

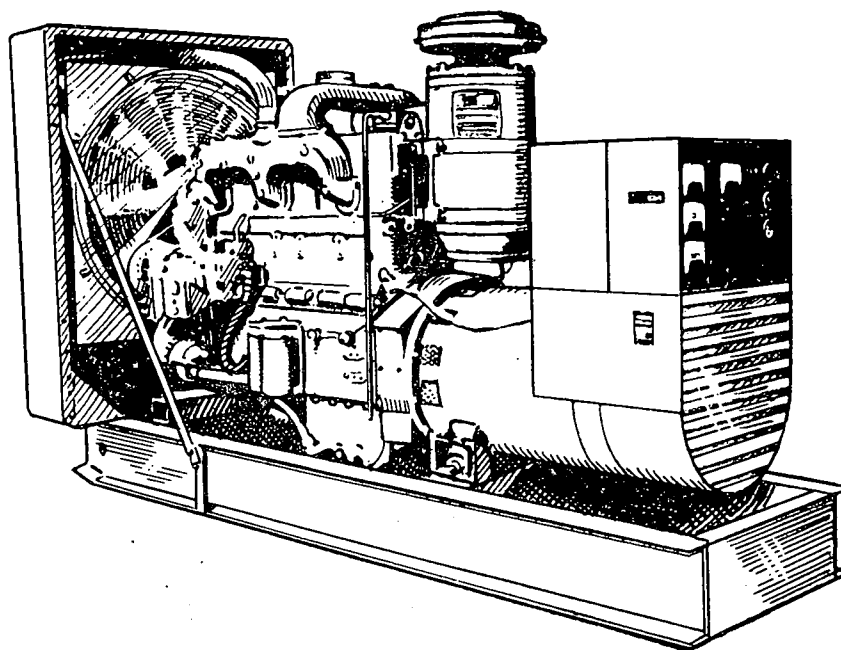
OPERATOR'S MANUAL AND PARTS CATALOG

FOR

DFE

SERIES

ELECTRIC GENERATING SETS



BEGIN SPEC. H

FORM NUMBER
956-0302

ISSUE DATE
4-77
(Spec H-K)

Printed in U.S.A.

SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

ONAN recommends that you read your manual and become thoroughly acquainted with it and your equipment before you start your unit. These recommendations and the following safety precautions are for your protection.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

WARNING Onan uses this symbol throughout this manual to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment damage.

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove any debris from set and keep the floor clean and dry.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the generating set are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts; cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.
- Do not work on this equipment when mentally or physically fatigued.
- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Bleed the system pressure first.

Protect Against Moving Parts

- Keep your hands away from moving parts.

- Before starting work on the generating set, disconnect batteries. This will prevent starting the set accidentally.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME in the vicinity of the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

Guard Against Electric Shock

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DON'T tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

Exhaust Gases Are Toxic

- Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

TABLE OF CONTENTS

| TITLE | PAGE |
|---|--------------|
| Safety Precautions..... | Inside Cover |
| Introduction | 2 |
| Specifications | 3 |
| Description..... | 5 |
| Installation | 9 |
| Operation | 20 |
| General Maintenance | 27 |
| Parts Catalog (table of contents) | 32 |
| Parts Catalog..... | 33 |

WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

INTRODUCTION

FOREWORD

This manual is applicable to the DFE Series electric generating set, consisting of an ONAN UR generator, driven by a Cummins NT855-G Diesel Engine. See *SPECIFICATIONS* for generator sizes.

The manual is divided into two sections.

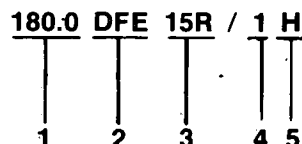
Section 1 provides information on installation, operation and troubleshooting.

Section 2 is a Parts Catalog for ONAN optional and standard equipment.

The manual should be used in conjunction with the Cummins engine manual, for specific engine information.

MODEL IDENTIFICATION

Identify your model by referring to the MODEL and SPECIFICATION NO. as shown on the Onan nameplate. Electrical characteristics are shown on the lower portion of the nameplate.



1. Indicates Kilowatt rating (180 kW).
2. Factory code for SERIES identification.
3. 15 = 60 Hz. Reconnectible
515 = 50 Hz. Reconnectible
R—Indicates remote starting feature.
4. Factory code for designating optional equipment.
5. Specification letter. (Advances when factory makes production modifications.)

When contacting a dealer or the factory regarding the set, always mention the complete Model, Spec No. and Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify your unit among the many manufactured. Refer to the engine nameplate when requesting information from its manufacturer. The Onan nameplate is located on the right side of the generator; the Cummins nameplate is on the right hand side on the auxiliary gear drive case.

Left side and right side are considered when viewed from the engine or front end of the generating set.

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

SPECIFICATIONS

155 kW

180 kW

ENGINE DETAILS

| | |
|--|----------------------------------|
| Engine Manufacturer | Cummins |
| Engine Series | NT 855-G |
| Number of Cylinders..... | 6 |
| Displacement..... | 855-in ³ (14.0 litre) |
| BHP @ 1800 r/min..... | 355 (265 kW) |
| Compression Ratio | 14.1:1 |
| Bore | 5.50-inch (139.70 mm) |
| Stroke | 6.00-inch (152.40 mm) |
| Fuel | Diesel |
| Battery Voltage..... | 24 |
| Battery Group (Two 12-Volt, 225 A.H. [810 kC]) | 8D |
| Starting Method | Solenoid Shift |
| Governor Regulation..... | Isochronous |
| Battery Charging Current | 35-Amperes |

GENERATOR DETAILS

| | | |
|-----------------------------------|----------------------|---------------------|
| Type | UR 15 60 Hz | UR 515 50 Hz |
| Rating (Watts) | | |
| 60 Hertz Continuous Standby | 155,000 (193.75 kVA) | 180,000 (225 kVA) |
| 50 Hertz Continuous Standby | 130,000 (162.5 kVA) | 150,000 (187.5 kVA) |
| AC Voltage Regulation..... | ± 2% | |
| 60 Hertz r/min | 1800 | |
| 50 Hertz r/min | 1500 | |
| Output Rating | 0.8 PF | |
| AC Frequency Regulation..... | Isochronous | |

CAPACITIES AND REQUIREMENTS

| | |
|---|--------------------------|
| Cooling System, Engine and Radiator | 14-Gallons (53 litres) |
| Engine Oil Capacity (Filter, Lines, Crankcase)..... | 10.5-Gallons (40 litres) |
| Exhaust Connection (inches pipe thread) | 5.0 OD. male |

AIR REQUIREMENTS (1800 r/min)

| | | |
|---|-------------------------------------|----------------------------------|
| Engine Combustion..... | 660-cfm (0.31 m ³ /s) | 700-cfm (0.33 m ³ /s) |
| Radiator Cooled Engine..... | 16,000-cfm (7.55 m ³ /s) | |
| Total for Radiator Cooled Model | 16,660 (8.00 m ³ /s) | 16,700 (8.00 m ³ /s) |
| Alternator Cooling Air (1800 r/min)..... | 1,000-cfm (0.47 m ³ /s) | |
| (1500 r/min)..... | 833-cfm (0.39 m ³ /s) | |
| Fuel Consumption at Rated Load ASTM No. 2 Diesel 60 Hz | 12.9 g/hr (13.56 lit/hr) | 14.8-g/h (15.56 lit/hr) |
| 50 Hz | 10.4 g/hr (10.9 lit/hr) | 12.2-g/h (12.83 lit/hr) |

GENERAL

| | |
|---------------------------------|--|
| Height | 69.50-inches (1.76 m) |
| Width | 44.0-inches (1.12 m) |
| Length | 114.0-inches (2.90 m) |
| Approximate Weight (Mass) | 5500-lb (2495 kg) 5650-lb (2563 kg) |

TABLE 1. UR GENERATOR VOLTAGE/CURRENT OPTIONS

| VOLTS | FREQ | PHASE | AMPERES | SERIES DELTA | PARALLEL WYE | SERIES WYE | REF VOLTAGE WIRE (W12) TAP |
|---------------|-------|-------|---------|-----------------|-----------------|---------------|-------------------------------|
| 110/190 | 50 Hz | 3 | 494 | | x | | H3 |
| 115/200 | 50 Hz | 3 | 469 | | x | | H4 |
| 120/208 | 50 Hz | 3 | 451 | | x | | H4 |
| 120/208 | 60 Hz | 3 | 538 | | x | | H3 |
| 110/220 | 50 Hz | 3 | 426 | x | | | H6 |
| 127/220 | 50 Hz | 3 | 426 | | x | | H5 |
| 127/220 | 60 Hz | 3 | 508 | | x | | H4 |
| 115/230 | 50 Hz | 3 | 408 | x | | | H6 |
| 120/240 | 60 Hz | 3 | 466 | x | | | H5 |
| 139/240 | 60 Hz | 3 | 466 | | x | | H5 |
| 220/380 | 50 Hz | 3 | 247 | | | x | H3 |
| 230/400 | 50 Hz | 3 | 235 | | | x | H4 |
| 240/416 | 50 Hz | 3 | 226 | | | x | H4 |
| 240/416 | 60 Hz | 3 | 269 | | | x | H3 |
| 254/440 | 50 Hz | 3 | 213 | | | x | H5 |
| 254/440 | 60 Hz | 3 | 254 | | | x | H4 |
| 277/480 | 60 Hz | 3 | 233 | | | x | H5 |
| 9X 347/600 | 60 Hz | 3 | 186 | | | | H5—Not Reconnectible |

155 kW 193.75 kVA 60 Hz

130 kW 162.50 kVA 50 Hz

TABLE 1A. UR GENERATOR VOLTAGE/CURRENT OPTIONS

| VOLTS | FREQ | PHASE | AMPERES | SERIES DELTA | PARALLEL WYE | SERIES WYE | REF VOLTAGE WIRE (W12) TAP |
|---------------|-------|-------|---------|-----------------|-----------------|---------------|-------------------------------|
| 110/190 | 50 Hz | 3 | 570 | | x | | H3 |
| 115/200 | 50 Hz | 3 | 541 | | x | | H4 |
| 120/208 | 50 Hz | 3 | 520 | | x | | H4 |
| 120/208 | 60 Hz | 3 | 625 | | x | | H3 |
| 110/220 | 50 Hz | 3 | 492 | x | | | H6 |
| 127/220 | 50 Hz | 3 | 492 | | x | | H5 |
| 127/220 | 60 Hz | 3 | 590 | | x | | H4 |
| 115/230 | 50 Hz | 3 | 471 | x | | | H6 |
| 120/240 | 60 Hz | 3 | 541 | x | | | H5 |
| 139/240 | 60 Hz | 3 | 541 | | x | | H5 |
| 220/380 | 50 Hz | 3 | 285 | | | x | H3 |
| 230/400 | 50 Hz | 3 | 271 | | | x | H4 |
| 240/416 | 50 Hz | 3 | 260 | | | x | H4 |
| 240/416 | 60 Hz | 3 | 312 | | | x | H3 |
| 254/440 | 50 Hz | 3 | 246 | | | x | H5 |
| 254/440 | 60 Hz | 3 | 295 | | | x | H4 |
| 277/480 | 60 Hz | 3 | 270 | | | x | H5 |
| 9X 347/600 | 60 Hz | 3 | 217 | | | | H5—Not Reconnectible |

180 kW 225 kVA 60 Hz

150 kW 187.5 kVA 50 Hz

DESCRIPTION

GENERAL

An Onan DFE series electric generating set is a complete unit consisting of an engine driven AC generator, with standard and optional controls and accessories as ordered.

ENGINE

The engine on the DFE is a Cummins NT855-G, as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS*. For operation, maintenance and service information, consult the Cummins manual.

AC GENERATOR

The generator is an ONAN Type UR, 12 lead, 4-pole revolving field, reconnectable, brushless unit. The main rotor is attached directly to the engine flywheel, therefore engine speed determines generator output frequency. The 60 Hz set operates at 1800 r/min, the 50 Hz at 1500 r/min. Excitation is achieved as follows—

Residual alternating current from the stator winding is applied to the voltage regulator, where it is compared with a reference voltage, rectified and returned to the field winding of the exciter. Current then induced in the exciter rotor is rectified and fed into the generator rotor. This induces a current in generator stator which is applied to the load.

CONTROL PANEL

The following is a brief description of each of the standard controls and instruments located on the face of the panel. See Figure 1.

DC Panel

Water Temperature Gauge: Indicates temperature of circulating coolant in engine. (Wired to a sensor unit located on the engine.)

Battery Charge Rate DC Ammeter: Indicates battery charging current.

Run-Stop/Reset-Remote Switch: Starts and stops the unit locally or from a remote location. Resets engine monitor relay in Stop/Reset position.

Warning Light: Indicates "Fault" in engine operation.

AC Panel

AC Voltmeter: Indicates AC generator output voltage. Dual range instrument: measurement range in use shown on indicator light.

Voltage Regulator: Rheostat, provides approximately plus or minus 5% adjustment of the rated output voltage.

Exciter Circuit Breaker: Provides generator exciter and regulator protection from overheating, in the event of certain failure modes of the generator, exciter and voltage regulator.

Running Time Meter: Registers the total number of hours, to 1/10th, that the unit has run. Use it to keep a record for periodic servicing. Time is accumulative, meter cannot be reset.

Voltmeter Phase Selector Switch: Selects phases of generator output to be measured by the AC voltmeter.

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the one "Fault" light and substitutes five indicator (see Figure 2) lights to give warning of—

- a. Overcrank
- b. Overspeed
- c. Low oil pressure
- d. High engine temperature
- e. Low engine temperature

Operation of these lights will be discussed in conjunction with engine monitor panel.

Reset Switch: Manual reset for engine monitor after shut-down.

Lamp Test: Press to test warning lamp bulbs (when engine is running only).

AC Panel

AC Ammeter: Indicates AC generator output current. Dual range in use shown on indicator lights.

Frequency Meter: Indicates the frequency of the generator output in hertz. It can be used to check engine speed. (Each hertz equals 30 r/min.)

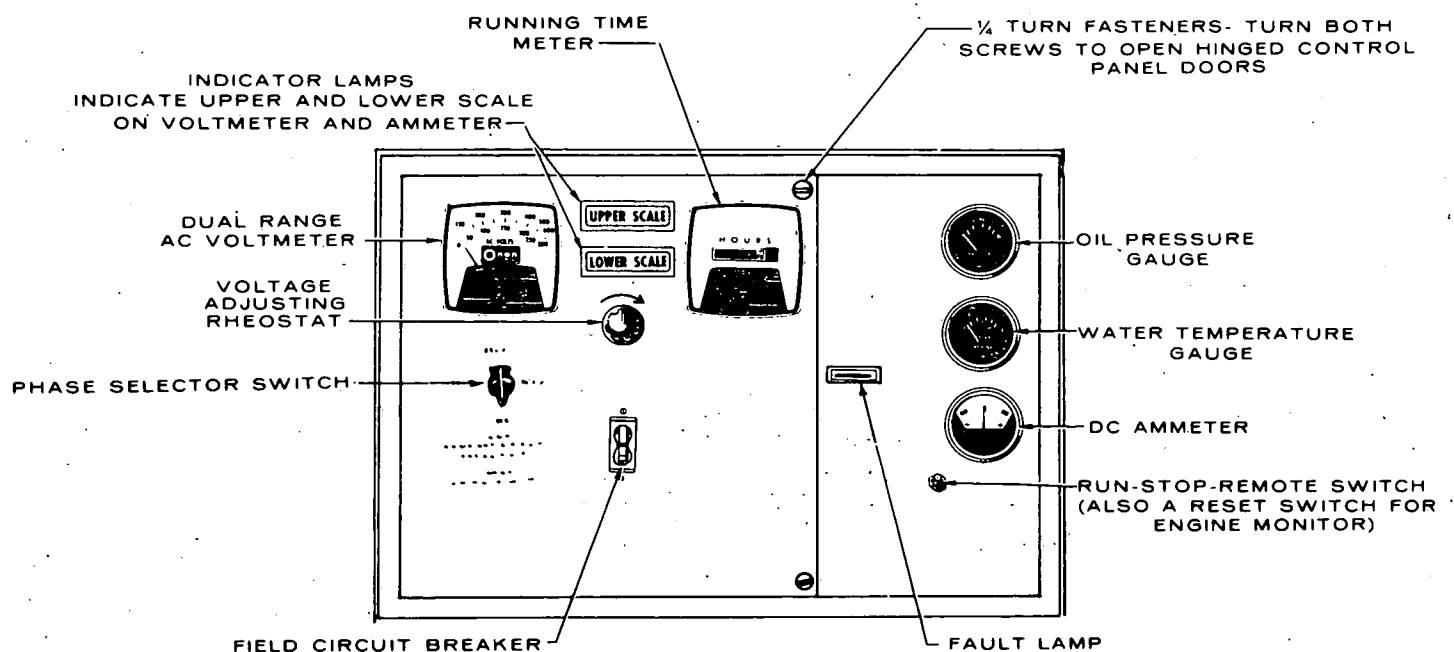


FIGURE 1. TYPICAL CONTROL PANEL (ONE FAULT LAMP)

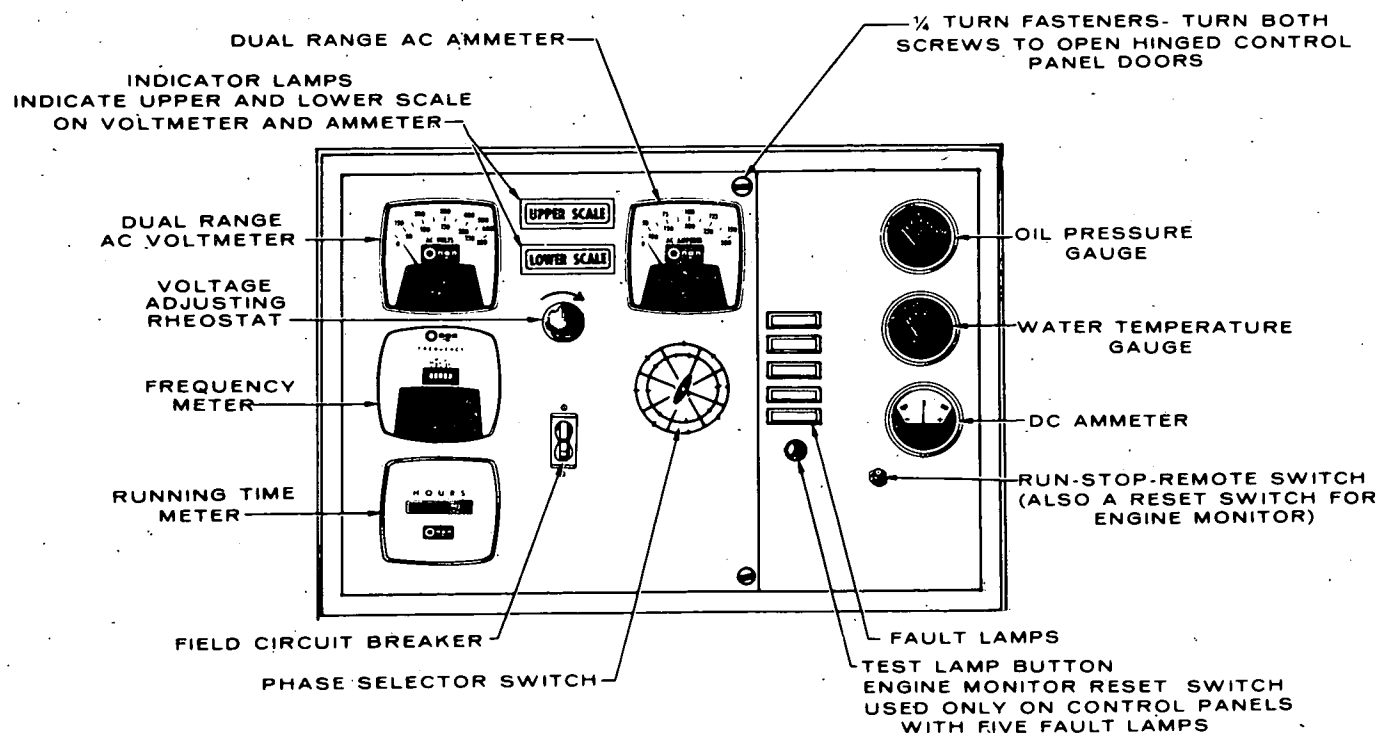


FIGURE 2. OPTIONAL CONTROL PANEL (FIVE FAULT LAMPS)

CONTROL PANEL INTERIOR

The only equipments discussed in this section will be those which the operator may have reason to adjust or inspect for service.

Terminal Board (TB) 21: Connection of wire W12 to terminals H3, H4, H5, and H6 is made at this point, to change reference voltage when reconnecting generator for different voltages. Refer to Figure 18.

Voltage Regulator: Solid state unit, consisting of printed circuit board VR21, an SCR bridge CR21, with a commutating reactor L21 are located in the control panel as part of the voltage regulator system. AC output from generator is controlled at predetermined level regardless of load; regulation is plus or minus 2% from no load to full load, at 0.8 P.F.

Engine Monitor: Printed circuit plug-in modules provide the following functions:

1. A 75 second cranking period.
2. Approximately a 12.5-second time delay for oil pressure buildup.
3. An external alarm contact to light a fault lamp and shut down the set for alarm conditions such as:

- a. Overcrank (failed to start after cranking 75 seconds).
- b. Overspeed (engine speed reaches 2100 r/min).
- c. Low oil pressure 14 psi (96.5 kPa).
- d. High engine temperature 215°F (102°C).

On standard control panels, all four alarms are wired into one common fault lamp; on units with five fault lamps, four have shutdown alarms, the fifth (low engine temperature) lights a fault lamp only. Refer to Table 2.

Standard Cranking Module: Limits engine cranking time to 75 seconds. If engine fails to start after 75 seconds the engine monitor lights a fault lamp and opens the cranking circuit.

WARNING

High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. Adequate engine coolant levels must be maintained to ensure operational shutdown protection capability of engine cooling system.

OPTIONAL MODULES

Cycle Cranker: Plug-in module replaces standard cranking circuit. Automatically provides a 15-second crank time and a 10-second rest time for three ON and two OFF cycles in 65 seconds. If engine fails to start, after 75 seconds the engine monitor lights a fault lamp and opens the cranking circuit. The ON and OFF cycle times are nominal and can be adjusted at potentiometers on the cranker module board.

Pre-Alarm: Gives advance warning for low oil pressure or high engine temperature. Requires two sensors each for engine temperature and oil pressure.

