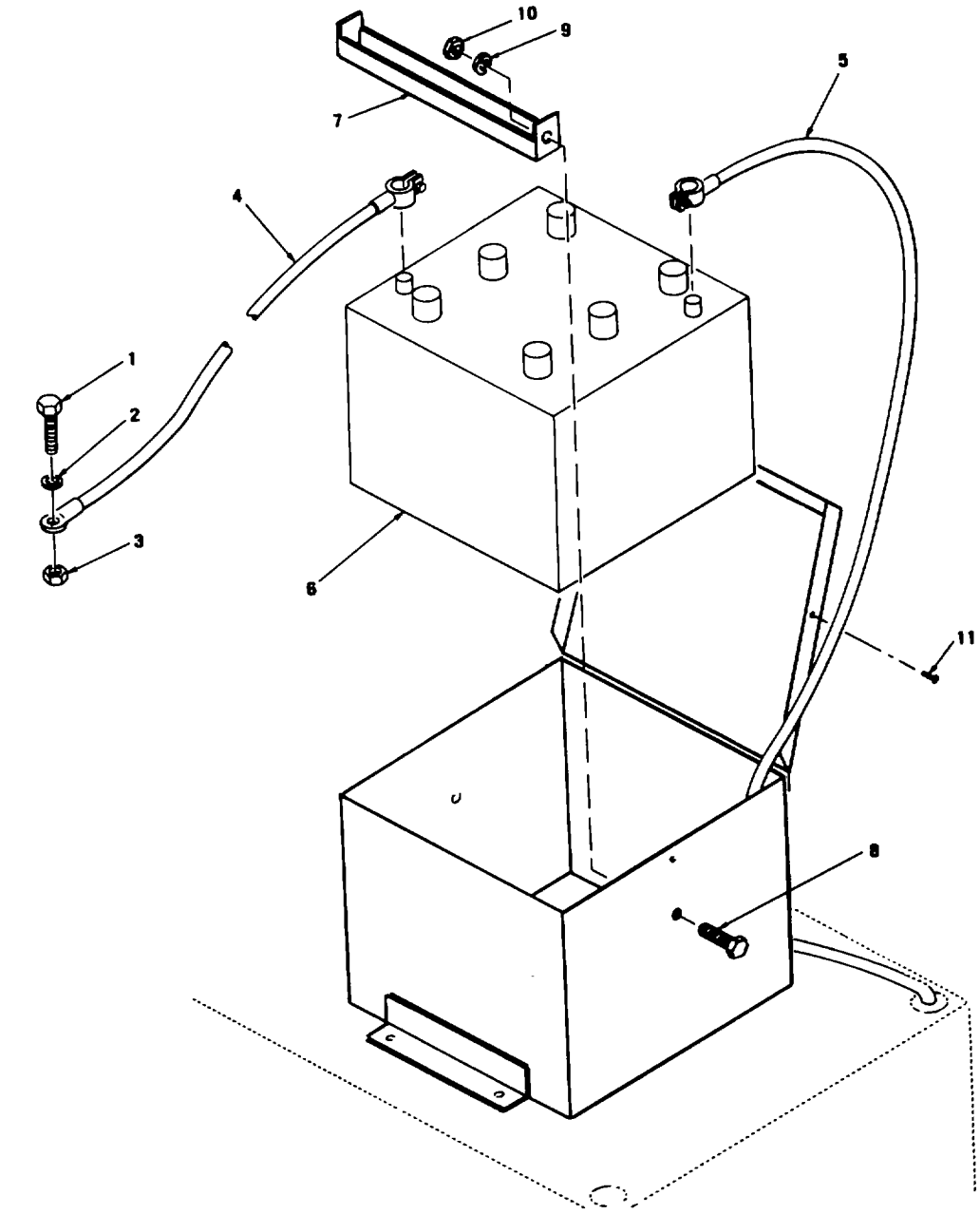
(1) Place battery (6) into battery box.

(2) Install battery hold-down bracket (7) with two screws, nuts & washers (8, 9 & 10).

(3) Fasten battery cables (4 and 5) tightly to proper battery terminals.

Table 4-3. Maximum and Minimum Voltage Limits

	0°F (-17.78°C)	20°F (-6.67°C)	40°F (4.4°C)	60°F (15.56°C)	80°F (26.67°C)	100°F (37.78°C)	120°F (48.89°C)	140°F (60°C)	160°F (71.1°C)
Minimum output terminal voltage (10 amp load)	14.60	14.45	14.26	14.13	13.95	13.80	13.65	13.60	13.30
Maximum output terminal voltage (12 amp load)	15.40	15.25	15.08	14.92	14.75	14.60	14.45	14.28	14.13



1. Screw
2. Washer
3. Nut
4. Cable
5. Cable
6. Battery
7. Bracket
8. Screw
9. Washer
10. Nut
11. Screw

Figure 4-15. Battery

Section XII. FANS, BELTS AND PULLEYS

4-41. GENERAL

This section provides instructions for removal, cleaning, inspection and installation of the condenser and evaporator fans, drive belts and pulleys.

4-42. CONDENSER FAN

a. Removal (fig. 4-16).

(1) Open right bottom side door (17, fig. 4-19).

(2) Loosen nut & washers (1, 2, 3) holding the condenser fan (4). Remove fan.

b. Cleaning and Inspection.

(1) Clean fan with an approved cleaning solvent and dry thoroughly.

(2) Inspect fan for cracks, dents, and other damage. Replace if defective.

c. Installation.

(1) Place key (39) on fan shaft and install fan (4) as in original configuration.

(2) Secure fan with nuts & washers (1, 2, 3).

4-43. FAN PULLEY AND CLUTCH

a. Removal (fig. 4-16).

(1) Refer to paragraph 4-42 and remove condenser fan (4).

(2) Loosen screws (16) securing sheave (1 5) to relieve tension on belt (36). Slip belt off rear of pulley (37).

(3) Loosen screw, washer and nut (24, 25 and 26) securing clutch handle (27) and clutch (5 1). Loosen setscrew to release pulley from fan shaft (38).

(4) Slide clutch and pulley offend of shaft. Use a suitable puller, if necessary. Remove key (39).

b. Cleaning and Inspection.

(1) Clean pulley and clutch with approved cleaning solvent and dry thoroughly.

(2) Inspect pulley for cracks, chips or other damage. Replace if defective.

(3) Replace defective or burned clutch.

c. Installation and Adjustment (fig. 4-16).

(1) Slide pulley (37) to key (39) on shaft (38). Slide clutch (51) on shaft. Secure pulley (37) as in original configuration with screw, washer, nut and clutch handle (24, 25, 26 & 27).

(2) Slip fan belt (36) on pulley (37). Adjust tension on belt by tightening screws (16) securing sheave (15).

(3) Refer to paragraph 4-42 and replace condenser fan (4).

4-44. EVAPORATOR FAN

a. Removal (fig. 4-16).

(1) Remove evaporator side access covers. (See figure 1-3.) (2) Loosen nut and washers (5, 6 and 7) securing evaporator fan (8) to shaft. Remove fan.

b. Cleaning and Inspection.

(1) Clean fan with an approved cleaning solvent and dry thoroughly.

(2) Inspect fan for cracks, dents or other damage. Replace if defective.

4-45. BEARINGS

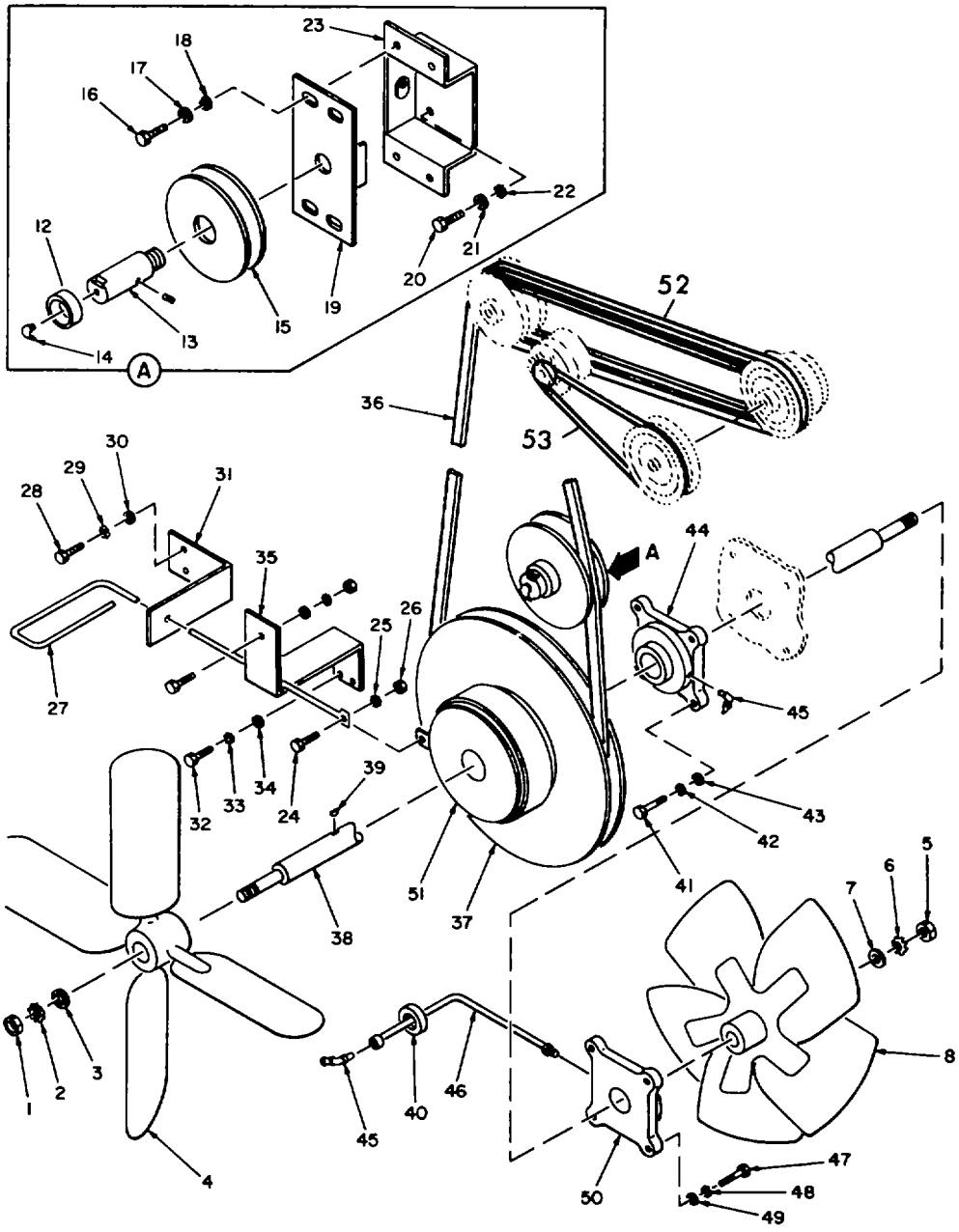
a. Removal (fig. 4-16).

(1) Remove condenser fan (4), evaporator fan (8), fan pulley and clutch (37 and 51) per paragraphs 4-42, 4-43, 4-44.

(2) Remove screw (41) and washers (42 & 43) that secure the front bearing (44).

(3) Remove bolt (47) and washers (48 and 49) securing rear bearing (50) and lube tubing (46)

b. Installation. Using serviceable shaft and bearings, reverse procedure above. Tighten belt as per paragraph 4-43c(2) above.



1. Nut, hex
2. Washer, lock
3. Washer, flat
4. Fan
5. Nut
6. Washer, lock
7. Washer, flat
8. Fan
9. Nut, hex
10. Not Used
11. Not Used
12. Not Used
13. Shaft
14. Fitting
15. Sheave
16. Screw
17. Washer, lock
18. Washer, flat
19. Mounting Plate
20. Screw
21. Washer, lock
22. Washer, flat
23. Bracket
24. Screw
25. Washer, lock
26. Nut
27. Handle
28. Screw
29. Washer, lock
30. Washer, flat
31. Bracket
32. Screw
33. Washer, lock
34. Washer, flat
35. Bracket
36. Belt
37. Sheave (Pulley)
38. Shaft
39. Key
40. Grommet
41. Screw
42. Washer, lock
43. Washer, flat
44. Bearing
45. Fitting
46. Tube Assembly
47. Screw
48. Washer, flat
49. Washer, lock
50. Bearing
51. Clutch
52. Belt, compressor drive
53. Belt, alternator

Figure 4-16. Blower Assembly and Controls

4-46. CENTRIFUGAL CLUTCH (FIG. 4-17)

a. Removal.

(1) Remove the gasoline engine from the refrigeration unit per paragraph 4-13a.

(2) Remove setscrew (1) and using appropriate puller, remove clutch off engine shaft.

b. Cleaning and Inspection.

(1) Inspect lining (4) for wear.

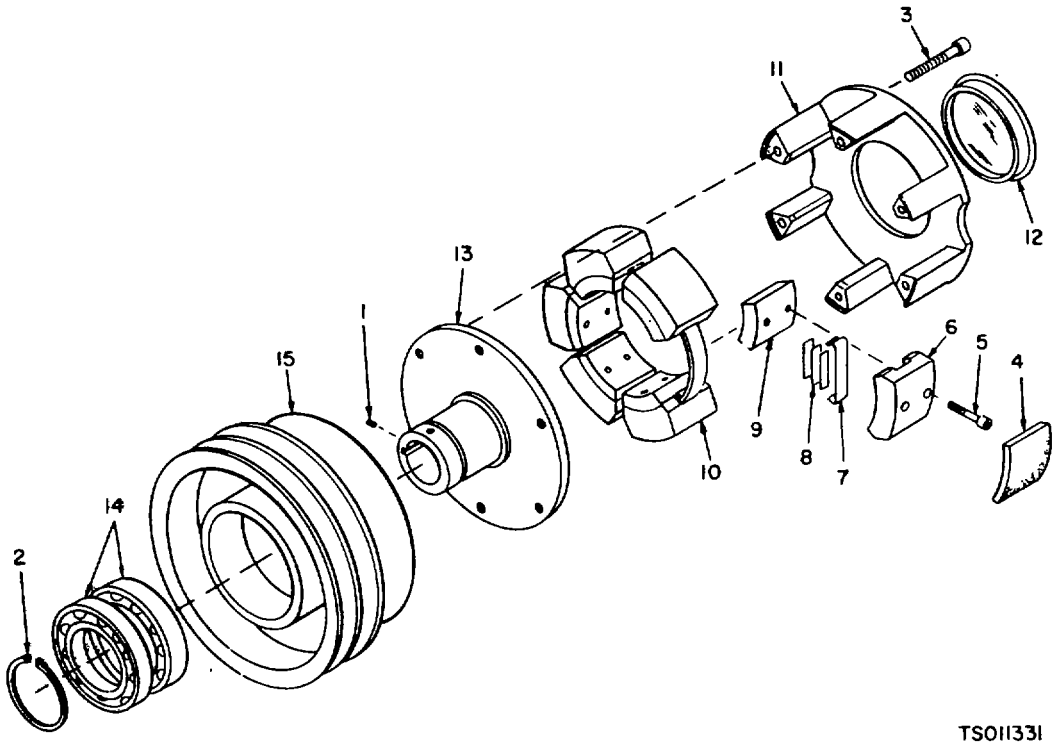
(2) Check ball bearings (14) for wear or damage.

(3) Clean all other clutch parts with an approved cleaning solvent and dry thoroughly. Replace defective linings and bearings.

c. Installation.

(1) Install clutch on engine shaft. Tighten setscrew(l).

(2) Reinstall engine per paragraph 4-15.



1.. Setscrew
2. Ring
3. Screw, cap
4. Lining
5. Screw, cap
6. Block, outer
7. Spring, hook
8. Spring, flat
9. Block, inner
10. Spring, hook
11. Body, drive
12. Plate
13. Flange, mounting
14. Bearing, ball
15. Body, driven

Figure 4-17. Centrifugal Clutch

Section XIII. CONTROLS AND INSTRUMENTS

4-47. GENERAL

a. The major controls and instruments consist of the control box assembly which includes an hourmeter, ammeter, thermostat, on-off switch, indicator lights, fuseholder and fuse. These items are mounted on the front panel of the control box.

b. Two plug-in relays are mounted on a printed circuit board on the back inside of the control box. These are an over-crank limit relay and starter relay.

c. A thermometer, compound pressure gauge, and high pressure gauge are mounted on right side of the front refrigeration unit chassis frame.

4-48. CONTROL PANEL REMOVAL(FIG.4-18)

a. Remove four screws and washers (1 & 2, fig. 4-18) holding control panel (3) to control box (39).

b. Carefully pull control panel from the unit to expose components for possible replacement.

c. Disconnect wiring to remove panel assembly, if necessary.

4-49. HOURMETER (FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a to open control panel. Carefully pull out the control panel. Try not to disturb the wiring.

(2) Remove No. 11 wire (positive)and No. 8 wire (negative) from back of hourmeter (13).

(3) Remove three screws (12) securing hourmeter to control box front panel.

b. Clean and Inspect.

(1) Clean hourmeter with a clean lint-free cloth.

(2) Inspect hourmeter for dents, cracks, or other damage. If hourmeter is defective, it must be replaced.

c. Installation

(1) Align holes in hourmeter (13) with holes in panel and secure with three screws (12).

(2) Connect No. 11 wire on positive terminal and No. 8 wire on negative terminal at back of hourmeter.

(3) Install control panel into refrigeration unit and fasten with four screws (1) and washers (2).

4-50. AMMETER (FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a and remove control panel.

(2) Disconnect all wires at ammeter (11) terminals; carefully label each terminal.

(3) Remove two nuts securing ammeter (11) to front panel bracket.

b. Clean and Inspect.

(1) Clean ammeter with a clean lint-free cloth.

(2) Inspect ammeter for dents, cracks or other damage. If ammeter is defective, it must be replaced.

c. Installation.

(1) Replace nuts that secure ammeter (11) to panel.

(2) Connect all wires as in original configuration.

(3) Install control panel with four screws and washers (1 and 2).

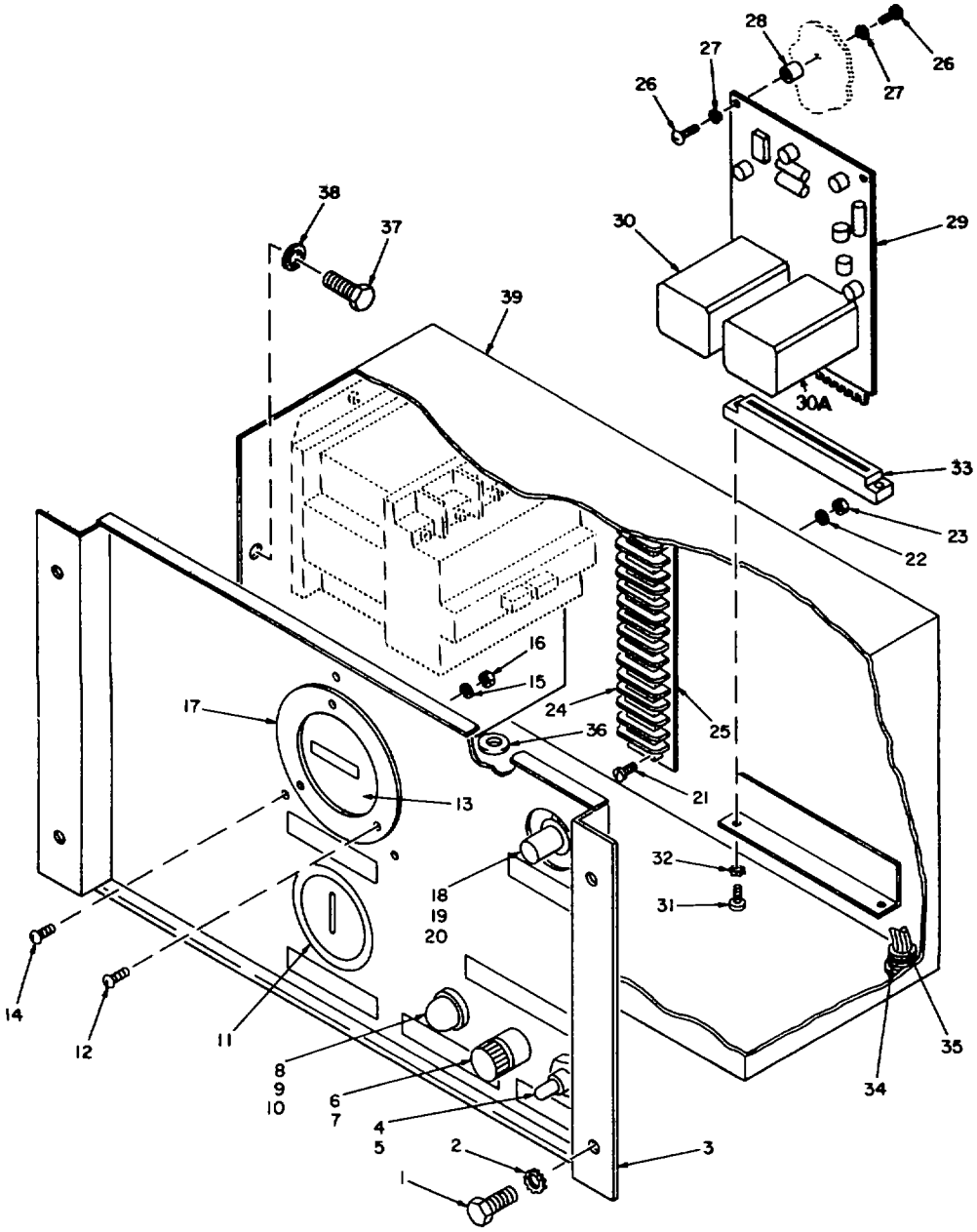
4-51. THERMOSTAT (FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a and open control panel.

(2) Disconnect all wires and carefully label each for proper terminal.

(3) Remove two screws (19) and washers (20) that secure thermostat (18) to panel.



1. Screw
2. Washer, lock
3. Door
4. Boot
5. Switch
6. Fuse
7. Fuseholder.
8. Lamp
9. Dome, red
10. Socket
11. Ammeter
12. Screw
13. Hourmeter
14. Screw
15. Washer
16. Nut
17. Dampner
18. Thermostat
19. Screw
20. Washer, lock
21. Screw
22. Washer, lock
23. Nut, hex
24. Terminal Block
25. Marking Strip
26. Screw
27. Washer, lock
28. Standoff
29. PC Card
30. Starter Relay
30A. Over-Crank Limit Relay
31. Screw
32. Washer, lock
33. Connector
34. Connector
35. Wiring Harness
36. Grommet
37. Screw
38. Washer, flat
39. Control Box

Figure 4-18. Control Panel

4-51. THERMOSTAT (cont)

b. Cleaning and Inspection.

(1) Clean thermostat with a clean lint-free cloth or compressed air.

(2) Inspect thermostat for cracks, chips, or other damage. Replace thermostat if defective.

c. Installation.

(1) Align mounting holes in thermostat (18) with hole in panel and secure with two screws (19) and washers (20).

(2) Replace all wires as in original configuration.

(3) Replace control panel with four screws and washers (1 and 2).

4-52. FUSEHOLDER (FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a and open control panel.

(2) Disconnect wires and carefully label each for proper terminal.

(3) Remove nut and lockwasher securing fuseholder (7) to control panel and remove fuseholder.

b. Cleaning and Inspection.

(1) Clean fuseholder with clean lint-free cloth.

(2) Inspect for cracks, chips, or other damage. Replace if defective.

c. Installation.

(1) Place fuseholder (7) in hole in control panel and secure with nut and lockwasher.

(2) Connect wires as in original configuration.

(3) Replace control panel with four screws and washers (1 and 2).

4-53. ON-OFF SWITCH (FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a and remove control panel.

(2) Remove retaining nut that secures switch (5) to panel at front of panel.

(3) Remove wires at rear of switch, carefully labeling each wire for correct terminal.

b. Cleaning and Inspection.

(1) Clean switch with a clean lint-free cloth.

(2) Inspect for cracks, chips, or other damage. Replace if defective.

(3) Replace control panel.

4-54. OVER-CRANK LIMIT RELAY(FIG. 4-18)

a. Removal.

(1) Refer to paragraph 4-48a and open control panel.

(2) Remove plug-in type over-crank limit relay (30A) from printed circuit board (29).

b. Cleaning and Inspection.

(1) Clean relay with a clean lint-free cloth.

(2) Inspect relay for cracks, chips, or other damage. Replace if defective.

c. Installation.

CAUTION

When reassembling relays (30 and 30A, fig. 4-18), don't push-in relays too forcefully. Printed circuit card may crack,

(1) Plug-in relay (30A) to printed circuit board (29).

(2) Replace control panel.

4-55. STARTER RELAY (FIG. 418)

a. Removal.

(1) Refer to paragraph 4-48a and open control panel.

(2) Remove plug-in type starter relay (30) from printed circuit board (29).

b. Cleaning and Inspection.

(1) Clean relay with a clean lint-free cloth.

(2) Inspect relay for cracks, chips, or other damage. Replace if defective.

c. Installation.

(1) Plug -in starter relay (30) to printed circuit board (29).

(2) Replace control panel.

4-56. THERMOMETER (FIG. 4-19)

a. Removal

(1) Carefully pull thermometer bulb thru the condenser section.

(2) Remove three screws (1), washers (3) and nuts (2) that secure thermometer (4) to the refrigeration unit frame and remove thermometer.

b. Cleaning and Inspection.

(1) Clean thermometer with a clean lint free cloth.

(2) Inspect thermometer for dents, cracks or other damage. Thermometer must be replaced if defective.

c. Installation.

(1) Align holes in thermometer (4) with holes in refrigeration unit frame and secure with three screws (1), washers (3) and nuts (2).

(2) Carefully thread thermometer bulb through condenser to panel and grille in rear of evaporator section.

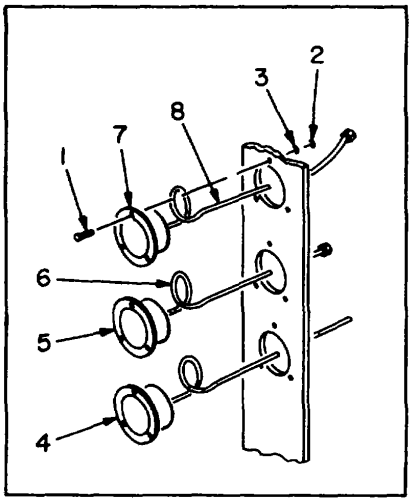


Figure 4-19. Thermometer

Section XIV. DOORS, FRONT GRILLE AND TOP SCREEN AND BATTERY BOX

4-57. GENERAL

The doors, grille, screen and battery frame are covered in this section.

4-58. BATTERY BOX (FIG. 4-20)

a. Removal.

(1) Refer to paragraph 4-40b to remove battery.

(2) Remove four screws and washers (5 & 6), securing battery box.

b. Cleaning and Inspection.

(1) Clean battery box and hardware with an approved cleaning solvent and dry thoroughly.

(2) Inspect for worn or damaged parts. Replace if required.

c. Installation. Reinstall per original configuration.

4-59. TOP SCREEN, DOORS AND GRILLE (FIG, 4-20)

a. Removal.

(1) Remove top screen (13) by unscrewing screws (11) and washers (12).

(2) Remove doors and grille as shown in figure 4-20, if necessary.

b. Cleaning and Inspection.

(1) Clean top screen, doors and grille with an approved cleaning solvent and dry thoroughly.

(2) Inspect for cracks, dents or other damage. Replace defective parts if unrepairable.

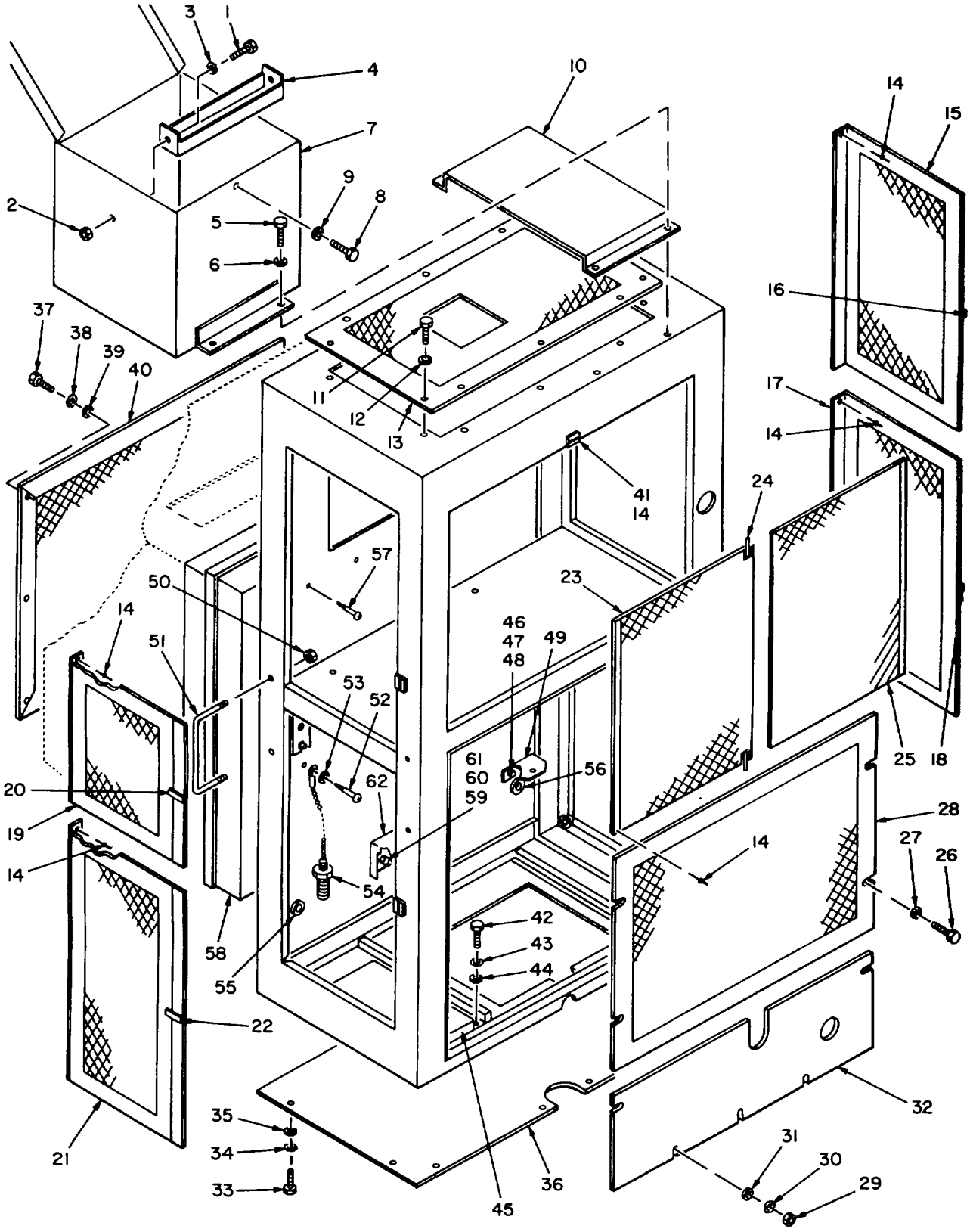


Figure 4-20. Structural Components (Sheet 1 of 2)

1. Nut, hex
2. Screw
3. Washer, flat
4. Bracket
5. Screw
6. Washer, flat
7. Battery Case
8. Screw
9. Washer, flat
10. Support
11. Screw
12. Washer, flat
13. Top Screen
14. Rivet, pop
15. Door Assembly
16. Bolt
17. Door Assembly
18. Bolt
19. Door Assembly
20. Bolt
21. Door Assembly
22. Bolt
23. Door Assembly
24. Bolt
25. Door Assembly
26. Screw
27. Washer, lock
28. Guard
29. Screw
30. Washer, lock
31. Washer, flat
32. Cover
33. Screw
34. Washer, lock
35. Washer, flat
36. Cover
37. Screw
38. Washer, lock
39. Washer, flat
40. Guard
41. Catch
42. Screw
43. Washer, lock
44. Washer, flat
45. Bracket
46. Screw
47. Washer, flat
48. Washer, lock
49. Bracket
50. Nut, hex
51. Handle
52. Screw, wood
53. Washer, flat
54. Bolt & Chain Assembly
55. Grommet
56. Grommet
57. Screw, wood
58. Frame Support
59. Screw
60. Washer, flat
61. Washer, lock
62. Bracket

Figure 4-20. Structural Components (Sheet 2 of 2)

4-60. FUEL TANK (FIG. 4-21)

a. Removal.

(1) Drain fuel tank (9) by removing drain plug (12).

(2) Remove panel (32) by removing four screws and washers (29, 30 and 31, fig. 4-20).

(3) Disconnect gas tank-to-pump line (2) by removing clamps (1).

(4) Loosen fuel tank hold-down strap (8) by removing screws and washers (5, 6 and 7).

(5) Lift tank out of unit.

b. Cleaning and Inspection.

(1) Clean all parts with approved cleaning solvent and dry thoroughly.

(2) Inspect tank for leaks or other damage. Replace defective parts.

c. Installation.

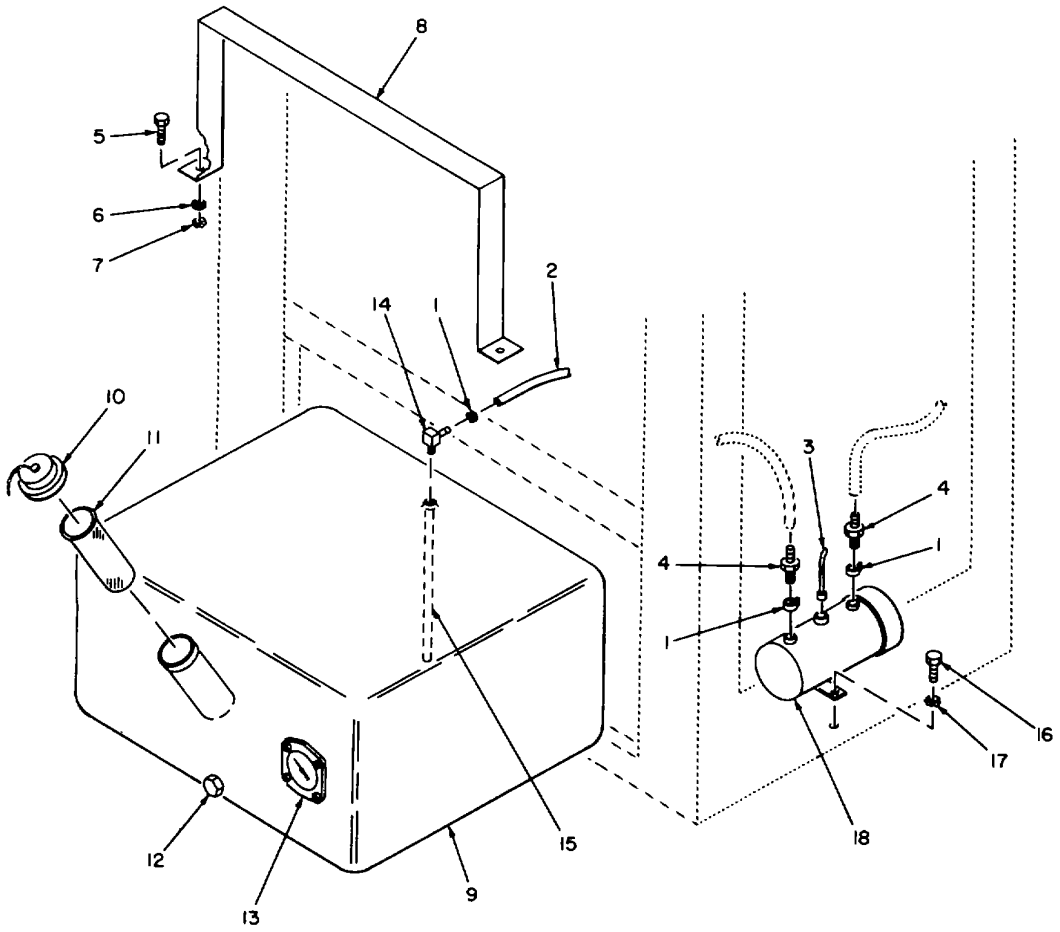
(1) Place tank into unit as in original configuration.

(2) Tighten fuel tank hold down strap (8) with screws and washers (5, 6 & 7).

(3) Connect fuel line (2) with clamp (1).

(4) Fill fuel tank with fuel.

(5) Reinstall panel (32, fig. 4-20).



1. Clamp
2. Hose
3. Hose
4. Fitting
5. Screw
6. Washer, flat
7. Washer, lock
8. Strap
9. Fuel Tank
10. Gas Cap
11. Screen
12. Plug
13. Fuel Gauge
14. Fitting
15. Tube
16. Screw
17. Washer, lock
18. Pump

Figure 4-21. Fuel Tank

CHAPTER 5

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

5-1. SPECIAL TOOLS AND EQUIPMENT

The following are special tools recommended by the engine manufacturer for repair and overhaul.

Bearing Clearance Guide (Plasti-Gauge):
.002" to .006" (.005cm to .015cm). ... 420-0256
.004" to .009" (.010cm to .023cm). ... 420-0257

Combination Bearing Remover-
Main and Cam 420-0325

Combination Bearing Driver-
Main and Cam 420-0324

Crankshaft Gear Puller 420-0072

Gear Puller Ring 420-0248

Flywheel Puller..... 420-0100

Carburetor Adjustment Wrench 420-0169

Continuity Tester 420-0290

Series Circuit Tester 420-0288

Torque Wrench--i/2 In. Drive (1.27cm):
0 to 100 Ft-Lb .....
420-0222
(0 to 135.6 Newton Meters)

Valve Seat Driver..... 420-0071

Valve Guide Driver 420-0300

Valve Spring Compressor..... 420-0119

Valve Lock Replacer 420-0105

Valve Guide Honing Set..... 420-0305

Ridge Reamer 420-0260

Cylinder Hone..... 420-0304

Cylinder Wall Micro-
Finishing Brush..... 420-0320

Ring Compressor..... 420-0214

Ring Spreader 420-0146

Piston Groove Cleaner. 420-0332

Oil Seal Guide and Driver
Bearing Plate 420-0181
Gear Cover 420-0313

Timing Advance Mechanical
Cover Driver 420-0296

5-2. DIRECT AND GENERAL SUPPORT MAINTENANCE REPAIR PARTS

Direct support and general support maintenance repair parts are listed and illustrated in TM 54110-235-24P.

Section II. TROUBLESHOOTING

5-3. GENERAL

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the refrigeration unit. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

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.

Table 5-1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

NOTE

Before you use this table, be sure you have performed all applicable operating checks (table 3-1). This table should be used in conjunction with table 4-2 troubleshooting in organizational maintenance.

ENGINE

1. ENGINE FAILS TO START OR HARD TO START.

Check for seized engine, loose, worn or damaged engine parts.
Overhaul engine. Repair worn or damaged parts.

2. ENGINE MISSES OR RUNS ERRATICALLY.

Check for loose, worn or damaged engine parts.
Overhaul engine. Repair worn or damaged parts.

3. ENGINE KNOCKS OR DEVELOPS EXCESSIVE NOISE.

Check for loose, worn or damaged engine parts.
Overhaul engine. Repair worn or damaged parts.

4. ENGINE OIL PRESSURE LOW.

Step 1. Check for sticky plunger on oil by-pass relief valve.
Remove spring and plunger with a magnet tool. Clean plunger and spring with approved solvent and reinstall.
Step 2. Check for defective oil pump assembly.
Replace oil pump assembly.
Step 3. Check for defective oil gauge.
Replace oil gauge.
Step 4. Inspect bearings for wrong clearings.
Replace bearings.

5. EXHAUST SMOKE EXCESSIVE.

Check for defective piston rings.
Overhaul engine.

Table 5-1. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

6. ENGINE NOISY.

Check for damaged, broken, or worn engine parts.
Overhaul engine.

7. ENGINE OIL CONSUMPTION EXCESSIVE.

Step 1. Check for gasket oil leaks.
Replace gaskets.
Step 2. Check for defective piston rings.
Overhaul engine.

REFRIGERATION SYSTEM

8. REFRIGERATION UNIT WILL NOT OPERATE.

Check for break or short in wiring.
Trace wiring and repair.

9. REFRIGERATION UNIT RUNS CONTINUOUSLY.

Step 1. Check for compressor valves holding open or leaking.
Replace compressor valve plates.
Step 2. Check for blown gasket on compressor cylinder head.
Replace gasket.
Step 3. Check for refrigerant shortage or leak.
Repair leak and add refrigerant.
Step 4. Check for restricted discharge tube or service inlet valve.
Service compressor discharge valve, tubing, and receiver inlet valve.
Step 5. Check for air in system.
Purge air from system.
Step 6. Check for refrigerant overcharge.
Purge excess refrigerant.
Step 7. Check for fan blades not turning.
Clutch not working. Replace or repair clutch.

10. REFRIGERATION UNIT OPERATES TOO LONG.

Step 1. Check to see if expansion valve is open too far.
Adjust expansion valve.
Step 2. Check for stuck-open or leaking compressor valves.
Clean or replace valve plates.
Step 3. Check for blown cylinder head gasket.
Replace gasket.
Step 4. Check for shortage of refrigerant and/or leaks.
Repair leaks/add refrigerant.
Step 5. Check for air in system.
Purge air from system.
Step 6. Check for overcharge of refrigerant.
Purge excess refrigerant.
Step 7. Check for partly closed receiver inlet valve.
Open valve as far as it will go.

Table 5-1. Troubleshooting (Cont)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

10. REFRIGERATION UNIT OPERATES TOO LONG (Cont).

Step 8. Check for incorrectly adjusted expansion valve.
Adjust expansion valve to admit more refrigerant.
Step 9. Check for possible restriction in liquid line.
Locate and remove restrictions.
Step 10. Check to see if expansion valve is open too far.
Adjust expansion valve to admit less refrigerant. Replace valve, if stuck open.
Step 11. Check for loose expansion valve bulb.
Tighten clamp.
Step 12. Check for restriction in expansion valve or liquid line.
Locate and remove restrictions.

11. NOISY OPERATION.

Step 1. Check for compressor pumping oil.
Drain oil to correct level.
Step 2. Check for unserviceable compressor bearings.
Repair or replace compressor.
Step 3. Check for unserviceable compressor valve plate.
Replace valve plate.
Step 4. Check for loose expansion valve feeler bulb.
Tighten feeler bulb.
Step 5. Check to see if expansion valve is operating.
Replace expansion valve.
Step 6. Check to see if expansion valve is stuck.
Replace expansion valve.
Step 7. Check if expansion valve is stuck shut.
Replace expansion valve.
Step 8. Check for moisture frozen in expansion valve.
Thaw expansion valve and replace dehydrator.
Step 9. Check for air in system.
Purge air from system.
Step 10. Check for overcharge of refrigerant.
Purge excess refrigerant.

Section III. GENERAL MAINTENANCE

5-4. GENERAL

a. Refer to the maintenance allocation chart (MAC) (Appendix B) for the repairs and functions which are allocated to direct support and the repairs allocated to general support.

b. Direct support maintenance includes the replacement of most of the gauges, valves and fittings in the refrigeration system and repairs on the compressor and engine. It covers repair of the carburetor, alternator and starter subassemblies and replacement of rings, pistons, valves, tappets and associated internal engine parts.

c. General support maintenance includes repair of the evaporator coil and condenser coil in the refrigeration system, and overhaul of the compressor and engine.

5-5. REPAIR OF MAJOR COMPONENTS

a. Chapters 5, 6,7 and 8 cover the various detailed repairs of the engine, refrigeration system and control panel and instruments, and electric motor.

b. Repair and replacement standards for the engine and compressor follow:

(1) Engine.

	Min.	Desired Clearance Max.
Valve tappet to cylinder block clearance	0.0150	0.0030
Valve stem in guide -- Intake 0.0010	0.0025	
Exhaust	0.0025	0.0040
Valve seat interference width	0.0312	0.0468
Valve face angle		44°
Valve seat angle		45°
Valve interference angle		1°
Crankshaft main bearing	0.0025	0.0038
Desired Clearance		
Crankshaft end play	0.006	0. 012
Crankshaft bearing	0.0015	0. 0030
Camshaft end play	0.003	--
Rod bearing (forged rod)	0.0005	0.0023
Connecting rod end play (ductile iron)	0.002	0.016
Timing gear backlash.	0.002	0.003
Oil pump gear backlash	0.002	0.005
Piston to cylinder, strut type (measured below Oil-- Controlling Rink--900 from pin) Clearance.	0.0025	0.0045
Piston pin in piston	Thumb Fit	Push
Piston pin in rod	0.0001	0.0006
Piston ring gap in cylinder	0.010	0.023
Crankshaft main bearing journal--standard size.	1.9992	2.000
Crankshaft rod bearing journal--standard size.	1.6252	1.6260
Cylinder bore-- standard size	3.2490	3.2500

NOTE

All clearances given at room temperature of 700F (21.1℃). All dimensions in inches unless otherwise specified.

(2) Compressor.

Cylinder sleeve bore dia	2.1886	2.1890
Piston diameter	2.1770	2.1820
Piston pin bore	0.7498	0.7500
Crankshaft		
Connecting rod	2.5597	2.5603
Main bearing	1.3742	1.3745
Piston pin dia	0.7498	0.7500
Connecting Rods		
Bore diameter:		
Crankshaft brg. shell I.D.	2.5632	2.5637
Piston end	0.7503	0.7506

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

5-6. ENGINE REMOVEL

Refer to paragraph 4-13 and 4-15 for information on removal and installation of the gasoline engine assembly from the refrigeration unit.

5-7. COMPRESSOR REMOVAL

The compressor is mounted on a common mounting plate with the engine. The assembly comprising of the engine and compressor mounted on the mounting plate can be removed by removing the hardware holding the mounting plate (6 thru 8, fig. 4-5).

CHAPTER 6

REPAIR OF ENGINE

Section I. ENGINE ACCESSORIES

6-1. GENERAL

This section contains instructions for maintenance of those items which are considered accessories to the engine.

6-2. STARTER

The starter is a 12-volt, 2 brush, direct cranking type starter. The starter converts the electrical energy of the battery into the mechanical energy necessary to rotate the engine crankshaft until the engine can operate on its own.

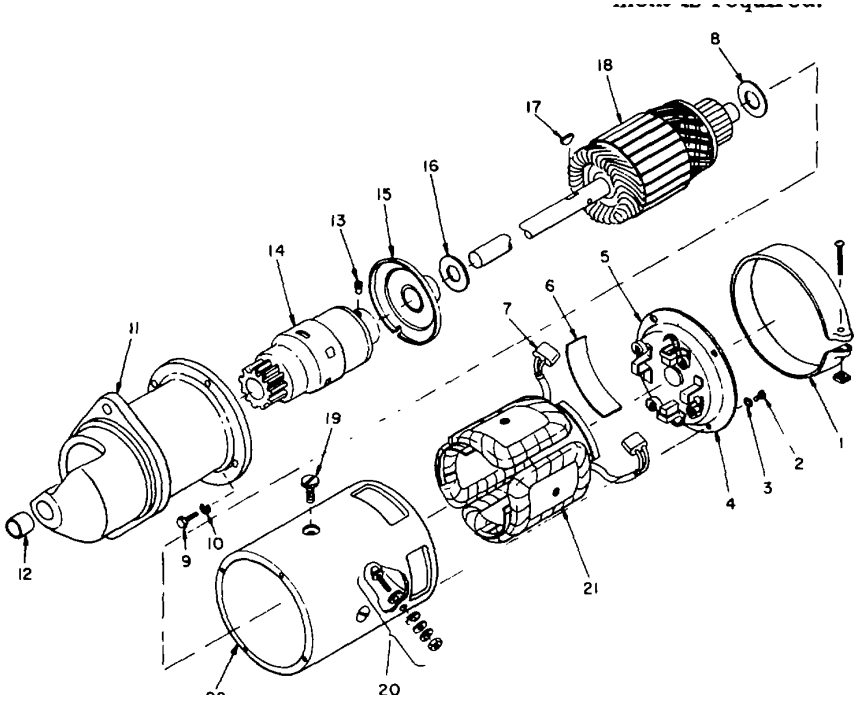
a. Removal. Refer to paragraph 4-34 and remove the starter.

b. Disassembly (fig. 6-1).

(1) Remove ban cover (1) by loosening its clamping screw.

(2) Remove four screws (2) and washers (3) to partially detach head assembly (4). Release brushes (7) from brush springs (5) to fully detach head assembly (4).

(3) Brush springs (5), strap (6) and brushes (7) can be removed if replacement if required.



1. Cover, band
2. Screw
3. Washer, lock
4. Head Assembly, commutator end
5. Spring, brush
6. Strap
7. Brush
8. Washer, armature thrust
9. Screw
10. Washer, lock
11. Housing, pinion
12. Bearing, drive end
13. Setscrew
14. Drive Assembly
15. Bearing Assy, intermed.
16. Washer
17. Key
18. Armature
19. Screw, flat head
20. Terminal Stud & Washer Set
21. Coil Assembly
22. Frame

Figure 6-1. Starter

6-2. STARTER (cont)

b. (4) Remove armature thrust washer (8) from shaft.

(5) Remove two screws & lockwashers (10) to release pinion housing (11). Remove drive end bearing (12), if required.

(6) Loosen setscrew (13) to slide off drive assembly (14) from armature shaft. Remove key (17).

CAUTION

Care must be taken not to thread-out the worm gear on the drive assembly. It is difficult to rethread. Keep it in a fully closed position unless further maintenance is required on the drive assembly.

(7) Slide off intermediate bearing assembly (15) and washer (16) from armature shaft.

(8) Remove four flat headscrews (19) and terminal stud and washers (20) holding coil assembly (21) to frame (22).

c. Brush and Spring Repairs (fig. 6-2).

(1) When brushes are worn more than 0.3 inch (. 762cm), replace them. Check to see that the brushes move smoothly in the brush holder.

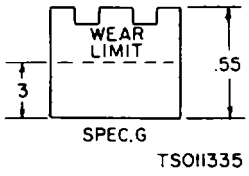


Figure 6-2. Brush Wear Limits

(2) Measure brush spring tension with a tension meter (fig. 6-3). Push the brush into its holder and take the reading just as the brush slightly projects from the brush holder. On a new brush, the spring tension should be 29 to 39 ounces (822.12 to 1105.61 grams).

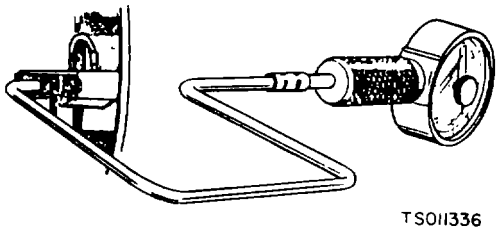


Figure 6-3. Measuring Brush Spring Tension

d. Armature Testing.

(1) Testing for grounds. Test the armature for grounds by touching the armature shaft or core and the end of each commutator bar with a pair of ohmmeter leads (fig. 6-4). If the ohmmeter reading is low, it indicates a grounded armature. Replace armature.

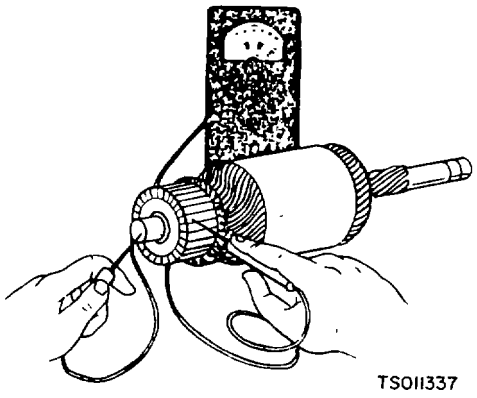


Figure 6-4. Test for Grounded Armature

(2) Testing for open circuit. The most common place for an open circuit to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections.

(3) Testing commutator runout. Place the cummutator in a test bench and check out runout with a dial indicator (fig. 6-5). When commutator runout exceeds.004 inch (. 010cm), reface the commutator.

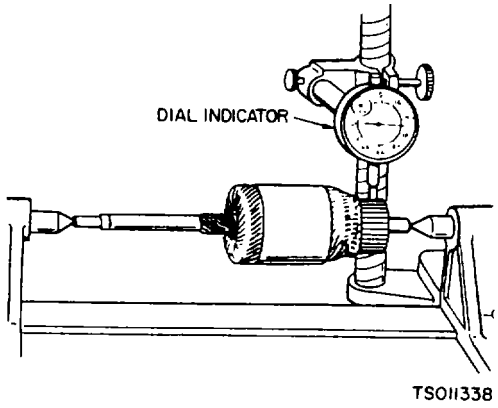


Figure 6-5. Checking Commutator Runout

d. (4) Testing armature shaft runout. The armature shaft as well as the commutator may be checked. A bent armature can often be straightened, but if the shaft is worn, a new armature is required.