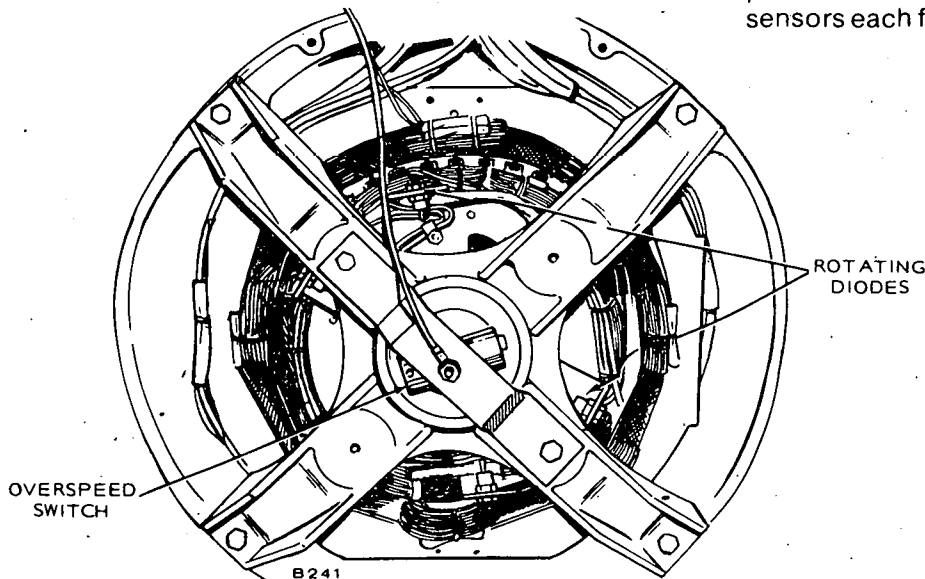


FIGURE 3. OVERSPEED SWITCH

TABLE 2. FAULT LAMP OPTIONS

| SYSTEM | FAULT | FAULT LAMP | STOP ENGINE | EXTERNAL ALARM | PRE-ALARM |
|-------------------------|-------------------------|------------|-------------|----------------|-----------|
| PENN STATE SINGLE LIGHT | Overcrank | x | x | x | |
| | Overspeed | x | x | x | |
| | Low Oil Pressure | x | | x | |
| | High Engine Temperature | x | | x | |
| STANDARD SINGLE LIGHT | Overcrank | x | x | x | |
| | Overspeed | x | x | x | |
| | Low Oil Pressure | x | x | x | |
| | High Engine Temperature | x | x | x | |
| 5 LIGHT | Overcrank | x | x | x | |
| | Overspeed | x | x | x | |
| | Low Oil Pressure | x | x | x | |
| | High Engine Temperature | x | x | x | |
| | Low Engine Temperature | x | | | |
| 5 LIGHT PRE-ALARM | Overcrank | x | x | x | |
| | Overspeed | x | x | x | |
| | Low Oil Pressure | x | * | x | x |
| | High Engine Temperature | x | * | x | x |
| | Low Engine Temperature | x | | | |

* - With additional optional sensors.

ENGINE SENSORS

Resistance units and switches in the engine temperature and oil pressure monitoring and shut-down systems are sealed units and are not repairable.

For location, refer to Figures 4 and 5. When changing a sensor, do not substitute, use recommended replacement parts. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

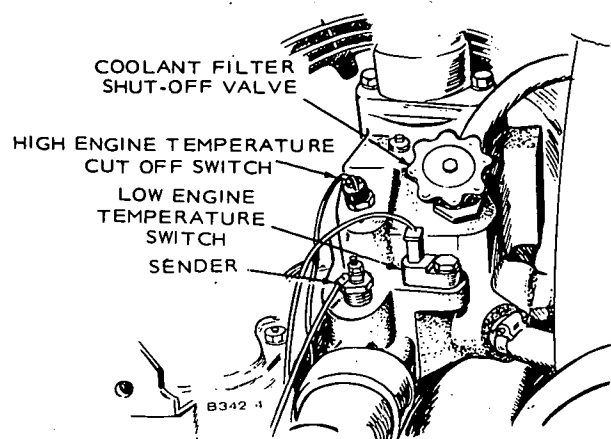


FIGURE 4. WATER TEMPERATURE MONITORS

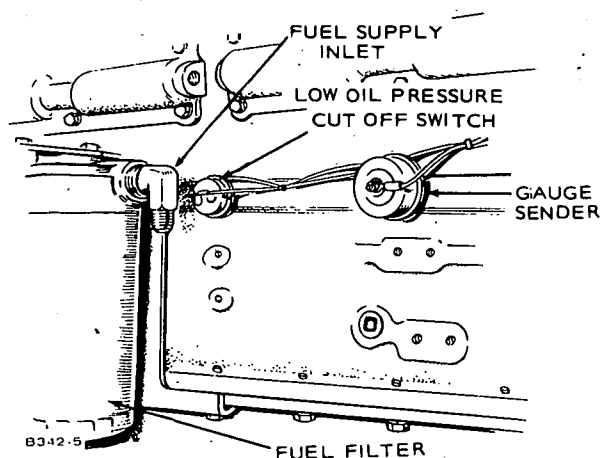


FIGURE 5. OIL PRESSURE MONITORS

INSTALLATION

GENERAL

Installations must be considered individually. Use these instructions as a general guide. All installations must meet regulations of state and local building codes, fire ordinances, etc., which may affect installation details. See Figure 6.

Requirements to be considered prior to installation:

1. Level mounting surface.
2. Adequate cooling air.
3. Adequate fresh induction air.
4. Discharge of circulated air.
5. Discharge of exhaust gases.
6. Electrical connections.
7. Fuel installation.
8. Water supply (city water cooling).
9. Accessibility for operation and servicing.
10. Vibration isolation.
11. Noise levels.

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a heated building for protection from extreme weather conditions.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. The engine-generator assembly is isolated from the skid base by rubber mounts which provide adequate vibration isolation for normal installations. For installations where vibration control is critical, install additional spring-type isolators between skid base and foundation.

For convenience in general servicing and changing crankcase oil, mount set on raised pedestal at least 6-inches (150 mm) high. Refer to *ONAN Technical Bulletin T-030* for further installation information.

VENTILATION

Generator sets create considerable heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for the required air flow. See *SPECIFICATIONS* for the air required to operate with rated load under normal conditions at 1800 r/min.

Radiator set cooling air travels from the rear of the set and is removed by a pusher fan which blows out through the radiator. Locate the air inlet to the rear of the set. Make the inlet opening at least 1½-times larger than the radiator.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The opening size should be at least 1½ times as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to air flow. Use a duct of canvas or sheet metal between the radiator and the air outlet opening. The duct prevents recirculation of heated air.

Provide a means of restricting the air flow in cold weather to keep the room or compartment temperature at a normal point. Keep in mind, however, that the engine must get adequate cooling air.

For operation outside a building, a shelter housing with electrically operated louvres is available as an option. Transformers connected across the generator output supply current to the motors.

When the generator is operating, current in the transformers actuate the motors and open the louvres. The louvres are held open for the duration of the set operation, then are closed by return springs when the set is shut down.

City water cooled sets do not use the conventional radiator. A constantly changing water flow cools the engine. Ventilation is seldom a problem, but sufficient air movement and fresh air must be available to properly cool the generator, disperse heat convected off the engine and support combustion in the engine.

For small compartments, a duct of equal or larger area than generator outlet is recommended to remove the heated air from the generator air outlet to the outside atmosphere. Limit bends and use radius type elbows where needed. A larger, well ventilated compartment or room does not require a hot air duct.

Installations made in a small room may require installation of an auxiliary fan (connected to operate only when the unit is running) of sufficient size to assure proper air circulation and evacuation of fumes.

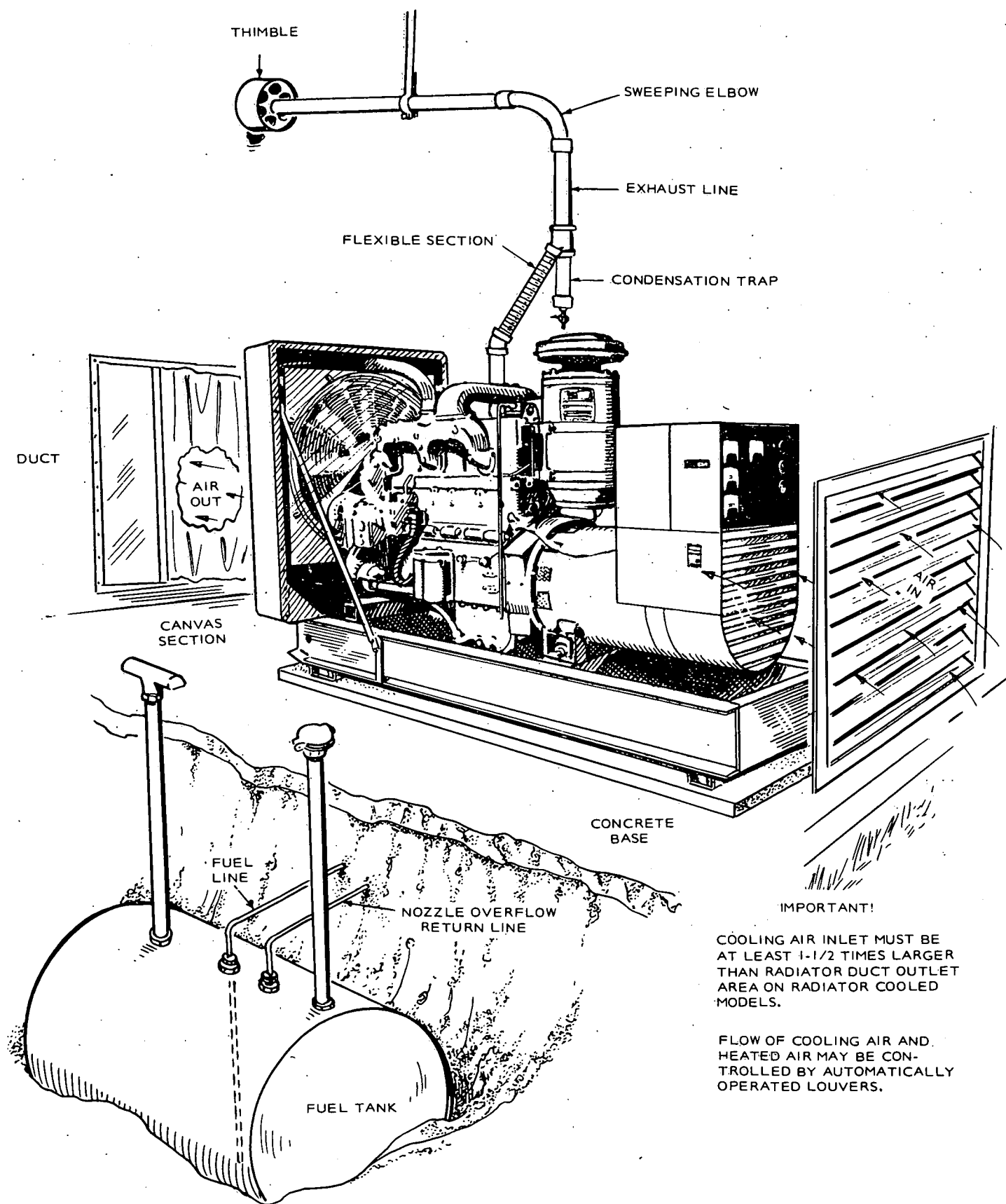


FIGURE 6. TYPICAL DFE INSTALLATION

COOLING SYSTEM

Standard Radiator Cooling, uses a set mounted radiator and engine driven pusher type fan to cool engine water jacket. Air travels from the generator end of the set, across the engine and out through the radiator. An integral discharge duct adapter flange surrounds the radiator grille.

Heat Exchanger Cooling (optional), uses a shell and tube type heat exchanger instead of the standard radiator and fan. Engine jacket coolant circulates through the shell side of the heat exchanger, while raw cooling water is pumped through the tubes. Engine coolant and raw water do not mix. This type of cooling separation is necessary when the raw water contains scale forming lime and other impurities.

This system reduces set enclosure airflow and noise levels. Proper operation depends upon a constant supply of raw water for heat removal. The engine coolant side of the system may be protected from freezing, the raw water side cannot. See Figure 7 for typical installation.

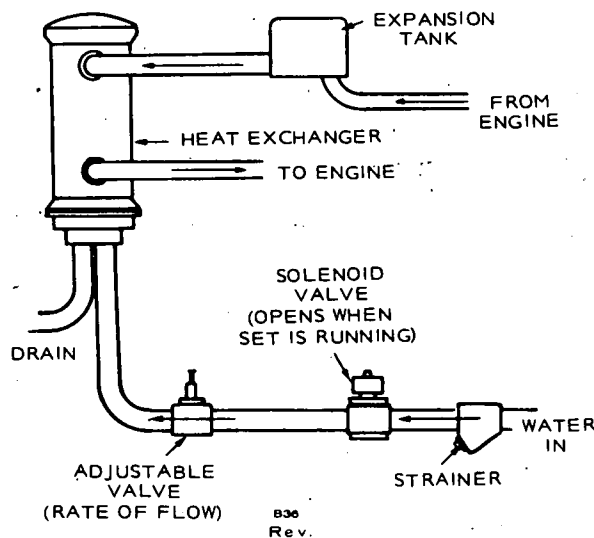


FIGURE 7. TYPICAL HEAT EXCHANGER SYSTEM

Standpipe Cooling (optional) substitutes a mixing (tempering) tank for the standard radiator and fan. Cooling water circulating through the engine jacket is mixed with raw water in the tank. Because raw water flows through the engine jacket, it must not contain scale forming impurities or fouling of the engine water will occur. Fouling results in engine overheating and costly repair bills.

This system reduces set enclosure airflow requirements and noise levels. Proper operation is dependent on a constant supply of cooling water. The system cannot be protected from freezing. See Figure 8.

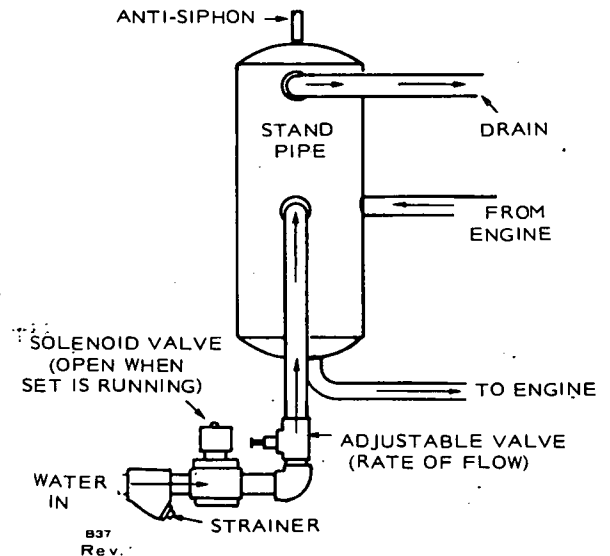


FIGURE 8. TYPICAL STANDPIPE SYSTEM

Remote Radiator Cooling (optional), substitutes a remote mounted radiator and an electrically driven fan, for the set mounted components. Removal of the radiator and fan from the set reduces set enclosure airflow requirements and noise levels without forcing dependence on a continuous cooling water supply. The remote radiator system can be completely protected against freezing.

This system must be designed to meet specific requirements of the application.

Water Jacket Heater (optional) may be installed to keep engine coolant warm while engine is shut down. It heats and circulates the coolant within the engine, which reduces start-up time and engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

COOLING CONNECTIONS

The radiator cooled (standard) set does not require any external connections except as discussed under *Ventilation*. Allow clearance around the set for access to service the radiator and fan belts. See Figure 6.

Heat Exchanger and Standpipe cooled sets must be connected to a pressurized supply of cold water. Make connections to the set with flexible pipe to absorb vibration. On the cool water line install a solenoid valve to shut off the flow when the set is shut down and a rate of flow valve to control engine temperature. This valve can be either manual or automatic. Actual rate of flow will depend on inlet water temperature.

Adjust the flow to maintain water temperature between 165°F and 195°F (73.9°C and 90.6°C) while viewing the water temperature gauge.

Before filling cooling system check all hardware for security. This includes hose clamps, capscrews, fittings and connections. Use flexible coolant lines with heat exchanger, standpipe or remote mounting radiator.

Remote radiator plumbing will vary with installation. All systems must comply with the following conditions—

1. Make all connections to the set and to the radiator, with flexible pipe.
2. Install an auxiliary circulating pump if the horizontal distance between the engine and pump exceeds 15-feet (4.65 m).
3. Install a hot-well system to relieve excess engine water jacket pressure if the top of the radiator is more than 15-feet (4.65 m) above the center-line of the engine crankshaft.

COOLANT FILTER

A spin-on type corrosion filter is standard equipment on a DFE set. This precharge filter is compatible with plain water or all permanent ethylene glycol base permanent antifreeze coolants. Refer to engine manufacturer's manual for instructions if a methoxy propanol base antifreeze is desired.

Do not use any type of antifreeze with a stop-leak additive. The filter will remove the additive (usually a particulate) and become clogged and ineffective. Replace filter periodically as recommended in *GENERAL MAINTENANCE* section. A shut-off valve is installed at each end of the bypass filter line to facilitate filter changing (see Figure 9).

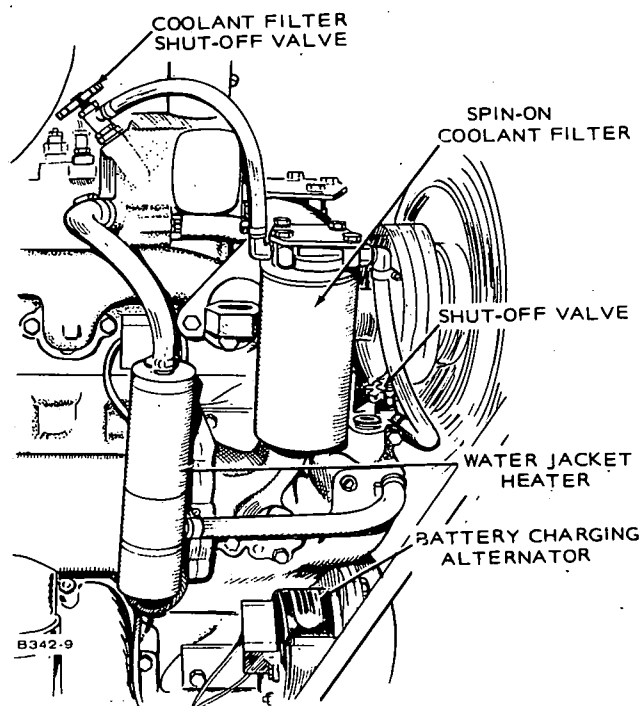


FIGURE 9. COOLANT FILTER INSTALLATION

WATER JACKET HEATER (Optional)

This heater is installed to maintain an elevated engine temperature in lower ambient temperature applications. It heats and circulates engine coolant, and is thermostatically controlled.

EXHAUST

WARNING

Inhalation of exhaust gases can result in death.

Engine exhaust gas must be piped outside building or enclosure. Do not terminate exhaust pipe near inlet vents or combustible materials. An approved thimble (Figure 10) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 11) at the point where a rise in the exhaust system begins. Avoid sharp bends; use sweeping long radius elbows. Provide adequate support for mufflers and exhaust pipes. Refer to Figure 6 for a typical exhaust installation. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9-inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 5-inch (127 mm) pipe size outlet of the engine with a flexible portion between the engine and the muffler.

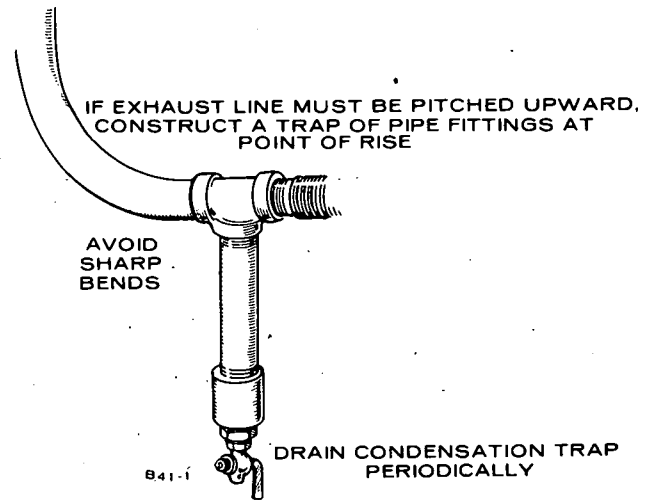


FIGURE 11. EXHAUST CONDENSATION TRAP

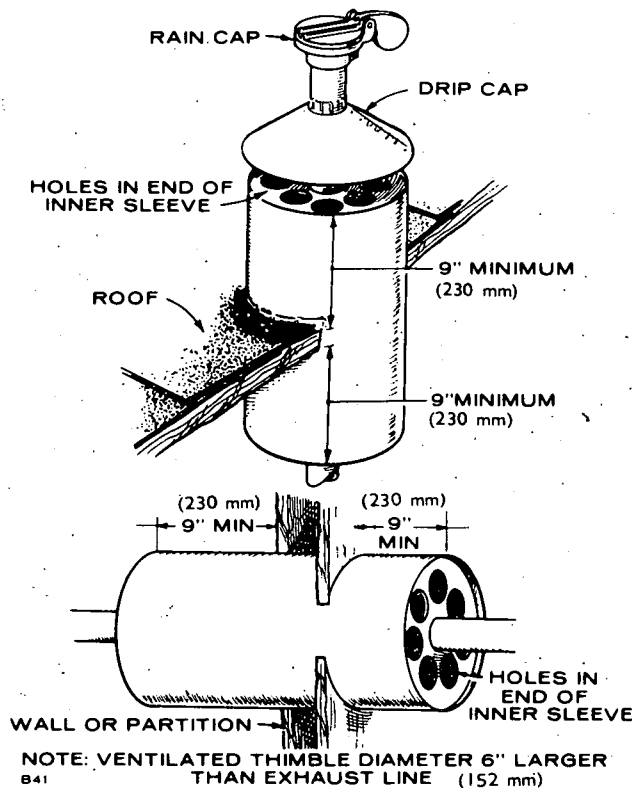


FIGURE 10. EXHAUST THIMBLE

Do not connect a flexible line to the exhaust manifold. Minimum diameters and maximum lengths of pipe (with critical muffler[s]) are as follows:

Single Exhaust system:

| | |
|------------------------------|-------------|
| 155 kW 460-Feet (140 m)..... | 6-inch dia. |
| 180 kW 315-Feet (96 m)..... | 6-inch dia. |

Maximum permissible exhaust restriction (back pressure) is 3-inches Hg (10.13 kPa).

FUEL SYSTEM

Cummins engines used on the DFE sets are designed for use with ASTM No. 2 Diesel fuel. They will however, operate on diesel fuels within the specifications delineated in the Cummins engine manual.

FUEL CONNECTIONS

Check local regulations governing the installation of a fuel supply tank.

In any diesel engine installation, fuel system cleanliness is of utmost importance. Make every effort to prevent entrance of moisture or contaminants of any kind. Do not use lines or fittings of galvanized material.

A fuel lift in excess of 12-feet (3.6 m) is not recommended without a day tank installation, because of fuel drainage.

Fuel inlet connection is to the filter and is threaded for 7/8-inch 14 UNF fitting. Injector's return to the tank is threaded for 3/4-inch 16 UNF fitting. See Figure 12 for fuel system installation.