(5) Testing field coils for grounds. Place one test lamp prod on the connector and the other on a clean spot on the frame after unsoldering shunt field coil wire. If the lamp lights, the fields are grounded either at the connector or in the windings (fig. 6-6).

Figure 6-6. Field Coil Ground Test

(6) Testing field coils for open circuit. Place one prod on the connector and the other on a clean spot on the brushholder (fig. 6-7). If the test lamp lights, the field coil is okay. Check all brushholders in the same manner.

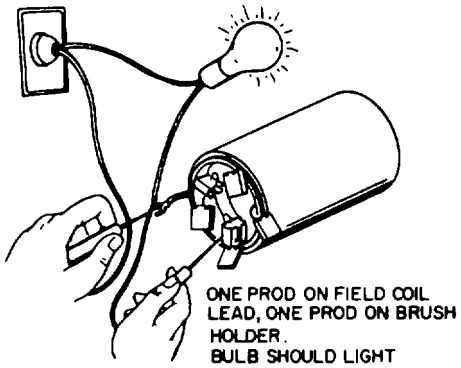


Figure 6-7. Test for Open Field Coil

e. Drive Assembly. Check for damage of the pinion gear. Verify that the drive shaft is free of rust, burrs, or bends so the screw shaft can move freely along it. A damaged pinion or screw shaft requires replacement of the drive assembly.

f. Cleaning and Lubrication.

(1) Clean all parts carefully with a dry cloth and compressed air if available.

CAUTION

Do not immerse bearing equipped parts in cleaning fluid. Clean with a brush dipped in mineral spirits. Do not immerse the overrunning clutch in cleaning solvent.

(2) Apply 20 weight oil to armature shaft and splines. Use grease sparingly on intermediate bearing assembly and spacing washers at end of the shaft.

g. Reassembly. Reverse disassembly procedure, paragraph b. above. Use spacing washers to adjust armature end play of 0.004 to 0. 020 inch (.010 to .051cm).

h. Installation. Refer to paragraph 4-35c and install starter. Check pinion clearance (fig. 6-8) between starting motor pinion gear and flywheel ring gear.

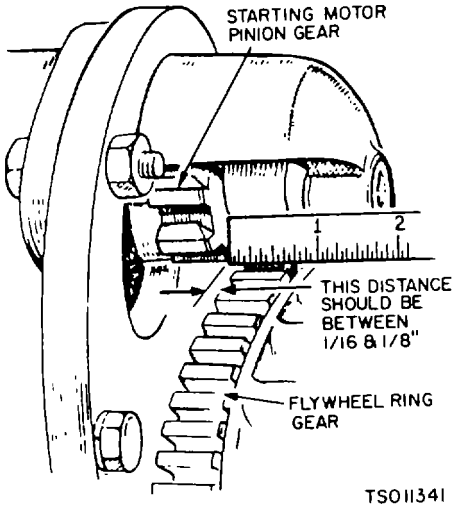


Figure 6-8. Pinion Clearances

6-3. ALTERNATOR

CAUTION
Do not remove alternator from unit without first disconnecting the negative (-) battery cable.

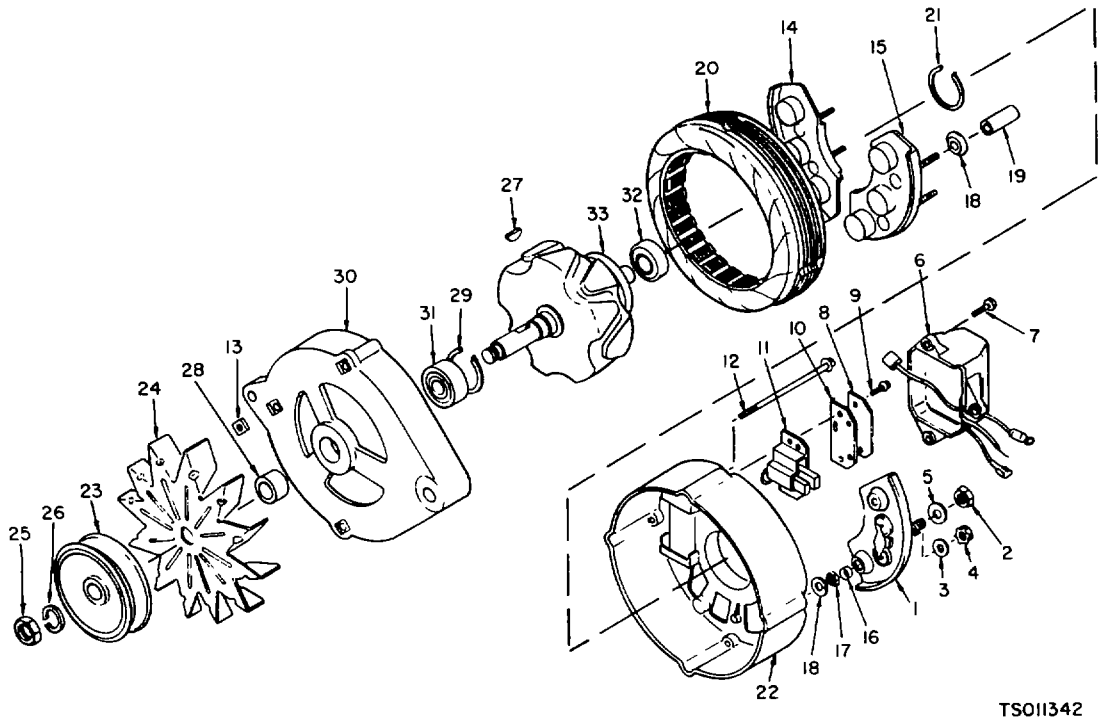
a. Removal. Refer to paragraph 4-38 and remove alternator.

b. Brush Assembly Insulation Test (fig. 6-9).

(1) Remove two screws (9), brush holder cover (8) and brush holder (11).

(2) Insulation Test. Connect ohmmeter or test lamp to field terminal and bracket. Resistance should be high (infinite) or test lamp should not light. If resistance is low or test lamp lights, brush assembly is shorted and must be replaced.

(3) Continuity test. Connect an ohmmeter to field terminal and insulated brush. Use an alligator clip to assure good contact to brush.



1. Diode, isolation
2. Nut, hex, 10-24
3. Washer, lock, 1/4 in.
4. Nut, hex, 1/4-20
5. Washer, insulator,#10
6. Voltage regulator
7. Screw, self-tapping, # 10
8. Cover, brushholder
9. Screw, self-tapping # 8
10. Shield, dust
11. Brush Assembly
12. Bolt, 10-32
13. Nut, square 10-32
14. Diode, negative
15. Diode, positive
16. Insulator, sleeve
17. Nut, hex, 10-24
18. Washer, insulator
19. Insulator, sleeve
20. Stator Assemblies
21. Retainer, rear brg
22. Housing, rear
23. Pulley
24. Fan
25. Nut, hex, 5/8-18
26. Washer, lock, 5/8
27. Key
28. Spacer
29. Retainer, front brg
30. Housing, front
31. Bearing, front
32. Bearing, rear
33. Rotor Assembly

Figure 6-9. Alternator

NOTE

Do not chip brush. Resistance reading should be zero. Move brush and brush lead wires to make certain that the brush lead wire connections are not intermittent. Resistance reading should not vary when brush and wire lead is being moved around.

(4) Connect ohmmeter to bracket and grounded brush. Resistance reading should be zero. Repeat same test on brush lead wire as described in paragraph (3) above.

c. Isolation Diode Test (fig. 6-9). If a commercial diode tester is used, follow tester manufacturer's instructions. If a commercial tester is not available, use a 12-volt DC test lamp. Connect the test lamp to output terminal and auxiliary terminal of isolation diode (1). Then reverse test probes. The test lamp should light in one direction but should not light in the other direction. If the test lamp lights in both directions, the isolation diode is shorted. If the test lamp does not light in either direction, isolation diode is open. Repeat test after isolation diode has been removed to ascertain findings.

d. In-Circuit Rectifier Diode Test (fig. 6-9). Any commercial in-circuit diode tester will suffice to make the check. Follow tester manufacturer's recommended testing procedure. If the in-circuit tester indicates that the diodes (14) and (15) are faulty, recheck diodes individually after diode assemblies have been disconnected from stator assembly (20). Shorted stator coil (20) or shorted insulation washers (18) or sleeves (16) on positive diode assembly (15) would make diodes appear to be shorted.

(1) To check negative diode assembly (14), connect tester to ground terminal and first diode to right of brush cover. Then successively check between ground terminal and second diode to right of brush cover and ground terminal and third diode to right of brush cover.

(2) To check the positive diode assembly (15), connect tester to regulator (auxiliary) terminal and first diode to the left of brush cover. Then successively check between regulator terminal and second diode to left of brush cover and regulator terminal and third diode to left of brush cover.

e. Rectifier Diode Test Using A Test Lamp (fig. 6-9). A test lamp will not indicate an open condition unless all three diodes of either assembly are open. However, a shorted diode can be detected. This test is not 100 percent effective but can be used if so desired when an incircuit diode tester is not available. Use a 12volt DC test lamp only; otherwise diodes will be damaged.

(1) Connect test lamp probes to ground terminal and first diode to right of brush cover, then reverse test probes. The test lamp should light in one direction but not in the other direction. If the lamp lights in both directions, one or more of the rectifier diodes of the assembly being tested are shorted. If the lamp does not light in either direction, all three diodes in the assembly are open. Recheck diodes individually after disassembly to ascertain findings.

NOTE

A shorted stator coil (20) to core would appear as a shorted negative rectifier diode assembly (14).

(2) To check the positive diode assembly (15), connect test probes to regulator (auxiliary) terminal and the first diode left of brush cover. Then reverse test probes. The same procedure and results apply as in paragraph (1) above.

NOTE

If the above procedures do not find the difficulties in the alternator, replace with a new alternator.

f. Installation. Refer to paragraph 4-38h and install alternator.

6-4. CARBURETOR

a. Remove the carburetor (fig. 6-10) as instructed in paragraph 4-19.

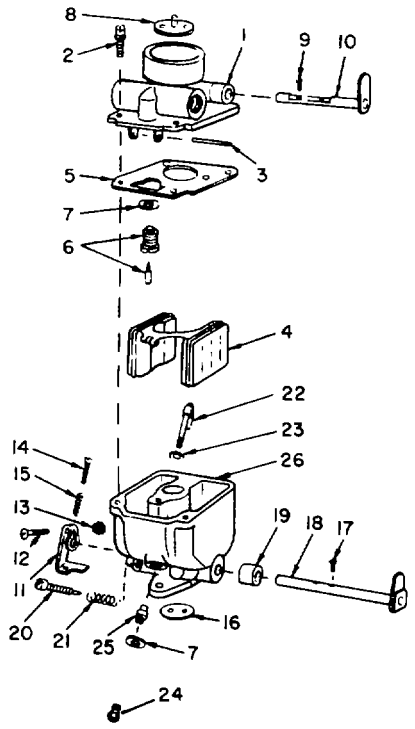
b. Disassemble the carburetor as illustrated in figure 6-10.

c. Clean all carburetor parts with an approved solvent. Pay particular attention to all air and fuel passages. Dry all parts with compressed air.

d. Inspect all carburetor parts for damage or deterioration. Replace all defective parts during reassembly.

e. Using the carburetor repair kit, reassemble the carburetor.

f. Install the carburetor and adjust the idle and high speed needles as described in para 4-19.



1. Choke cover assy
2. Screw
3. Shaft, float
4. Float Assy
5. Gasket, cover
6. Valve & Seat
7. Gasket
8. Fly, choke
9. Screw
10. Shaft, choke
11. Lever, idle stop
12. Screw, throttle stop
13. Nut
14. Screw, throttle adj.
15. Spring
16. Fly, throttle
17. Screw
18. Shaft, throttle
19. Bushing
20. Needle, idle adj.
21. Spring, idle adj.
22. Nozzle
23. Gasket, nozzle
24. Needle assy
25. Nozzle, jet
26. Body

Figure 6-10. Carburetor

6-5. GASOLINE TANK

a. Draining Gasoline Tank. (fig. 4-6). Place a clean empty container under fuel tank plug (15).

Remove plug (15) and drain tank (1). Replace plug after draining.

b. Removal, Disconnect fuel lines from gasoline tank. Loosen two straps holding tank to refrigeration unit. Lift out tank.

c. Cleaning and Inspection.

(1) Flush gasoline tank with approved cleaning solvent. Clean exterior of gasoline tank with an approved cleaning solvent. Dry exterior thoroughly.
(2) Clean filler cap and screen with an approved cleaning solvent and dry thoroughly.

d. Repair. Replace defective filter cap (16) and strainer (17), fuel gauge (14) or drain plug (15).

e. Installation.

(1) Position gasoline tank in frame. Collar tank with two straps to frame. Be sure drain plug and gauge face out in front of unit. Tighten straps.

(2) Connect fuel line to tank.

6-6. FUEL PUMP

a. General. The fuel pump is an electric type pump. If fuel does not reach the carburetor, check the condition of the fuel pump.

b. Checking the Fuel Pump. The pump can be checked by disconnecting the fuel line at the carburetor and energizing fuel pump to observe whether fuel comes from the line at the carburetor. If there is enough fuel in the tank and the line between the tank and pump is open, but the pump fails, it must be replaced. Gasoline diluted oil also may indicate a faulty fuel pump that should be replaced.

CAUTION

Use care when replacing pump. A leaking pump is a potential fire hazard.

Fittings must be perfectly aligned, tight and without leaks.

c. Removal and Installation. Refer to para4-20 for removal and installation of the fuel pump.

Section II. FLYWHEEL, GEAR COVER, GOVERNOR CUP, TIMING GEARS AND OIL PUMP

6-7. GENERAL

If engine disassembly is necessary, remove engine from refrigeration unit and first remove all the complete assemblies. Individual assemblies can be removed and serviced later, if necessary.

Refer to Section I for removal of the engine accessories. Most engine repairs will require the removal of blower housing group (13, fig. 4-7) prior to start of defective components repair.

NOTE

When disassembling the engine, keep all parts in their respective order, such as valve assemblies, rod caps for respective rod and piston assemblies, etc. Analyze reasons for parts failures. Use new gaskets for reassembly.

6-8. FLYWHEEL

a. Removal. To remove the flywheel, turn the flywheel mounting screw outward about two turns and use Onan puller (420-0100 or equivalent) and pull flywheel (127, fig. 4-7).

CAUTION

DO NOT use a screwdriver or similar tool or pry behind the flywheel against the gearcase. The gearcase cover is diecast material and will break if undue pressure is applied in this manner. Handle the flywheel with care. Do not drop the flywheel. A broken fin will destroy the balance.

b. Installation. Press on flywheel. Make sure the steel key (202, fig. 4-7) is used to lock the flywheel to the shaft (199).

6-9. GEAR COVER (FIG. 4-7)

a. General. After removing the flywheel (127) and flywheel key (202), the gear cover (135) can be removed.

b. Removal. Remove five screws (135A & 135B) and lockwashers (135C) holding gear cover assembly. Gently tap the gear cover with a soft-faced hammer to loosen it.

c. Repair. Replace leaking oil seal gasket (148) or defective governor shaft and arm (138), governor shaft yoke (139) or roll pin (137).

d. Installation (figure 6-11).

CAUTION

When installing the gear cover, make sure that the roll pin in the gear cover engages the governor cup correctly.

(1) Prior to installing the gear cover assembly to the engine, adjust the stop pin to protrude to a point 3/4-inch (1. 91cm) from the cover mounting surface. Also use a feeler to check 1/2-inch (1. 27cm) ball. Replace missing ball (fig. 6-11).

(2) Turn the governor cup so that the plastic lined hole is at the three-o'clock position. The smooth side of the governor yoke must ride against the governor cup.

(3) Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase.

CAUTION

Care must be taken not to damage the gear cover oil seal.

(4) Reinstall flywheel (para 6-8).

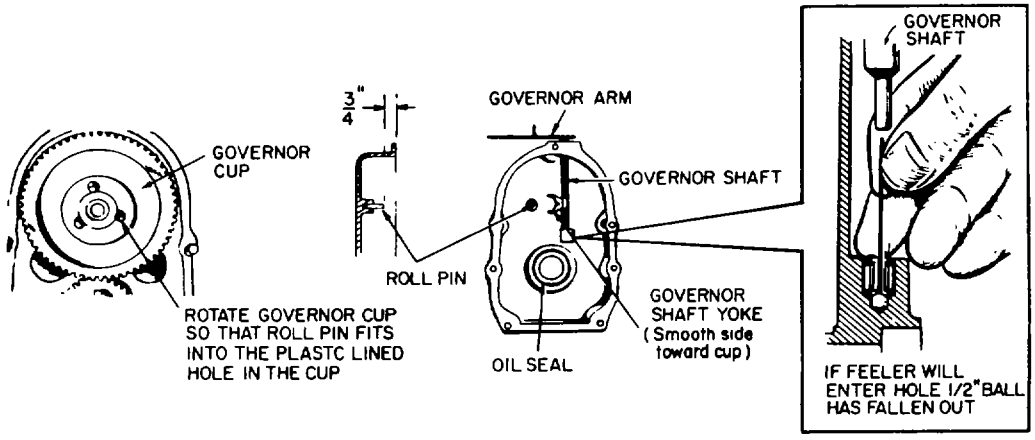


Figure 6-11. Gear Cover Assembly Installation

6-10. GOVERNOR CUP (FIG. 6-12)

a. Removal. Remove the gear cover assembly (para 6-9). The governor cup can be taken off after removing the snap ring from the cam shaft center pin. Catch the flyballs while sliding the cup off.

b. Repair.

(1) Replace any flyball that is grooved or has a flat spot. If the arms of the ball spacer are worn or otherwise damaged, replace the entire timing gear set.

(2) The governor cup must spin freely on the camshaft center pin without excessive looseness or wobble. If the race surface of the cup is grooved or rough, replace it with a new one.

c. Installation.

(1) When installing the governor cup, tilt the engine so the gear is up. Put the flyballs in place and install the cup and snap ring on the center pin.

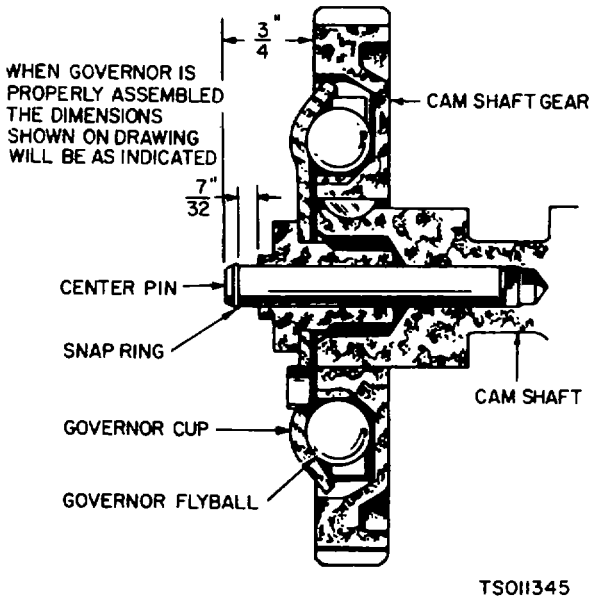


Figure 6-12. Governor Cup

(2) The camshaft center pin extends out 3/4-inch (1. 91cm) from the end of the camshaft. This distance provides an in out travel distance of 7/32-inch (. 56cm) for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine may race, especially at no load), remove the center pin and press a new pin in only the required amount. Otherwise, grind off the hub of the cup as required. The camshaft center pin cannot be pulled outward or removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

(3) Reinstall gear cover and flywheel (para 6-8 and 6-9).

6-11. TIMING GEARS (FIG. 4-7)

a. General. If replacement of either the crankshaft gear (153-1, fig. 4-7) or the camshaft gear (153-2, fig. 4-7) becomes necessary, install both gears new; never one only. Use a gear pulling ring (420-0248) to remove the crankshaft gear. Be sure to remove the lock ring (155) first.

b. Removal.

(1) Remove flywheel, gear cover and governor cup (para 6-8 thru 6-10).

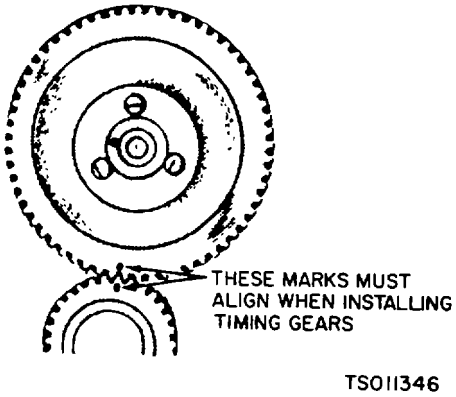


Figure 6-13. Timing Gear Removal & Installation

(2) The camshaft gear (153-2) is pressed on and keyed to the camshaft (181). The camshaft (181) and gear (153-2) must be removed as an assembly after first removing the crankshaft gear lock ring (155) and washer (156). Before removing the camshaft (181) and gear assembly (153-2), remove the cylinder head (para 6-14) and valve assemblies (para 6-17). Remove the operating plunger (107) for the breaker points (102). Remove the tappets (168).

(3) The camshaft may be pressed out of the gear (153-2) by use of a hollow tool or pipe which will fit over the camshaft center pin (179). Do not press on the center pin or damage it in any way. The governor ball spacer is a press fit to the camshaft gear.

c. Installation.

(1) When pressing a camshaft gear (155-2) onto the camshaft (181), be sure the gear is started straight and that the key (181A) is properly in place. Install the governor cup assembly to the gear before installing the camshaft and gear assembly in the engine.

(2) Each timing gear (153) is stamped with a O mark near the edge. The gear teeth of the gear set must mesh so that these marks coincide exactly when the gears are installed in the engine (fig. 6-13). Be sure, when installing the camshaft gear (153-2) and shaft assembly (181) that the thrust washer (154) is properly in place behind the camshaft gear (153-2). Replace the plate (156) and lock ring (155) to the crankshaft (199).

(3) Reassemble governor cup, gear cover, and flywheel (para 6-8 thru 6-10).

OIL PUMP

a. Removal (fig. 4-7).

(1) Remove flywheel and gear cover (paragraph 6-8 and 6-9).

(2) Remove two screws (183) and washers (184) holding pump assembly (182) to engine and replace complete pump assembly, if worn.

b. Installation (fig. 6-14). Oil the pump to prime it before reinstalling. Use a new gasket.

Replace oil pump intake cup, if necessary. Reinstall gear cover & flywheel (para 6-8 & 6-9).

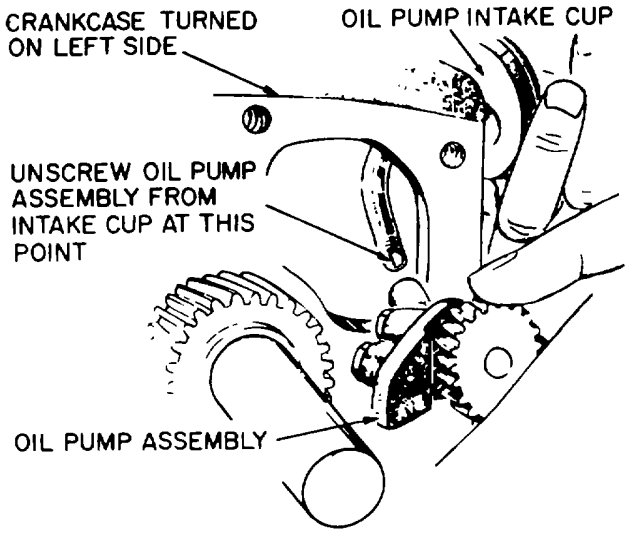


Figure 6-14. Oil Pump

Section III. CYLINDER HEADS

6-13. GENERAL

The cylinder head forms a removeable, shaped cover for the combustion chamber.

6-14. CYLINDER HEAD

CAUTION
Do not remove heads when they are hot. Warpage may occur.

a. Removal (fig. 4-7).

(1) Disconnect ignition cable (220 & 221) from spark plug (84). Remove spark plug and gasket (85).

(2) Remove nine screws (163, 165) and washers (164) that attach cylinder head (161) to crankcase (208).

CAUTION
Do not use a pry to loosen the cylinder head. It may damage the head or crankcase. A softfaced hammer may be carefully used to sharply tap the cylinder head edge. Take care not to break any cooling fins.

(3) Remove cylinder head (161) and gasket (166). Discard gasket.

b. Cleaning and Inspection.

(1) Carefully clean cylinder head, crankcase, and top of piston with scraper or wire brush. Use approved cleaning solvent to clean all applicable parts. Dry parts thoroughly.

(2) Inspect all threaded parts for damaged threads. Inspect cylinder head and crankcase for cracks, dents, and broken fins. Replace defective parts.

c. Installation (fig. 4-7).

(1) Install new cylinder head gasket (166) on crankcase.

(2) Align holes in gasket (166) and cylinder head (161) with holes in crankcase with nine screws (163 & 165) and washers (164). Tighten screws to a torque of 5 foot-pounds; then 1 foot-pounds, etc. until all are torqued to 29 to 31 footpounds (6.78 to 42. 036 Newton-Meters). Refer to figure 6-15 for head bolt tightening sequence.

(3) Install spark plug (84), gasket (85) and connect ignition cables (220 &221).

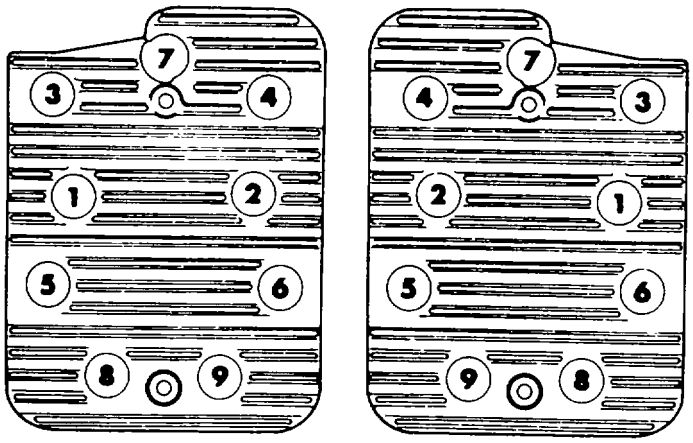


Figure 6-15. Cylinder Head Bolt Tightening Sequence

Section IV. VALVES AND TAPPETS

6-5. GENERAL

Positive type valve rotors are furnished in this model engine. The action of the rotor cap, which rotates the valve slightly each time the valve opens, helps prevent sticking valves, and will impart a wiping action between the valve face and valve seat, thereby preventing the buildup of foreign deposits. Valve rotation will also avoid prolonged exposure of any one section of the valve face to a local hot spot on the seat which will result in lower and more uniform valve face and seat temperatures.