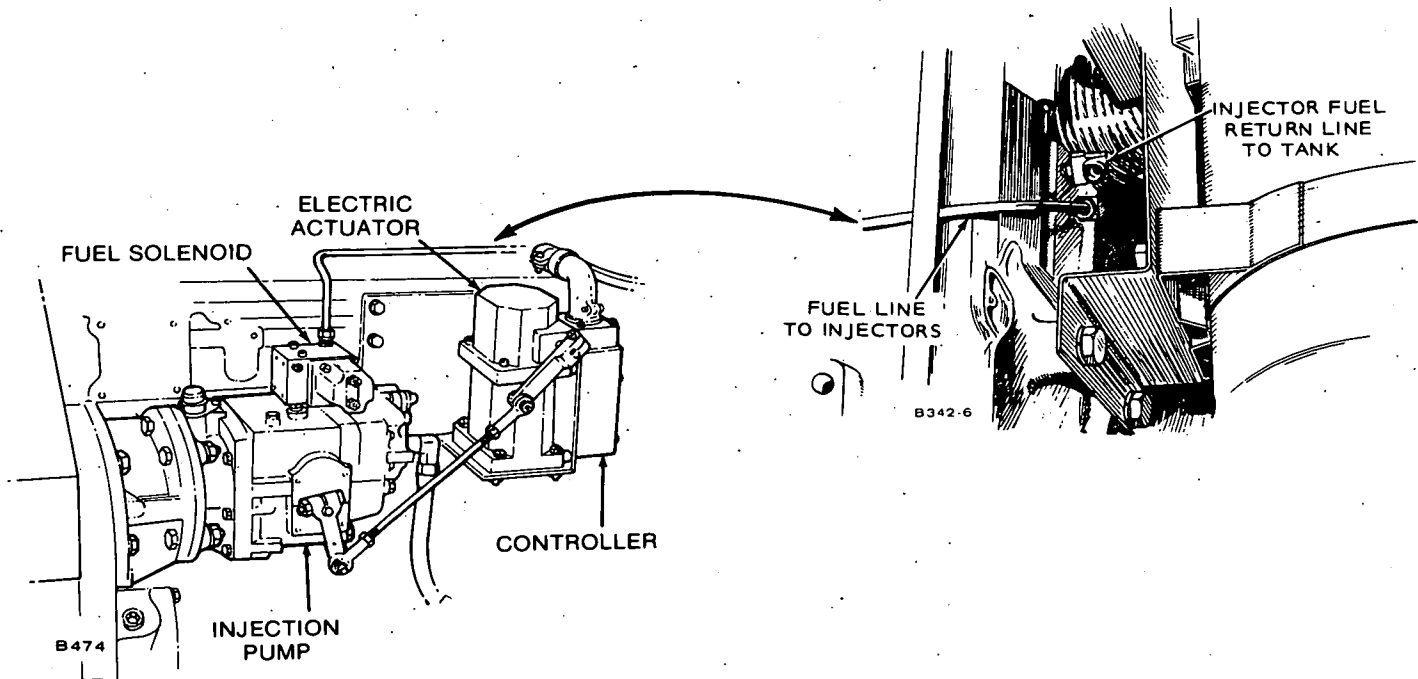


FIGURE 12. FUEL SYSTEM

DAY TANK

Generator set installations may be equipped with an optional separate fuel day tank. A float operated valve controls fuel flow into the fuel tank. The correct level is maintained to assure a constant source of fuel. It is necessary to install an overflow line between the day tank and main fuel tank. Refer to the installations included with the tank. See Figure 13 for an example of a day tank installation. Tank and lines must be below level of injector pump return outlet.

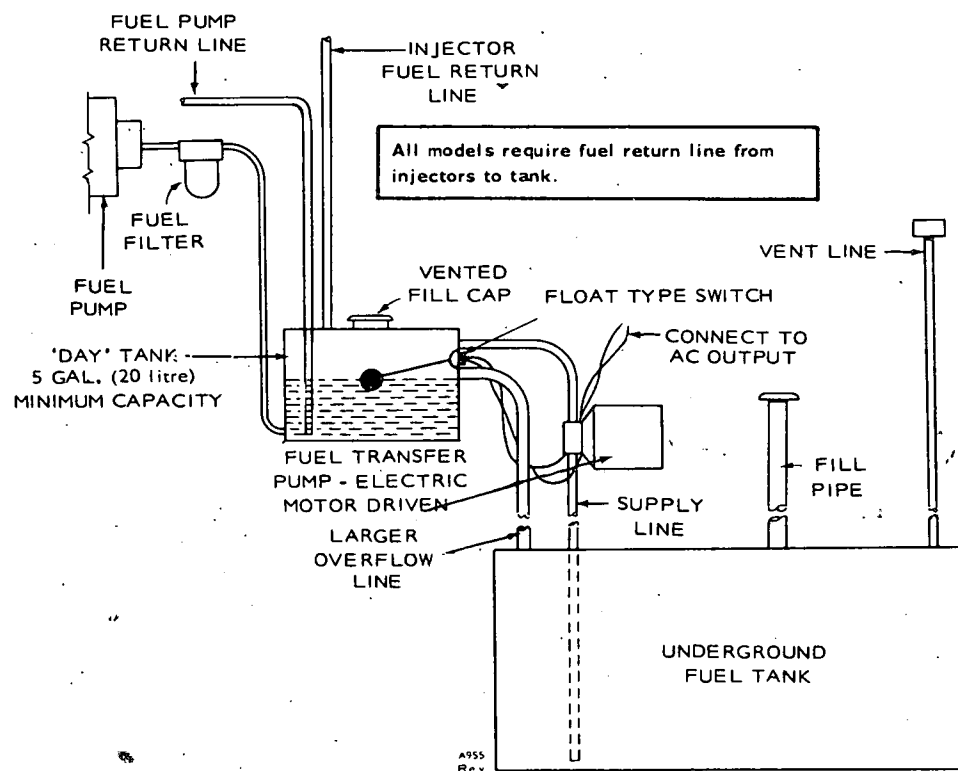


FIGURE 13. DAY TANK (TYPICAL)

BATTERY

Starting the unit requires 24-volt battery current. Use two 12-volt (see *SPECIFICATIONS*) batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second) as in Figure 14. Necessary battery cables are on unit. Service the batteries as necessary. Infrequent unit use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger.

WARNING

Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.

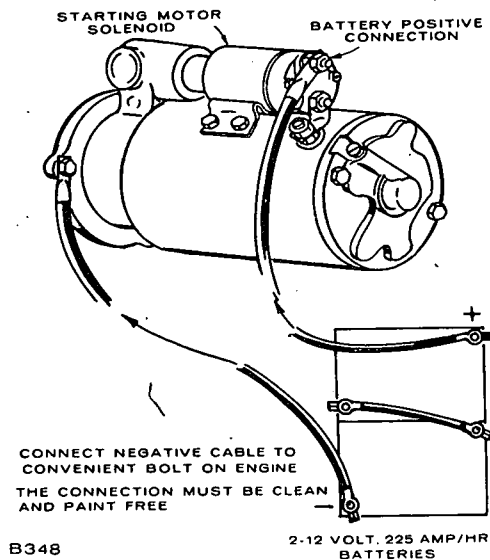


FIGURE 14. BATTERY CONNECTION

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90°F (32.3°C) such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.275 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90°F (32.2°C), this should not be noticed. The lengthened battery life will be worth the effort.

1. Fully charge the battery.
2. With the battery still on charge, draw off the electrolyte above the plates in each cell. **DO NOT ATTEMPT TO POUR OFF**; use a hydrometer or filler bulb and dispose of it in a safe manner. Avoid skin or clothing contact with the electrolyte.
3. Refill each cell with distilled water, to normal level.
4. Continue charging for 1 hour at a 4 to 6 hour rate.
5. Test each cell. If the specific gravity is still above 1.255, repeat steps 2, 3, and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

REMOTE CONTROL CONNECTIONS

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated within the control box. Connect one or more remote switches across remote terminal and B+ terminal as shown in Figure 15. If the distance between the set and remote station is less than 1000-feet (305 m), use No. 18 AWG wire; between 1000- and 2000-feet (305 m and 610 m), use No. 16 AWG wire.

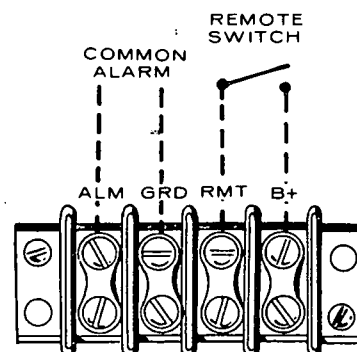


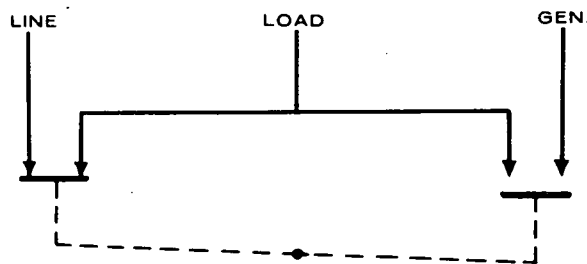
FIGURE 15. REMOTE START CONNECTION (TB12)

WIRING CONNECTIONS

Most local regulations require that wiring connections be made by a licensed electrician and that the installation be inspected and approved before operation. All connections, wire sizes, etc. must conform to requirements of electrical codes in effect at the installation site.

Generator set grounding must be in accordance with National Electrical Code (NFPA 70-1975) Article 250.

If the installation is for standby service, a double throw transfer switch must always be used. Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator current to be connected to the load at the same time. See Figure 16. Instructions for connecting an automatic load transfer control are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.

FIGURE 16. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

Control Box Connections: The factory ships these 12 lead generators with load connections wires NOT connected together in the control box. These 12 wires are labeled T1 through T12 and must be brought together before making load connections. Proceed as follows:

1. Remove either right, left or top panel from control box. See Figure 17.

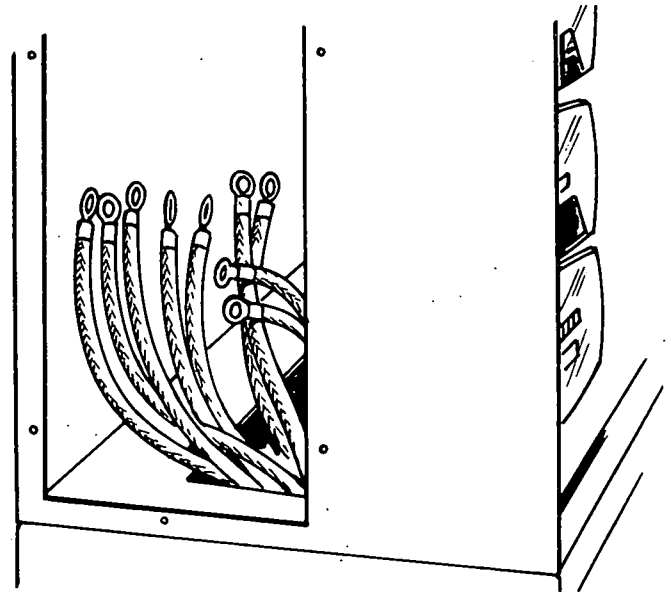


FIGURE 17. CONTROL BOX (SIDE PANEL REMOVED)

2. Connect wires together as shown on panel drawing and in Figure 21 according to voltage desired.
3. Open hinged control panel doors. Connect lead from terminal 63 to correct terminal for voltage desired. These terminals are labeled H2, H3, H4, H5 and H6. See Figure 18.
4. Close front panel and secure with 1/4 turn fasteners.
5. Connect load wires to generator leads.

Preceding instructions do not apply to models designated Code 3 or 9X; this connection is made at the factory. The installer must only connect load wires.

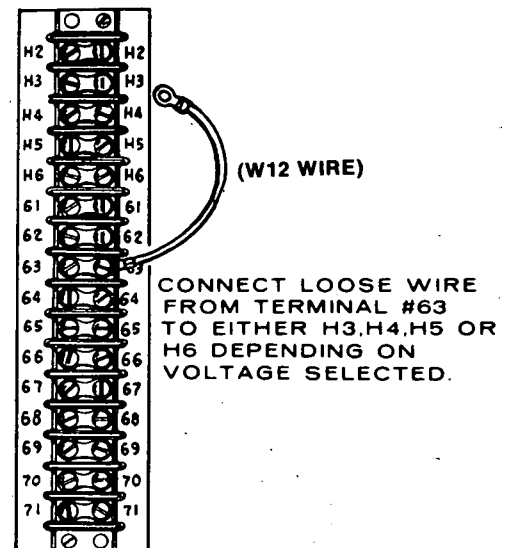


FIGURE 18. REFERENCE VOLTAGE CONNECTION (TB21)

120/240 Volt, 3 Phase, Delta Connected Set; 12 Lead:

The 3 phase Delta connected set is designed to supply 120 and 240 volt, 1 phase current and 240 volt, 3 phase current, Figure 19. For 3 phase operation, connect the three load wires to generator terminals L1, L2 and L3—one wire to each terminal; the L0 terminal is not used.

For 120/240 volt, 1 phase, 3 wire operation, terminals L1 and L2 are the "hot" terminals. The L0 terminal is the neutral, which can be grounded if required. For 120 volt service, connect the black load wire to either the L1 or L2 terminal. Connect the neutral (white) wire to the L0 terminal. Two 120 volt circuits are available. Connect between any two 3-phase terminals for 240 volt 1-phase loads.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as total current does not exceed the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

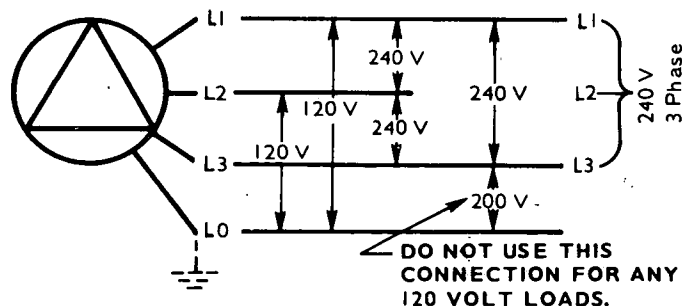


FIGURE 19. 120/240 V. 3-PHASE DELTA

3 Phase, Wye Connected Set: The 3 phase, 4 wire set produces line to neutral voltage and line to line voltage. The line to neutral voltage is the lower voltage as noted on the unit nameplate, and the line to line voltage is the higher nameplate voltage.

For 3 phase loads, connect separate load wires to each of the set terminals L1, L2 and L3. Single phase output of the higher nameplate voltage is obtained between any two 3 phase terminals as shown in Figure 20.

The terminal marked L0 can be grounded. For 1 phase loads, connect the neutral (white) load wire to the L0 terminal. Connect the black load wire to any one of the other three terminals—L1, L2 or L3. Three separate 1 phase circuits are available. Total 1-phase current available is 2/3 rated 3-phase capacity of generator.

If using 1 phase and 3 phase current at the same time, use care to properly balance the 1 phase load, and not to exceed rated line current.

Figure 20 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye connection as in Figure 21.

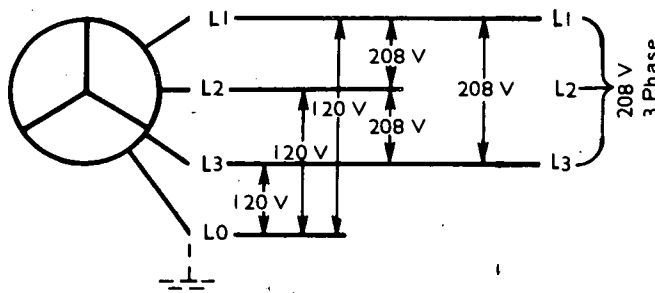
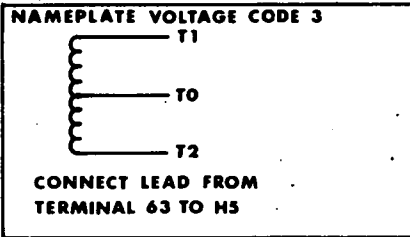
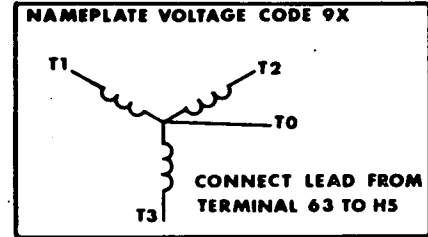


FIGURE 20. 120/208 V. 3-PHASE WYE

120/240 VOLT, 1 PHASE, 60 HERTZ



347/600VOLT, 3 PHASE, 60 HERTZ



+

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

| NAMEPLATE VOLTAGE CODE | VOLTAGE | PHASES | HERTZ | CONNECT LEAD FROM TERMINAL 63 TO: | GENERATOR CONNECTION | GENERATOR CONNECTION SCHEMATIC DIAGRAM | GENERATOR CONNECTION WIRING DIAGRAM (WITH CURRENT TRANSFORMERS WHEN USED) |
|------------------------|---------|--------|-------|--------------------------------------|----------------------|---|--|
| 15 | 120/240 | 1 | 60 | H5 | DOUBLE DELTA | | |
| 515 | 115/230 | 1 | 50 | H6 | DOUBLE DELTA | | |
| 60 | 240/480 | 3 | 60 | H5 | SERIES DELTA | | |
| 15 | 120/240 | 3 | 60 | H5 | SERIES DELTA | | |
| 515 | 115/230 | 3 | 50 | H6 | SERIES DELTA | | |
| 15 | 120/208 | 3 | 60 | H3 | PARALLEL WYE | | |
| 15 | 127/220 | 3 | 60 | H4 | PARALLEL WYE | | |
| 15 | 139/240 | 3 | 60 | H5 | PARALLEL WYE | | |
| 515 | 110/190 | 3 | 50 | H3 | PARALLEL WYE | | |
| 515 | 115/200 | 3 | 50 | H4 | PARALLEL WYE | | |
| 515 | 120/208 | 3 | 50 | H4 | PARALLEL WYE | | |
| 515 | 127/220 | 3 | 50 | H5 | PARALLEL WYE | | |
| 15 | 240/416 | 3 | 60 | H3 | SERIES WYE | | |
| 15 | 254/440 | 3 | 60 | H4 | SERIES WYE | | |
| 15 | 277/480 | 3 | 60 | H5 | SERIES WYE | | |
| 515 | 220/380 | 3 | 50 | H3 | SERIES WYE | | |
| 515 | 230/400 | 3 | 50 | H4 | SERIES WYE | | |
| 515 | 240/416 | 3 | 50 | H4 | SERIES WYE | | |
| 515 | 254/440 | 3 | 50 | H5 | SERIES WYE | | |
| 7 | 220/380 | 3 | 60 | H3 | SERIES WYE | | |

98C2193

OPERATION

GENERAL

Onan DFE Series electric generating sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Inspect your unit closely for loose or missing parts and damage which may have occurred in transit. Tighten loose parts, replace missing parts and repair any damage before putting set into operation.

PRESTART SERVICING

Lubrication System: Engine oil was drained prior to shipment. Fill crankcase to capacities shown below. After engine has been run, check dipstick, add oil to bring level to full mark. Record capacity for future oil changes.

Lubricating oil recommended for turbo-charged diesel engines is API Class CC/CD with a maximum sulphated ash content of 1.85%. Oils in this class should be satisfactory for most operating conditions. Do not mix brands nor grades of oil.

Oil viscosity should be as follows:

| Ambient Temperatures | Viscosity |
|-----------------------------|---|
| -10° F (-23° C) and below | See engine manual. 10W 20-20W 30 |
| -10 to 30° F (-23 to -1° C) | |
| 20 to 60° F (-7 to 16° C) | |
| 40° F (4° C) and above | |

Oil Capacities (nominal)
Oil Pan—28 quarts (26.5 litres)
Filter—12 quarts (11.4 litres)

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 14.0 gallons (53.0 litres). For units using either a radiator or heat exchanger (city water cooled), fill the system with clean soft water. Use a good rust and scale inhibitor additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures use anti-freeze with an ethylene glycol base. During initial engine run, check the coolant level several times and replenish if necessary to compensate for air pockets which may have formed during filling. Refer to Cummins engine manual for additional information.

CAUTION

1. Verify that the electric solenoid valve used with city water cooled sets is open before initial starting of unit to allow coolant chambers to fill. Overheating and damage to the engine could result from noncompliance.

CAUTION

If engine is equipped with a cooling system filter, do not use antifreeze with an anti-leak formula. The stop leak element can prevent or retard the coolant flow through the filter, thereby eliminating the filtering process completely.

WARNING

Be careful when checking coolant under pressure. It is advisable to shut engine down and bleed off pressure before removing pressure cap. Severe burns could result from contact with hot coolant.

Fuel System: Refer to the Cummins engine manual for fuel oil specifications. Check with fuel supplier and ensure that fuel supplied meets the specifications. Filter or strain fuel when filling tank. Fuel supply tanks should be kept as nearly full as possible by topping up each time engine is used. Warm fuel returning from the injector pump heats the fuel in the supply tank. If the fuel level is low in cold weather, the upper portion of the tank not heated by returning fuel tends to increase condensation. In warm weather both the supply tank and fuel are warm. Cool night air lowers the temperature of the tank more rapidly than the temperature of the fuel. Again this tends to increase condensation.

Condensate mixing with the sulphur in the fuel forms a sulphurous acid which will corrode and damage the engine. KEEP FUEL CLEAN.

WARNING

DO NOT SMOKE while handling fuel. Diesel fuel is flammable.

Priming Oil System: To prime oil system proceed as follows:

1. Remove oil inlet line from turbo-charger housing (Figure 22), fill bearing housing with clean engine lubricating oil; replace line, secure.
2. Fill crankcase to "L" (low) mark on dipstick.
3. Remove plug from head of oil filter housing (Figure 22) and connect a hand or motor-driven priming pump from a source of clean lubricating oil to the plug boss in filter housing.
4. Prime until a 30 psi (207 kPa) pressure is obtained.
5. Disconnect wire from fuel solenoid valve (Figure 24), close throttle and crank engine while maintaining an external prime pressure of 15 psi (103 kPa), for 15 seconds.
6. Remove external priming equipment, replace plug in filter housing, torque 15 to 20 lb-ft (20 to 27 N.m).
7. Reconnect wire to fuel shut-off valve.
8. Complete oil fill to "H" (high) mark on dipstick.

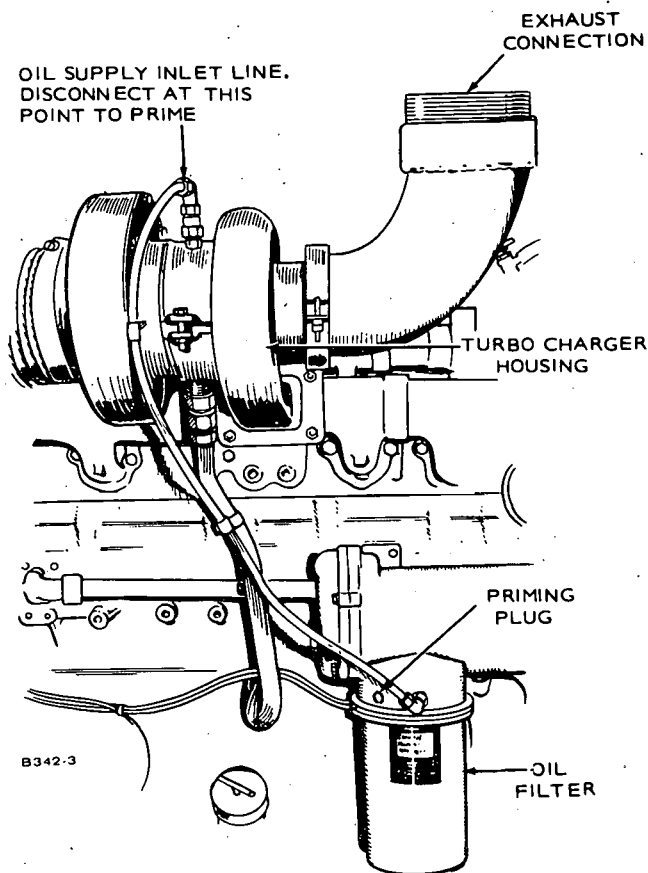


FIGURE 22. PRIMING TURBOCHARGER

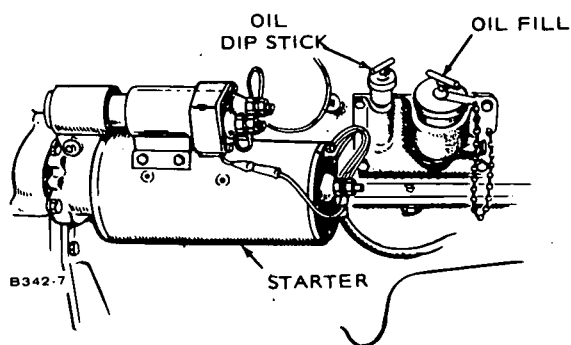


FIGURE 23. OIL FILL AND DIPSTICK LOCATIONS

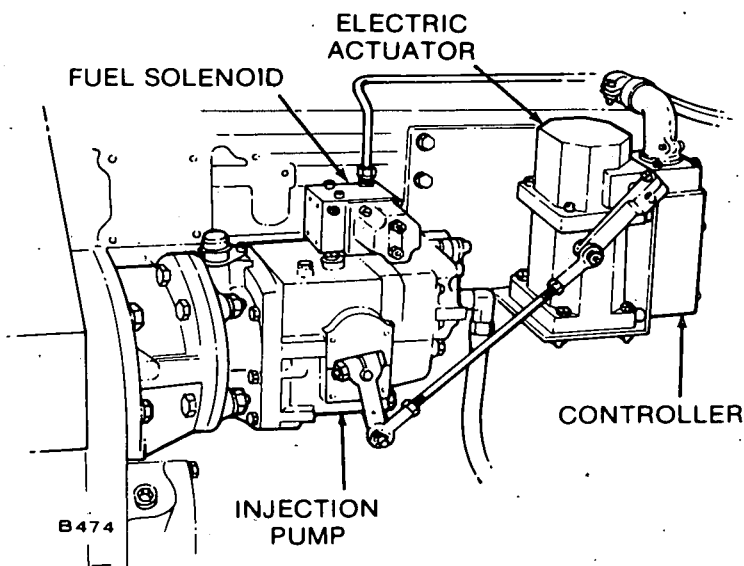


FIGURE 24. FUEL SOLENOID VALVE LOCATION

Priming Fuel System: Priming should not be necessary as the set was checked out before shipping. If however it is desired to verify and reprime system, remove each fuel filter and fill with clean fuel oil. Replace filters and make sure that all connections are secure (see Figure 28).

BATTERIES

Ensure that the cable connections to the batteries are secure. Coat connections with petroleum based or non-conductive grease to retard formation of corrosive deposits.

Check level of electrolyte to be at split ring mark. Measure specific gravity of electrolyte: SG 1.280 at 80°F (26.7°C). If distilled water has been added or specific gravity is less than 1.280, place batteries on charge until desired reading is reached. Do not over charge.

STARTING

When the preceding service functions have been performed, recheck to verify unit is ready to start.

1. Crankcase filled.
2. Cooling system filled—input solenoid valve open.
3. Batteries charged and connected.
4. Fuel solenoid valve open.

To start, move the "run-stop/reset-remote" switch to the "run" position. The engine should start after a few seconds of cranking. Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 50 and 70 psi (345.0-483 kPa). Check the following gauges:

1. DC Ammeter—10 to 30 amperes.
2. AC Voltmeter—AC generator output voltage.
3. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 165°F to 195°F (74°C to 90.6°C). On city water cooled units an adjustable valve is connected in the water supply line. Adjust the hand wheel valve to provide a water flow that will keep the water temperature gauge reading within the range of 165°F to 195°F (74°C to 90.6°C).

STOPPING

To reduce and stabilize the engine temperatures and prevent turbocharger housing damage, run the engine at no load for three to five minutes before shutting down.

Move the run-stop/reset-remote switch to stop position to shut down the set.

Break-in Note: Run set at 50 percent rated load for the first half-hour of initial operation after reaching operating temperature.

Non-Start: If after a few seconds of cranking, engine fails to start, or starts and runs then stops and fault lamp lights, refer to appropriate troubleshooting chart, Table 3 or Table 4.

NO LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

EXERCISE PERIOD

Generator sets on continuous standby service are required to be operative at essential loads from a cold start in a short period of time in the event of a power outage.

This imposes severe conditions on the engine. Friction of dry piston rings upon dry cylinder walls causes scuffing and rapid wearing. These can be relieved by exercising the set at least once a week for a minimum time of 30 minutes per exercise period. Preferably, run the set under at least 50 percent load to allow the engine to reach normal operating temperature. This will keep engine parts lubricated, maintain fuel prime, prevent electrical relay contacts from oxidizing and insure easy emergency starts. Onan automatic transfer switches contain an optional exercise switch which, by pre-selection, will start, determine run period and shut down a set on a weekly frequency. For example, the switch can be set for time of start, length of run, A.M. or P.M. and day of week.

After each exercise period, top off fuel tank, check engine for leaks and unit for general condition. Locate cause of leaks (if any) and correct.

TABLE 3.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Engines with only one fault lamp)

| SYMPTOM | CORRECTIVE ACTION |
|--|---|
| 1. Engine stops cranking and fault lamp lights, after cranking approximately 75 seconds. | 1. See engine service manual for troubleshooting fuel system. After correcting problem, reset engine monitor relay by placing Run-Stop/Reset-Remote switch to Stop/Reset, then back to the required running position. |
| 2. Fault lamp lights immediately after engine starts. | 2. Check for: Overspeed condition as engine starts. |
| 3. Fault lamp lights and engine shuts down after running for a period. | 3. Check the following: a. Oil level. Engine will shut down if sensor is closed. b. Check engine manual for troubleshooting oil system. c. High engine temperature. Check coolant level; check water flow (city water cooled systems); check radiator for free air flow, and fan belts for tightness. See engine manual for troubleshooting cooling system. d. Check for faulty oil pressure sensor or faulty high engine temperature sensor. |
| 4. Engine runs, shuts down and cranks for 75-seconds. Cranking cycle stops; fault lamp lights. | 4. Check fuel supply. |
| 5. Fault lamp lights, no fault exists. | 5. To check a no-fault condition, disconnect leads from TB11 terminals 29, 30 and 31. If fault lamp lights with leads disconnected, replace engine monitor board. Reconnect leads. |

TABLE 4.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Units with five fault lamps)

| SYMPTOM | CORRECTIVE ACTION |
|--|---|
| 1. Overcrank fault lamp lights and engine stops cranking after approximately 75-seconds. | 1. See engine service manual for troubleshooting fuel system. After correcting fault, reset engine monitor relay by placing Run-Stop/Reset-Remote switch to Stop/Reset position, depressing Reset button, then to the required running position. |
| 2. Engine runs, shuts down, cranks for 75-seconds, cranking cycle stops, overcrank light ON. | 2. Check fuel supply. |
| 3. *Low oil pressure shutdown. | 3. Check— a. Oil level. Replenish if necessary. b. Sensor. Faulty sensor will shut down engine. c. Refer to engine service manual for troubleshooting guide for oil system. |
| 4. *High engine temperature shutdown. | 4. Check— a. Coolant level. Replenish if necessary. b. City water cooled sets. Check water flow, valves, etc. c. Check sensor; check thermostat. d. Radiator model, check fan belts, radiator for obstructions, etc. |
| 5. Overspeed shutdown. | 5. Check governor and throttle linkages for freedom of movement. Check overspeed switch. |
| 6. Overspeed light on, no shutdown. | 6. Disconnect wire at TB11-29. Light on after reset; replace engine monitor board. |
| 7. *Low oil pressure light ON. No shutdown. | 7. Disconnect wire at TB11-30. Light ON after relay reset. Replace engine monitor board. |
| 8. *High engine temperature light ON. No shutdown. | 8. Disconnect wire at TB11-31. Light ON after relay reset. Replace engine monitor board. |

*NOTE: Not applicable on Pennsylvania State models.

OUT-OF-SERVICE PROTECTION

If an engine remains out of service for three or four weeks (maximum six months), special precautions should be taken to prevent rust. The operations listed below are required to minimize or prevent damage to temporarily stored engines.

1. Engine must be started and operated until thoroughly warm. Disconnect fuel lines to engine fuel filter and injector drain line. Fill two containers, one with diesel fuel and a second with preservative oil.
2. Start engine with fuel line to filter using diesel fuel. The injector drain line can flow into the container with diesel fuel. After engine is running smoothly, switch fuel line to container with preservative oil. Operate five to ten minutes on preservative oil. Stop engine and reconnect the fuel lines.
3. Drain fuel filters and fuel tank and reinstall drain plugs. Tag engine with warning tag.
4. Disconnect electrical wiring and turn fuel pump manual shut-off valve fully counterclockwise. Spray lubricating oil into intake manifold and air compressor while cranking engine slowly.
5. Cover all openings with tape to prevent entrance of dirt and moisture.
6. Drain coolant from cooling system unless it is permanent type antifreeze with rust inhibitor added.
7. Store engine in dry and uniform temperature area.
8. Bar engine crankshaft two or three revolutions each three to four weeks.

Above storage procedure is valid for a six month maximum period. For storage in excess of six months, refer to Cummins Service manual.

PREPARING A STORED ENGINE FOR SERVICE

When an engine is removed from storage and put into service, the following operations should be performed.

Clean Engine

1. Clean accumulated dirt from exterior of engine. Remove covers, tape and wrappings.

2. Use suitable cleaner to remove rust preventive compound from unpainted surfaces.
3. Refill crankcase with clean lubricating oil. Flush and fill cooling system.

Inspection

1. When an engine has been stored for six months or less, it is necessary to adjust injectors, valves and belts, tighten cylinder head capscrews and connections; replace filters and check air filter and screens.
2. When an engine has been stored for six months or more, the following procedure should be followed:
 - a. Flush fuel system with clean fuel oil until all preservative oil is removed.
 - b. Remove plug from oil gallery and force hot, light mineral oil through the oil passages to flush away all preservative oil. Bar over engine crankshaft three or four revolutions during flushing operation.
 - c. Replace all filters and clean all screens before engine is started.
 - d. After inspecting engine and parts, make sure all preservative oil and gummed oil has been flushed away.
3. Clean and check battery. Measure specific gravity (1.250 at 77°F [25°C]) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If level is low, add distilled water and charge until specific gravity is correct. DO NOT OVERCHARGE.

WARNING

Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

4. Check coolant level, adjust or refill as necessary.
5. Connect batteries.
6. Verify that no loads are connected to generator.
7. Perform 'PRESTART SERVICING.' Start engine.
8. After start, apply load to at least 50 percent of rated capacity.
9. Check all gauges to be reading correctly. Unit is ready for service.

HIGH ALTITUDE

Ratings apply to altitudes up to 5000-feet (1500 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to-and-from the set.
2. Keep cooling system clean.
3. Use correct SAE No. oil for temperature conditions.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.
5. Connect water jacket heater when set is not running.
6. Refer to Cummins manual for further information.

Water Jacket Heater: The function of this optional heater is to keep the engine warm enough to assure starting under adverse weather conditions. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

GENERAL MAINTENANCE

GENERAL

Establish and adhere to a definite schedule of maintenance inspection and servicing, application and environment being the governing factors in determining such a schedule. If your set is a prime power application, base your schedule on operating hours. Use the running time meter to log hours run; maintain an accurate record of hours and service for warranty support.

A set on stand-by duty will need servicing at times other than those recommended by Onan and the engine manufacturer. Refer to Cummins manual for engine services and maintenance procedures. Adjust your schedule to satisfy the following conditions—

- Continuous duty (prime power)
- Standby power
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water or sea air
- Exposure to dust, sand, etc.

Consult with your ONAN distributor or dealer for a schedule of maintenance and service more suitable to the unique environment and application of your set.

WARNING

Before commencing any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring, disconnect batteries. Failure to do so could result in damage to the unit or serious personal injury in the event of inadvertent starting.

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

| MAINTENANCE ITEMS | OPERATIONAL HOURS | | | |
|---|-------------------|----|-----|---------|
| | 8 | 50 | 100 | 200-250 |
| Inspect Set | x7 | | | |
| Check Radiator Coolant | x | | | |
| Check Oil Level | x4 | | | |
| Check Air Cleaner (Clean if Required) | | x1 | | |
| Clean and Inspect Crankcase Breather | | | x | |
| Inspect Fan Belt | | | x2 | |
| Check Cooling System | | | x3 | |
| Clean and Inspect Battery Charging Alternator | | | | x |
| Change Crankcase Oil | | | x1 | |
| Replace Oil Filter Element | | | x1 | |
| Check Batteries | | x5 | | |
| Replace Fuel Filter | | | | x |
| Check all hardware, fittings, clamps, fasteners, etc. | | | x6 | |

x1 - Or every 3 months, perform more often in extremely dusty conditions.

x2 - Or every 3 months, adjust to 1/2 inch depression between pulleys.

x3 - Or every 3 months, check for rust or scale formation. Flush if necessary.

x4 - For accurate readings, check oil level approximately 15 minutes after shutdown. Keep oil level as near "FULL" mark on dipstick as possible. See engine manual.

x5 - Or every month.

x6 - Or every 3 months.

x7 - Give unit general inspection. Then with generator set running, visually and audibly check the exhaust system for leaks.

NOTE: The above schedule is a minimum requirement. For the recommended service periods for your engine, refer to engine manual.

ENGINE SPEED

Generator frequency is in direct ratio to engine speed, which is controlled by the governor.

A Barber Colman governor is standard equipment on the DFE generator set. High speed and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment. Therefore if your set is used on continuous standby service, the governor may never need to be touched. If however the unit is used frequently, adjustment may be required due to wear of internal components. This is accomplished as follows:

1. Remove four screws and cover from governor controller. Refer to Figure 25.
2. Disconnect wire from TB11-22. This disconnects the starter solenoid.
3. Place Run-Stop-Remote switch to RUN position. Governor should stay at the minimum fuel position. If this position is not obtained, consult with Onan service representative.
4. Return Run-Stop-Remote switch to STOP. Reconnect wire at TB11-22.
5. Position speed control rheostat on generator control panel to mid-range of travel (out 5-turns from low r/min).
6. Adjust speed reference potentiometer in governor controller counterclockwise four complete turns. Refer to Figure 25A.
7. Start engine. Be prepared at this point, to assume manual control of engine in the event that adjustments are incorrect. If engine does not attain correct r/min it may be necessary to adjust the speed reference potentiometer. Clockwise to increase speed, counterclockwise to decrease.
8. Adjust Gain potentiometer slightly clockwise then counterclockwise as necessary until engine is stable and responsive to governor control.
9. Load and unload engine several times to ensure correct gain adjustment.
10. Shut down engine. Restart engine to make sure that unit does not overspeed.
11. Shut down engine. Replace governor control box cover. Engine is now ready for service.

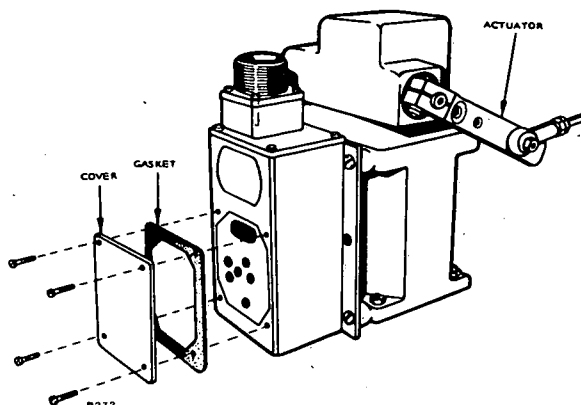


FIGURE 25. BARBER COLMAN GOVERNOR

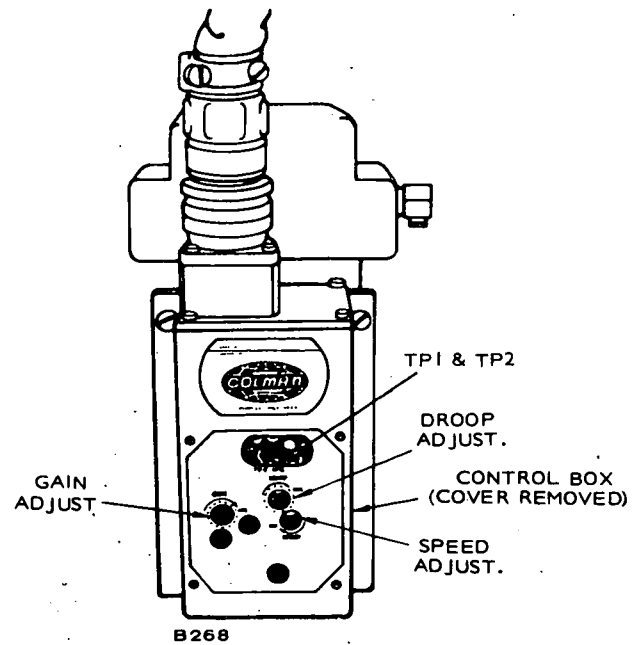


FIGURE 25A. GOVERNOR ADJUSTMENT

Any subsequent speed adjustment can be made at the control panel potentiometer.

When using generator frequency meter to determine engine speed, multiply frequency by 30 to calculate engine speed.

Example: $30 \times 61 \text{ Hz} = 1830 \text{ rpm}$.

Adjust engine speed to 1800 rpm for 60 Hertz and 1500 rpm for 50 Hertz sets.

BATTERIES

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity, recharge if below 1.280.

CONNECTIONS (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the set while running at rated load. Some of the things to check for are as follows:

1. Check all fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically or daily, drain moisture from condensation traps.
4. Inspect water lines and connections for leaks and security.
5. Inspect electrical wires and connections for security and fray damage.

AC GENERATOR

There are no brushes, brush springs or collector rings on these generators, therefore they require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

Generator Bearing: Inspect every 1000 hours while the unit is running.

If using the unit for "prime power," replace the bearing every 10,000 hours or two years; if for "standby," replace every five years.

INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause diodes overheating and subsequent failure. Blow out the assembly periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 15 lb-in (1.7 N.m) or finger tight plus a quarter turn. Blow dust out of control panel.

If generator requires major repair or servicing, contact an authorized Onan dealer or distributor.

FILTERS

A planned program of filter cleaning or replacement will pay dividends in engine life, operation and reliability.

Air Filter: Replace or clean when plugged, or in accordance with service maintenance instructions. To remove filter element loosen eight nuts holding head, lift off head and remove filter element (see Figure 26).

Recommended clean method for element.

1. Blow dry compressed air (30 psi [207 kPa] maximum) through element from clean side. Hold air nozzle at least 1 inch (25 mm) away.
2. Soak for at least 15 minutes in water and Donaldsons D1400 solvent to remove soot and carbon as well as dirt. Rinse until water is clear (use low pressure water) and air dry. Do not use compressed air.

CAUTION

Filters should be handled with care to prevent damage. If the filter does become damaged, install recommended replacement part.

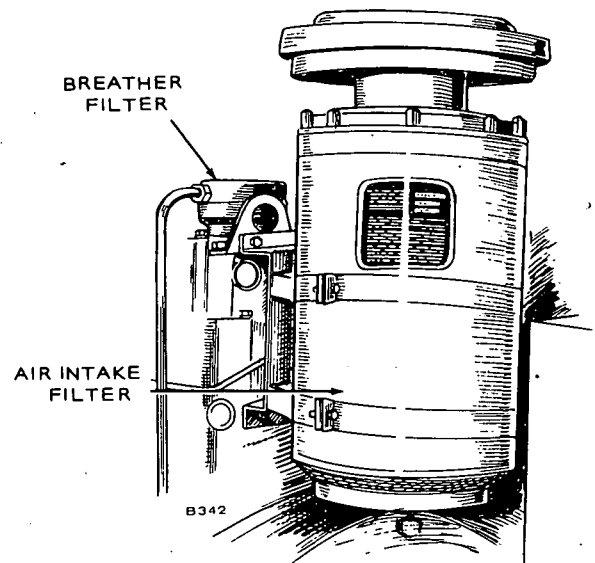


FIGURE 26. AIR FILTER

Lubrication Oil Filter: Replace every oil change or when differential pressure across filter reaches 15 psi (103.5 kPa).

To change filter, proceed as follows—

1. Remove drain plug (see Figure 27) and allow oil to drain.

Capacity of oil filter is 2.9 gallons (11 litres).

2. Loosen capscrew at base of filter case and remove assembly from engine. Remove filter element.

Before discarding element, inspect for metal particles indicating internal failure. Notify engine manufacturer if found. Wrinkles on outside wrapper and waviness or bunching on pleats indicates moisture in oil. This is an indication that engine weekly exercise period is too short. Engine is not run long enough for full heat saturation. Moisture will also combine with sulphur in the oil to form sulphurous acid.

3. Discard filter element, remove and discard oil seal ring from filter head.
4. Clean filter case; reinstall drain plug.

Cummins recommends that small oil rings (2) at bottom of filter be replaced every second oil change to prevent leakage due to hardening.

5. Position element end seals and install new filter element over spring support.
6. Position new seal ring on filter case, then insert element. Position to filter head and secure center capscrew. Torque 25- to 35 lb-ft (34 to 47 N.m).
7. Fill crankcase to "H" mark on dipstick, run engine to verify no oil leaks, shut down engine and add oil as necessary.

Always allow 15 minutes after engine shutdown before checking oil level. This will give oil time to drain back into the crankcase.

Fuel Filter: Spin-off throw-away unit. A water drain is situated at the bottom of the filter case. This should be used to drain off moisture either daily or at the end of every exercise period, depending on unit application. When replacing filter, fill with clean fuel before installation.