6-16. VALVE TAPPET ADJUSTMENT

a. Valve Tappet Inspection Cover Removal (fig. 4-7).

(1) Remove screw (158) and washer (159) that attaches valve tappet inspection cover (157) to crankcase.

(2) Remove inspection cover & gasket (160).

b. Adjustment.

(1) Crank the engine over slowly by hand until the left hand intake valve, when facing the flywheel, opens and closes. Continue about 1/4 turn until the correct timing marks align. This should place the left hand piston at the top of its compression stroke which is the position it must be in to get proper valve adjustment for the left hand cylinder.

(2) Clearances are indicated in para 4-5b. For each valve, the gauge should just pass between the valve stem and valve tappet (fig. 6-16).

(3) To correct the valve clearance, turn the valve adjusting screw as needed to obtain the right clearance. The screw is self-locking (fig. 6-17).

(4) To adjust the valves on the right hand cylinder, crank the engine over one complete revolution and again line up the correct timing marks. Then follow the adjustment given for the valves of the left hand cylinder.

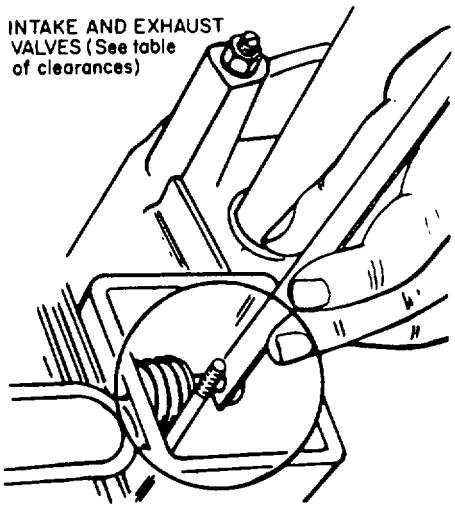


Figure 6-16. Adjusting Tappets Figure

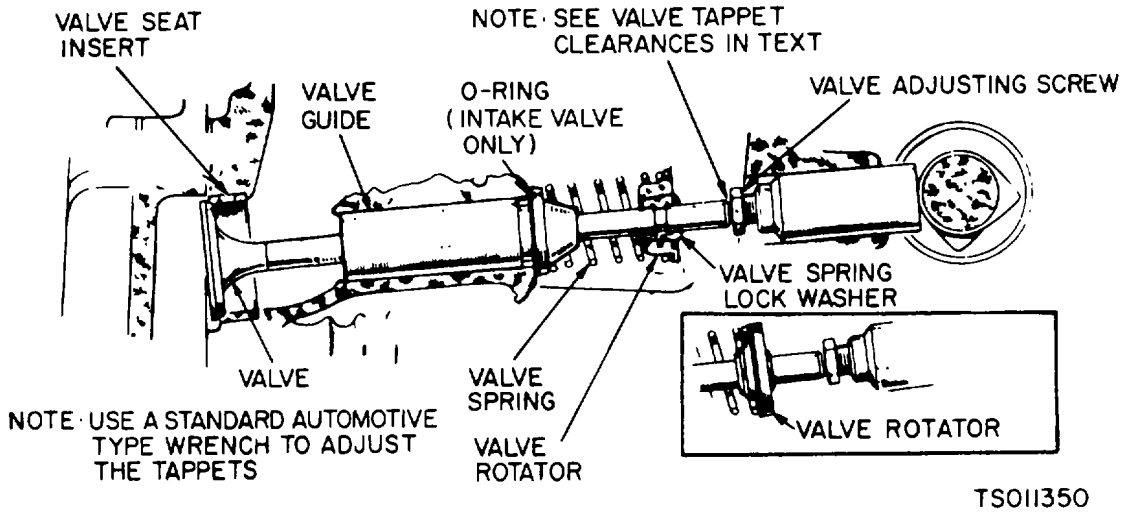


Figure 6-17. Valve System

6-17. REMOVAL OF VALVES (FIG. 4-7)

If a valve face is burned or warped, or the stem is worn, install a new valve.

a. Remove engine from refrigeration unit (para 4-13).

b. Remove cylinder head (para 6-14).

c. Remove valve tappet cover (para 6-16a).

d. Using valve spring compressor Onan Part No. 420-0119, compress valve spring (172). Remove valve spring washer lock (169) from valve stems.

e. Remove valves (177 & 178) from crankcase.

f. Remove valve springs (172) and rotators (170 & 171).

g. Worn valve stem guides (174) may be replaced from inside the valve chamber. An O-ring seal (173) is provided behind the intake valve guides (174) only.

h. Tappets (168) are also replaceable from the valve chamber, after first removing the valve assemblies.

6-18. CLEANING & INSPECTION OF VALVES

a. Clean all carbon and gum deposits from the valve, valve rotators, seats, ports and guides in the cylinder block with an approved cleaning solvent.

b. Inspect valve springs for set or out-of-round. Inspect valve rotators and spring washer locks for damage or wear. Replace unrepairable or defective parts.

c. The valve face angle is 44 degrees. The valve seat angle is 45 degrees. This 1-degree interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life (fig. 6-18).

d. The valves should not be hand lapped, if at all avoidable, since the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44degrees. Valve seats should be ground with a 45-degree stone and the width of the seat band should be 1/32 to 3/64 of an inch (. 08 to. 12cm) wide. Grind only enough to assure proper seating.

e. Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat using an air pressure type testing tool. If such a tool is not available, make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

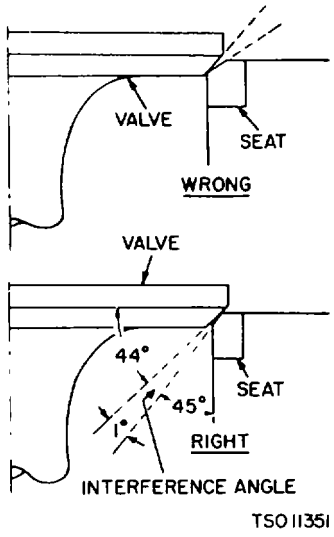


Figure 6-18. Valve Face and Seat Angles

f. Lightly oil the valve stems prior to installation.

g. Check the rotators periodically by removing the cylinder heads and cranking the engine. When functioning properly, the valve is rotated a fraction of a turn each time it opens. If rotators are faulty, install new ones.

6-19. INSTALLATION OF VALVES AND TAPPETS (FIG. 4-7)

NOTE

Refer to paragraph 4-5b for dimensions and clearances prior to valve installation.

a. If replaced, install tappets (168) in valve chamber from which removed.

b. If replaced, install valve guides (174) in valve ports of crankcase from which removed. The small diameter of the tapered valve guides must face toward the valve head. Install O-ring (173) on intake valve side only.

c. Install valves (177 & 178) through aligned holes of valve guides from which removed.

d. Install valve spring (172) and valve rotators (170 & 171). Depress springs with valve spring compressor, Onan Part No. 42 0019, and lock spring in place with valve spring washer lock (169).

e. Install valve tappet cover (157) using four bolts (158) and washers (159).

f. Install cylinder head (para 6-14c).

Section V. CONNECTING ROD, PISTONS AND RINGS

6-20. GENERAL

The engine is a two cylinder engine equipped with two connecting rods, two pistons, and two sets of rings. The connecting rod is aluminum and comes equipped with bushings and place bolts. The piston comes with a piston pin and pin retainer. The ring set is made up of two compression rings, one oil control ring with an expander.

6-21. CONNECTING ROD, PISTON, AND PISTON RINGS

a. Removal (fig. 4-7).

CAUTION

Whenever there is a noticeable wear ridge at the top of each cylinder, remove the ridge with a ridge reamer before removing the pistons. If the ridge is not removed, the rings can catch the ridge when the pistons are pushed out and cause a ring land fracture (fig. 6-19).

(1) Remove engine accessories and other major assemblies and components described in paragraph 6-1 thru 6-19.

CAUTION

Be careful not to scratch the crackpin or the cylinder wall when removing the parts.

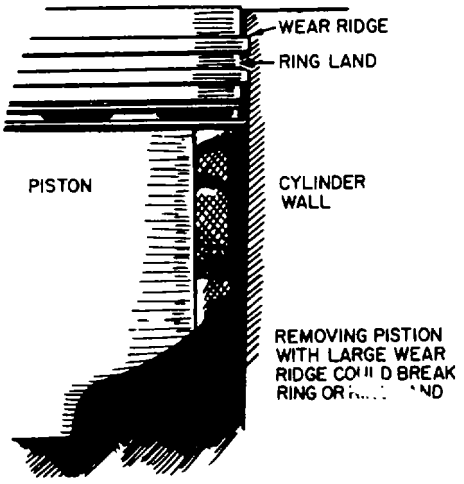


Figure 6-19. Wear Ridge and Cylinder Wall

(2) To remove the piston and connecting rod assemblies, turn the crankshaft until a piston is at the bottom of the stroke. Bend out tabs on lockwasher (195) to release screw (196). Remove the screw (196) and washer (195) from the connecting rod. Lift out the rod bearing cap (197) from the rod. With the end of a hammer, push the rod and piston assembly out of the cylinder.

NOTE

Keep the connecting rod bearing caps and bearings with their respective rods. Tag each piece.

b. Disassembly.

(1) Using a piston ring spreader tool Onan Part No. 420-0146, remove piston ring set (207) from piston (206).

(2) Remove retainer ring (203) from piston pin (204) in piston (206). Push out piston pin. Separate piston from connecting rod (197). Drive piston pin bushing (205) from connecting rod (197).

c. Cleaning. Inspection and Repair.

(1) Clean all parts in an approved cleaning solvent. Dry thoroughly with clean lint-free cloth. Remove carbon deposits from piston ring grooves. Use piston groove cleaner tool Onan Part No. 420-0332 to remove dirt in grooves (fig. 6-20). Blow out all oil passages with compressed air.

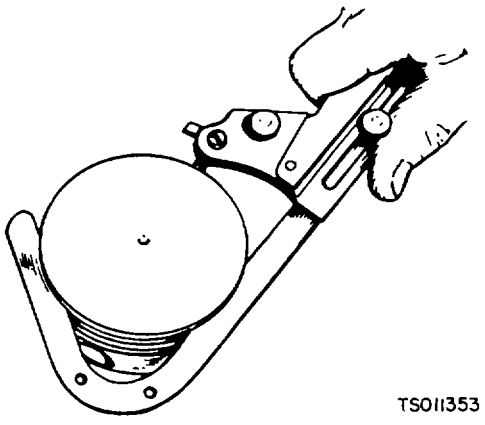


Figure 6-20. Cleaning Ring Grooves

6-21. CONNECTING ROD, PISTON, AND PISTON RINGS (cont)

c. (2) Inspect piston for cracks, breaks, and scored condition. Inspect clearances between piston pin and piston. Piston pin is a thumb push fit. If piston is excessively loose on piston pin, install a new piston pin. Inspect clearance between piston and cylinder wall. Position piston in cylinder. Clearance between piston and cylinder measured below oil controlling ring, 90degrees from pin, should be 0.0025 to 0. 0045inch

(3) Inspect the piston for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring land using new rings and a feeler gauge as shown in figure 6-21.

(4) Check for excessive ring side clearance or improper width rings. These can result in ring breakage. New rings in worn ring grooves will not have good cylinder wall contact. (See figure 6-22.)

(5) Check for pistons showing signs of bad scoring or burring, excessive skirt clearance, wavy or worn ring lands, fracture or damage from detonation. Replace piston pins showing fractures, scored bores, or bores out of round more than 0. 002-inch.

(6) Use a new piston pin to check the pin bushing in the connecting rod for wear. Clearance of piston pin in rod should be 0. 0001 to 0. 0006.

d. Reassembly (fig. 4-7).

(1) Before installing new rings on the piston, check the ring gap by placing each ring squarely in its cylinder at a position corresponding to the bottom of its travel.(See figure 6-23.) The piston ring gap in cylinder should be 0. 010 min. to 0. 023 max. Rings which are slightly oversize may be filed as necessary to obtain the correct gap, but do not use rings which require too much filing. Standard size rings may be used on . 005-inch oversize pistons. Other oversize rings must be used with corresponding oversize pistons. Rings of the tapered type are usually marked top on one side or identified in some other manner and the ring must be installed with this mark toward the closed end of the piston.

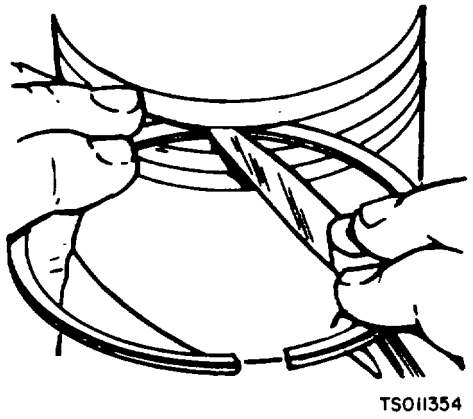


Figure 6-21. Inspecting Ring Lands Figure

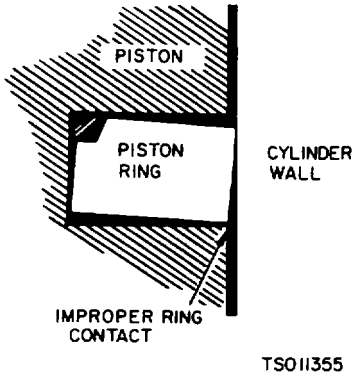


Figure 6-22. New Ring in Worn Piston Ring Groove

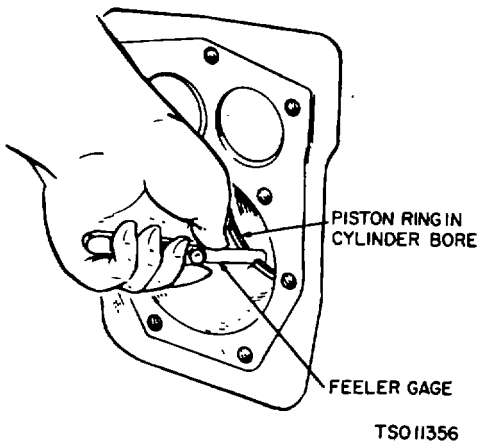


Figure 6-23. Fitting Piston Rings to Cylinder

(2) Drive piston pin bushing (205) in connecting rod (197).

(3) Position piston (206) on connecting rod (197). Thumb-push piston pin (204) through piston and connecting rod. Secure pin with two retaining rings (203).

(4) Install the piston rings (207). Space each ring gap one third of the way around the piston from the preceding one, with no gap directly in line with the piston pin. The bottom piston ring groove should be fitted with an expander and an oil control ring and the two upper grooves fitted with compression rings. If a chrome faced ring is used, it will be in the top groove. The oil control ring is selected for best performance in regard to the correct unit pressure characteristics.

e. Installation.

CAUTION

Be careful not to distort rings. Install rings, gap end first, in piston grooves. Staggering piston ring gaps reduces engine oil consumption.

(1) Assemble ring compressor tool Onan Part No. 420-0214 over piston rings.

(2) Install the piston and connecting rod assembly in cylinder. Back off compression ring tool from piston as each ring enters crankcase.

(3) Install the connecting rods (197) and caps with raised lines (witness marks) aligned and with the caps facing toward the oil base. The rod and cap numbered 2 fits on the crankshaft journal nearest the bearing plate.

(4) Coat the crankshaft journal bearing surfaces with oil before installing the rods.

(5) If necessary, rap the connecting rod cap screws (196) sharply with a softfaced hammer to set the rod square on the journal.

f. Checking Bearing Clearance With Plastigauge (figure 6-24).

(1) Place a piece of correct size plastigauge in the bearing cap the full width of the bearing insert about 1/4 inch (. 64cm) off center.

(2) Rotate the crank about 30 degrees from bottom dead center and reinstall the bearing cap. Tighten the connecting rod screw (196) to the torque of 27-29 pounds-foot (37-39 Newton Meters). Do not turn the crankshaft.

(3) Remove the bearing cap. Leave the flattened plastigauge on the part to which it has adhered and compare the widest point with the graduations on the plastigauge envelope to determine bearing clearance.

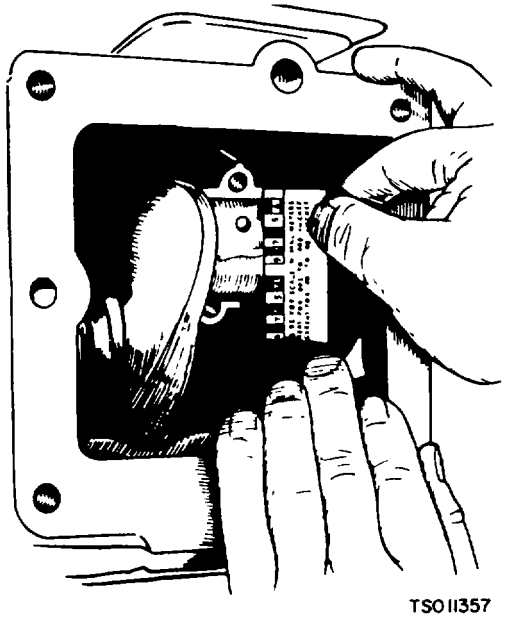


Figure 6-24. Measuring Bearing Clearance With Plastigauge

Section VI. CRANKSHAFT AND BEARINGS

6-22. GENERAL

Removal of the camshaft or crankshaft bearings requires complete disassembly of the engine. This would include the removal of all accessories and assemblies covered in previous removal paragraphs in Chapter 6, Sections I thru V. This repair would also cover the inspection, repair, or replacement of the crankshaft, camshaft and oil seals.

6-23. CRANKSHAFT AND BEARINGS

a. Removal (fig. 4-7).

(1) Remove engine accessories and other major assemblies and components described in paragraphs 6-1 thru 6-21.

(2) Refer to para 6-21 for crankshaft (199) removal. Remove crankshaft from crankcase at end opposite flywheel end. Label piston parts to assure proper reassembly.

(3) Use a press or a suitable drive plug to remove crankshaft bearings (117A) and camshaft bearings (209) from the crankcase (208) and bearing plate (117).

CAUTION

Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation.

b. Cleaning and Inspection.

(1) Clean all parts in approved cleaning solvent. Blow out all oil passages. Dry parts thoroughly with clean, lint-free cloth.

(2) Inspect crankshaft, camshaft, bearings and oil seals for cracks, chips, burrs, worn condition, and other defects.

(3) Inspect crankshaft and camshaft bearing journals for scoring. Inspect the drilled passages of the crankshaft for dirt or foreign material. Clean passages to assure proper lubrication of the connecting rods.

(4) Remove crankshaft or camshaft burrs with fine whetstone. Replace or repair crankshaft or camshaft as necessary.

(5) Replace defective bearings and oil seals. Refer to para 4-5b tabulated data for tolerances and clearances. Refer to para 6-24 and 6-25 for oil seal replacement.

c. Installation of Camshaft Bearings (figure 6-25).

(1) Replacement camshaft bearings are precision type which do not require line reaming or line boring after installation. Coat the bearing with lubricating oil to reduce friction prior to assembly.

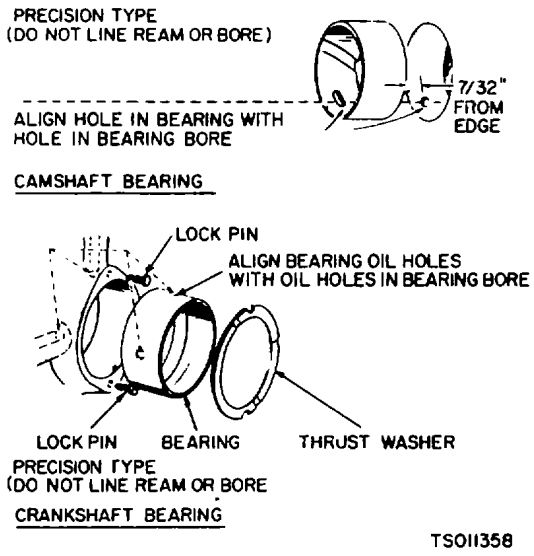


Figure 6-25.
Installation of Camshaft & Crankshaft Bearings

(2) Place the camshaft bearing (209, fig. 4-7) on the crankcase (208, fig. 4-7) over the bearing bore with the lubricating hole (front only) in proper position. Be sure to start the bearing straight. Press the front camshaft bearing in flush with the outside end of the bearing bore.

(3) Press the rear camshaft bearing in until past the ignition plunger hole.

d. Installation of Crankshaft Bearings (fig. 4-7).

(1) New crankshaft main bearings (117A) a are precision type which do not require line reaming or line boring after installation.

CAUTION

Support the casting to avoid distortion and avoid damaging the bearing bore during installation. Use oil on the bearings to reduce friction when installing and after installation.

(2) Before putting in the main crankshaft bearings (117A), expand the bearing bore by placing the casting in hot water or in an oven heated to 2000F (93. 30C). If practical, cool the precision bearing to shrink it.

CAUTION

If a torch is used, to prevent warpage, apply only a little heat.

(3) For putting in either the front or rear main bearing, always align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open. The cold oiled precision bearing should require only light taps to position it. Install the bearing flush with the inside end of the bore. If the head of a lock pin is damaged, use side cutters or "EasyOut" tool to remove pin. Then install a new lock pin. Apply oil to the thrust washers to hold in place when the crankshaft is installed. The oil grooves in the thrust washer bearings must face the crankshaft. Be sure two notches fit over lock pin.

(4) Reassemble engine partially to enable to perform a check of the crankshaft endplay (fig. 6-26). Reassemble the crankshaft (199) and associated parts, piston assemblies (206), connecting rod (197), and bearing plate (117) with washer and gasket (120 & 121).

(5) After the rear bearing end plate (117) has been tightened using the torque recommended in tabulated data (para 4-5b), check the crankshaft endplay as shown in figure 6-26. If there is too much endplay as shown in figure 6-26 (see Dimensions and Clearances in tabulated data, para 4-5b for minimum and maximum endplay) remove the rear bearing end plate and replace the gasket with a thinner gasket from the gasket kit. For too little endplay, remove the rear bearing end plate and replace the gasket with a thicker one. Reinstall the end plate making sure the thrust washer notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

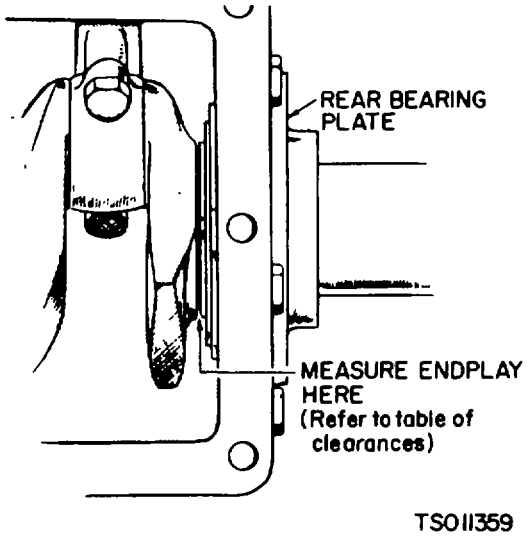


Figure 6-26. Measuring Crankshaft Endplay

Section VII. OIL SEALS

6-24. BEARING PLATE OIL SEAL

(1) Remove clutch (114) by loosening setscrew (115).

(2) Remove crankshaft bearing plate (117) to replace its oil seal (116).

(3) Drive the oil seal out from the inside using bearing plate driver tool Onan Part No. 420-0181.

b. Reassembly(fig. 4-7).

(1) Before installing the new bearing plate oil seal (116), fill the space between the seal with a fibrous grease or stiff cup grease. This will improve sealing. Refer to figure 6-27.

(2) When installing the bearing plate oil seal (116), tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate (117) to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

6-25. GEAR COVER OIL SEAL

a. Removal (fig. 4-7).

(1) Remove gear cover assembly (135) (para 6-9).

(2) Drive out gear cover oil seal (136) out from the inside using gear cover driver tool Onan Part No. 420-0313.

b. Reassembly (fig. 4-7).

(1) Before installing the new gear cover oil seal (136), fill the space between the seal with a fibrous grease or stiff cup grease. This will improve sealing. Refer to figure 6-27.

(2) When installing the gear cover oil seal (136), tap the seal inward until rear (spring side) of casing is one inch (2. 54cm) from the mounting face of the gear cover. Install new style, thin open face seal, 1-7/64 inch (2. 82cm) from mounting face of cover.

(3) Reassemble engine. Refer to paragraphs 6-1 thru 6-24.

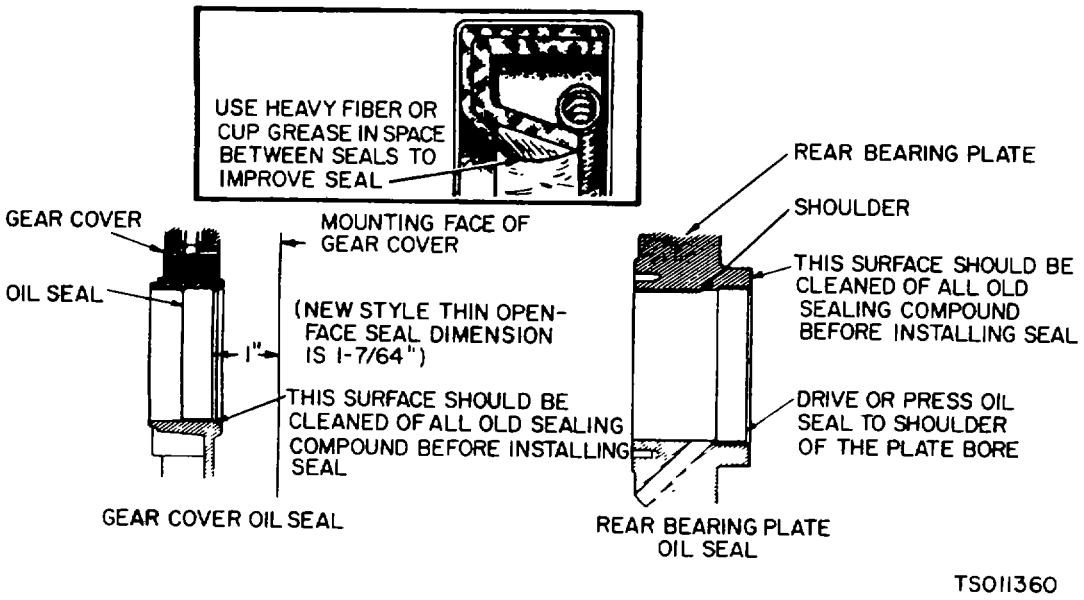


Figure 6-27. Gear Cover & Rear Bearing Plate Oil Seals

Section VIII. CYLINDER BLOCK

6-26. CYLINDER BLOCK INSPECTION

a. Make a thorough check for cracks. Minute cracks may be detected by coating the suspected area with a-mixture of 25 percent kerosene and 75 percent light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide (white lead) dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.

b. Inspect the cylinder bore for scoring. Check the Welsh plugs for a tight, even fit, and the fins for breakage.

c. Check the cylinder bore for taper, out of round, and wear with a cylinder bore gauge, telescope gauge or inside micrometer (fig. 6-28). These measurement should be taken at four places -two at the top and two at the bottom of piston ring travel.

d. Record measurements taken lengthwise at the top and bottom of the piston travel as follows:

(1) Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where the greatest ring wear occurs.

(2) Also, lengthwise of the block, measure and record as "B" the cylinder diameter at the piston skirt travel.

(3) Crosswise of the block, measure and record as "C" the diameter of the top of the cylinder at the greatest point of wear.

(4) Measure and record as "D" the diameter at the bottom of the cylinder bore and crosswise of the block.

(5) Reading "A" compared to reading "B" and reading "C" compared to reading "'D" indicates cylinder taper.

(6) If cylinder taper exceeds 0.005 inch (. 0 cm), rebore and hone to accommodate the next oversize piston. Reading " "compared to reading "C" and reading "B" compared to reading "'D" indicates whether or not the cylinder is our of round. If the out of round exceeds 0. 005 inch (. 0 cm) the cylinder must be rebored and honed for the next oversize piston. A reboring machine is used when going to oversize pistons.

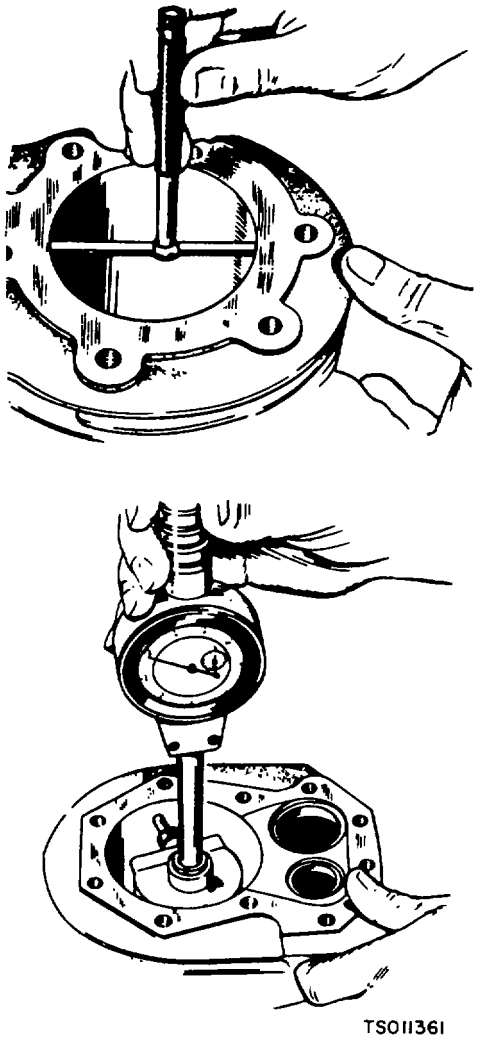


Figure 6-28.
Methods of Cylinder Bore Inspection

6-27. CYLINDER BLOCK REPAIR

a. A hone can be used to rebore a cylinder (figure 6-29). Remove stock to .002 inch(. 005cm) undersize of finish bore with course hone (100 grit), then complete honing with finish hones (300 grit).

b. Anchor the block solidly for either vertical or horizontal honing. Use either a drill press or heavy-duty drill which operates at approximately 250 to 450 rpm.

c. Lower the hone into the cylinder until it protrudes 1/2 to 3/4 inch (1.27 to 1. 91cm) past the end of the cylinder. Rotate the adjusting nut until the stones come in contact with the cylinder wall at the narrowest point.

d. Turn the hone by hand. Loosen the adjusting nut until the hone can be turned.

e. Connect drill to hone and start drill. Move the hone up and down in the cylinder approximately 40 cycles per minute. Usually the bottom of the cylinder must be worked out first because it is smaller. Then when the cylinder takes a uniform diameter, move the one up and down all the way through the bore. Follow the hone manufacturer's recommendations for wet or dry honing and oiling the hone.

f. Check the diameter of the cylinder regularly during honing. A dial bore gauge is the easiest method but a telescoping gauge can be used. Check the size at six places in the bore; measure twice at the top, middle and bottom at 90 degree angles.

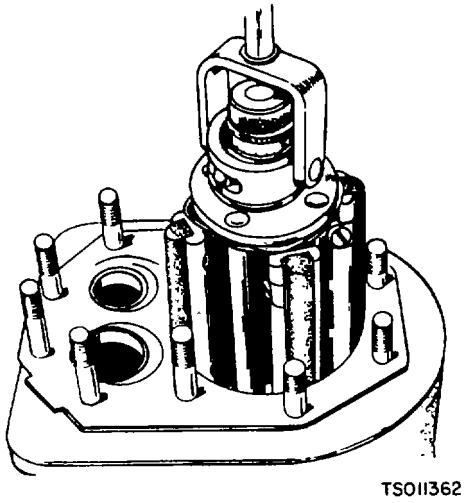


Figure 6-29. Honing Cylinder

g. When the cylinder is approximately .002 inch (. 005cm) within the desired bore, change to fine stones and finish the bore. The finish should not be smooth but as shown in fig. 6-30. The crosshatch formed by the scratching of the stones should form an angle of 23 degrees. This can be achieved by moving the hone up and down in the cylinder about 40 cycles per minute.

h. Clean the cylinder block thoroughly with soap, water and clean rags. A clean white rag should not be soiled on the wall after cleaning is complete. Do not use a solvent or gasoline since they wash the oil from the walls but leave the metal particles.

i. Dry the crankcase and coat it with oil.

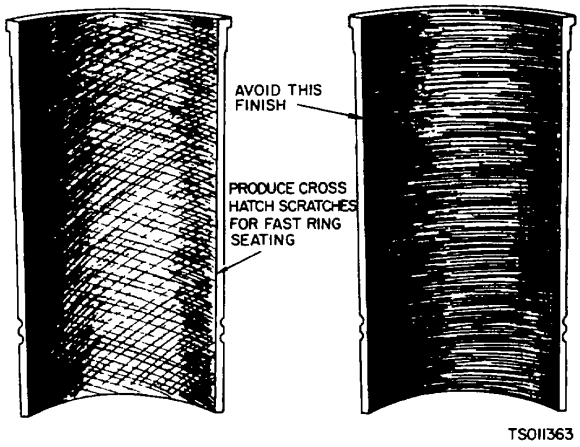


Figure 6-30. Correct Hone Finish

CHAPTER 7

REFRIGERATION SYTSTEM REPAIR

Section I. SERVICING REFRIGERATION SYSTEM

7-1. PUMPING DOWN

Before the refrigeration system can be opened for maintenance, as much refrigerant as possible must be liquefied and removed from tubing and other components and placed in the receiver tank in the condenser compartment. The procedure involved in transferring refrigerant to the receiver tank is known as pumping down. To pump down the system, proceed as follows:

a. Be sure that compressor suction and discharge valves are open.

b. Close receiver outlet valve by turning valve stem clockwise as far as it will go.

c. Operate unit until suction pressure gauge registers between 0and 1-pound per square inch (0-6.9 kilopascals).

d. Shut off machine and observe suction pressure gauge. If pressure rebuilds appreciably, again operate machine until pressure is between 0and I-pound per square inch (0-6.9 kilopascals). Repeat this step until pressure no longer rebuilds appreciably.

e. Close receiver inlet valve by turning valve stem clockwise as far as it will go.

7-2. OPENING SYSTEM

Before opening the refrigeration system, the pressure in the system should be known. If the system is open under high pressure, excessive loss of refrigerant will occur; if opened under vacuum, air is drawn into the equipment and causes future operating difficulties. If pressure gauge indicates a vacuum after system has been pumped down, cautiously open receiver outlet valve enough to build a slight pressure in the system.

When a positive pressure is assured, the part of system to be opened should be shut off from remainder of system. Thus, if the compressor is to be removed, compressor suction and discharge valves should be closed after system is pumped down. In opening the system, observe the following precautions:

a. Clean and dry equipment at the point to be opened. Use a clean, lint-free cloth for this purpose.

b. Open the necessary joints and plug and cover opening to prevent dirt from entering.

c. After opening the system, do not touch internal parts unless hands are thoroughly dry and clean.

d. If a spare part is to be installed, clean and dry the part as follows: (1) Clean the part by brushing it while immersed in an approved cleaning solvent.

(2) Dry the part with heat by placing part on blocks above large electric light bulb. If heat from other sources is used, be sure that temperature is not raised above 175°F (79.44°C).

7-3. ADDING REFRIGERANT

NOTE

Whenever available, use recycled refrigerant for charging the refrigeration system.

When refrigerant passing through sight glass appears frothy during normal operation of refrigeration unit, the system needs additional refrigerant. A normal refrigerant charge consists of 130 ounces of R 12. This amount of R12 is in the unit when shipment is made. If additional refrigerant is required, it indicates that a leak has developed in the system. In this case, test for leak (para 7-9), repair faulty connection and add refrigerant as follows:

WARNING

AVOID BODILY CONTACT WITH OR INHALING OF REFRIGERANT GAS. WHEN IN AN ENCLOSED AREA, BE SURE OF PROPER VENTILATION. BREATHING OF REFRIGERANT 12 FOR LONG PERIODS OF TIME COULD BE INJURIOUS TO PERSONNEL.

a. Turn stem of suction service valve counterclockwise as far as possible.

7-3. ADDING REFRIGERANT (cont)

b. Connect line from R 12 charging drum to the connection of compressor service valve. Leave connection loose at compressor suction valve and open charging drum outlet valve long enough to purge all air from the charging line through the loose connection. Tighten charging line connection at compressor suction valve.

c. Turn stem of suction service valve clockwise 3 or 4 turns.

d. Open charging drum outlet valve one or two turns.

e. Snap start switch to ON position.

f. Operate unit while observing sight glass. When frothiness disappears, turn suction service valve counterclockwise as far as it will go. Allow unit to operate a while to see if sight glass remains clear. If not, add more RI 2.

g. Close outlet valve of charging drum.

h. Disconnect charging line from suction valve and replace bonnet and nut.

i. Turn suction service valve clockwise until suction pressure gauge registers.

j. Return unit to normal operation.

7-4. INSPECTING COMPRESSOR OIL LEVEL

Compressor oil in the unit travels through a sealed system and cannot escape. It should be necessary to add oil only after repair of the refrigeration system. To inspect compressor oil level, proceed as follows:

a. Operate unit with 70'F (21 .1 °C) air passing through evaporator coil for twenty-five minutes.

b. With unit running, inspect oil level through sight glass at side of compressor. If oil can be seen in glass, oil level is correct; if oil cannot be seen, oil must be added.

7-5. ADDING COMPRESSOR OIL

To add compressor oil, proceed as follows:

a. Pump down compressor by closing suction service valve. Turn switch to "ON" momentarily until suction pressure gauge registers between 0- and 1-pound per square inch (6.9 kilopascals) Snap switch to "OFF" position.

b. Close compressor discharge valve.

c. Remove compressor oil filler plug and permit gas to escape through filler plug opening. Never open compressor when suction pressure gauge registers a vacuum.

d. Add oil through filler plug opening until level is at center of the compressor sight glass.

e. Crack suction service valve and purge compressor.

f. Replace compressor filler plug.

g. Fully open suction service valve and turn stem clockwise until suction pressure gauge registers.

h. Fully open discharge service valve and then turn valve stem clockwise one-fourth of a turn.

i. Return unit to normal operation.

7-5.1 DISCHARGING REFRIGERATION SYSTEM

NOTE

In accordance with Environmental Protection Agency regulations, refrigerants cannot be discharged into the atmosphere. A refrigerant recovery & recycling unit must be used whenever discharging the refrigerant system.

Operation of the recovery/recycling unit must be by AUTHORIZED PERSONNEL ONLY

Connect and operate a recovery/recycling unit in accordance with the manufacturer's instructions.

7-6. PURGING REFRIGERATION SYSTEM

When the refrigeration system is opened for servicing, there is a possibility of air entering the system. Before closing the system, that portion opened must be purged to eliminate air.

a. Purging System when Unit has Lost Complete Charge.

(1) Test for and repair leak.

(2) Attach charging line from drum ofRl2 to charging port of suction service valve.

(3) Remove expansion valve outlet flare nut.

(4) Fully close suction service valve.

(5) Partly open valve on charging drum and let gas enter system. Refrigerant will travel through compressor, discharge line, condenser, receiver, liquid line and expansion valve. Let gas pass through system for ten seconds.

(6) Open compressor suction service valve 3 or 4 turns and close compressor discharge valve.

(7) Partly open valve on charging drum and let gas pass through system for ten seconds. The refrigerant will travel through the crankcase, pressure regulating valve, heat exchanger and evaporator.

(8) Replace expansion valve outlet flare nut.

(9) Return all service valves to normal operating position.

(10) Charge system with refrigerant (para 7-3).

b. Purging Low Side of System. When unit has been pumped down in order to service a part on the low side, and there is refrigerant in the receiver tank, proceed as follows:

(1) Close discharge service valve fully clockwise. Remove cap from discharge service valve tee.

(2) Open receiver outlet valve and let gas escape through discharge service port for 10 seconds. Replace cap on port.

(3) Open discharge service valve to normal position. Open receiver outlet valve slightly and build pressure to pounds. Check for leaks.

(4) Reset valves on unit for normal operation.

7-7. DETECTING MOISTURE

Excessive water vapor may enter the refrigeration system. At the low temperature developed in the system, this vapor condenses and may freeze the expansion valve in an open or closed position. The operating characteristics of a unit with a frozen expansion valve are given below.

a. Valve Frozen Shut. If expansion valve is frozen shut, the following operating characteristics may be observed.

(1) Unit operates continuously; box temperature remains high.

(2) Suction pressure remains abnormally low.

(3) Suction tubing remains abnormally warm.

b. Valve Frozen Open. If the expansion valve is frozen open, the following characteristics may be observed:

(1) Suction pressure remains abnormally high.

(2) Compressor pounds.

c. Liquid Moisture Indicator. If color indicator is pink, moisture is present in system.

7-8. REMOVING MOISTURE

The following means may be used to remove moisture from the refrigeration system. It will be necessary to artificially warm the expansion valve or shut off and warm the entire unit for a long enough period of time to thaw the frozen water in the system, enabling it to be recirculated with the refrigerant.

a. Change Dehydrator. If activated silicagel charge of dehydrator has absorbed all the moisture it can hold, change the dehydrator (para 7-17). Run on this for approximately one day, then change again to another fresh dehydrator. This may strip enough moisture from system to correct the condition.

b. Use Service Dehydrator. Operate the unit approximately an hour with service drier and replace dehydrator on unit with a fresh dehydrator.

7-9. TESTING FOR LEAKS

To test for leaks, use Halide leak detector.

a. Follow instructions provided with Halide leak detector. Use only kind of fuel recommended by instruction sheet supplied with unit.

b. Hold open end of leak detector finder tube near each soldered joint and fitting. If burned flame turns blue-green, a leak is indicated. If a leak is indicated, close nearest valves on each side of leak; release pressure, and make repair before operating refrigeration unit.

7-10. SOLDERING

Many sections of tubing in the refrigeration system are connected by means of hard soldered joints. Although established soldering principles are used, the following precautions should be observed:

a. Cut tubing square and remove all burrs.

b. When tubing is mated to the socket of a fitting make alight scribe line or other equivalent marking on tubing at a distance of 1-inch (2. 54cm) plus depth of the socket from the tube end. This provides an accurate method for checking that tubing is fully engaged in the socket throughout soldering operation.

c. Use steel wool and clean inside of socket and outside of tube for a length greater than the depth of the socket. Clean to a bright finish; remove all foreign substances such as oil, scale, and oxides. Do not handle clean surfaces.

d. When brazing at valve socket, partly open valve to avoid damaging valve seat or seat disk by thermal expansion.

e. Apply flux evenly to outside of socket end and the tube to distance close to the scribe line.

f. Apply only enough heat to cause the solder to flow. Apply heat to socket uniformly in order to draw the solder into the joint. Continue heating until the flux becomes liquid or has the appearance of water. In soldering at sockets of valves, direct flame away from body and towards tube so that excess heat is not absorbed by internal parts of valve.

g. Lay solder firmly against junction of socket and tubing and permit the alloy to flow throughout the joint.

h. When solder becomes set, apply wet cloth or swab to the joint to carry away excess heat and to remove residual flux. If necessary, use a wire brush to remove all flux.

7-11. USE OF WRENCHES ON FLARED FITTINGS

The following precautions are advised in regard to flare nuts used in conjunction with copper tubing.

a. Overtightening of Flare Nuts. As copper tubing is relatively soft, overtightening of flare nuts will ruin the copper flare.

b. Hardening of Flares. Continued tightening of flare nuts will in time cause a hardening effect of the copper flare. To soften tubing which has become hard, apply torch to the hardened section until dull red; then quench in water.

Section II. COMPRESSOR

7-12. GENERAL

The Dunham-Bush Model BP42-1 compressor (fig. 7-1) is a four cylinder piston type pump, constructed mainly of cast iron. The aluminum pistons and connecting rods are driven in a reciprocating motion by an iron crankshaft. To prevent leakage around the crankshaft, a rotary seal is used. Lubrication to the connecting rods and bearing is provided by a vane type oil pump. The oil level can be observed through a sight glass in the compressor body.

7-13. COMPRESSOR REPAIR

a. Removal of Compressor from Engine and Compressor Mounting Plate.

NOTE

Before removing the compressor from the engine and compressor mounting plate, note the oil level in the compressor sight glass. It should be at the center of the sight glass. If not, it should be filled to center before re-installation.

(1) Close liquid line valve (6, fig. 7-7) and pump the system down.

(2) Front seat the discharge service valve (12, fig. 7-1) and the suction service valve (7, fig. 7-1).

(3) Remove discharge and suction service valves (12 and 7, fig. 7-1) respectively off the compressor.

(4) Remove drive belts (36 & 52,fig. 4-16) from compressor pulley (5,fig. 7-1).

(5) Remove compressor mounting hardware (9, 10 &11, fig. 4-5) and slide compressor from mounting plate.

b. Repair. Direct support units may repair a compressor to the extent of replacing any of the following defective parts.(Refer to fig. 7-1.)

(1) Suction and discharge service valves (7 and 12).

(2) Cylinder head (29).

(3) Valve plates (31).

(4) Crankshaft and sleeve bearing (49 & 46).

(5) Piston assembly (43).

(6) Oil pump (42).

(7) Seal assembly (26).

(8) Pulley (5).

More extensive repair must be performed by a higher category of maintenance (General Support).

c. Disassembly (fig. 7-1).

(1) Remove screw (1) and washers (2) securing pulley (5) to compressor crankshaft (49); slide off pulley (5) and key (39) with screw (3) and stop plate(4) attached.

(2) Remove seal cover plate (24) by removing screw (23). Remove gasket (25).

(3) Remove seal assembly (26).

(4) Inspect the shaft for pitting or other damage that may make the new seal malfunction.

(5) Remove nine screws (1) securing cylinder head (29) to compressor body.

NOTE

It may be necessary to tap edge of cylinder head with a soft-faced hammer or wooden block.

(6) Remove cylinder head (29) along with head gasket (30), valve plate (31) and gasket (32).

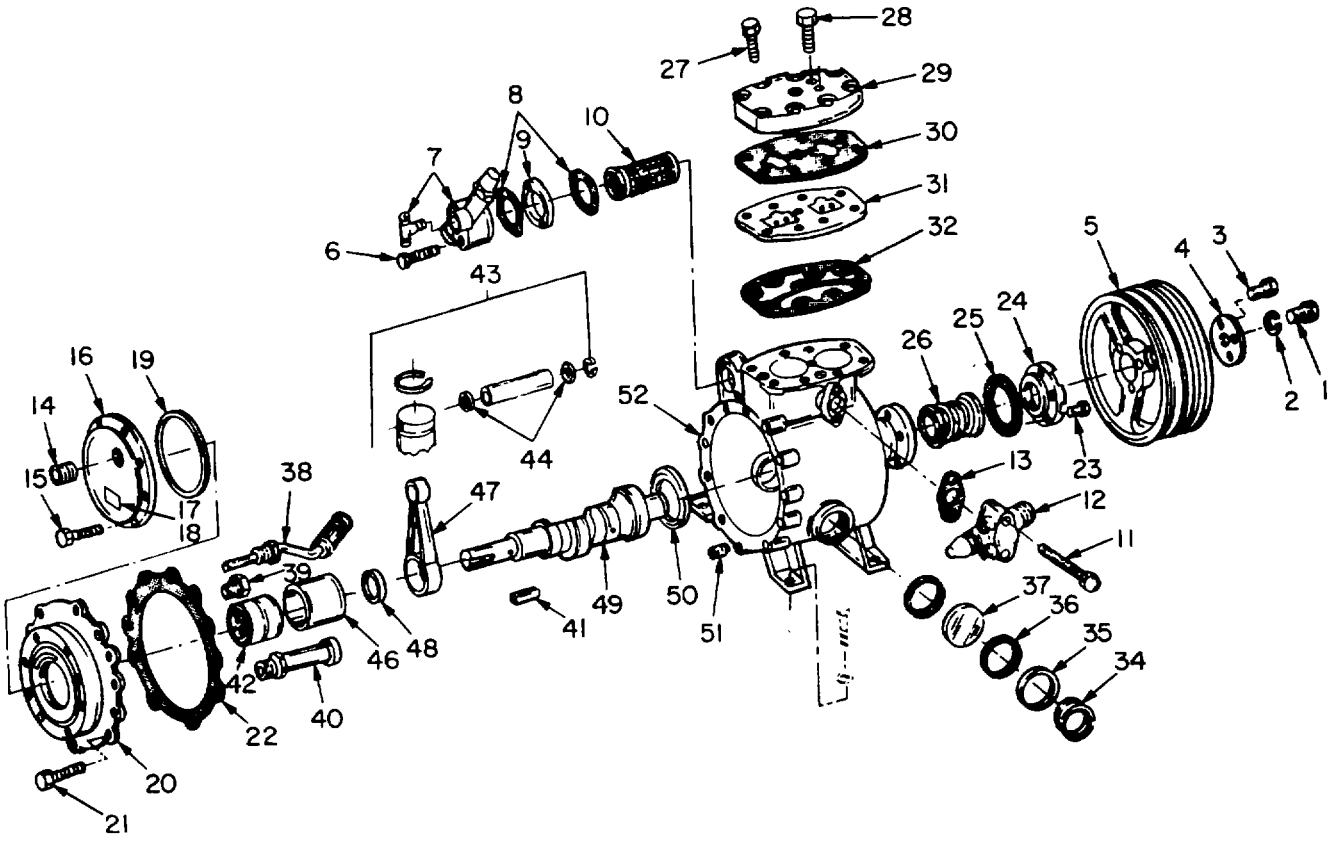
(7) Remove oil pump assembly (42) with associated parts; oil plug (14), screws (15) and pump plate (16) with gasket (19) from end plate (20).

(8) Remove twelve screws (21) securing end plate (20) to compressor body.

(9) Remove end plate (20) along with gasket (22).

(10) Rotate and gently slide out crankshaft (49) with associated parts from compressor body.

(11) Remove two connecting rods (47) and piston assemblies (43) from the cylinder by pulling them down into the crankcase and out the pump end of the compressor.



1. Screw
2. Washer, lock
3. Screw
4. Stop plate
5. Pulley (flywheel)
6. Screw
7. Valve, suction
8. Gasket, suction
9. Adapter, suction valve
10. Strainer, suction
11. Screw
12. Valve, discharge
13. Gasket, discharge valve
14. Plug
15. Screw
16. Plate, pump
17. Pin, drive
18. Plate, specification
19. Gasket, pump plate (Plate seal end)
20. Plate, end
21. Screw
22. Gasket, end plate
23. Screw
24. Plate, seal cover
25. Gasket, seal cover
26. Seal assembly
27. Screw
28. Plug
29. Cylinder head
30. Gasket
31. Valve plate assembly
32. Gasket, valve plate
33. Nut Used
34. Retainer, sight glass
35. Ring
36. Gasket, sight glass
37. Sight glass
38. Oil pickup
39. Fitting
40. Valve, relief
41. Key
42. Oil pump assembly
43. Piston assembly
44. Washer
45. Pin, piston
46. Bearing, sleeve
47. Connecting rod
48. Washer, thrust
49. Crankshaft
50. Washer, thrust
51. Plug, oil drain
52. Crankcase

Figure 7-1. Compressor

7-13. COMPRESSOR REPAIR (cont)

d. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect cylinder heads and valve plates for cracks and dents. Replace if defective.

(3) Inspect suction and discharge valves for dents and cracks. Replace if defective. Check suction strainer for foreign matter; clean if needed.

(4) Remove pump plate and end plate from compressor; inspect oil pump for broken vanes or excessive wear and end plate bearing for wear. If either are damage, the whole end plate should be replaced.

(5) Remove pulley and seal assembly from crankshaft. Inspect seal assembly for excess wear. If any of its components are damaged, replace entire assembly.

(6) Remove crankshaft and inspect for wear at the eccentric and in the seal assembly area. Replace if defective.

(7) Inspect connecting rods and piston assemblies for damage and replace if defective.

(8) After all components have been removed from the compressor body, the crankcase and cylinder walls can be inspected for wear. If wear has occurred, replace crankcase.

e. Reassembly (fig. 7-1).

(1) Replace any defective components before assembly. Always install new gaskets. Coat all parts with a light film of clean compressor oil prior to assembly.

CAUTION

Take care not to break the piston rings.

(2) Insert the pistons (43) and connecting rods into the pump end of the compressor, gently working them up into the cylinders.

CAUTION

Take care not to use force while assembling.

(3) Simultaneously push and rotate the crankshaft (49)with sleeve bearing (46) and thrust washers (48&50) attached, thru connecting rod (47) until crankshaft eccentric aligns with connecting rod.

(4) Align mounting holes of end plate (20) with new gasket (22) attached to compressor. Secure with twelve screws (21).

(5) Place oil pump assembly (42) on end plate (20).

(6) Mount and secure oil pump plate and new gasket (19) to end plate (20) with eight screws (15). Screw oil plug (14) to oil pump plate (16).

(7) Install valve plates (31) with new gaskets (32) attached, and cylinder heads (29) with new gaskets (30) attached to compressor body. Secure with nine screws (27).