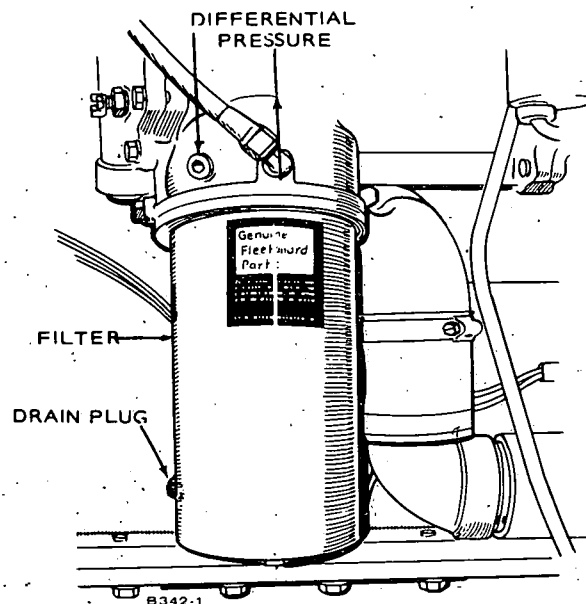


FIGURE 27. LUBRICATION OIL FILTER

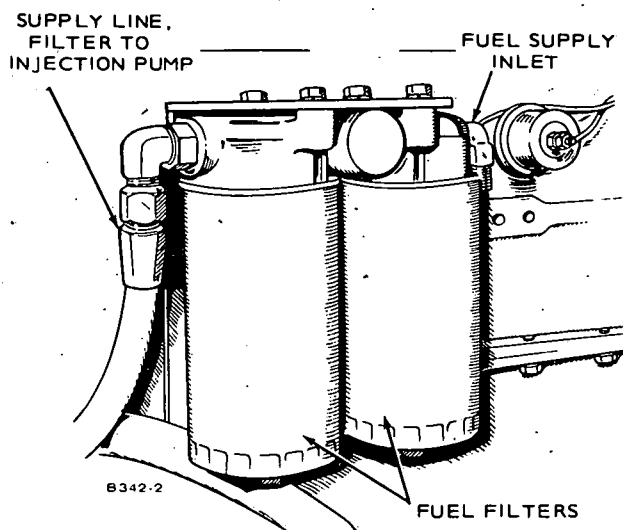


FIGURE 28. FUEL FILTERS

Coolant Filter: A shut off valve (see Figure 29) is installed in the inlet and outlet line to the coolant filter to be closed, for minimum coolant loss when the filter is removed. Refer to engine manufacturer's manual for coolant filter replacement information.

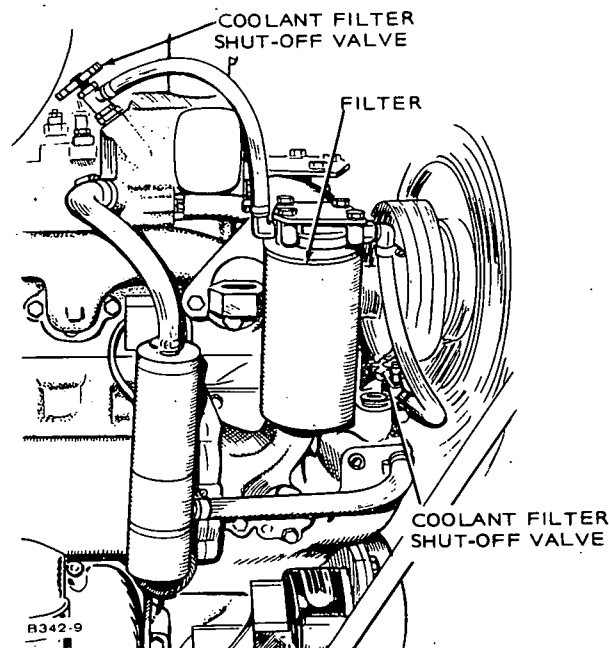


FIGURE 29. COOLANT FILTER

Crankcase Breather Filter: To clean crankcase breather filter elements, proceed as follows:

1. Remove wing nut, flat-washer and rubber washer holding cover, lift cover and swing away from filter assembly (see Figure 30).
2. Lift out breather element, vapor element and gasket.
3. Clean all parts with approved solvent. Dry with compressed air (30 psi maximum [OSHA]).
4. Inspect all parts, replace if necessary.
5. Reassemble filter assembly, replace cover and secure.

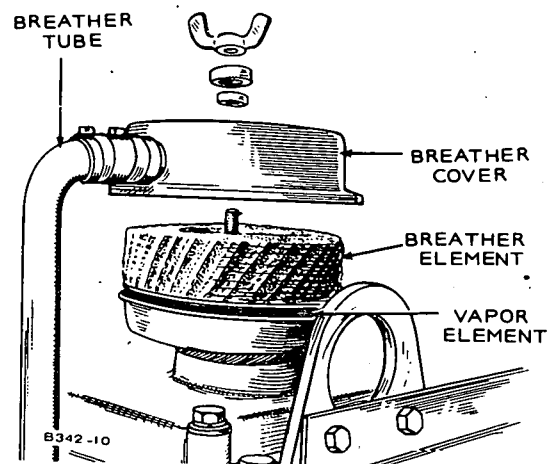


FIGURE 30. CRANKCASE BREATHING FILTER

TABLE OF CONTENTS


| TITLE | PAGE |
|---|-------|
| Parts Catalog..... | 33 |
| Electric Generator Set Data Table | 34 |
| Cooling System Group..... | 35 |
| Miscellaneous Engine Part Group | 36,37 |
| Mounting and Housing Group..... | 38,39 |
| Control Group (AC Portion)..... | 40,41 |
| Control Group (Engine Portion) | 42,43 |
| Printed Circuit Board Assembly (AC) - 322-1268 | 44 |
| Printed Circuit Board Assembly (AC) - 332-1956 begin Spec K | 45 |
| Control Cycle Cranker Group - Optional | 46 |
| Engine Control Monitor Group - Penn State..... | 47 |
| Engine Control Monitor Group | 48 |
| Generator Group | 49 |

PARTS CATALOG

INSTRUCTIONS FOR ORDERING REPAIR PARTS

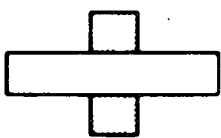
ONAN PARTS

All parts in this list are Onan parts. For Onan parts or service, contact the dealer from whom you purchased this equipment or your nearest authorized service station. To avoid errors or delay in filling your order, please refer to the Onan nameplate and give the complete MODEL, SPECIFICATION and SERIAL NUMBER.

| | |
|---|--|
| Onan® | |
| ELECTRIC GEN SET | |
| MODEL | <input type="text"/> |
| SERIAL NO. | <input type="text"/> |
| IMPORTANT - ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS | |
| CONTINUOUS | RATING |
| HERTZ-60 RPM - 1800 | |
| 3 PHASE | 1 PHASE |
| KW <input type="text"/> KVA <input type="text"/> | KW <input type="text"/> KVA <input type="text"/> |
| VOLTS 120/208 127/220 139/240 120/240 240/416 | |
| AMPS <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> | |
| VOLTS 254/440 277/480 347/600 120/240 | |
| AMPS <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> | |
| BAT. <input type="text"/> VOLTS | |
| MANUFACTURED BY ONAN DIV. OF STUDEBAKER CORPORATION MINNEAPOLIS, MINN. 55432, U.S.A. FOR ELECT. EQUIPMENT ONLY  | |

CUMMINS PARTS

All Cummins parts must be ordered from the Cummins Engine Company, Inc., Columbus, Indiana or their nearest authorized Cummins distributor or dealer. When ordering parts, refer to the Cummins nameplate and supply all information stated.

| | | | | | | | |
|----------------|----------------------|---|----------------------|---|----------------------|----------------|----------------------|
| CUMMINS | | CUMMINS ENGINE COMPANY, INC. COLUMBUS, INDIANA, U.S.A. | |  | | | |
| SBM NO. | <input type="text"/> | MODEL | <input type="text"/> | ENG NO. | <input type="text"/> | OTHER REF. NO. | <input type="text"/> |

This catalog applies to the standard DFE generator sets as listed below, powered by a Cummins NT855G engine (see Cummins manual). Engine parts modified or added by Onan will be in this list and have Onan part numbers. These supersede similar parts listed in the Cummins manual. Onan parts are arranged in groups of related items and are identified by a reference number. All parts illustrated are typical. Unless otherwise mentioned, parts are interchangeable. Right and left generator set sides are determined by *facing* the front end of the engine.

ELECTRIC GENERATOR SET DATA TABLE

| MODEL AND SPEC NO. * | ELECTRICAL DATA | | | | |
|----------------------------|-----------------|------|-------|-------|-----|
| | WATTS † | WIRE | HERTZ | PHASE | KEY |
| 155 DFE 15R/ | 155,000 | 12 | 60 | 3 | 1 |
| 155 DFE 515R/ | 155,000 | 12 | 50 | 3 | 1 |
| 155 DFE 15R50/(Penn State) | 155,000 | 12 | 60 | 3 | 1 |
| 155 DFE 9XR/ | 155,000 | 12 | 60 | 3 | 2 |
| 180 DFE 15R/ | 180,000 | 12 | 60 | 3 | 3 |
| 180 DFE 515R/ | 180,000 | 12 | 50 | 3 | 3 |

* - The Specification letter advances (A to B to C, etc.) with manufacturing changes.

† - These sets are reconnectible; refer to Specifications (generator details).

NOTE: Hertz is a unit of frequency equal to one cycle per second.

REPLACEMENT ENGINE

100-1358

1

Engine, Replacement (Cummins NT855G).

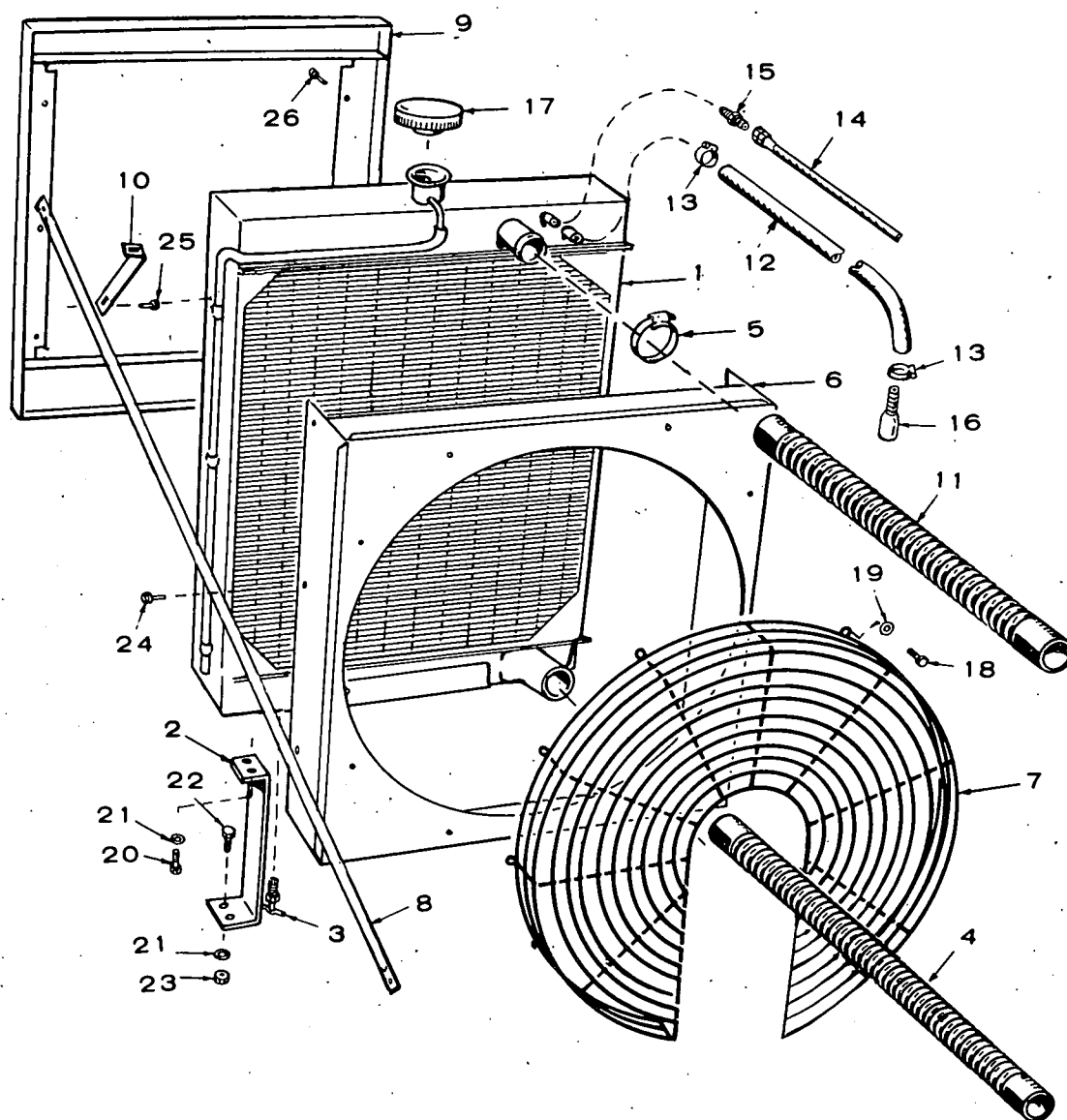
General Description:

Includes: Complete Cylinder Block, Fuel Pump, Fuel Filters, Oil Filter, Governor, Fan Blades (Pusher Type), Flywheel, Fan Belt, Water Pump, Turbo Charger, 90° Turbo Exhaust Connector, 90° Water Outlet

Excludes: Alternator, Starter, Water Temperature Sender, Oil Pressure Sender, Radiator, Ammeter.

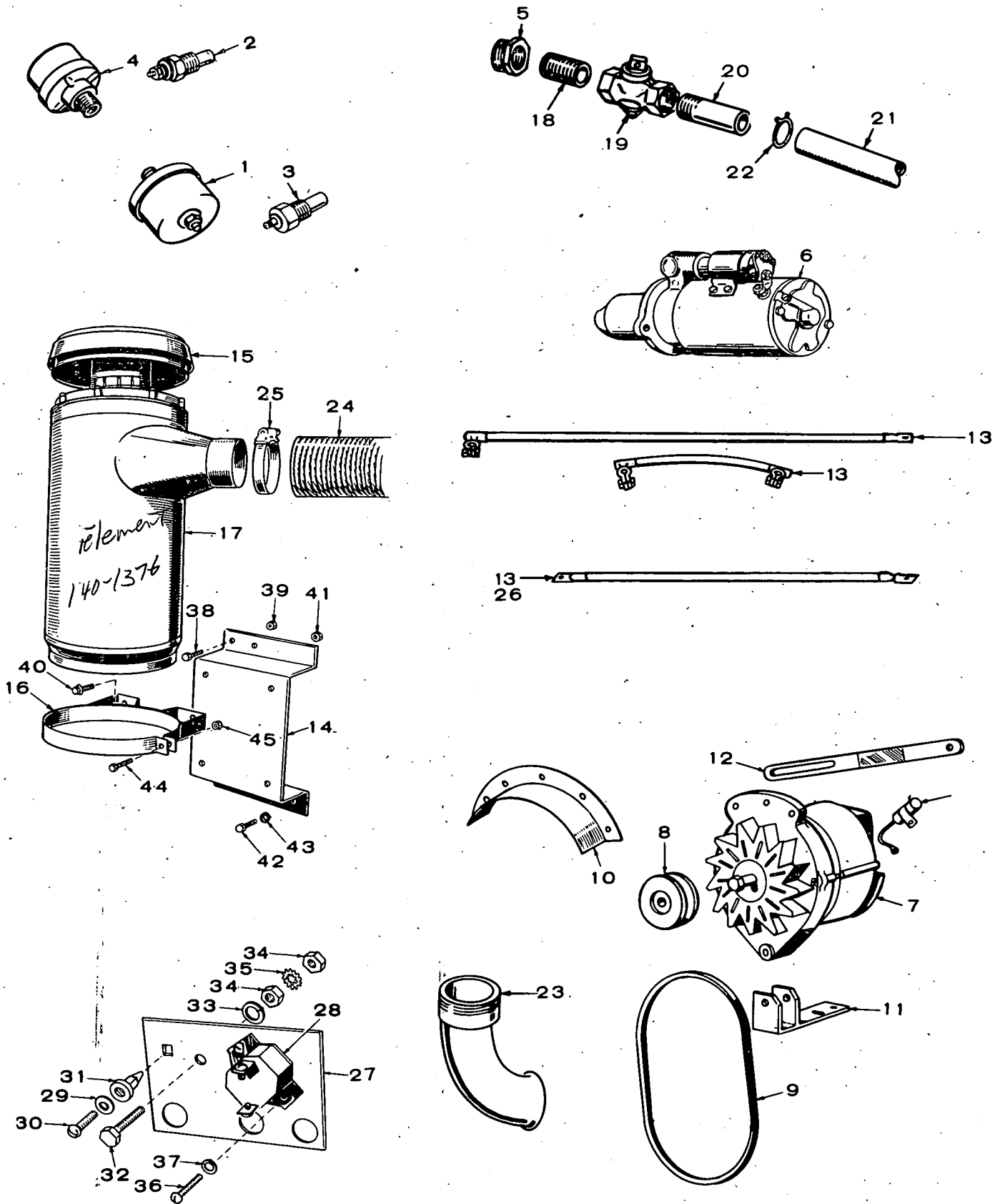
NOTE: Replacement engine is for standard Spec 1 generator sets. For all other Specs refer to factory.

COOLING SYSTEM GROUP



| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|----------|-----------|--|----------|----------|-----------|---|
| 1 | 130-0992 | 1 | Radiator | 20 | 800-0130 | 4 | Screw, Cap (Hexhead) Radiator Support Mounting (5/8-11 x 1") |
| 2 | 130-0843 | 2 | Bracket, Radiator Support | 21 | 850-0070 | 4 | Washer, Lock (Spring) Radiator Support Mounting (5/8) |
| 3 | 504-0028 | 1 | Cock, Radiator Drain | 22 | 821-0016 | 4 | Screw, Cap (Lockhead) - Radiator Brace Mounting (5/16-18 x 3/4") |
| 4 | 503-0756 | 1 | Hose, Radiator (Lower) | 23 | 870-0257 | 2 | Nut, Self Locking Hex - Radiator Brace Mounting (5/16-18) |
| 5 | 503-0354 | 4 | Clamp, Radiator Hose | 24 | 821-0014 | 8 | Screw, Cap (Lockhead) Radiator for Shroud Mounting (5/16-18 x 1/2") |
| 6 | 130-0846 | 1 | Shroud, Radiator Fan | 25 | 821-0029 | 2 | Screw, Cap (Lockhead) Radiator Support Brace Mounting (3/8-16 x 3/4") |
| 7 | 130-0924 | 1 | Guard, Radiator Fan | 26 | 821-0014 | 8 | Screw, Cap (Lockhead) Radiator Shroud Mounting (5/16-18 x 1/2") |
| 8 | 405-1888 | 2 | Brace, Radiator Support | | | | |
| 9 | 130-0842 | 1 | Shroud, Radiator | | | | |
| 10 | 130-0848 | 2 | Brace, Radiator Support | | | | |
| 11 | 503-0752 | 1 | Hose, Radiator | | | | |
| 12 | | 1 | Hose, Deration (34" of Bulk hose 503-0249) | | | | |
| 13 | 503-0429 | 2 | Clamp, Hose | | | | |
| 14 | 501-0087 | 1 | Hose, Vent | | | | |
| 15 | 502-0184 | 1 | Connector | | | | |
| 16 | 505-0759 | 1 | Adapter, Pipe (1") | | | | |
| 17 | 130-0449 | 1 | Cap, Radiator | | | | |
| 18 | 821-0018 | 8 | Screw, Cap (Lockhead) Radiator Fan Guard Mounting (1/4-20 x 5/8) | | | | |
| 19 | 526-0018 | 8 | Washer, Flat - Radiator Fan Guard Mounting (17/64" ID x 5/8" OD x 1/16" THK) | | | | |