(8) Insert seal assembly (26), seal plate (24) with new gasket (25) attached over crankshaft (49) and secure with screws (23).

(9) Align pulley (5) to shaft with key (41) and secure with stop plate (4) and screw (3).

(10) Place suction valve (7) with new gaskets (8) and strainer (10) on compressor body; mount with hardware (6).

(11) Place discharge valve (12) with new gasket (13) on compressor body; mount with hardware (11).

f. Installation.

NOTE

Check compressor sight glass; oil level should be at the center of glass; if not fill to center prior to installation.

(1) Place assembled compressor (fig. 7-1) on engine and compressor mounting plate (fig. 4-5). Secure with four screws and washers (9, 10 & 11), fig. 4-5).

(2) Place compressor drive belts and fan belt (36 & 52, fig. 4-16) on compressor pulley (5, fig. 7-1). Adjust tension on belts.

Section III. CRANKCASE PRESSURE REGULATING VALVE

7-14. GENERAL

The crankcase pressure regulating valve is designed to limit the maximum pressure at the compressor inlet to prevent overloading the engine. At high load conditions, the valve imposes a partial restriction in the suction line. When the condition has passed, and suction pressures drop below the valve setting, the valve assumes an open position. The correct pressure of the valve is between 8 and 10pounds per square inch (55.12 Kpa and 68. 9 Kpa).

7-15. CRANKCASE PRESSURE REGULATING VALVE

a. Adjusting (fig. 7-2).

(1) Operate unit with 70°F (21. 1°°C) air passing through evaporator coil for five minutes and read suction pressure gauge.

(2) If pressure needs adjustment, remove protector cap from valve adjustment and then using screwdriver, adjust the valve. Turn adjustment clockwise to raise pressure and counterclockwise to lower pressure as observed on suction pressure gauge.

b. Removal (fig. 7-2).

(1) Refer to paragraph 7-1 and pump down refrigeration system.

(2) Remove U-bolt and attaching hardware (29, 30 &31) and bracket (42) with hardware (39, 40 & 41).

(3) Unsweat the two copper tubes (23&37) joining the valve (32) to the refrigeration system and remove valve.

c. Cleaning and Inspection.

(1) Clean valve with an approved cleaning solvent and dry thoroughly.

(2) Inspect valve for dents, cracks, or other damage. Valve must be replaced if defective.

d. Installation.

(1) Place valve (32) in position and resweat copper tubes (23 & 37).

(2) Refer to paragraph 7-6 and purge the refrigeration system.

(3) Refer to para 7-9 and test for leaks.

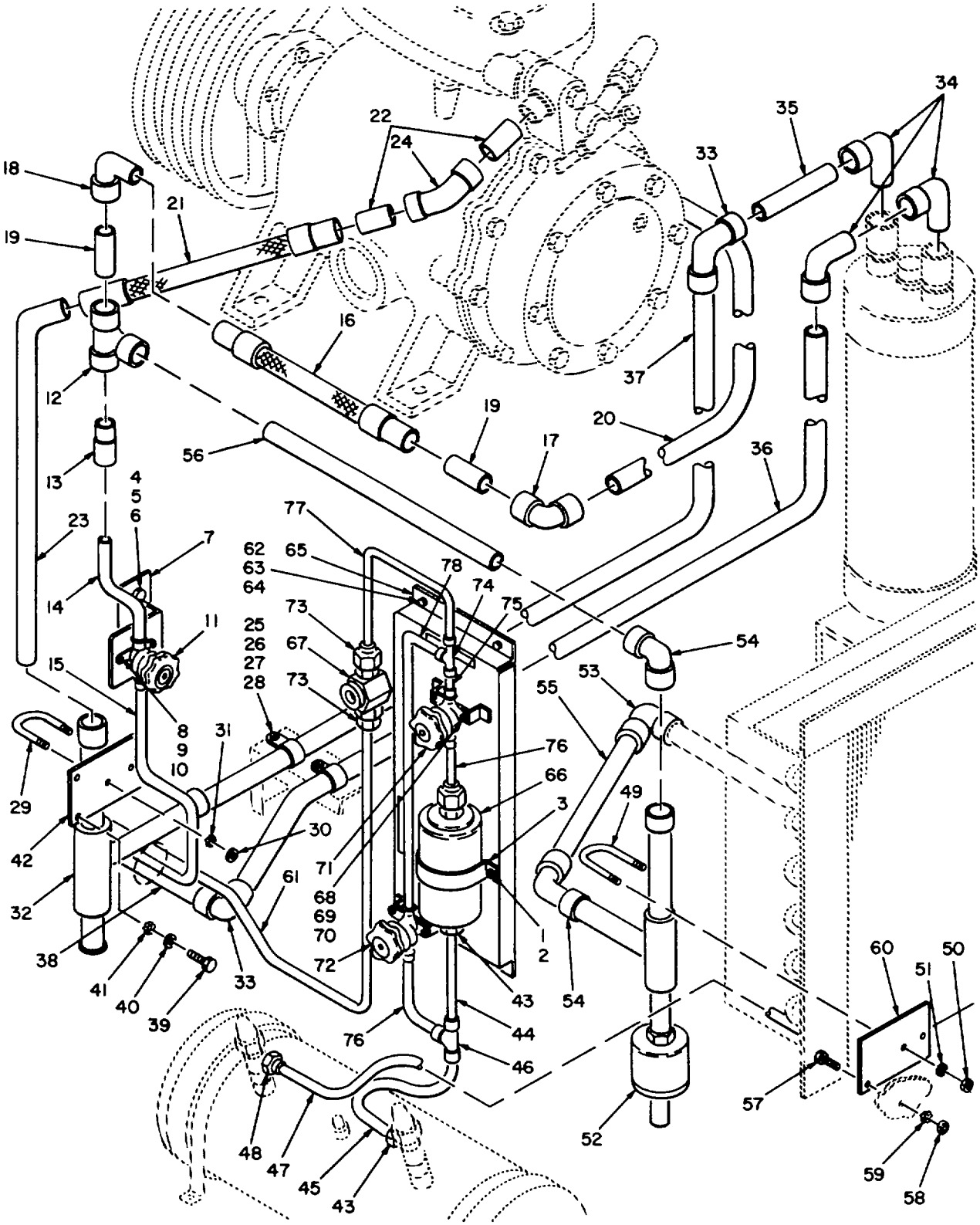


Figure 7-2. Refrigerant Piping and Valves (Sheet 1 of 2)

1. Nut, hex
2. Washer, lock
3. Clamp
4. Screw
5. Washer, lock
6. Washer, flat
7. Bracket
8. Screw
9. Washer, lock
10. Nut, hex
11. Valve
12. Tee
13. Coupling
14. Tube
15. Tube
16. Vibration Eliminator
17. Elbow
18. Elbow
19. Tube
20. Tube
21. Vibration Eliminator
22. Tube
23. Tube
24. Elbow
25. Clamp
26. Screw
27. Nut, hex
28. Washer, flat
29. U-Bolt
30. Nut, hex
31. Washer, lock
32. Valve, crankcase, pressure regulating
33. Elbow
34. Elbow
35. Tube
36. Tube
37. Tube
38. Tube
39. Screw
40. Washer, flat
41. Washer, lock
42. Bracket
43. Nut, flare
44. Tube
45. Tube
46. Tee
47. Tube
48. Nut, flare
49. U-Bolt
50. Nut, hex
51. Washer, flat
52. Valve
53. Elbow
54. Elbow
55. Tube
56. Tube
57. Screw
58. Nut, hex
59. Washer, lock
60. Bracket
61. Tube
62. Screw
63. Washer, lock
64. Washer, flat
65. Panel
66. Dehydrator
67. Liquid Indicator
68. Screw
69. Nut, hex
70. Washer, lock
71. Valve, hand
72. Valve, hand
73. Nut, flare
74. Tee
75. Tube
76. Tube
77. Tube
78. Tube

Figure 7-2. Refrigerant Piping and Valves (Sheet 2 of 2)

Section IV. DEHYDRATOR

7-16. GENERAL

a. The dehydrator is a cylindrical vessel attached by a clamp on the refrigeration panel assembly. The body of the dehydrator contains activated alumina, a material which removes moistures from the refrigerant by absorption. A filter in the inlet end of the dehydrator prevents activated alumina and other material from entering other parts of the refrigeration system. If the dehydrator is removed for any purpose, it should never be replaced with a unit smaller than the original.

b. A two-valve bypass, makes it possible to bypass the dehydrator or change the dehydrator without pumping down the system.

7-17. DEHYDRATOR

a. Emergency Operation. If the dehydrator is plugged by dirt, oil, or saturated with moisture, the unit may be operated until a replacement dehydrator is available. To operate, close valve (71,fig. 7-2) and open bypass valve (72, fig. 7-2), but do not remove dehydrator. This will allow the refrigerant to flow direct from the receiver outlet valve (6, fig. 7-7) to the expansion valve (3,fig. 7-3) bypassing the dehydrator (66,fig. 7-2). A replacement dehydrator should be installed as soon as possible.

b. Removal.

(1) Refer to paragraph 7-1 and pump down refrigeration system. Close the dehydrator valves and the receiver valve.

(2) Disconnect flare nuts at dehydrator (66, fig. 7-2) inlet and outlet.

(3) Loosen nut and washer (l&2,fig. 7-2) on dehydrator mounting clamp (3, fig. 7-2) and remove dehydrator (66, fig. 7-2).

c. Installation.

NOTE
Always install a new dehydrator when one has been removed.

(1) Install dehydrator (66, fig. 7-2) in clamp (3, fig. 7-2) as in original configuration and tighten washer (2) with nut (1).

(2) Tighten inlet nut but leave outlet nut off. Open receiver outlet valve (6, fig. 7-7) slightly to purge line; then tighten outlet nut.

(3) Refer to para 7-9 and test for leaks before operating unit.

(4) If unit was operated by bypassing dehydrator, be sure that bypass valve (72, fig. 7-2) is closed and valves (71,fig.7-2) are open.

Section V. EXPANSION VALVE

7-18. GENERAL

The expansion valve acts as a pressure-sensitive variable restriction between the high and low pressure sides of the refrigeration system. The flow of refrigerant through the valve is controlled by the opening and closing movement of a plunger connected to the diaphragm of the expansion valve. The coupled plunger and diaphragm are acted upon by two forces. The pressure of the liquid in the bulb of the expansion valve causes a downward or opening movement on the diaphragm and plunger. The valve plunger and diaphragm are spring-loaded to assist the evaporator pressure to cause an upward or closing movement. A gas-filled thermo bulb is clamped to the evaporator outlet line and connected to the diaphragm by means of a capillary tube. When the evaporator is refrigerated and the thermo bulb is cold, the gas in the bulb contracts and the pressure on the diaphragm decreases in direct proportion. As pressure on the diaphragm decreases, the plunger spring in the valve housing forces the plunger against the valve orifice, shutting off the flow of refrigerant to the evaporator. An external equalizer line connects a chamber under the valve diaphragm to the suction line, which enables the expansion valve to make an accurate reading of and response to the suction pressure at the thermo bulb. bulb. Any increase in suction line temperature causes the gas in the thermo bulb to expand and the diaphragm then forces the valve plunger away from the orifice, allowing refrigerant to enter the evaporator. The expansion valve is preset by the manufacturer to maintain a balance when the temperature of the thermo bulb is approximately 400 to 50°F (4.4° to 10°C) above the temperature of refrigerant entering the evaporator.

7-19. EXPANSION VALVE (FIG. 7-3)

a. Adjusting.

(1) Remove panel (6,fig. 7-4) at rear of evaporator section.

(2) Remove superheat adjustment cap and turn square adjustment stem only 1/4 turn at a time. Turning stem to right decreases flow and raises superheat. Turning stem to left increases flow and lowers superheat. The superheat is correctly adjusted when the suction line at the expansion valve thermo bulb is 10°F (-12.20°C) warmer than the saturated refrigerant in the coil.

(3) Replace adjustment cap.

(4) Replace panel at rear of evaporator section.

b. Removal.

(1) Refer to para 7-1 and pump down refrigeration system.

(2) Remove panels (6, fig. 7-4) at rear of evaporator section.

(3) Loosen screws holding expansion valve bulb clamp to suction line and remove bulb.

(4) Disconnect three flare nuts at expansion valve (3).

(5) Remove screw and clamp that attach expansion valve bulb lead to evaporator coil.

(6) Remove two screws (1) and washers (2) that attach expansion valve (3) to bracket (5) and remove expansion valve.

c. Cleaning and Inspection.

(1) Clean expansion valve thoroughly with an approved cleaning solvent and dry thoroughly.

(2) Inspect expansion valve for cracks, chips, or other damage. Replace if defective.

d. Installation.

(1) Secure expansion valve (3) in place with two screws (1) and washers (2).

(2) Place expansion valve bulb in clamp in suction line and tighten clamp screws.

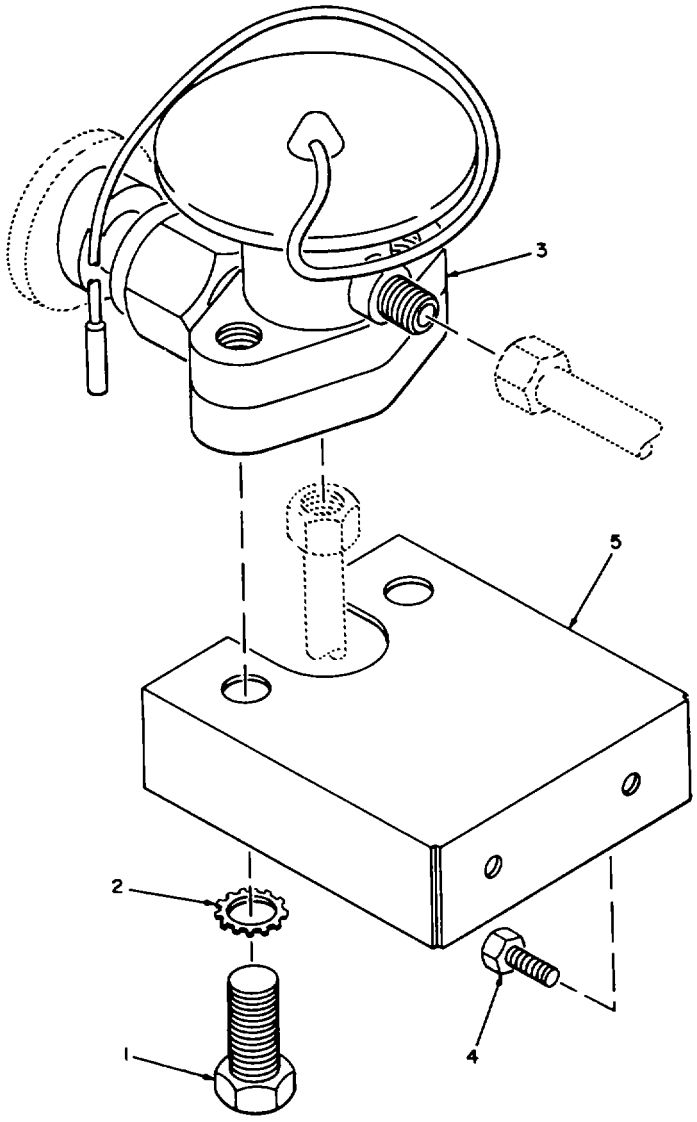
(3) Secure expansion valve bulb lead to evaporator coil.

(4) Connect three flare nuts at expansion valve.

(5) Refer to para 7-6 and purge refrigeration system.

(6) Refer to para 7-9 and test for leaks.

(7) Replace panel (6,fig.7-4) at rear of evaporator section.



1. Screw
2. Washer, lock
3. Valve
4. Screw
5. Bracket

Figure 7-3. Expansion Valve

Section VI. EVAPORATOR COIL

7-20. GENERAL

The evaporator coil consists of an aluminum housing containing a series of parallel tubes equipped with external radiator type fins. Liquid refrigerant enters the evaporator and vaporizes as it passes through the tubes. The low temperature produced by the vaporizing refrigerant cools the evaporator coils and the air surrounding the coils. Air is recirculated over the coils through the refrigerator by means of a fan located between the evaporator and the forward plate of the evaporator housing. The vaporized refrigerant is collected in a header and carried back to the compressor by the suction line.

7-21. EVAPORATOR COIL

a. Removal.

(1) Refer to paragraph 7-1 and pump down the refrigeration system.

(2) Remove eight screws and washers (12, 13, 14, fig. 7-4) along back panel (15 , fig. 7-4). Remove panel.

(3) Remove screws, washers and bottom cover (1, 2, 3 and 4, fig. 7-4).

(4) Remove screw (5, fig. 7-4) to remove side covers (6, fig. 7-4).

(5) Remove bulbs from the evaporator grille bracket.

(6) Remove screws (10, fig. 7-5) alongside of evaporator, holding pan assembly (7,fig. 7-5).

(7) Unsweat refrigerant lines to evaporator coil.

(8) Evaporator may be removed as a unit.

b. Cleaning and Inspection.

(1) Use stiff brush or compressed air to remove dust or other foreign matter from between fins of evaporator coil. If compressed air is used, force air through fins in a direction opposite from normal circulation.

(2) Clean external surfaces with an approved cleaning solvent and dry thoroughly.

(3) Inspect evaporator for bent fins. Straighten fins as necessary to permit free passage of air.

(4) Repair leaks in evaporator tubing by brazing or soldering with a compound having a melting point of more than 100°F (538°C). Use flux sparingly.

c. Installation.

(1) Place evaporator coil (9, fig. 7-5) into the refrigeration unit as in original configuration.

(2) Resweat refrigerant lines to evaporator coil.

(3) Attach bulbs to evaporator grille bracket.

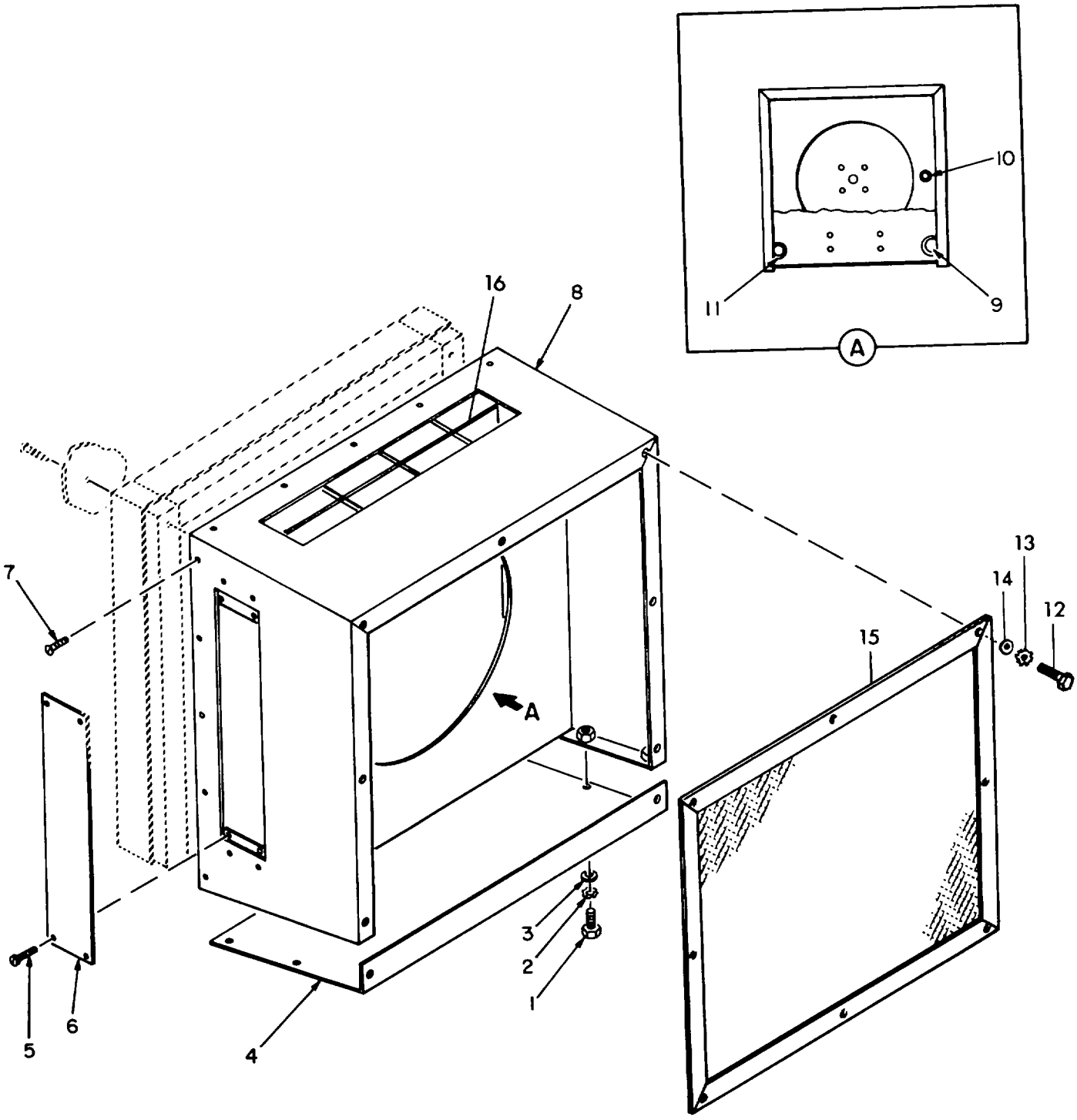
(4) Attach pan assembly (7, fig. 7-5) with screw (10, fg.7-5).

(5) Install back panel (15, fig. 7-4) with eight screws.

(6) Attach side covers (6, fig. 7-4) with screw (5, fig. 7-4).

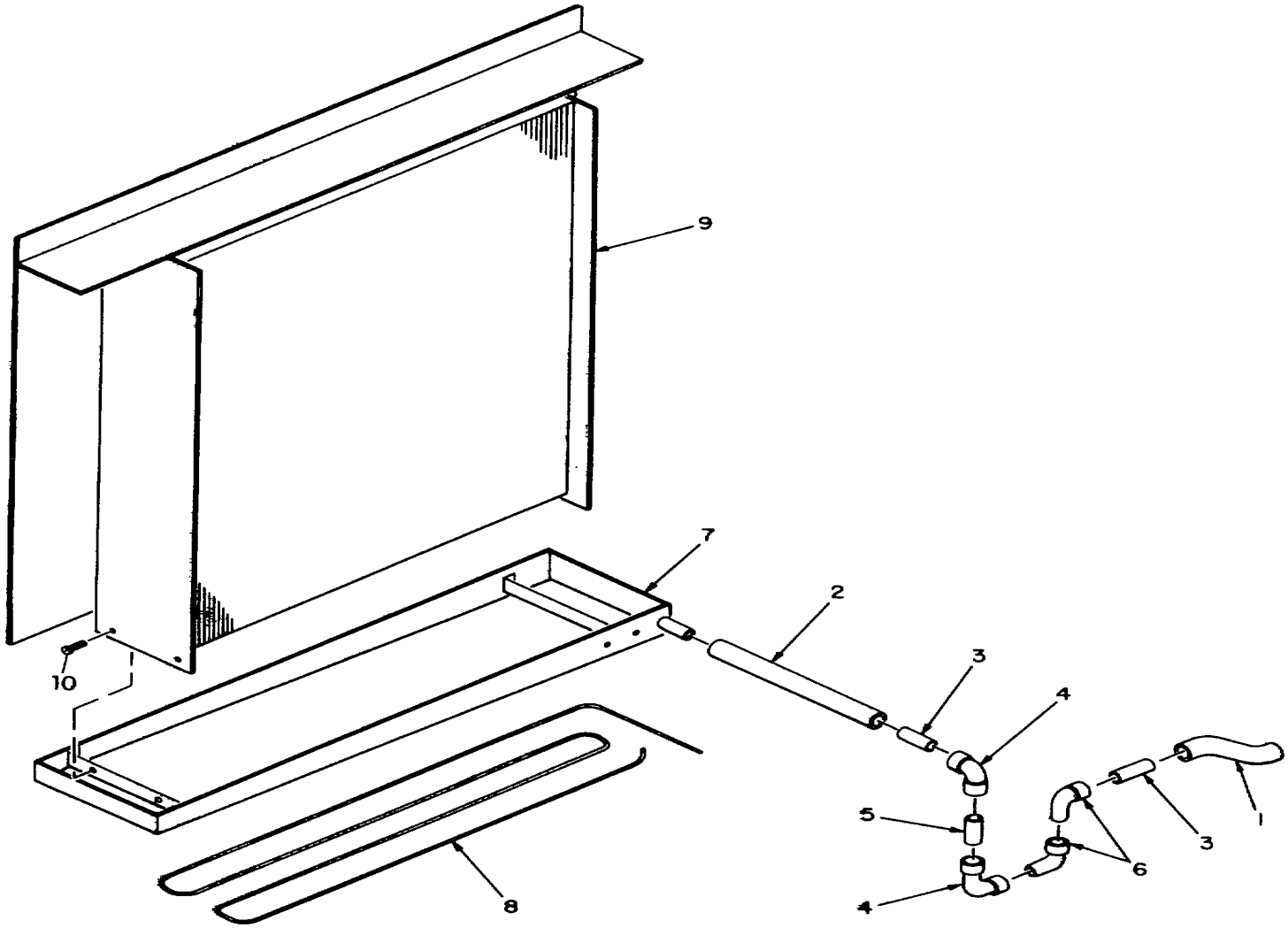
(7) Refer to paragraph 7-6 and purge refrigeration system.

(8) Refer to para 7-9 and test for leaks.



1. Screw
2. Washer, lock
3. Washer, flat
4. Cover, bottom
5. Screw
6. Cover, side
7. Screw
8. Bulkhead & Housing
9. Grommet
10. Grommet
11. Grommet
12. Screw
13. Washer, lock
14. Washer, flat
15. Panel
16. Grille

Figure 7-4. Housing, Evaporator



1. Tubing
2. Tubing
3. Tube
4. Elbow
5. Tube
6. Elbow
7. Pan Assembly
8. Coil, Hot Gas
9. Coil
10. Screw

Figure 7-5. Evaporator Coil and Attaching Parts

Section VII. CONDENSER COIL

7-22. GENERAL

The condenser coil consists of an aluminum housing containing a series of parallel tubes equipped with external radiator type fins. Hot refrigerant gas enters the condenser at the top and flows downward through the tubes. Heat from the compressed gas radiates outward along the fins and is carried away by the air flow from a fan. As the refrigerant reaches the lower tubes of the condenser coil, it becomes cool enough to condense to a liquid.

7-23. CONDENSER COIL (FIG. 7-6)

a. Removal.