MISCELLANEOUS ENGINE PARTS GROUP



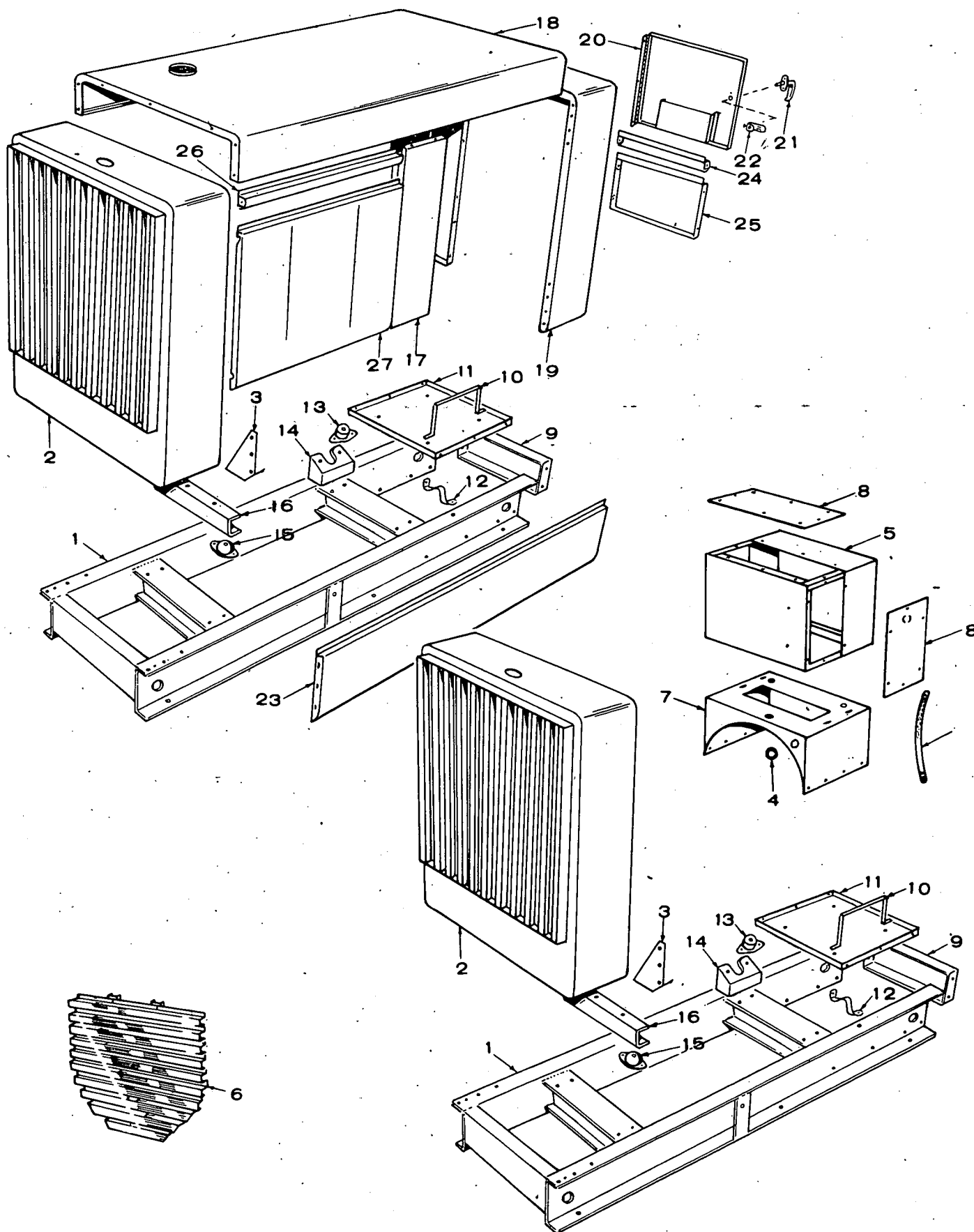
MISCELLANEOUS ENGINE PART GROUP

| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|---------------------------------|-----------|--|----------|-------------------------|-----------|---|
| 1 | SENDER, OIL PRESSURE GAUGE | | | 39 | 870-0281 | 2 | Nut, Hex (Self Lock) - Air Cleaner Bracket Mounting (3/8-16) |
| | 193-0108 | 1 | Spec H Through J | | | | |
| | 193-0244 | 1 | Begin Spec K | 40 | 821-0029 | 4 | Screw, Cap (Lockhead) - Air Cleaner Band Mounting (3/8-16 x 3/4) |
| 2 | SENDER, WATER TEMPERATURE GAUGE | | | 41 | 870-0281 | 4 | Nut, Hex (Self Lock) - Air Cleaner Band Mounting (3/8-16) |
| | 193-0109 | 1 | Spec H Through J | | | | |
| | 193-0247 | 1 | Begin Spec K | 42 | 801-0097 | 2 | Screw, Cap (Hexhead) - Air Cleaner Bracket Mounting (5/8-18 x 1-1/4") |
| 3 | 309-0178 | 1 | Switch, High Temperature | 43 | 850-0070 | 2 | Washer, Lock (Spring) - Air Cleaner Bracket Mounting (5/8) |
| 4 | 309-0169 | 1 | Switch, Low Oil Pressure | | | | |
| 5 | 505-0117 | 1 | Bushing, Reducer | 44 | 800-0032 | 2 | Screw, Cap (Hexhead) - Air Cleaner Band (5/16-18 x 1-3/4") |
| 6 | 191-0852 | 1 | † Starter (24 Volt) | 45 | 870-0257 | 2 | Nut, Hex (Self Lock) - Air Cleaner Band (5/16-18) |
| 7 | 191-0688 | 1 | Alternator (24 Volt) | 46 | 800-0048 | 2 | Screw, Hex Cap - Steel (3/8-16 x 3/4") |
| 8 | 191-0781 | 1 | * Pulley, Alternator | 47 | 850-0050 | 2 | Washer, Spring Lock (3/8") |
| 9 | 511-0084 | 1 | Belt, Alternator Drive | 48 | 526-0183 | 2 | Washer, Flat (25/64 I.D. x 5/8 O.D. x 3/32" Thick-Steel) |
| 10 | 191-0725 | 1 | Guard, Alternator Belt | 49 | 862-0015 | 1 | Nut, Hex Steel (5/16-18) |
| 11 | 191-1141 | 1 | Bracket, Alternator Mounting | 50 | 856-0013 | 1 | Washer, Lock - EIT (1/2") |
| 12 | 191-0869 | 1 | Bracket, Alternator Adjusting | 51 | 800-0025 | 1 | Screw, Hex Cap - Steel (5/16-18 x 5/8") |
| 13 | CABLE, BATTERY | | | 52 | 800-0030 | 1 | Screw, Hex Cap - Steel (5/16-18 x 1-1/4") |
| | 416-0636 | 1 | Positive | 53 | 800-0094 | 1 | Screw, Hex Cap - Steel (1/2-13 x 2") |
| | 416-0639 | 1 | Negative | 54 | 850-0045 | 2 | Washer, Spring Lock (5/16") |
| | 416-0473 | 1 | Jumper, Battery | 55 | 526-0022 | 1 | Washer, Flat - Steel (21/64" I.D. x 9/16" O.D. x 1/16" Thick) |
| 14 | 140-1349 | 1 | Bracket, Air Cleaner Mounting | 56 | 862-0005 | 1 | Nut, Hex - Steel (1/2-13) |
| 15 | 140-1347 | 1 | Cap, Air Cleaner | 57 | SENDER, OIL TEMPERATURE | | |
| 16 | 140-1345 | 2 | Band, Air Cleaner Mounting | | 193-0202 | 1 | Spec H Through J |
| 17 | 140-1346 | 1 | Cleaner, Air | | 193-0249 | 1 | Begin Spec K |
| 18 | 505-0100 | 1 | Nipple, Pipe - Oil Drain | 58 | 501-0216 | 1 | Line, Fuel |
| 19 | 504-0011 | 1 | Valve, Shut-off - Oil Drain | 59 | 501-0084 | 1 | Line, Fuel |
| 20 | 505-0185 | 1 | Nipple, Half - Oil Drain | | | | |
| 21 | | 1 | Hose, Rubber - Oil Drain (Order 8" of 503-0098 Bulk Rubber Hose) | | | | |
| 22 | 503-0197 | 1 | Clamp, Oil Drain Hose | | | | |
| 23 | 155-1035 | 1 | Outlet, Exhaust | | | | |
| 24 | 503-0641 | 1 | Hose, Flexible Air Cleaner | | | | |
| 25 | 503-0748 | 2 | Clamp, Hose - Air Cleaner | | | | |
| 26 | 416-0632 | 1 | Cable Assembly, Starter | | | | |
| 27 | 332-1382 | 1 | Bracket, Terminal Mounting | | | | |
| 28 | 320-0240 | 1 | Breaker, Circuit | | | | |
| 29 | 508-0015 | 1 | Washer, Fibre | | | | |
| 30 | 809-0035 | 1 | Screw, Tapping - Roundhead (#8 x 3/4") | | | | |
| 31 | 870-0196 | 1 | Nut, Insulated | | | | |
| 32 | 800-0007 | 1 | Screw, Cap - Hexhead (1/4-20 x 1") | | | | |
| 33 | 850-0040 | 1 | Washer, Lock - Spring (1/4) | | | | |
| 34 | 862-0001 | 2 | Nut, Hex (1/4-20) | | | | |
| 35 | 856-0006 | 1 | Washer, Lock - External/Internal (1/4") | | | | |
| 36 | 811-0103 | 2 | Screw, Tapping - Roundhead (10-32 x 3/4") | | | | |
| 37 | 850-0030 | 2 | Washer, Lock - Spring (#10) | | | | |
| 38 | 800-0050 | 2 | Screw, Cap (Hexhead) - Air Cleaner Bracket Mounting (3/8-16 x 1) | | | | |

* - For components contact your nearest Motorola Dealer or Motorola Automotive Products Inc., 9401 W. Grand Ave., Franklin Park, Illinois 60131.

† - For components contact your nearest Delco Remy Division of General Motors Corporation, Anderson, Indiana 46011.

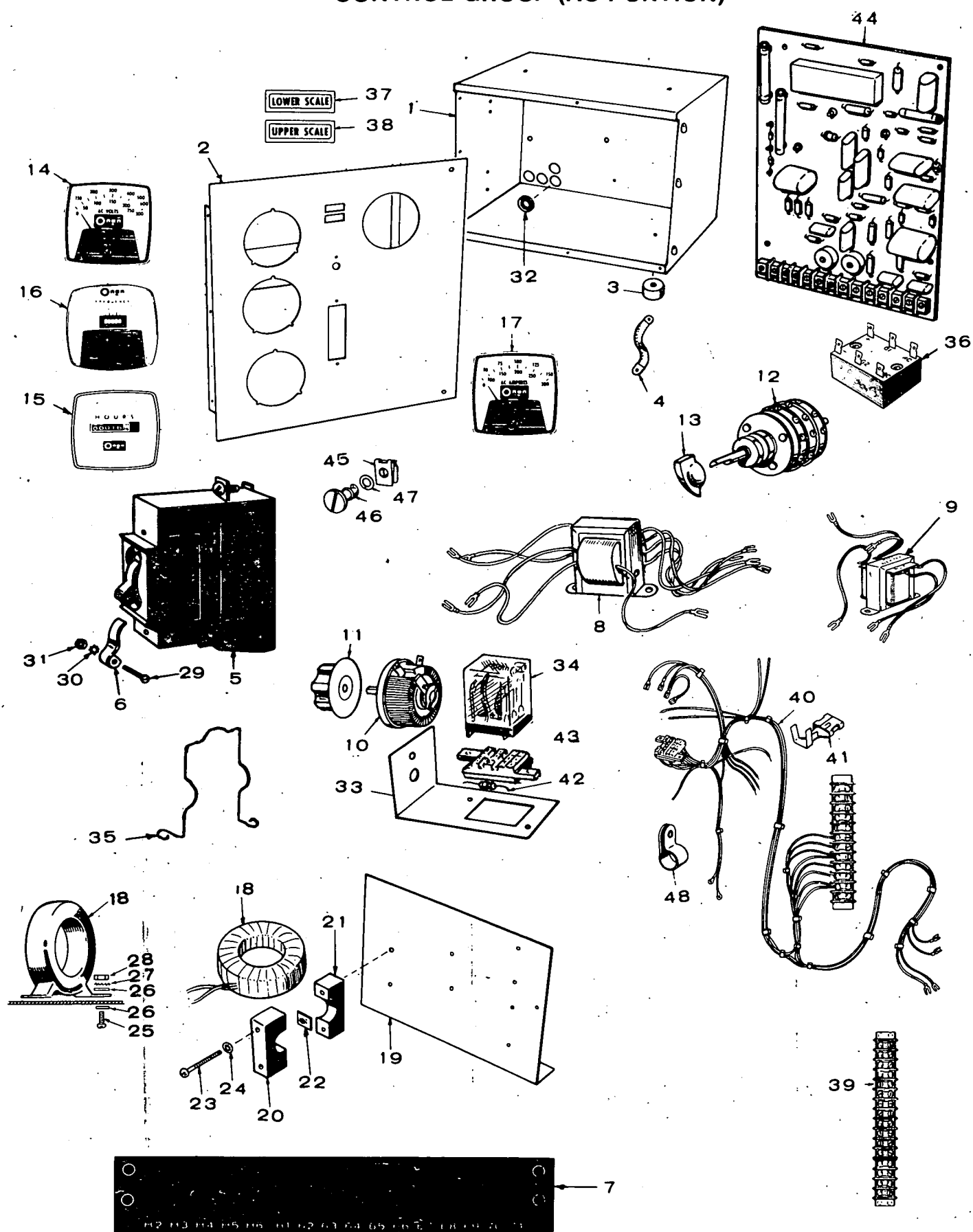
MOUNTING AND HOUSING GROUP



MOUNTING AND HOUSING GROUP

| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|--|----------|-----------|--|----------|----------|-----------|---|
| 1 | 403-1197 | 1 | Skid, Base | | 800-0090 | 1 | Screw, Cap (Hexhead) - Ground Strap Mounting (1/2-13 x 1") |
| 2 | 405-1884 | 1 | Panel, Front End Housing | | 856-0013 | 2 | Washer, Lock (External/Internal) Ground Strap Mounting (1/2") |
| 3 | 405-2016 | 2 | Bracket, Panel Mounting | | 821-0016 | 3 | Screw, Cap (Lockhead) Battery Tray Mounting (5/16-18 x 3/4") |
| 4 | 508-0001 | 1 | Grommet, Rubber | | 870-0257 | 3 | Nut, Hex (Self Locking) Battery Tray Mounting (5/16-18) |
| 5 | 301-3155 | 1 | Housing, Control Box | | 800-0153 | 2 | Screw, Cap (Hexhead) - Engine Front Mount (3/4-10 x 1-1/2") |
| 6 | 234-0370 | 1 | Grille, Generator Air Inlet | | 850-0079 | 2 | Washer, Lock (Spring) Engine Front Mount (3/4) |
| 7 | 301-3154 | 1 | Saddle, Control Box Housing | | 862-0020 | 2 | Nut, Hex - Front Engine Mount (3/4-10) |
| 8 | 301-3156 | 3 | Panel, Control Box Housing | | 800-0138 | 2 | Screw, Cap (Hexhead) Engine Front Mount (5/8-11 x 3") |
| 9 | 403-1198 | 1 | Panel, Base | | 850-0070 | 2 | Washer, Lock (Spring) Engine Front Mount (5/8) |
| 10 | 416-0635 | 2 | Strap, Battery Hold-down | | 862-0007 | 2 | Nut, Hex - Engine Front Mount (5/8-11) |
| 11 | 416-0673 | 1 | Tray, Battery | | 800-0132 | 4 | Screw, Cap (Hexhead) Rear Engine Mount (5/8-11 x 1-1/2") |
| 12 | 377-0090 | 1 | Strap, Electrical Ground | | 850-0070 | 4 | Washer, Lock (Spring) Rear Engine Mount (5/8) |
| 13 | 402-0384 | 2 | Isolator, Vibration | | 862-0007 | 4 | Nut, Hex - Rear Engine Mount (5/8-11) |
| 14 | 232-2208 | 2 | Bracket, Generator Mounting | | 800-0163 | 2 | Screw, Cap (Hexhead) Rear Engine Mount (3/4-10 x 4") |
| 15 | 402-0371 | 2 | Cushion, Vibration | | 526-0238 | 2 | Washer, Flat - Rear Engine Mount (13/16" ID x 2" OD x 3/16" THK) |
| 16 | 403-1196 | 1 | Support, Engine Front | | 850-0079 | 4 | Washer, Lock (Spring) Rear Engine Mount (3/4") |
| 17 | 405-2220 | 2 | Panel, Center (Housed Models) | | 800-0035 | 4 | Screw, Cap (Hexhead) - Battery Hold-down (5/16-18 x 2-1/2") |
| 18 | 405-2222 | 1 | Panel, Top Housing (Housed Models) | | 850-0045 | 4 | Washer, Lock (Spring) Battery Hold-down (5/16) |
| 19 | 405-1883 | 1 | Panel, Rear End (Housed Models) | | 821-0016 | 4 | Screw, Cap (Lockhead) - Base Panel Mounting (5/16-18 x 3/4") |
| 20 | 405-1880 | 1 | Door, Rear Housing (Housed Models) | | 870-0257 | 4 | Nut, Hex (Self Locking) - Base Panel Mounting (5/16-18) |
| 21 | 406-0157 | 1 | Handle, Lock (Housed Models) | | 800-0073 | 12 | Screw, Cap (Hexhead) - Generator Mounting (7/16-14 x 1-1/2") |
| 22 | 406-0089 | 1 | Catch, Lock (Housed Models) | | 850-0055 | 12 | Washer, Lock (Spring) - Generator Mounting (7/16") |
| 23 | 405-2221 | 2 | Panel, Base (Housed Models) | | 821-0018 | 4 | Screw, Cap (Lockhead) - Panel to Saddle (1/4-20 x 5/8") |
| 24 | 405-1858 | 2 | Panel, Rear Louver (Housed Models) | | 526-0018 | 4 | Washer, Flat - Panel to Saddle |
| 25 | 405-1856 | 1 | Panel, Lower Rear Housing (Housed Models) | | 870-0212 | 4 | Nut, Hex (Self Locking) Panel to Saddle (1/4-20) |
| 26 | 405-2014 | 8 | Panel, Louver (Housed Models) | | 821-0010 | 10 | Screw, Cap (Lockhead) - Saddle Mounting (1/4-20 x 1/2") |
| 27 | 405-2021 | 4 | Door, Removable (Housed Models) | | 821-0010 | 1 | Screw, Cap (Lockhead) Generator Air Grille Mounting (1/4-20 x 1/2") |
| Associated Mounting Hardware (Not Illustrated) | | | | | 821-0014 | 16 | Screw, Cap (Lockhead) Panel Mounting (5/16-18 x 1/2") |
| | 800-0092 | 4 | Screw, Cap (Hexhead) - Radiator Mounting Bracket (1/2-13 x 1-1/2") | | 815-0350 | 18 | Screw, Tapping (Slotted Head) Cover Mounting (10-32 x 3/8) |
| | 850-0060 | 4 | Washer, Lock (Spring) - Radiator Mounting Bracket (1/2) | | | | |
| | 862-0016 | 4 | Nut, Hex - Radiator Mounting Bracket (1/2-13) | | | | |
| | 800-0030 | 4 | Screw, Cap (Hexhead) - Panel Bracket Mounting (5/16-18 x 1-1/4") | | | | |
| | 800-0092 | 1 | Screw, Cap (Hexhead) - Ground Strap Mounting (1/2-13 x 1-1/2") | | | | |
| | 856-0013 | 2 | Washer, Lock (External/Internal) Ground Strap Mounting (1/2") | | | | |
| | 850-0060 | 1 | Washer, Lock (Spring) - Ground Strap Mounting (1/2") | | | | |
| | 862-0016 | 1 | Nut, Hex - Ground Strap Mounting (1/2-13) | | | | |
| | 800-0090 | 4 | Screw, Cap (Hexhead) - Vibration Mounting (1/2-13 x 1") | | | | |
| | 850-0060 | 4 | Washer, Lock (Spring) - Vibration Mounting (1/2") | | | | |
| | 862-0016 | 4 | Nut, Hex - Vibration Mounting (1/2-13) | | | | |
| | 800-0090 | 4 | Screw, Cap (Hexhead) - Generator Bracket Mounting (1/2-13 x 1") | | | | |
| | 850-0060 | 4 | Washer, Lock (Spring) - Generator Bracket Mounting (1/2") | | | | |

CONTROL GROUP (AC PORTION)

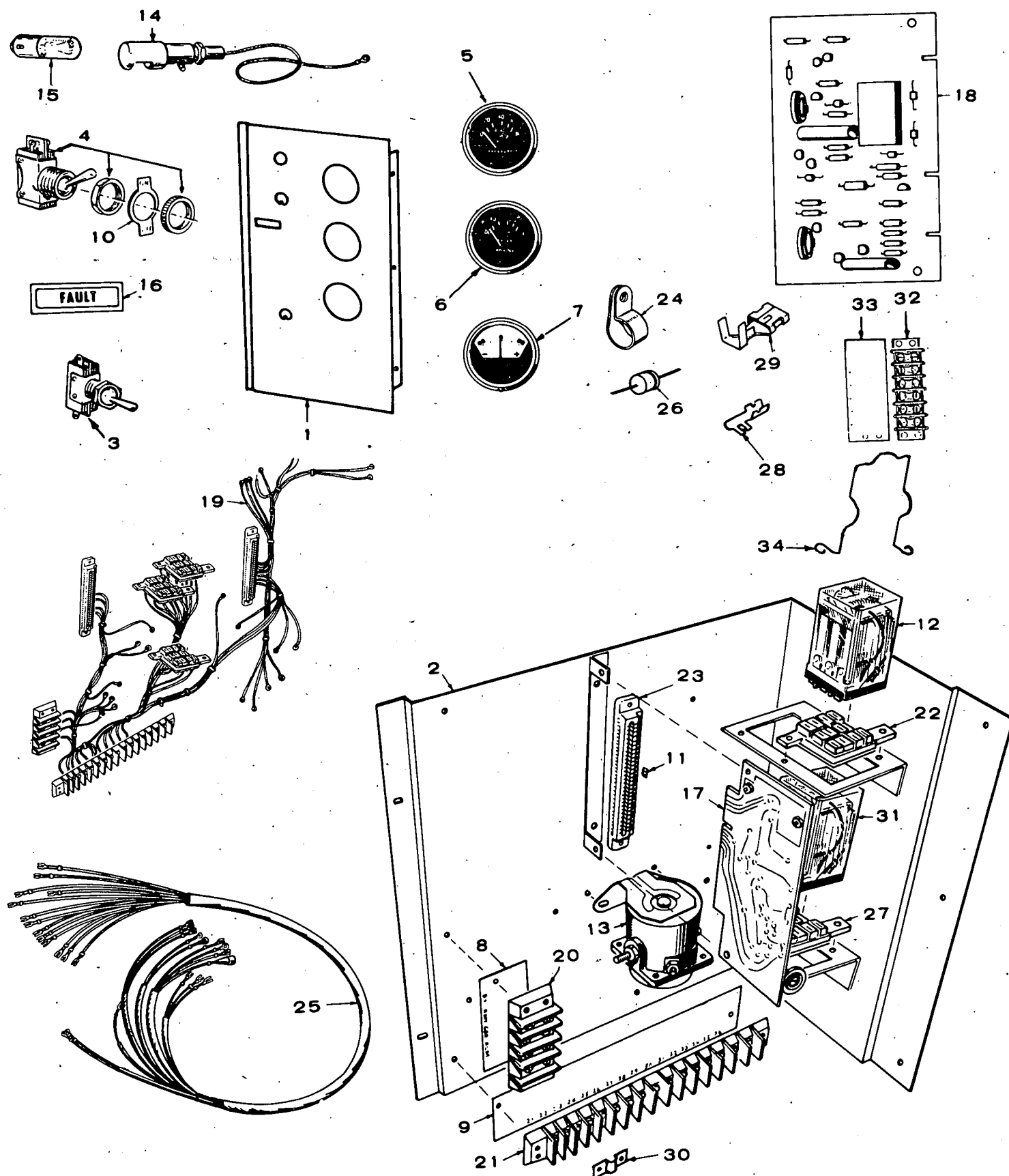


CONTROL GROUP (AC Portion)

| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|-------------------------------|-----------|--|----------|---|-----------|--|
| 1 | 301-3158 | 1 | Box, Control | 30 | 854-0010 | 2 | Washer, Lock (Internal) - Circuit Breaker Lock Mounting (#10) - Penn State |
| 2 | PANEL ONLY, CONTROL | | Sets Without Meter Panel | 31 | 871-0010 | 3 | Nut, Hex - Circuit Breaker Lock Mounting (10-32) - Penn State |
| | 301-3274 | 1 | Key 1 & 3 | 32 | 508-0001 | 4 | Grommet, Rubber |
| | 301-3821 | 1 | Key 2 | 33 | 301-3244 | 1 | Bracket, Relay Mounting - Key 1 & 3 |
| | 301-3170 | 1 | Sets With Meter Panel | 34 | 307-1061 | 1 | Relay, Voltage Selector - Key 1 & 3 |
| | 301-3342 | 1 | Key 1 & 3 | 35 | 307-1157 | 1 | Spring, Relay Hold-down - Key 1 & 3 |
| 3 | 402-0078 | 4 | Key 2 | 36 | 315-0524 | 1 | Bridge, Rectifier |
| 4 | 337-0049 | 1 | Dampener, Vibration | 37 | 322-0130 | 1 | Light, Lower Scale |
| 5 | 320-0431 | 1 | Strap, Ground | 38 | 322-0131 | 1 | Light, Upper Scale |
| 6 | 320-0307 | 1 | Breaker, Circuit (2 Amp) | 39 | *BLOCK, TERMINAL | | |
| | | | Lock, Circuit Breaker Handle (Penn State) | | 332-0607 | 1 | Sets without Meter Panel (12 Place) |
| 7 | STRIP, MARKER | | | | 332-0795 | 1 | Sets with Meter Panel (16 Place) |
| | 332-1242 | 1 | Sets with Meter Panel | 40 | HARNES, WIRING - AC CONTROL (Includes Parts Marked *) | | |
| | 332-1248 | 1 | Sets without Meter Panel | | 338-0764 | 1 | Sets without Meter Panel |
| 8 | TRANSFORMER, VOLTAGE | | | | 338-0766 | 1 | Key 1 & 3 |
| | 315-0342 | 1 | Spec H Through J | | 338-0730 | 1 | Key 2 |
| | 315-0431 | 1 | Begin Spec K | | 338-0759 | 1 | Sets with Meter Panel |
| 9 | REACTOR, COMMUTATOR | | | | 338-0759 | 1 | Key 1 & 3 |
| | 315-0384 | 1 | With Leads and Terminals | 41 | 332-1280 | As Req. | Terminal, Crimp |
| | 315-0343 | 1 | Without Leads and Terminals | 42 | 350-0556 | 1 | *Resistor (47,000-Ohm, 1/2 Watt) |
| 10 | 303-0170 | 1 | Rheostat, Voltage Adjust (35,000-Ohm, 25 Watt) | 43 | 323-0764 | 1 | *Socket, Relay |
| 11 | 303-0032 | 1 | Knob, Rheostat | 44 | BOARD ASSEMBLY, VOLTAGE REGULATOR (See Separate Group for Components) | | |
| 12 | SWITCH, SELECTOR | | | | 332-1268 | 1 | Spec H Through J |
| | 308-0012 | 1 | Sets without Meter Panel | | 332-1956 | 1 | Begin Spec K |
| | 308-0284 | 1 | Sets with Meter Panel | 45 | 406-0332 | 2 | Receptacle, Fastener |
| 13 | 303-0076 | 1 | Knob, Selector Switch | 46 | 406-0333 | 2 | Stud, Fastener |
| 14 | VOLTMETER | | | 47 | 406-0334 | 2 | Washer, Stud Retainer |
| | 302-0718 | 1 | Key 1 & 3 | 48 | 332-0050 | 2 | Clip, Tinnerman |
| | 302-0779 | 1 | Key 2 | 49 | 338-0989 | 1 | Harness, Wiring (Not Illustrated) |
| 15 | METER, RUNNING TIME | | | 50 | 151-0402 | 1 | Δ Potentiometer, Speed (5000 Ohm) - NOT ILLUSTRATED |
| | 302-0469 | 1 | Sets with Meter Panels | | | | |
| | 302-0466 | 1 | 50 Hertz Sets | | | | |
| 16 | METER, FREQUENCY | | | | | | |
| | 302-0256 | 1 | 60 Hertz Sets | | | | |
| | 302-0221 | 1 | Sets with Meter Panel | | | | |
| 17 | AMMETER, AC | | | | | | |
| | 302-0724 | 1 | 50 Hertz Sets | | | | |
| | 302-0412 | 1 | 60 Hertz Sets | | | | |
| 18 | TRANSFORMER, CURRENT | | | | | | |
| | 302-0741 | 3 | Sets with Meter Panel | | | | |
| | 302-0209 | 3 | Key 1 & 3 | | | | |
| 19 | BRACKET, TRANSFORMER MOUNTING | | | | | | |
| | 302-0764 | 1 | Key 2 | | | | |
| | 302-0729 | 1 | Key 1 & 3 | | | | |
| 20 | 302-0235 | 3 | Key 2 | | | | |
| 21 | 302-0236 | 3 | Clamp, Transformer Mounting (Upper) - Key 2 | | | | |
| 22 | 302-0253 | As Req. | Clamp, Transformer Mounting (Lower) - Key 2 | | | | |
| 23 | 813-0110 | 6 | Shim, Transformer Mounting - Key 2 | | | | |
| 24 | 854-0010 | 6 | Screw, Machine (Roundhead) - Transformer Mounting (10-32 x 2") - Key 2 | | | | |
| 25 | 813-0100 | 6 | Washer, Lock (Internal) - Transformer Mounting (#10) - Key 2 | | | | |
| 26 | 526-0008 | 12 | Screw, Machine (Roundhead) - Transformer Mounting (10-32 x 1/2") - Key 1 & 3 | | | | |
| 27 | 856-0003 | 6 | Washer, Flat - Transformer Mounting - Key 1 & 3 | | | | |
| 28 | 870-0053 | 6 | Washer, Lock (External/Internal) - Transformer Mounting (#10) - Key 1 & 3 | | | | |
| 29 | 815-0203 | 1 | Nut, Hex - Transformer Mounting (10-32) - Key 1 & 3 | | | | |
| | | | Screw, Machine (Roundhead) - Circuit Breaker Lock Mounting (10-32 x 7/8") Penn State | | | | |

Δ - Installed in Control of all Non-Paralleling Units.
 Installed in Switch Gear of all Paralleling Units.
 - Included in Wiring Harness Assembly.

CONTROL GROUP (ENGINE INSTRUMENT PORTION)



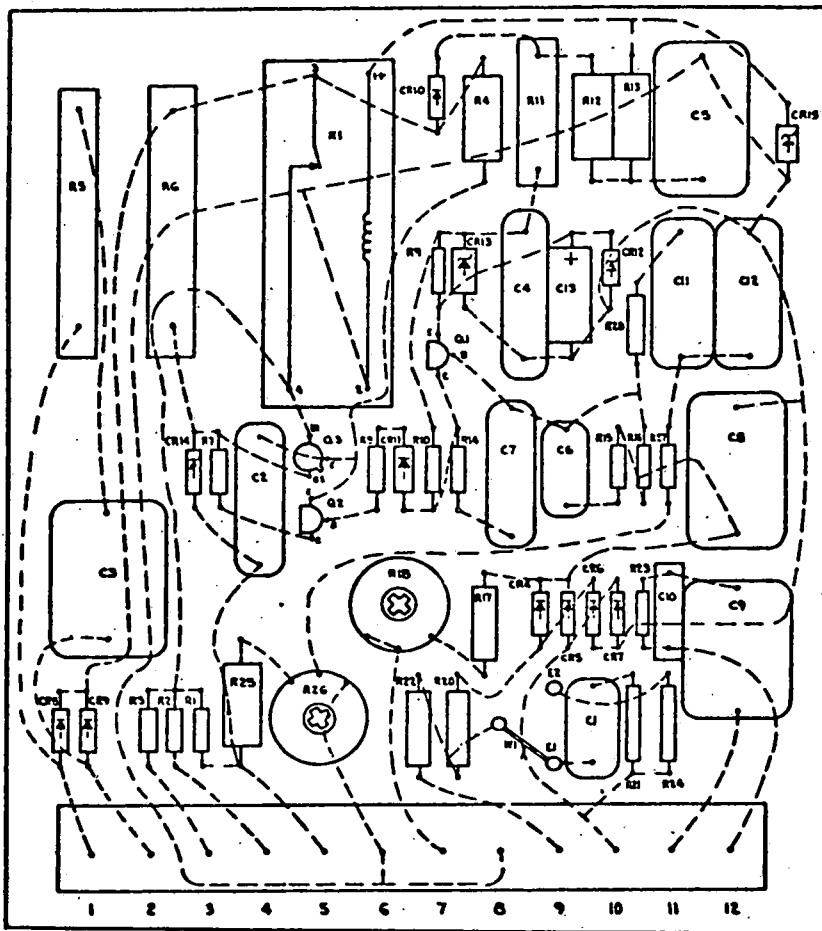
CONTROL GROUP (Engine Portion)

| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|--|-----------|--|----------|------------------------|-----------|--|
| | PANEL ONLY, ENGINE CONTROL | | | 23 | 332-1271 | 2 | *Housing, Printer Circuit Board Terminal |
| | 301-3165 | 1 | Sets With One Fault Light (Standard) | 24 | 332-0051 | 1 | Clip, Tinnerman |
| | 301-3267 | 1 | Sets With Five Fault Lights (Optional) | 25 | 338-0533 | 1 | Harness Assembly, Wiring - Engine to Control |
| 2 | 301-3253 | 1 | Bracket, Engine Control | 26 | 357-0004 | 1 | Rectifier, Diode (Part of Standard Cranker Control) |
| 3 | SWITCH, SELECTOR | | | 27 | 323-0764 | 1 | *Socket, Relay - 8 Place |
| | 308-0138 | 1 | Standard | 28 | 332-1269 | As Req. | *Terminal, PC Board |
| | 308-0327 | 1 | Penn State | 29 | 332-1280 | As Req. | *Terminal, Crimp |
| 4 | 308-0002 | 1 | Switch, Panel Light | 30 | 332-1043 | 1 | *Jumper, Terminal - Sets With One Fault Light |
| 5 | GAUGE, OIL PRESSURE | | | 31 | 307-1061 | 1 | Relay, Starter Protection - Begin Spec C |
| | 193-0107 | 1 | Spec H Through J | 32 | 332-0669 | 1 | *Block, Terminal (6 Place) - Sets With Five Fault Lights |
| | 193-0243 | 1 | Begin Spec K | 33 | 332-1240 | 1 | *Strip, Marker (53 through 58) - Sets With Five Fault Lights |
| 6 | GAUGE, WATER TEMPERATURE | | | 34 | 307-1157 | 3 | Spring, Relay Hold-down |
| | 193-0106 | 1 | Spec H Through J | 35 | 193-0189 | 2 | Resistor, Gauge |
| | 193-0245 | 1 | Begin Spec K | 36 | 320-0240 | 1 | Breaker, Circuit (12.5 Ampere) |
| 7 | 302-0061 | 1 | Ammeter, Charge (30-0-30) | 37 | GAUGE, OIL TEMPERATURE | | |
| 8 | 332-1239 | 1 | Strip, Marker (B+, Remote and Ground Alarm) | | 193-0187 | 1 | Spec H Through J |
| 9 | 332-1241 | 1 | Strip, Marker (21 through 36) | | 193-0248 | 1 | Begin Spec K |
| 10 | 308-0003 | 1 | Plate, Switch (On/Off) | 39 | 193-0250 | 1 | Resistor |
| 11 | 332-1276 | 2 | Plug, Keying (Sets with Five Fault Lights use Qty. of 1) | | | | |
| 12 | 307-1056 | 1 | Relay (1 Start Disconnect, 1 Ignition) | | | | |
| 13 | 307-0061 | 1 | Relay, Start Solenoid | | | | |
| 14 | 322-0149 | 1 | Holder, Lamp | | | | |
| 15 | 322-0017 | 1 | Lamp, Panel | | | | |
| 16 | LAMP, FAULT | | | | | | |
| | 322-0129 | 1 | Standard Sets | | | | |
| | 322-0107 | 1 | Overcrank (Optional) | | | | |
| | 322-0111 | 1 | Overspeed (Optional) | | | | |
| | 322-0108 | 1 | Low Oil Pressure (Optional) | | | | |
| | 322-0109 | 1 | High Engine Temperature (Optional) | | | | |
| | 322-0110 | 1 | Low Engine Temperature (Optional) | | | | |
| 17 | CONTROL, CRANKER | | | | | | |
| | 300-0751 | 1 | Standard Cranker | | | | |
| | 300-0715 | 1 | Cycle Cranker (Optional) - See Separate Group for Components | | | | |
| 18 | MONITOR, ENGINE CONTROL (See Separate Group for Components) | | | | | | |
| | 300-0680 | 1 | Sets With One Fault Light - Standard | | | | |
| | 300-0731 | 1 | Sets With Five Fault Lights - Optional | | | | |
| 19 | HARNESS ASSEMBLY, WIRING - CONTROL (Includes Parts Marked *) | | | | | | |
| | 338-0528 | 1 | Sets With One Fault Light - Standard | | | | |
| | 338-0534 | 1 | Sets With Five Fault Lights - Optional | | | | |
| 20 | 332-0537 | 1 | *Block, Terminal - 4 Place | | | | |
| 21 | 332-0795 | 1 | *Block, Terminal - 16 Place | | | | |
| 22 | 323-0765 | 2 | *Socket, Relay - 11 Place | | | | |

* - Included in Wiring Harness Assembly.

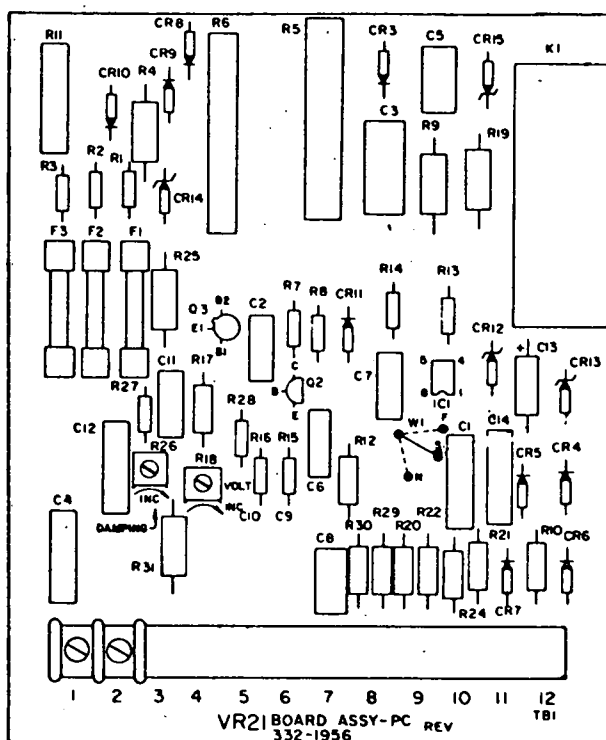
Wrong
Should be
300-682
mg

PRINTED CIRCUIT BOARD ASSEMBLY (AC)
SPEC H THROUGH J - 332-1268



| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------------------|----------|-----------|--------------------------------------|----------|----------|-----------|---|
| TB1 | 332-1252 | 1 | Terminal Block | R18, R16 | 350-0447 | 2 | Resistor (330,000-Ohm, 1/2 Watt) |
| C1 | 355-0018 | 1 | Capacitor (.47., 100 Volt) | R9, R10 | 350-0423 | 2 | Resistor (33,000-Ohm, 1/2 Watt) |
| C2, C7 | 355-0005 | 2 | Capacitor (.22 Mfd., 200 Volt) | R11 | 352-0151 | 1 | Resistor, Fixed (15,000-Ohm, 5 Watt) |
| C3, C9 | 355-0017 | 2 | Capacitor (.47 Mfd., 400 Volt) | R12 | 350-1014 | 1 | Resistor (13,000-Ohm, 2 Watt) |
| C4, C12 | 355-0006 | 2 | Capacitor (.47 Mfd., 200 Volt) | R13 | 350-1007 | 1 | Resistor (6,800-Ohm, 2 Watt) |
| C5, C8 | 355-0016 | 2 | Capacitor (1 Mfd., 100 Volt) | R14 | 350-0443 | 1 | Resistor (220,000-Ohm, 2 Watt) |
| C6 | 355-0015 | 1 | Capacitor (.1 Mfd., 200 Volt) | R15, R27 | 350-0435 | 2 | Resistor (100,000-Ohm, 1/2 Watt) |
| C10 | 355-0014 | 1 | Capacitor (.047 Mfd., 200 Volt) | R17 | 351-0524 | 1 | Resistor, Metal Film (13,000-Ohm, 1/4 Watt) |
| C11 | 355-0020 | 1 | Capacitor (.1 Mfd., 400 Volt) | R18 | 303-0168 | 1 | Potentiometer |
| C13 | 356-0039 | 1 | Capacitor (100 Mfd., 10 Volt) | R20, R22 | 351-0520 | 2 | Resistor, Metal Film (28,000-Ohm, 1/4 Watt) |
| CR4,5,6,7, 8,9,10,11 | 357-0014 | 8 | Rectifier, Silicon | R21 | 351-0522 | 1 | Resistor, Metal Film (5,110-Ohm, 1/4 Watt) |
| CR12 | 359-0035 | 1 | Diode, Zener (6.8 Volt) | R24 | 351-0523 | 1 | Resistor, Metal Film (8,870-Ohm, 1/4 Watt) |
| CR13 | 359-0025 | 1 | Diode, Zener (20 Volt) | R25 | 350-1011 | 1 | Resistor (10,000-Ohm, 2 Watt) |
| CR14 | 359-0026 | 1 | Diode, Zener (18 Volt) | R26 | 303-0164 | 1 | Potentiometer |
| CR15 | 359-0015 | 1 | Diode, Zener (24 Volt) | | | | |
| K1 | 307-1063 | 1 | Relay, Magnetic Reed | | | | |
| Q1, Q2 | 362-0017 | 2 | Transistor, Silicon | | | | |
| Q3 | 361-0004 | 1 | Transistor, Unijunction | | | | |
| R1, R23 | 350-0355 | 2 | Resistor (47-Ohm, 1/2 Watt) | | | | |
| R2, R3 | 350-0351 | 2 | Resistor (33-Ohm, 1/2 Watt) | | | | |
| R4 | 350-1075 | 1 | Resistor (4.7 Megohm, 2 Watt) | | | | |
| R5 | 353-0040 | 1 | Resistor, Fixed (270-Ohm, 10 Watt) | | | | |
| R6 | 353-0039 | 1 | Resistor, Fixed (5,000-Ohm, 15 Watt) | | | | |
| R7 | 350-0398 | 1 | Resistor (3,000-Ohm, 1/2 Watt) | | | | |

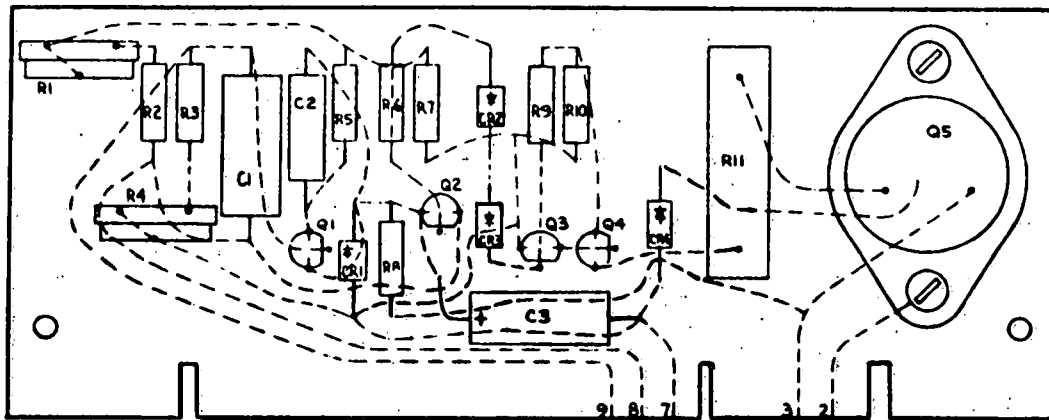
PRINTED CIRCUIT BOARD ASSEMBLY (AC) **BEGIN SPEC K - 332-1956**



| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION | REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|------------|----------|-----------|---|----------|----------|-----------|---|
| | 332-1956 | 1 | Board Assembly, Printed - Complete | R11 | 352-0151 | 1 | Resistor - Fixed 5 Watt, 15,000-Ohm |
| C1,14 | 355-0042 | 2 | Capacitor - 47 Mfd, 250 Volt | R12 | 351-0909 | 1 | Resistor - 1/2 Watt, 90,900-Ohm |
| C2, C7 | 355-0043 | 2 | Capacitor - 22 Mfd, 250 Volt | R13 | 350-0411 | 1 | Resistor - 1/2 Watt, 10,000-Ohm |
| C3 | 355-0047 | 1 | Capacitor - 47 Mfd, 400 Volt | R14 | 350-0443 | 1 | Resistor - 1/2 Watt, 220,000-Ohm |
| C4, C12 | 355-0044 | 2 | Capacitor - 47 Mfd, 250 Volt | R15, R27 | 350-0435 | 2 | Resistor - 1/2 Watt, 100,000-Ohm |
| C5, C8 | 355-0046 | 2 | Capacitor - 1 Mfd, 100 Volt | R17 | 351-0521 | 1 | Resistor, Metal Film - 1/4 Watt, 12,100-Ohm |
| C6 | 355-0056 | 1 | Capacitor - .33 Mfd, 250 Volt | R18 | 303-0210 | 1 | Potentiometer - 5,000-Ohm, 1/2 Watt |
| C11 | 355-0048 | 1 | Capacitor - 1 Mfd, 400 Volt | R20, 22 | 351-0520 | 4 | Resistor - 1/4 Watt, 28,000-Ohm |
| C13 | 356-0039 | 1 | Capacitor - Electrolytic 100 Mfd, 10 Volt | R21 | 351-0522 | 1 | Resistor - Metal Film - 1/4 Watt, 5,110-Ohm |
| CR3 | | | | R24 | 351-0523 | 1 | Resistor - Metal Film - 1/4 Watt, 8,870-Ohm |
| Thru 11 | 357-0014 | 9 | Rectifier - Silicon | R25, R31 | 350-1011 | 2 | Resistor - 2 Watt, 10,000-Ohm |
| CR12 | 359-0036 | 1 | Diode - Zener 5.6 Volt | R26 | 303-0211 | 1 | Potentiometer - 1/2 Watt, 100,000-Ohm |
| CR13 | 359-0025 | 1 | Diode - Zener 20 Volt | R28 | 350-0568 | 1 | Resistor - 1/2 Watt .47 Meg-Ohm |
| CR14 | 359-0026 | 1 | Diode - Zener 18 Volt | TB1 | 332-1252 | 1 | Terminal Block |
| F1, F2, F3 | 321-0204 | 3 | Fuse 1/4 Amp | CR15 | 359-0015 | 1 | Diode - Zener - 24 Volt |
| IC1 | 367-0005 | 1 | Integrated Circuit | | 321-0163 | 6 | Clip - Fuse |
| Q2 | 362-0017 | 1 | Transistor - Silicon NPN | K1 | 307-1063 | 1 | Relay, Magnetic Reed |
| Q3 | 361-0004 | 1 | Transistor - Unijunction | R9 | 350-1014 | 1 | Resistor - 2 Watt, 13,000-Ohm |
| R1 | 350-0355 | 1 | Resistor - 1/2 Watt, 47-Ohm | R19 | 350-1007 | 1 | Resistor - 2 Watt, 6,800-Ohm |
| R2, R3 | 350-0351 | 2 | Resistor - 1/2 Watt, 33-Ohm | | | | |
| R4 | 350-1075 | 1 | Resistor - 2 Watt, 4.7 Meg-Ohm | | | | |
| R5 | 353-0040 | 1 | Resistor - Fixed 10 Watt, 270-Ohm | | | | |
| R6 | 353-0039 | 1 | Resistor - Fixed 15 Watt, 5,000-Ohm | | | | |
| R7 | 350-0398 | 1 | Resistor - 1/2 Watt, 3,000-Ohm | | | | |
| R8, R16 | 350-0447 | 2 | Resistor - 1/2 Watt, 330,000-Ohm | | | | |
| R10 | 351-0885 | 1 | Resistor - 1/2 Watt, 51,100-Ohm | | | | |

CONTROL, CYCLE CRANKER GROUP (OPTIONAL EQUIPMENT)