(1) Refer to paragraph 7-1 and pump down the refrigeration system.

(2) Remove condenser grille (6) by removing screws and washers (4 & 5).

(3) Unsweat the condenser (1) from refrigerant lines.

(4) Remove rivets (3) attaching condenser (1) to shroud (2).

b. Cleaning and Inspection.

(1) Use stiff brush or compressed air to remove dust or other foreign matter from between fins of condenser coil. If compressed air is used, force air through fins in a direction opposite from normal circulation.

(2) Clean external surfaces with an approved cleaning solvent and dry thoroughly.

(3) Inspect condenser coil for bent fins. Straighten fins as necessary to permit free passage of air.

(4) Repair leaks in condenser coil tubing by brazing or soldering with a compound having a melting point of more than 100°F (38°C). Use flux sparingly.

c. Installation.

(1) Slide-in condenser (1) into shroud (2).

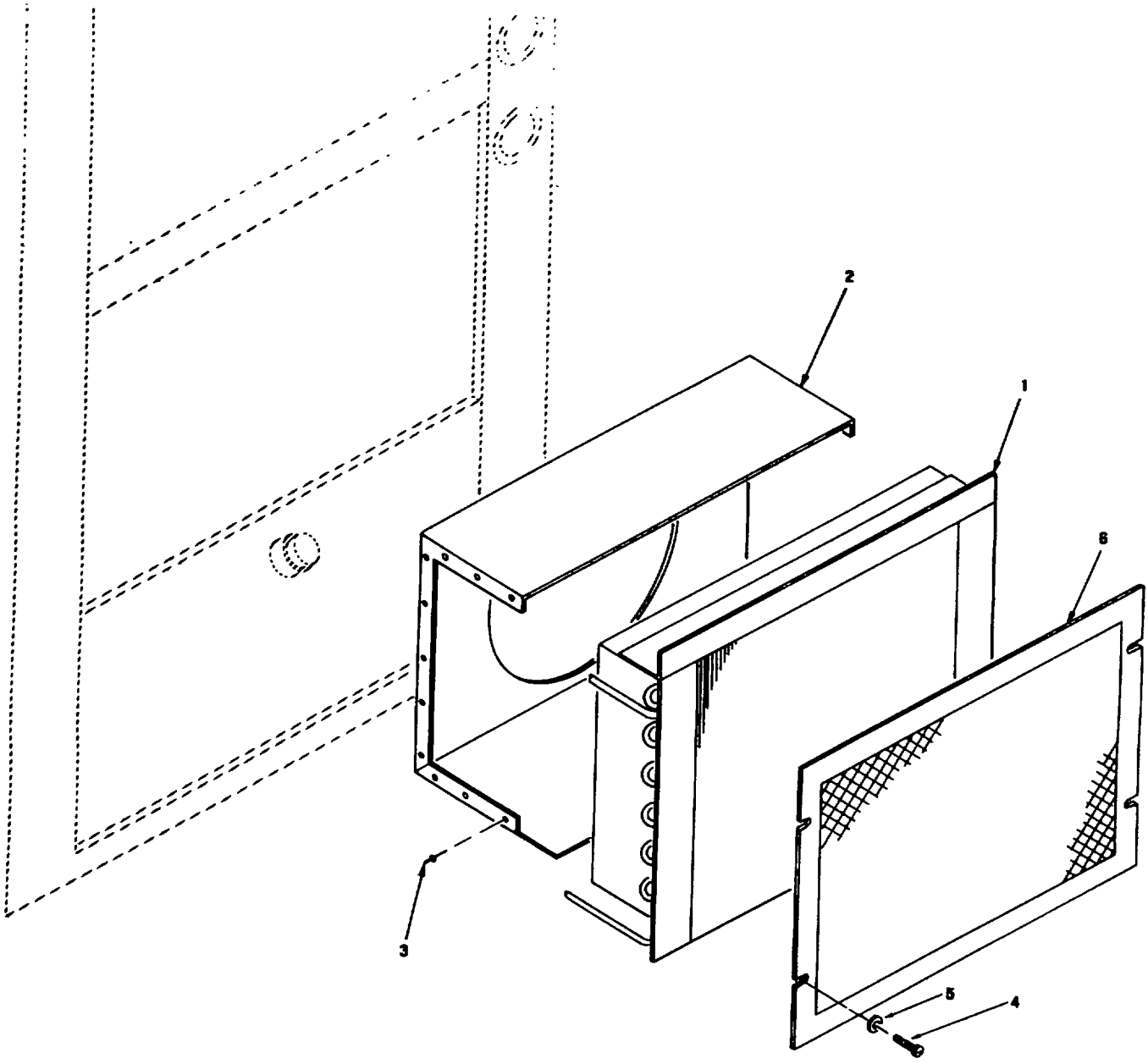
(2) Connect top and bottom refrigerant lines.

(3) Attach condenser (1) to shroud with rivets (3).

(4) Place condenser grille (6) in position and secure with screws & washers (4 & 5).

(5) Refer to para 7-6 and purge refrigeration system.

(6) Refer to para 7-9 and test for leaks.



1. Condenser Coil
2. Shroud, fan
3. Rivet, shroud
4. Screw
5. Washer
6. Grille, condenser

Figure 7-6. Condenser Coil

Section VIII. RECEIVER TANK

7-24. GENERAL

The receiver tank is a cylindrical reservoir of welded steel construction. The tank is equipped with inlet and outlet angle valves and a fusible type plug. The receiver tank valves are standard two-way valves. The outlet valve is installed below the liquid level of the receiver. Although the receiver is capable of holding the entire charge of refrigerant in the system, only a part of this refrigerant will be in the receiver at any one time during normal operation. Liquid refrigerant from the condenser flows through an inlet valve and leaves through the outlet valve.

7-25. RECEIVER TANK

a. Removal (fig. 7-7).

(1) Release the refrigerant charge.

(2) Disconnect brass flare nuts at inlet valve (5) and outlet valve (6) connections of receiver tank (8).

(3) Remove two nuts and washers (1, 2, 3) securing clamps (4) around tank (8) and remove tank.

b. Cleaning and Inspection.

(1) Clean external surface with an approved cleaning solvent and dry thoroughly.

(2) Inspect tank and valves for cracks, dents, or other damage. Replace if defective.

c. Installation. (fig. 7-7).

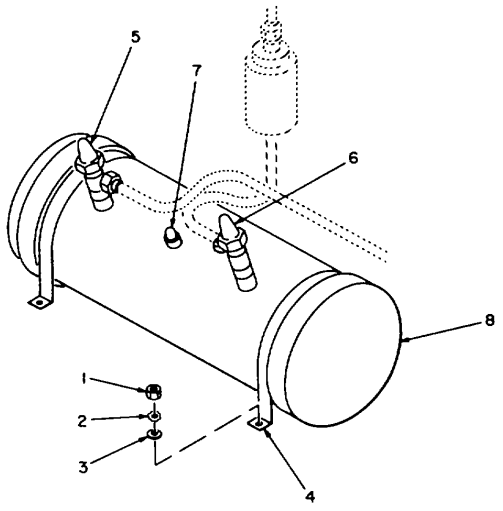
(1) Place receiver tank (8) inside clamps (4) and secure with two nuts & washers (1, 2, 3).

(2) Connect brass flare nuts from lines to inlet valve (5) and outlet valve (6).

(3) Refer to paragraph 7-3 and recharge refrigeration system.

(4) Refer to paragraph 7-6 and purge refrigeration system.

(5) Refer to para 7-9 and test for leaks.



1. Nut, hex
2. Washer, lock
3. Washer, flat
4. Clamp, receiver
5. Valve, inlet
6. Valve, outlet
7. Plug
8. Receiver

Figure 7-7. Receiver

Section IX. ACCUMULATOR TANK

7-26. GENERAL

The accumulator tank is in the refrigeration circuit. Its function is to trap liquid in the suction line and permit gradual evaporation of trapped liquid.

7-27. ACCUMULATOR TANK (FIG. 7-8)

a. Removal.

(1) Refer to paragraph 7-1 and pump down refrigeration system.

(2) Unsweat copper elbows (5 & 6) at accumulator tank (4).

(3) Remove nut (1) and washers (2 & 3) securing tank to accumulator bracket (11) and remove accumulator tank from unit.

b. Cleaning and Inspection.

(1) Clean external surface of tank with an approved cleaning solvent and dry thoroughly.

(2) Inspect tank for cracks, dents or other damage. Replace if defective.

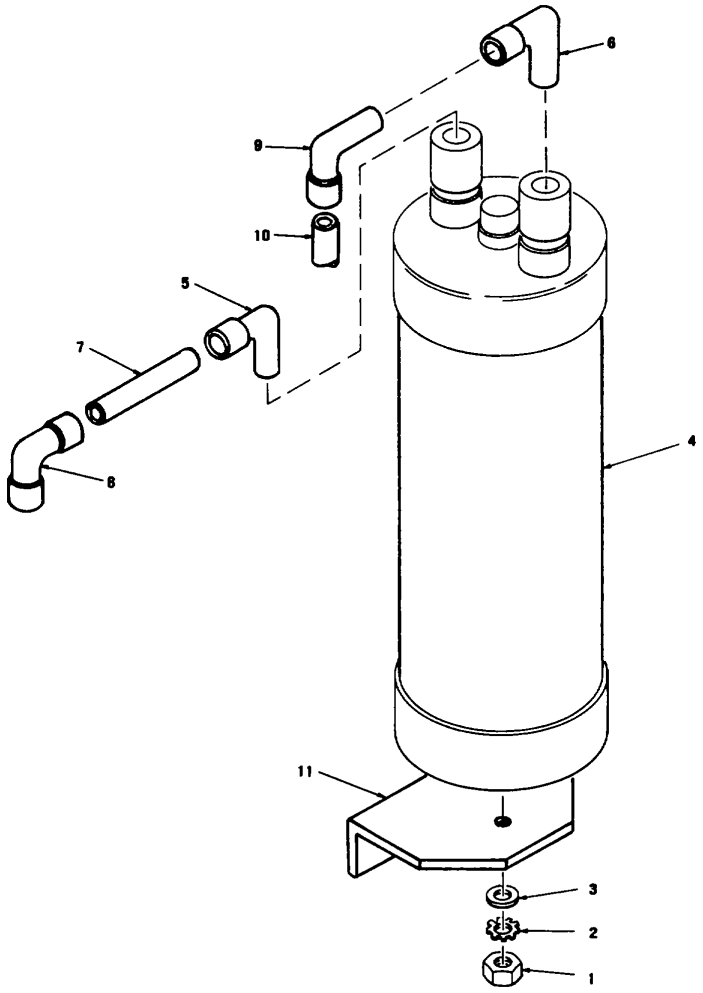
c. Installation.

(1) Place accumulator tank (4) in position in unit and attach with nut (1) and washers (2 & 3).

(2) Resweat copper elbows (5 & 6) at accumulator tank.

(3) Refer to paragraph 7-6 and purge refrigeration system.

(4) Refer to paragraph 7-9 and test for leaks.



1. Nut, hex
2. Washer, lock
3. Washer, flat
4. Accumulator
5. Elbow
6. Elbow
7. Tube
8. Elbow
9. Elbow
10. Tube
11. Bracket

Figure 7-8. Accumulator

Section X. HEAT EXCHANGER

7-28. GENERAL

The heat exchanger consists of a section of liquid line enclosed in enlarged section of the suction line. The liquid line to the expansion valve is finned to promote a rapid transfer of heat from the liquid by the cold gas leaving the evaporator coil. By using the waste refrigerating capacity, the liquid refrigerant enters the evaporator coil at a more efficient temperature.

7-29. HEAT EXCHANGER (FIG. 7-9)

a. Removal.

(1) Refer to paragraph 7-1 and pump down refrigeration system.

(2) Remove panels (6 and 15, fig. "7-4) at rear of evaporator section.

(3) Unsweat copper tubes (11, 15, 16, 14) from heat exchanger (17).

(4) Remove two nuts (3) and two washers (4) securing U-bolts (5) to heat exchanger and remove heat exchanger.

b. Cleaning and Inspection.

(1) Clean heat exchanger with an approved cleaning solvent and dry thoroughly.

(2) Inspect heat exchanger for cracks, dents or other damage. Replace if defective.

c. Installation.

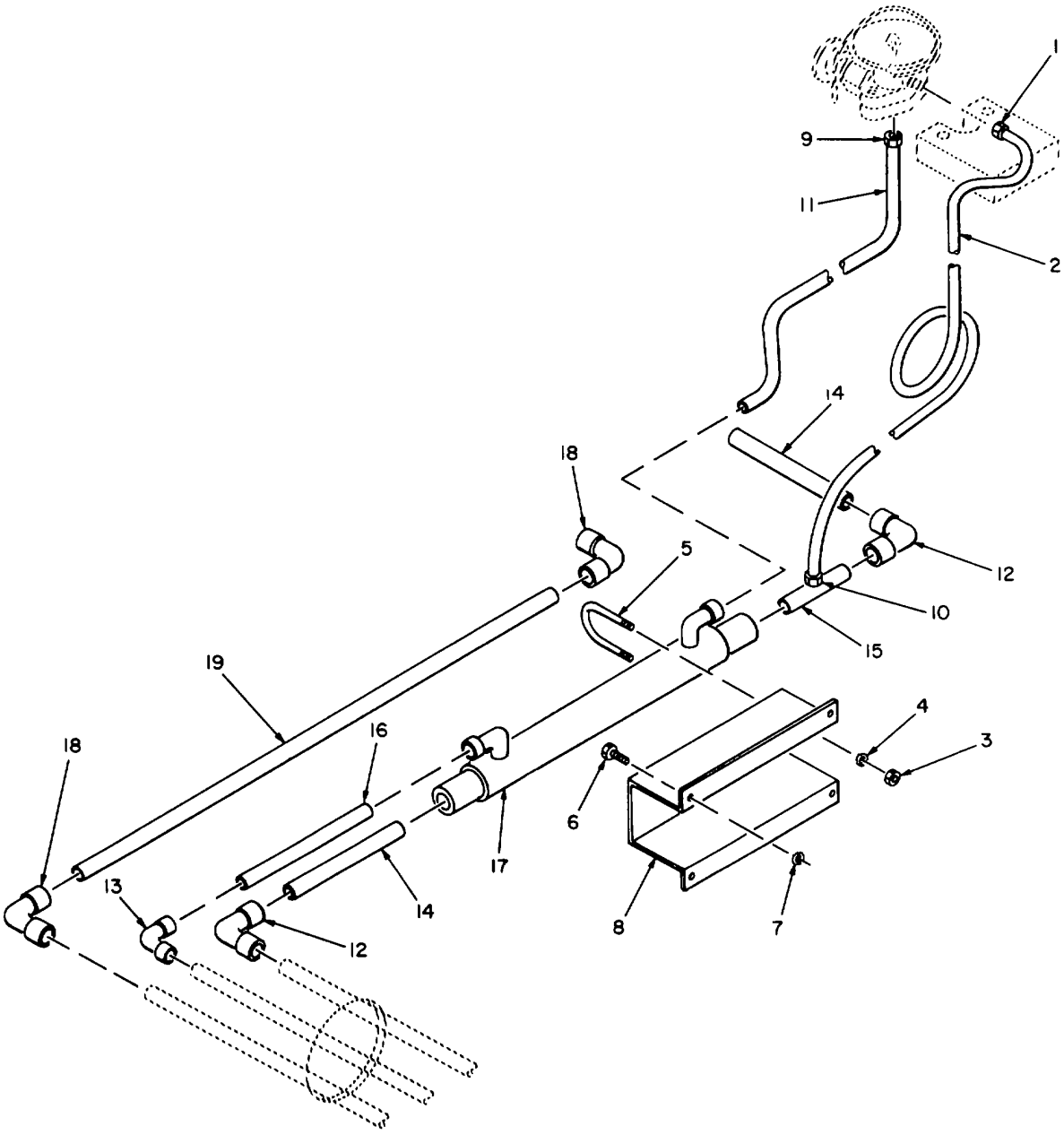
(1) Place heat exchanger (17) in U-bolts (5) and secure with two nuts (3) and washers (4).

(2) Resweat copper tubes (11, 15, 16, 14) to heat exchanger (17).

(3) Refer to paragraph 7-6 and purge refrigeration system.

(4) Refer to paragraph 7-9 and test for leaks.

(5) Install the panels (15, 6, fig. 7-4).



1. Nut, flare
2. Tube Assembly
3. Nut
4. Washer, lock
5. U-Bolt
6. Screw
7. Washer, lock
8. Bracket
9. Nut, flare
10. Tap, line
11. Tube
12. Elbow
13. Elbow
14. Tube
15. Tube
16. Tube
17. Heat Exchanger
18. Elbow
19. Tube

Figure 7-9. Heat Exchanger

Section XI. SIGHT GAUGE

7-30. GENERAL

The sight gauge assembly consists of a flare fitting containing a sight glass. The sight gauge is used to observe liquid refrigerant as it flows through the system. If the unit contains sufficient refrigerant and is operating normally, the sight gauge will appear clear. If insufficient refrigerant is present, bubbles will show in the sight glass.

7-31. SIGHT GAUGE

a. Removal (fig. 7-10).

(1) Refer to paragraph 7-1 and pump down refrigeration system.

(2) Remove flare nuts at liquid indicator sight gauge and remove gauge.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect sight gauge for cracks, chips, or other damage, paying particular attention to the threaded parts. Replace if defective.

c. Installation.

(1) Place sight gauge in position and tighten flare nuts.

(2) Refer to paragraph 7-6 and purge refrigeration system.

(3) Refer to paragraph 7-9 and test for leaks.

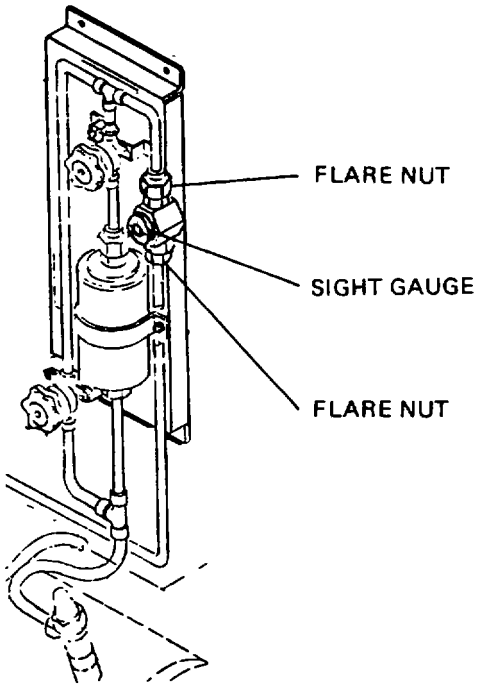


Figure 7-10. Sight Gauge

CHAPTER 8

CONTROLS AND INSTRUMENTS

8-1. GENERAL

A general description of the control box assembly is given in para 4-47. Organizational maintenance may make most all repairs or replacements in the control box, or on its panel. Removal or replacement of the high pressure cutout switch or any repair or replacement of parts which require the opening of the refrigeration system must be referred to Direct Support.

8-2. CONTROL BOX ASSEMBLY (FIG. 8-1)

a. Removal.

(1) Remove four screws & washers (1&2) securing the control box panel (3) to the frame and carefully open panel.

(2) Disconnect main wire harness (35). Tag all connections.

(3) Remove screw (37) and washer (38)to remove control box (39).

b. Cleaning and Inspection.

(1) Clean all parts with a clean lint-free cloth or compressed air.

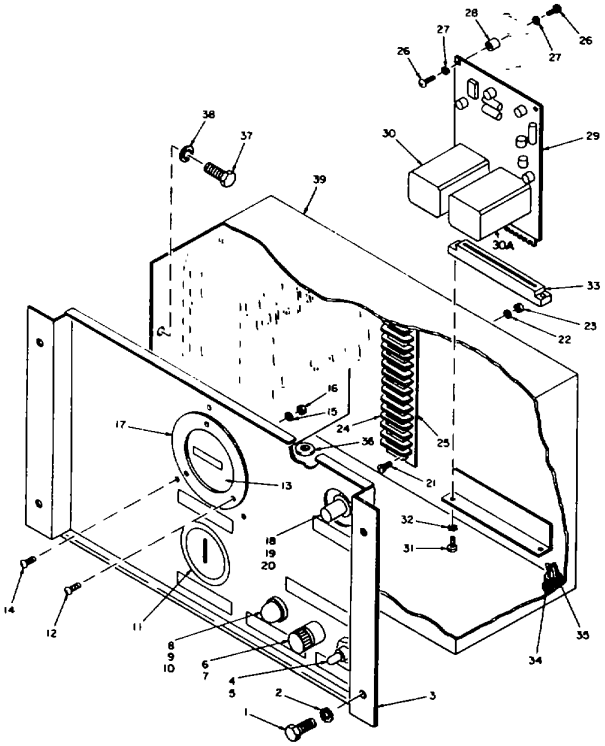
(2) Inspect parts for cracks, burning, or other damage. Replace all defective parts.

c. Installation.

(1) Align holes in control box (39) with holes in frame and secure with four screws and washers (37 and 38).

(2) Connect main wire harness to components as tagged.

(3) Install panel (3) with four screws and washers (1 & 2).



1. Screw
2. Washer, lock
3. Door
4. Bolt
5. Switch
6. Fuse
7. Fuseholder
8. Lamp
9. Dome, red
10. Socket
11. Ammeter
12. Screw
13. Hour Meter
14. Screw
15. Washer
16. Nut
17. Dampner
18. Thermostat
19. Screw
20. Washer, lock
21. Screw
22. Washer, lock
23. Nut, hex
24. Terminal Block
25. Marking Strip
26. Screw
27. Washer, lock
28. Standoff
29. P.C. Card
30. Starter Relay
30A. Over-Crank Limit Relay
31. Screw
32. Washer, lock
34. Connector
35. Wiring Harness
36. Grommet
37. Screw
38. Washer, flat
39. Control Box

Figure 8-1. Control Box Assembly

8-3. HIGH PRESSURE CONTROL SWITCH

a. Removal (fig. 8-2).

(1) Refer to paragraph 7-1 and pump down refrigeration system.

(2) Turn off power source.

(3) Front seat discharge and suction service valves.

(4) Remove flare nut of high pressure control switch (3) at compressor.

(5) Remove wires carefully labeling each for proper terminal.

(6) Remove two screws (1) and washers (2) attaching switch (3) to frame.

b. Cleaning and Inspection.

(1) Clean switch with an approved cleaning solvent and dry thoroughly.

(2) Inspect switch for dents, cracks, or other damage. Replace if defective.

c. Installation (fig. 8-2).

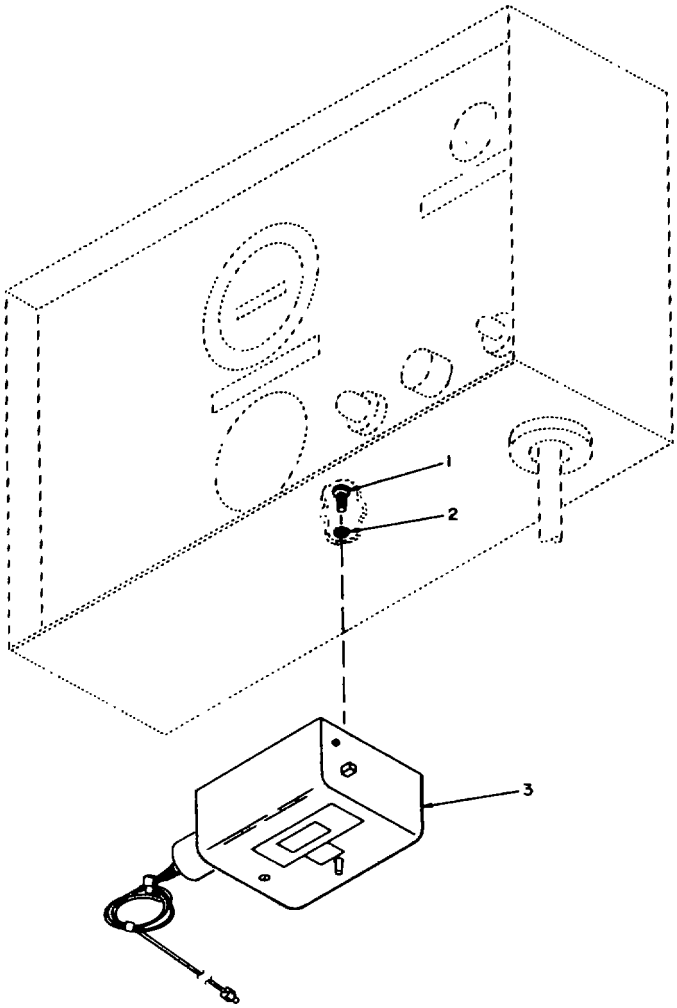
(1) Attach switch (3) to frame with two screws and washers (1 and 2).

(2) Connect wires to proper terminals.

(3) Connect flare nut of high pressure control switch (3) to compressor.

(4) Back seat suction and discharge service valves, opening one turn for gauge connection., (5) Refer to para 7-9 and test for leaks.

(6) Apply power.



1. Screw
2. Washer, lock
3. Switch, high pressure control

Figure 8-2. High Pressure Control Switch

8-4. HIGH PRESSURE GAUGE (FIG. 8-3)

a. Removal.

(1) Back seat discharge service valve (12, fig. 7-1) and remove gauge line nut at back of high pressure gauge (5).

(2) Remove three screws, nuts and washers (1,2&3) securing gauge (5) to frame.

(3) Remove fitting at back of gauge. Do not remove fitting unless gauge is to be replaced.

b. Cleaning and Inspection.

(1) Clean gauge with a clean lint-free cloth.

(2) Inspect for cracks, dents or other damage. Inspect all threaded parts for damage. Replace if defective.

c. Installation.

(1) Place high pressure gauge (5) in hole of refrigeration unit frame as in original configuration and secure with three screws, nuts & washers (1, 2 & 3).

(2) Replace fitting at back of gauge.

(3) Screw gauge line nut on fitting at back of gauge and turn valve stem of discharge service valve (12, fig. 7-1)until pressure registers on gauge.

8-5. COMPOUND PRESSURE GAUGE (FIG. 8-3)

a. Removal.

(1) Back seat the suction service valve (7, fig. 7-1) and remove gauge line nut at back of compound pressure gauge (7).

(2) Remove three screws, nuts and washers (1, 2, &3) securing gauge (7)to frame.

(3) Remove fitting at back of gauge. Do not remove fitting unless gauge is to be replaced.

b. Cleaning and Inspection.