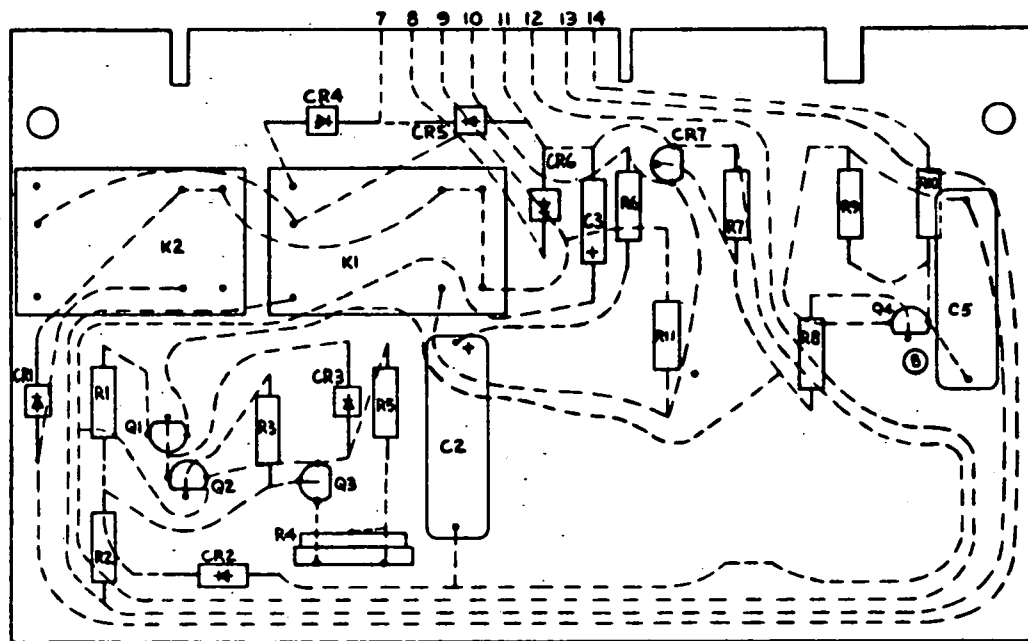
300-0715 - Printed Circuit Board, Complete



| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|-------------|-------------|--------------|---|
| C3 | 356-0045 | 1 | Capacitor, Electrolytic 25 Mfd., 15 Volt |
| C2 | 355-0010 | 1 | Capacitor, Dielectric .0022 Mfd., 100 Volt |
| H3 | 860-0006 | 2 | Nut, RMS (#6-32) |
| H2 | 853-0003 | 2 | Washer, ET Lock (#6) |
| H1 | 812-0061 | 2 | Screw, RHM (#6-32 x 3/8") |
| R11 | 352-0158 | 1 | Resistor, Fixed (5 Watt, 50-Ohm) |
| R10 | 350-0500 | 1 | Resistor, Fixed (1.0-Ohm) |
| R8 | 350-0534 | 1 | Resistor, Fixed (6.8-Ohm) |
| R7 | 350-0546 | 1 | Resistor, Fixed (6.8-Ohm) |
| R6 | 350-0420 | 1 | Resistor, Fixed (24,000-Ohm) |
| R5 | 350-0558 | 1 | Resistor, Fixed (68,000-Ohm) |
| R3, R9 | 350-0548 | 2 | Resistor, Fixed (10,000-Ohm) |
| R2 | 350-0560 | 1 | Resistor, Fixed (100,000-Ohm) |
| R1, R4 | 303-0171 | 2 | Potentiometer |
| Q5 | 362-0019 | 1 | Transistor, Power |
| Q4 | 362-0026 | 1 | Transistor, Signal |
| Q3 | 362-0011 | 1 | Transistor |
| Q1, Q2 | 362-0008 | 2 | Transistor, Signal |
| CR2,3,4 | 357-0004 | 3 | Rectifier, Diode |
| CR1 | 359-0027 | 1 | Diode, Zener (7.5 Volts) |
| C1 | 356-0039 | 1 | Capacitor, Electrolytic (100 Mfd.) |

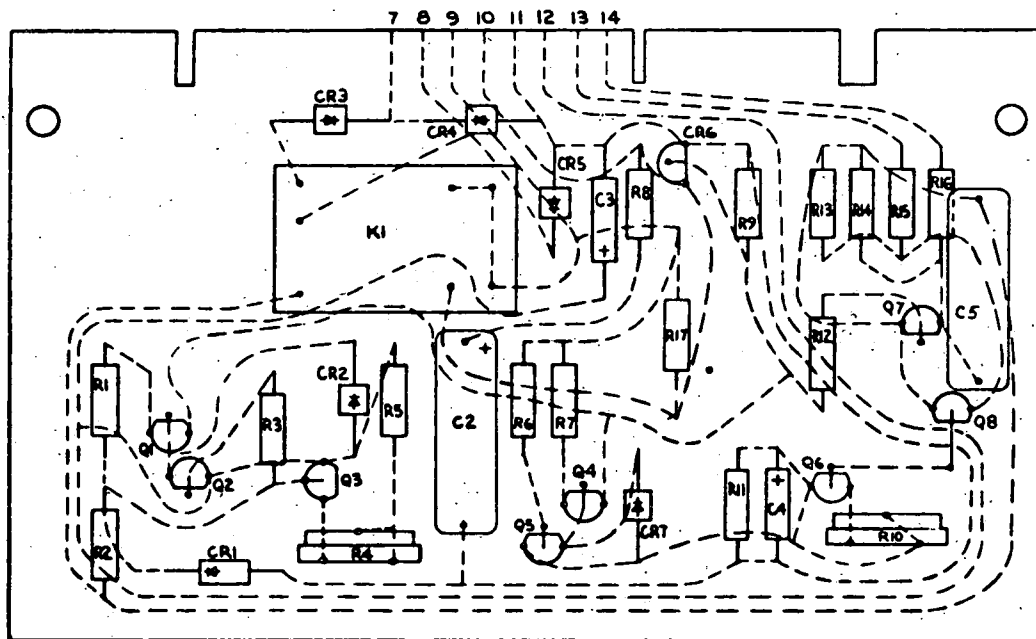
ENGINE CONTROL MONITOR GROUP (PENN STATE)

300-0731 - Printed Circuit Board, Complete

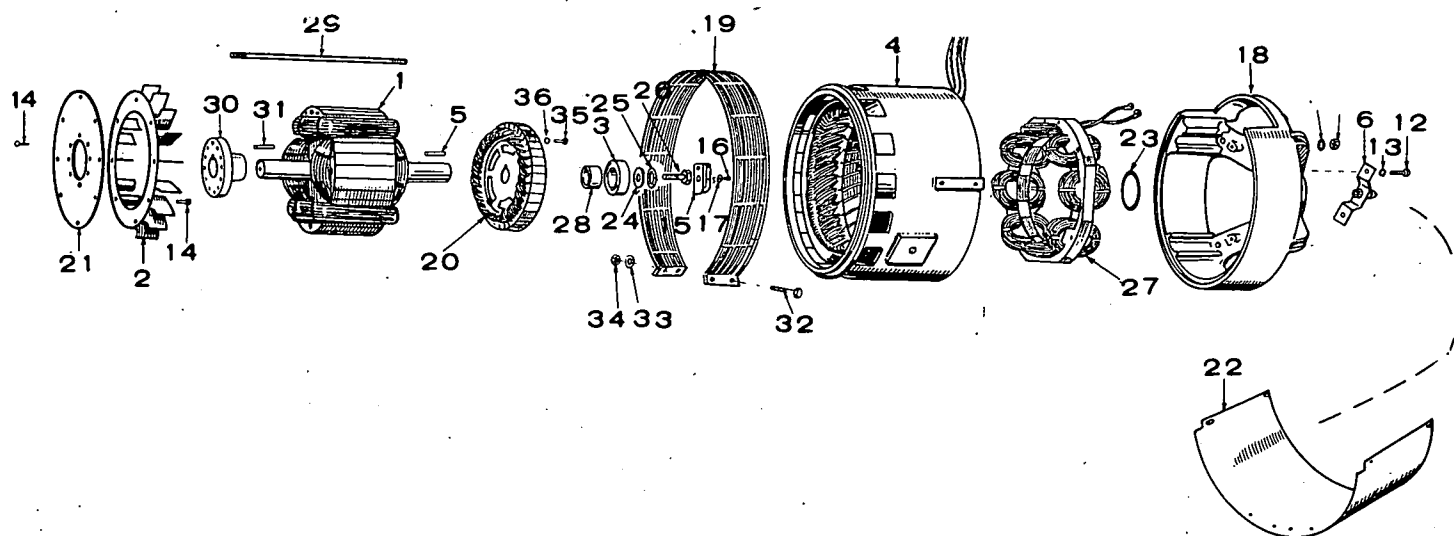


| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|-----------------|-------------|--------------|------------------------------|
| R11 | 350-0980 | 1 | Resistor (510-Ohm, 2 Watt) |
| R8 | 350-0380 | 1 | Resistor (510-Ohm, 1/2 Watt) |
| R10 | 350-0544 | 1 | Resistor (4,700-Ohm) |
| R9 | 350-0529 | 1 | Resistor (270-Ohm) |
| R7 | 350-0517 | 1 | Resistor (27-Ohm) |
| R6 | 350-0505 | 1 | Resistor (2.7-Ohm) |
| R5 | 350-0572 | 1 | Resistor (1.0 Megohm) |
| R4 | 303-0169 | 1 | Potentiometer |
| R3 | 350-0552 | 1 | Resistor (22,000-Ohm) |
| R2 | 350-0534 | 1 | Resistor (680-Ohm) |
| R1 | 350-0536 | 1 | Resistor (1000-Ohm) |
| Q4 | 362-0027 | 1 | Transistor, Silicon |
| Q2, Q3 | 362-0025 | 2 | Transistor, Field Effect |
| Q1 | 361-0003 | 1 | Transistor |
| CR7 | 364-0011 | 1 | Rectifier, Gate Control |
| CR2 | 359-0027 | 1 | Diode, Zener |
| CR1,3,4, 5,6 | 357-0004 | 5 | Rectifier, Diode |
| C3 | 356-0040 | 1 | Capacitor (10 Mfd.) |
| C2, 5 | 355-0005 | 2 | Capacitor (.22 Mfd.) |
| K1, K2 | 307-1076 | 2 | Relay |

**ENGINE CONTROL MONITOR GROUP
(STANDARD SETS WITH ONE FAULT LIGHT)
24 VOLT**



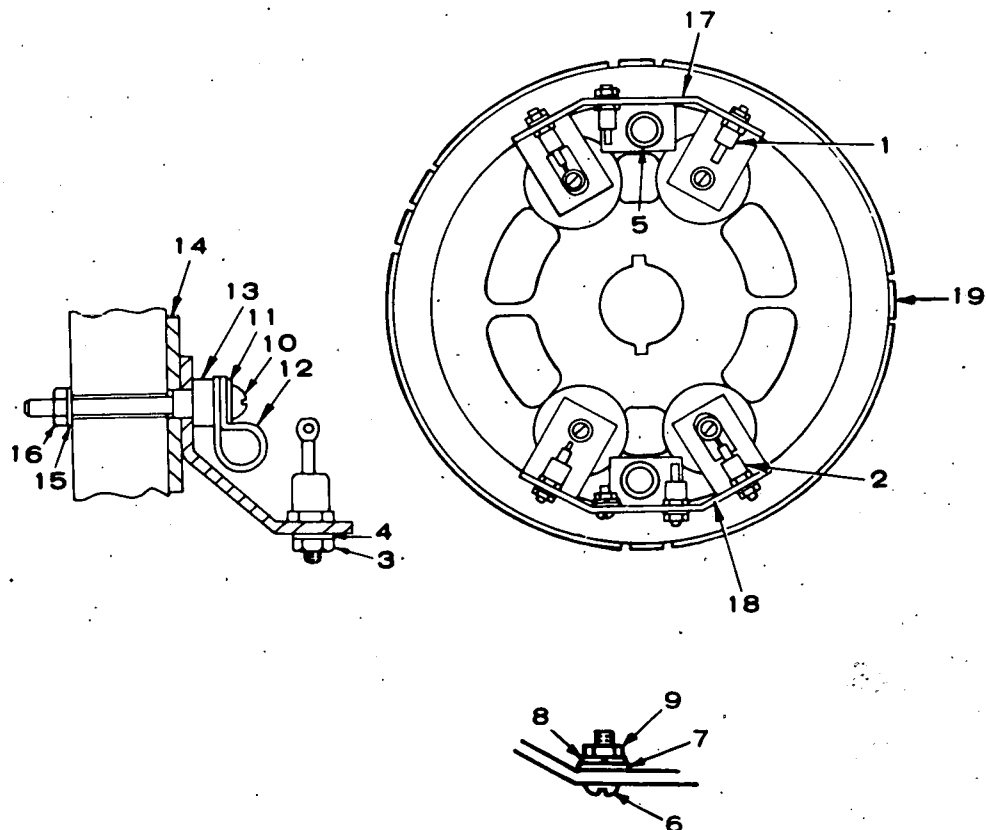
| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|-------------|-------------|--------------|----------------------------------|
| | 300-0680 | 1 | Printed Circuit Board - Complete |
| R10 | 303-0182 | 1 | Potentiometer (1.0 Megohm) |
| Q5, 6 | 362-0031 | 2 | Transistor, Field Effect |
| R3 | 350-0548 | 1 | Resistor (10,000-Ohm) |
| R17 | 350-0980 | 1 | Resistor (510-Ohm) |
| R12 | 350-0380 | 1 | Resistor (510-Ohm) |
| R15, R16 | 350-0544 | 2 | Resistor (4,700-Ohm) |
| R13, 14 | 350-0529 | 2 | Resistor (270-Ohm) |
| R11 | 350-0587 | 1 | Resistor (18 Megohm) |
| R9 | 350-0517 | 1 | Resistor (27-Ohm) |
| R8 | 350-0505 | 1 | Resistor (2.7-Ohm) |
| R5 | 350-0572 | 1 | Resistor (1.0 Megohm) |
| R4 | 303-0169 | 1 | Potentiometer (3.5 Megohm) |
| R6 | 350-0552 | 1 | Resistor (22,000-Ohm) |
| R2 | 350-0534 | 1 | Resistor (680-Ohm) |
| R1, R7 | 350-0536 | 2 | Resistor (1000-Ohm) |
| Q7, Q8 | 362-0027 | 2 | Transistor, Silicon |
| Q2, 3 | 362-0025 | 2 | Transistor, Field Effect |
| Q1, Q4 | 361-0003 | 2 | Transistor |
| CR6 | 364-0011 | 1 | Rectifier, Gate Control |
| CR2,3,4,5,7 | 357-0004 | 5 | Rectifier, Diode |
| CR1 | 359-0027 | 1 | Diode, Zener |
| C4 | 356-0030 | 1 | Capacitor (1 Mfd.) |
| C3 | 356-0040 | 1 | Capacitor (10 Mfd.) |
| C2,5 | 355-0005 | 2 | Capacitor (.22 Mfd.) |
| K1 | 307-1076 | 1 | Relay |



| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|--------------------------------|-----------|--|
| 22 | 234-0361 | 1 | Wrapper, Generator End Bell |
| 23 | 509-0125 | 1 | Seal, "O" Ring - Bearing |
| 24 | 526-0238 | 1 | Washer, Bearing Retainer |
| 25 | 850-0079 | 1 | Washer, Lock (Spring) Rotor through Stud |
| 26 | 800-0513 | 1 | Screw, Cap (Hexhead) - Bearing Retainer (3/4-10 x 1-1/2") |
| 27 | STATOR ASSEMBLY, WOUND EXCITER | | |
| | 220-1420 | 1 | 155 DFE |
| | 220-1421 | 1 | 180 DFE |
| 28 | 232-2102 | 1 | Spacer, Bearing |
| 29 | 520-0735 | 4 | Stud, Generator End Bell (5/8-11 x 5-3/4") |
| 30 | 232-1393 | 1 | Hub, Drive |
| 31 | 515-0211 | 1 | Key, Woodruff |
| 32 | 114-0023 | 2 | Screw, Cap (Hexhead) - Generator Screen Mounting (1/4-20 x 1-1/4") |
| 33 | 850-0040 | 2 | Washer, Lock (Spring) - Generator Screen Mounting (1/4) |
| 34 | 862-0001 | 2 | Nut, Hex - Generator Screen Mounting (1/4-20) |
| 35 | 800-0009 | 4 | Screw, Cap (Hexhead) - Exciter Rotor Mounting (1/4-20 x 1-1/2") |
| 36 | 850-0040 | 4 | Washer, Lock (Spring) Exciter Rotor Mounting (1/4") |

† - Parts Included in 150-1546 Overspeed Bracket and Point Assembly.

EXCITER ROTOR GROUP



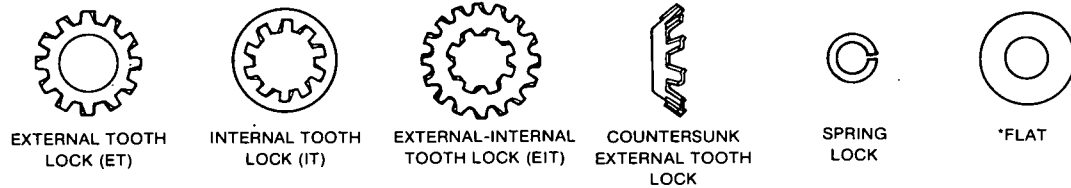
| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|----------|-----------|---|
| 1 | 358-0016 | 3 | Rectifier, Diode - Positive |
| 2 | 358-0015 | 3 | Rectifier, Diode - Negative |
| 3 | 870-0053 | 6 | Nut, Hex (#10-32) |
| 4 | 850-0030 | 6 | Washer, Lock - Spring (#10) |
| 5 | 508-0093 | 2 | Grommet, Rubber |
| 6 | 813-0100 | 2 | Screw, Machine - Round Head (#10-32 x 1/2") |
| 7 | 526-0008 | 2 | Washer, Flat (13/64" ID x 7/16" OD x 1/32" THK) |
| 8 | 850-0030 | 2 | Washer, Lock - Spring (#10) |
| 9 | 870-0053 | 2 | Nut, Hex (#10-32) |
| 10 | 813-0110 | 4 | Screw, Machine - Round Head (#10-32 x 2") |

| REF. NO. | PART NO. | QTY. USED | PART DESCRIPTION |
|----------|----------|-----------|---|
| 11 | 526-0009 | 4 | Washer, Flat (7/32" ID x 1/2" OD x 1/16" THK) |
| 12 | 332-0050 | 2 | Clamp, Loop |
| 13 | 508-0187 | 4 | Spacer, Stepped |
| 14 | 508-0156 | 4 | Washer, Flat - Fiber (19/64" ID x 1-7/8" OD x 1/8" THK) |
| 15 | 850-0030 | 5 | Washer, Lock - Spring (#10) |
| 16 | 870-0053 | 4 | Nut, Hex (#10-32) |
| 17 | 363-0054 | 1 | Heat Sink, Rectifier - Positive |
| 18 | 363-0055 | 1 | Heat Sink, Rectifier - Negative |
| 19 | 201-1737 | 1 | Rotor, Exciter |

HARDWARE IDENTIFICATION

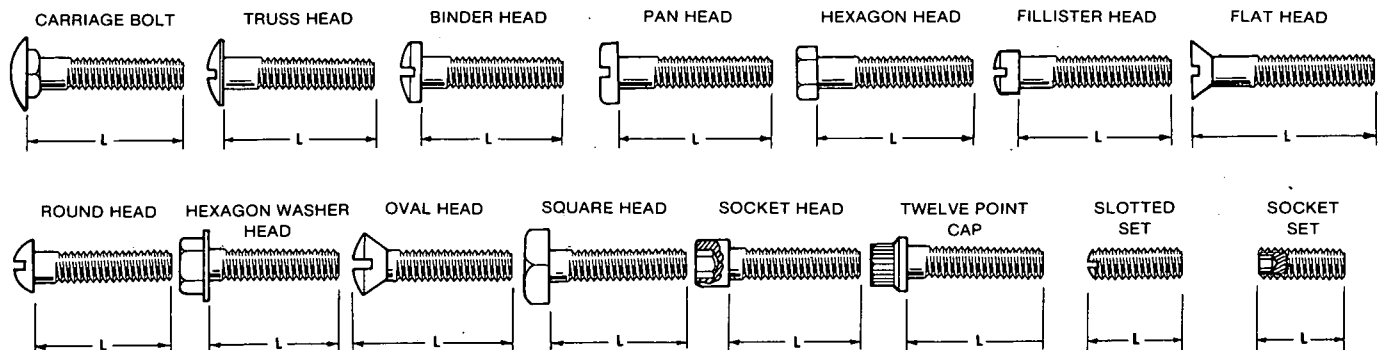
Illustrated hardware items are only for identification purposes. All hardware items listed throughout this parts catalog are steel SAE grade five (5) or lower (zinc plated with clear chromate dip) unless parts description indicates differently. All dimensions are in inches.

WASHER TYPES



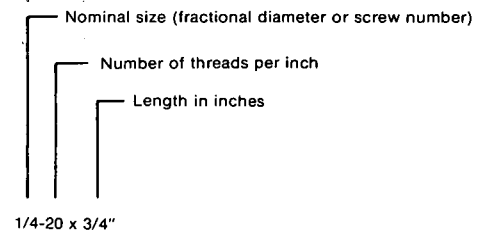
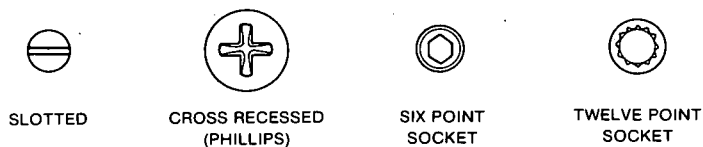
* - Flat washer dimensions given are: Inside Diameter (ID), Outside Diameter (OD) and Thickness (Thk).

BOLT AND SCREW TYPES



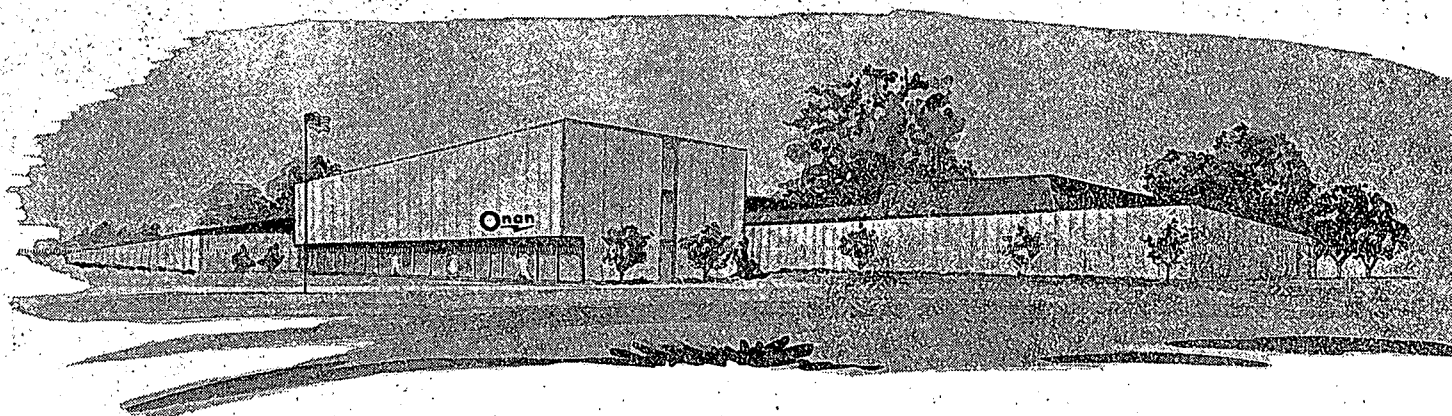
L - Measure length between these points.

INTERNAL DRIVE TYPES



NUT TYPES





ONAN 1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432
A DIVISION OF ONAN CORPORATION