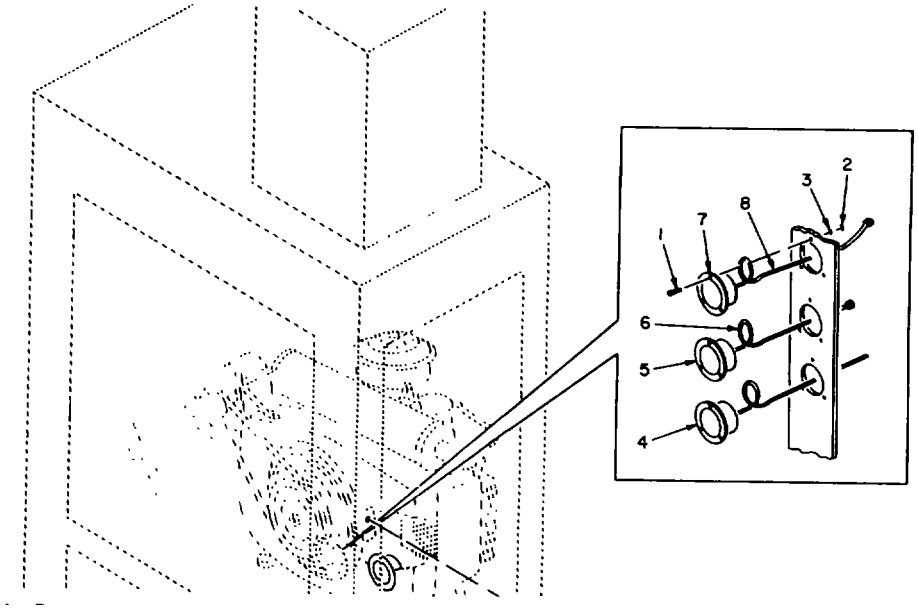
(1) Clean gauge with a clean lint-free cloth.

c. Installation.

(1) Place compound pressure gauge (7) in hole in frame as in original configuration and secure with three screws, nuts and washers (1, 2 & 3).

(2) Replace fitting at back of gauge.

(3) Screw gauge line nut on fitting at back of gauge and turn valve stem of suction service valve (7,fig. 7-1) until pressure registers on gauge.



1. Screw
2. Nut, hex
3. Washer, lock
4. Thermometer
5. Gauge, high pressure
6. Tubing
7. Gauge, compound pressure
8. Tubing

Figure 8-3. Gauges

CHAPTER 9

ELECTRIC MOTOR CONVERSION KIT

9-1. GENERAL

The 5-horsepower electric motor used in the conversion kit is a 208 volt, 3-phase, 60-cycle alternating current motor that requires 13.8 amperes for a proper operation. The series 184T motor operates at 1750 rpm. The electric motor is internally grounded by the green wire of the power cable. Rotation of the motor may be reversed by reversing the position of any two power leads. A magnetic starter is included in the electric system to control the operation of the motor. When the coil of the magnetic starter is activated, the contacts in the starter close, completing the electric circuit and energizing the motor. The starter is equipped with overload switches and heaters that protect the motor from current overload.

9-2. CONVERSION FROM GASOLINE ENGINE TO ELECTRIC MOTOR POWER UNIT

a. General. The instructions contained in this paragraph are for the conversion of the gasoline engine power unit to the electric motor power unit. Parts contained in the conversion kit are listed and illustrated on Figure 9-1. Parts removed will be disposed of in accordance with the provisions of AR 755-1.

b. Conversion Procedure.

(1) Remove positive battery cable from battery and engine.

(2) Remove entire battery and box from top of cabinet.

(3) Remove the gasoline engine (para4-13).

(4) Remove the fuel line to the tank.

(5) Remove the drain plug from the fuel tank and drain the fuel from the tank.

(6) Remove the fuel filler cap and the strainer from the fuel tank. Flush the tank to remove all traces of gasoline.

(7) Drill out the rivets and remove the gasoline engine unit instruction plate and the wiring diagram plate.

(8) Install the electric motor unit instruction plate and the wiring diagram plate using the self-tapping screws.

(9) Install the entire electric motor assembly into the cabinet aligning the holes in the mounting plate with old engine mounting holes. Bolt into position, but do not tighten securely.

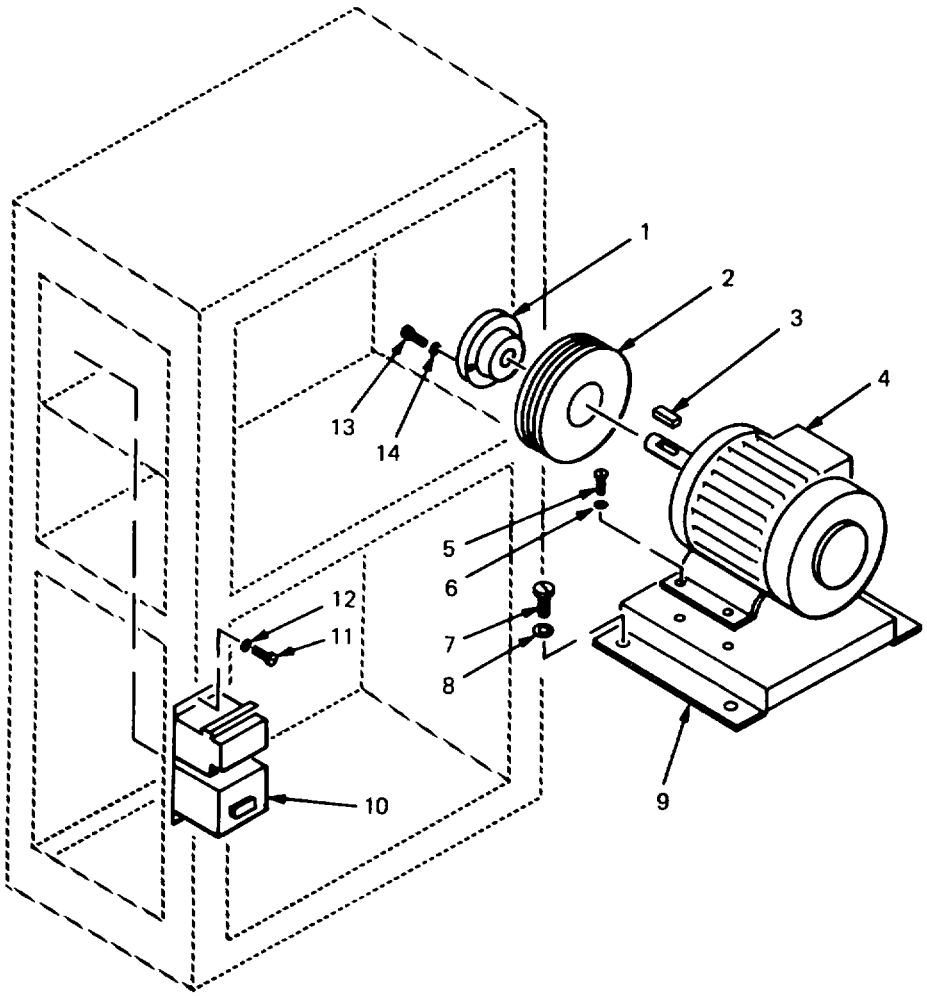
(10) Install and align the compressor drive V-belts and tighten to a 3/4-inch deflection midway between the pulleys. Tighten the motor mounting bolts securely.

(11) Remove control panel door and install the electric motor starter into the holes provided on the left hand side of the control box.

(12) Connect the wiring as shown in the wiring diagram (fig. 1-5).

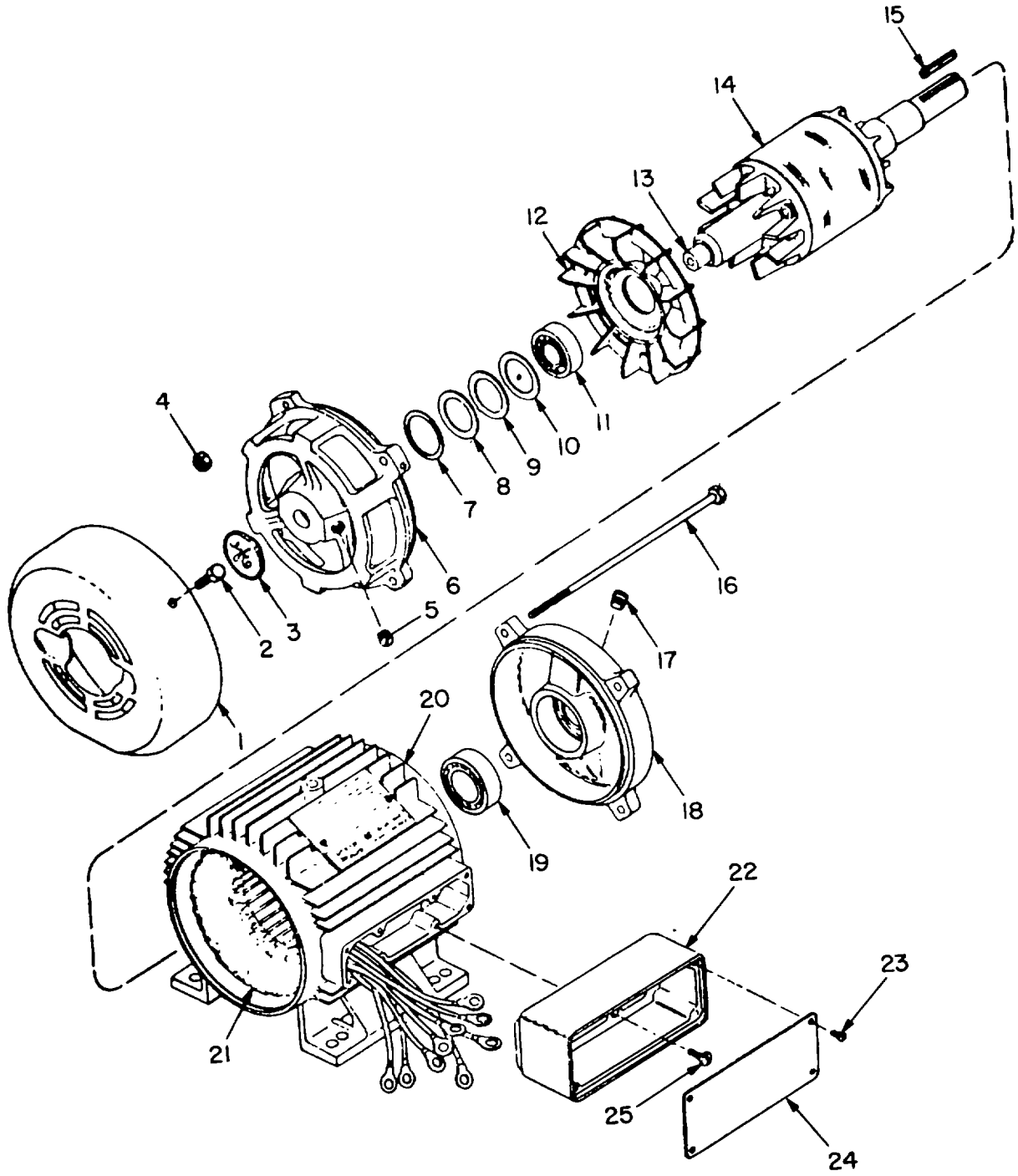
(13) Connect the power source and activate the electric motor momentarily. If the motor does not rotate in the direction prescribed in the arrow, reverse any two wire connections to obtain proper motor rotation.

(14) Replace control panel door and set temperature for desired operating temperature.



1. Tapered Bushing
2. Sheave
3. Key
4. Electric Motor
5. Screw, Cap
6. Washer, Lock
7. Screw, Cap
8. Washer, lock
9. Mounting Base
10. Starter
11. Screw
12. Washer
13. Screw, Cap
14. Washer, Lock

Figure 9-1. Electric Motor Conversion Kit



1. Dust Cover
2. Screw, cap
3. Nameplate
4. Nut, hex
5. Plug
6. Bell, end
7. Washer, spring
8. Washer, spring
9. Washer, spring
10. Shield, dust
11. Bearing
12. Fan
13. Shaft
14. Rotor
15. Key
16. Screw, cap
17. Plug
18. Plate, cover
19. Bearing
20. Frame
21. Windings, coil
22. Junction Box
23. Screw
24. Cover, junction box
25. Screw

Figure 9-2. Electric Motor

APPENDIX A

REFERENCES

A-1. Fire Protection and Safety

TB5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users
TB MED 251	Noise and Conservation of Hearing

A-2. Lubrication

C9100IL	Fuels, Lubricants, Oils and Waxes
LO5-4110-235-12	Lubrication Order

A-3. Painting

TM43-0139	Painting Instruction for Army Materiel

A-4. Maintenance

DA Pam 738-750	The Army Maintenance Management System (TAMMS)
TM5-41 10-235-24P	Organizational, Direct and General Support Maintenance Repair Parts and Special Tools List, Refrigeration Unit, Mechanical, Panel Type, 5000 BTU/HR Gasoline Engine Driven (Model ERU-5G)
TM5-670	Repairs and Utilities; Preventive Maintenance for Refrigeration, Air Conditioning, Mechanical Ventilation and Evaporative Cooling
TM9-6140-200	Operator and Organizational Maintenance Manual for Lead-Acid Storage Batteries

A-5. Destruction of Army Equipment

TM750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. GENERAL

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component and the work measurement time required to perform the functions by the designated maintenance level. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from Section II.

B-2. EXPLANATION OF COLUMNS IN SECTION II

a. Column (1), Group Number. Column 1 lists group numbers to identify related components, assemblies, sub-assemblies, and modules with their next higher assembly. The applicable groups are listed in the MAC in disassembly sequence beginning with the first group removed.

b. Column (2), Component/Assembly. This column contains the noun names of components, assemblies, sub-assemblies and modules for which maintenance is authorized.

c. Column (3), Maintenance Functions. This column lists the functions to be performed on the item listed in Column 2. The maintenance functions are defined as follows:

(1) Inspect. To determine serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examinations.

(2) Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

(3) Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

(4) Adjust. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

(5) Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

(6) Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

(7) Install. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

(8) Replace. The act of substituting a serviceable like type part, sub-assembly, or module (component or assembly) for an unserviceable counterpart.

(9) Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, sub-assembly, module (component or assembly), end item, or system.

B-2. EXPLANATION OF COLUMNS IN SECTION II (cont)

(10) Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

(11) Rebuild. Consists of those services/ actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/ components.

d. Column (4), Maintenance Category. This column is made up of sub-columns for each category of maintenance. Work time figures are listed in these sub-columns for the lowest level of maintenance authorized to perform the function listed in Column 3. These figures indicate the average active time required to perform the maintenance function at the indicated category of maintenance under typical field operating conditions.

e. Column (5), Tools and Equipment. This column is provided for referencing by code, the common tool sets (not individual tools) special tools, test and support equipment required to perform the designated function.

B-3. EXPLANATION OF COLUMNS IN SECTION III

a. Column (1), Reference Code. This column consists of an arabic number listed in sequence from Column 5 of Section II. The number references the common tool sets, special tools and test equipment requirements.

b. Column (2), Maintenance Category. This column shows the lowest category of maintenance authorized to use the special tools or test equipment.

c. Column (3), Nomenclature. This column lists the name or identification of the common tool set s, special tools or test equipment.

d. Column (4), National/Nato Stock No. (NSN). This column is provided for the NSN of common tool sets, special tools and test equipment listed in the Nomenclature column.

e. Column (5), Tool Number. This column lists the manufacturer's code and part number of tools and test equipment.

f. Column (6), Remarks. This column indicates an alphabetical reference code. Refer to Section IV for applicable remarks.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
01	Cabinet, Doors, Panels,								
	Base Door Assembly	Inspect	0.1						
		Replace		0.5					
		Repair			1.0			1	
	Guards	Inspect	0.1						
		Replace		0.5					
		Repair			1.0			1	
02	Battery, Control Panel and Wiring Harness								
	Hourmeter	Inspect	0.1						
		Test		0.2				1	
		Replace		0.5					
	Switches	Inspect	0.1						
		Adjust	0.1					1	
		Test		0.1					
		Replace		0.5					
	Battery	Inspect	0.1						
		Test		0.2				1	
		Service	0.1	1.0					
		Replace		0.2				1	
	Fuses	Test		0.1					
		Replace		0.1				1	
	Harness Assembly	Inspect	0.1						
		Test		0.5					
		Repair		1.0				1	
		Replace		2.0					
03	Gauges, Mtg & Controls								
	Gauge, Temp.	Inspect	0.1						
		Calibrate		2.0				1	
		Replace		1.0					
	Gauge, Suction	Inspect	0.1						
		Replace			1.0			1	
	Gauge, Discharge	Inspect	0.1						
		Replace			1.0			1	

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
04	Blower Assy & Controls								
	Belts	Inspect	0.1						
		Adjust		0.5				1	
		Replace		0.5					
	Idler Assy	Inspect	0.1						
		Service		0.2					
		Adjust		0.5				1	
		Replace		1.0					
	Fans	Inspect	0.1						
		Replace		2.0				1	
	Bearings	Inspect	0.1						
		Service		0.2				1	
		Replace		3.0					
	Shaft	Inspect	1.0						
		Replace		3.0				1	
05	Refrigerant Piping & Valves								
	Valve, Expansion	Inspect	0.1						
		Adjust			1.0			1, 2	
		Replace							
	Tubing & Fittings	Inspect	0.1						
		Repair			1.0			1,2	
		Replace			1.0				
	Valve, Suction Press Reg.	Inspect	0.1						
		Adjust			1.0			1, 2	
		Replace			1.0				
	Valve, Hand	Inspect	0.1						
		Replace			1.0			1,2	
	Valve, Solenoid	Inspect	0.1						
		Test			0.5			1,2	
		Replace			1.0				
	Filter, Drier	Inspect	0.1						
		Replace			1.0			1,2	

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
06	Evaporator Coil & Tat.	Parts							
	Coil	Inspect	0.1						
		Clean				2.0		1	
		Repair			3.0			1, 2	A
		Replace		2.0					
	Housing, Evaporator	Inspect	0.1		1.0			1, 2	
		Repair			2.0				
		Replace							
07	Condenser Coil, Rec. Tank & Attaching Parts								
	Coil	Inspect	0.1		1.				
		Clean			1.0				
		Repair				2.0		1, 2	A
		Replace			3.0				
	Tank Receiver	Inspect	0.1						
		Replace			2.0				
		Repair			2.0			1,2	
	Accumulator Assy	Inspect	0.1						
		Replace			2.0			1, 2	
	Housing, Condenser	Inspect	0.1						
		Repair			1.0				
		Replace			2.0			1	
08	Compressor Assembly								
	Compressor	Inspect	0.1						
		Service			0.5			1,2	
		Test			0.5				
		Repair			2.0				
		Replace			2.0				
		Overhaul				4.0			B
	Valves, Suction &	Inspect	0.1						
	Dish. Service	Replace			1.0			1,2	
	Cylinder Heads &	Inspect			2.0				
	Valve Plates	Replace			2.0			1, 2	
	Crankshaft & Bearings	Inspect			1.5			1, 2	
		Replace			3.0	3.0		1	B
	Piston & Rod Assy	Inspect			2.0				1, 2
		Replace			2.0				

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
08	Compressor Assy (cont)								
	Seal Assy	Inspect			0.5				
		Replace			2.0			1,2	
	Flywheel	Inspect	0.1						
		Replace			1.0			1	
	Oil Pump Assy	Inspect		2.0					
		Replace		2.0				1,2	
09	Engine Assembly								
	Engine	Inspect		0.3					
		Test		0.5					
		Service	0.4						
		Adjust		0.4				1	
		Replace		4.0					
		Repair		6.0					
		Overhaul			16.0				
	Air Cleaner	Inspect	0.1						
		Service	0.3						
		Replace		1.0				1	
	Carburetor	Inspect		0.2					
		Adjust		0.5				1	
		Repair			2.0				
		Replace		1.0					
	Fuel Pump	Inspect		0.1					
		Test		0.3				1	
		Replace		1.0				1	
	Belt, Compressor Drive	Inspect	0.1						
		Adjust		0.3				1	
		Replace		1.0					
	Belt, Alternator Drive	Inspect	0.1						
		Adjust		0.3					
		Replace		0.5				1	

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
09	Engine Assembly (cont)								
	Alternator	Inspect		0.1					
		Test		0.3				1	
		Replace		1.0					
		Repair			2.0				
		Overhaul			2.0				
	Starter Motor	Inspect		0.1					
		Test		0.2					
		Repair		2.0				1	
		Replace		1.0					
	Solenoid Starter	Inspect		0.1					
		Test		0.2				1	
		Replace		1.0					
	Points, Ignition	Inspect		0.1					
		Adjust		0.5					
		Replace		1.0					
	Spark Plugs	Inspect		0.1					
		Adjust		0.3				1	
		Test		0.1					
		Replace		0.5					
	Lead Spark Plug	Inspect		0.1					
		Test		0.2				1	
		Replace		0.5					
	Governor Assembly	Inspect		0.1					
		Adjust		0.5				1	
		Repair			2.0				
		Replace			3.0				
	Muffler	Inspect	0.1						
		Replace		0.5				1	
	Block, Engine	Inspect		0.3					
		Repair			6.0			1	
		Replace			6.0				
		Overhaul				10.0		1	C
	Shroud, Cooling	Inspect	0.2						
		Repair			1.0			1	
		Replace			2.0				
	Head, Cylinder	Inspect			1.0				
		Replace			2.0			1	

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
09	Engine Assembly (cont)								
	Sump Oil	Inspect			1.0				
		Replace			2.0			1	
	Pump Oil	Inspect			0.5				
		Test			0.5			1	
		Replace			2.0				
	Piston & Rod Assy	Inspect			2.0				
		Repair			2.0			1	
		Replace			4.0				
		Overhaul			2.0				
	Piston Assy	Inspect			2.0				
		Replace			2.0				
		Repair			2.0			1	
	Rings, Piston	Inspect			2.0				
		Replace			2.0			1	
	Gears, Timing	Inspect			2.0				
		Replace			4.0			1	
	Flywheel	Inspect			2.0				
		Replace			2.0			1	
	Crankshaft	Inspect			2.0				
		Repair			4.0			1	C
		Replace			4.0				
	Bearing, Main Crank	Inspect			2.0				
		Replace			4.0			1	
	Valves	Inspect			1.0				
		Test			0.3				
		Repair			4.0			1	
		Replace			4.0				
	Springs, Valves	Inspect			1.0				
		Test			1.0			1	
		Replace			2.0				
	Tappets	Inspect			1.0				
		Adjust			1.0			1	
		Replace			3.0				
	Camshaft	Inspect			3.0				
		Replace			3.0			1	
	Guides, Valve	Inspect			1.0				
		Test			2.0				
		Replace				4.0		1	C

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
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Section II. MAINTENANCE ALLOCATION CHART (cont)

(1) Group Number Remarks	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category* C	O	F	H	D	(5) Tools and Equipment	(6)
09	Engine Assembly (cont)								
	Seat, Valve	Inspect			1.0				
		Test			1.0			1	
		Repair			1.0				
		Replace				4.0			C
10	Fuel System								
	Tank, Fuel	Inspect	0.1						
		Service	0.3						
		Repair			2.0			1	
		Replace		1.0					
	Strainer, Fuel	Inspect	0.1						
		Service	0.1						
		Replace		0.5				1	
	Gauge, Fuel	Inspect	0.1						
		Replace		1.0				1	
	Fuel Lines	Inspect	0.1						
		Repair		1.0				1	
		Replace		0.5					
	Electric Fuel Pump	Inspect	0.1						
		Test		0.3				1	
		Replace		1.0					
11	Electric Motor								
	Motor	Inspect	0.1						
		Test		0.2					
		Repair			2.0			1	D
		Replace		1.0					
	Contactors	Inspect	0.1						
		Test		0.2					
		Repair			1.0			1	E
	Wiring	Inspect	0.1						
		Test		0.5				1	
		Replace		1.0					

* Subcolumns Are As Follows:
C - OPERATOR/CREW O- ORGANIZATIONAL F-DIRECT SUPPORT
H-GENERAL SUPPORT D-DEPOT

Section III. TOOLS AND TEST EQUIPMENT REQUIREMENT

(1) Reference Code	(2) Maintenance Category	(3) Nomenclature	(4) National/Stock Number (NSN)	(5) Tool Number
1	O-F-H	Tool Kit, Refrigeration	5180-00-596-1474	
2	F-H	Pump, Vacuum (Large)	4310-00-289-5967	
		Pump, Vacuum (Small)	4310-00-098-5272	
3	F-H	Recovery and Recycling Unit, Refrigerant	4130-01-338-2707	17500B (07295)

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Section IV. REMARKS

Reference Code	Remarks
A	Internal tube repair or replacement.
B	Crankshaft bearing replacement in housing including fitting and boring with crank polishing.
C	Replacement of valve seats and guides with crank-shaft polishing of journals.
D	Limited to bearing replacement.
E	Limited to holding coil and contact point replacement.

APPENDIX C

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

C-1. SCOPE

This appendix lists Expendable Supplies and Materials you will need to operate and maintain the Refrigeration Unit. These items authorized to you by CTA 50970, Expendable Items (except Medical Class V, Repair Parts and Heraldic Items).

C-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.

b. Column 2--Level. This column identifies the lowest level of maintenance that requires the listed item.

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 Commercial and Government Entity Code (CAGE) in parenthesis, if applicable.

e. Column 5--Unit of Measure (UM). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two character alphabetical abbreviation, e.g., each (ea), inch (in), pair (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	0		Lubricating Oil, SE or Se/CC, SAE 30, 1 OW-20 and 5W-30, MIL-L-21 40	GL
2	0	6850-00-264-9037	Dry Cleaning Solvent P-D-680 (81348)	GL
3	F	6830-00-290-4377	Dichlorodifluoromethane, Technical w/cylinder 22 lb (Refrigerant -12), BB-F-1421, Type 12 (81348)	CY
4	0		Insulation, Slvg, Elec MIL-1-3190/4 Cl 155 (81349)	
5	0	7920-00-205-1711	Rags	
6	F	3439-00-184-8952	Brazing Alloy, QQ-B-654 (81348)	
7	F	3439-00-640-3713	Brazing Flux, O-F-499 Type B (81348)	
8	F	6830-00-292-0732	Nitrogen	CY
9	F		Compressor Oil, CPP33-2	GL
10	0		Lead Tin Solder, Sb5 of QQ-S-571 (81348)	
11	0		Soldering Flux, Type I of O-F-506	
12	0		Ball and Roller bearing Grease MIL-G-25013	
13	0	8030-00-081-2333	Loctite MIL-S-22473	OZ

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 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 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 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 = 33.81 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. decimeter = 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	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 049019-000