

OPERATORS MANUAL AND PARTS CATALOG

FOR
ELECTRIC GENERATING SETS

DEH
SERIES
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DEH

SECTION

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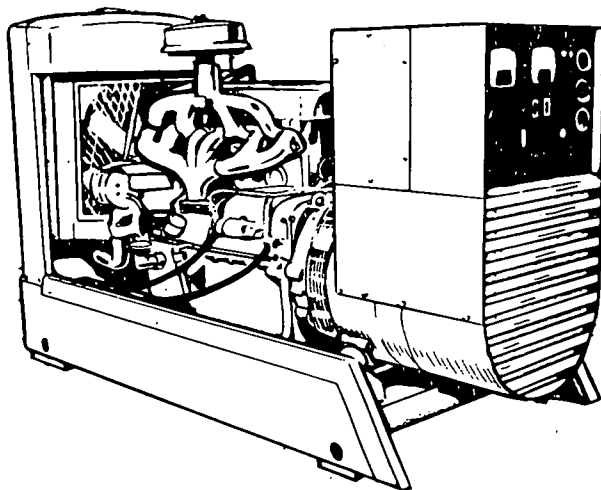


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The need for an international standard of measurement has been increased by today's improved communication and transportation between countries.

This has prompted formation of modernized metrics known as the International System of Units, officially abbreviated SI.

ONAN products appear on the world market, therefore both metric and the present American system of units (CU) will be found in this manual.

To assist in familiarization, refer to the following terms.

TERM	METRIC	ENGLISH
Length	millimetre (mm)	Inch (in)
Pressure	kilopascals (kPa)	pounds per square inch (PSI)
Mass (Weight)	kilogram (kg)	pound (lb)
Volume (Liquid)	litre	gallon (gal)
Power	kilowatt	horsepower (HP)
Frequency	hertz (Hz)	cycles per second (CPS)
Energy	Joules (J)	BTU
Battery Capacity	Coulomb (C)	Ampere Hour (AH)
Revolutions per Minute	r/min	rpm
Temperature	Celsius (°C)	Fahrenheit (°F)

The customary unit of Brake Horsepower (BHP) becomes kilowatts (kW) when converted to SI metric units. This kW rating should not be confused with the kW rating of the generator which will always be lower due to losses inherent with any electrical induction device.

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 DEH Series electric generating set, consisting of an ONAN 30.0 kW, UR generator, driven by a Ford-Dorset, Diesel Engine.

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 Ford engine manual, for specific engine information.

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

CAUTION This symbol refers to possible equipment damage.

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.

<u>30.0</u>	<u>DEH</u>	<u>15R</u>	/	<u>1</u>	<u>G</u>
1	2	3		4	5

1. Indicates Kilowatt rating.
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 Ford nameplate is on the upper left side, on flywheel housing.

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

SAFETY PRECAUTIONS

Throughout this manual you will find eye-catching flags containing Warnings and Cautions. These will alert you to conditions that could result in danger to you or the equipment, if the notice is ignored.

ONAN recommends that you read your manual and become thoroughly acquainted with it and your equipment before you start your unit. The accumulated experience of ONAN engineers is available to you, enabling you to operate your set in the most efficient and safest manner possible. These recommendations and the following safety precautions are for your protection. Study and know them!

REMEMBER. Most accidents are caused by failure to follow simple and fundamental safety rules or precautions.

Most accidents can be prevented!

KNOW YOUR MANUAL—KNOW YOUR EQUIPMENT

WARNING

Set forth below are a number of potential hazards which could result in some degree of personal injury. The suggested procedures should be adhered to.

General

- Keep your electric generating set and the surrounding area clean and free from obstructions. Remove all oil deposits; 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 necessary to make adjustments while the unit is running, use extreme caution when close to hot exhausts, moving parts, etc.

- Do not stand on a wet floor while working on electrical equipment. Use rubber insulative mats placed on dry wood platforms.

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.

REMEMBER—IF YOU CAN SMELL FUMES—A POSSIBLE EXPLOSION AND FIRE CONDITION EXISTS!

- Make sure that oily rags are not left on or near the engine. Oil soaked rags are combustible and present hazardous walking conditions.
- 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.
- Your engine installation should be equipped with a means of positive fuel shutoff in applications when fuel is conducted from a remote source. Fuels under pressure (e.g. natural gas or liquefied petroleum gas) should be controlled by a positive shutoff valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause serious personal injury, if inhaled. All engine installations, especially those within a confine, should be equipped with an exhaust system to discharge gases to the atmosphere. Do not use exhaust gases to heat a compartment.
- Inspect exhaust system regularly to assure that system is free of leaks.

Coolant System

- Coolants under pressure have a higher boiling point than that of water. DO NOT open a radiator or heat exchanger pressure cap or break a system while the engine is running, and in no case until the system pressure has been bled off.
- Radiator fan belts are guarded for your protection. DO NOT remove covers or guards.
- Keep your hands away from moving parts.

Ventilation System

- Check remote radiators frequently. Remove any dirt, debris, bird nests, etc.
- Check ventilation louvres frequently. Make sure that free-fall louvres and motor operated louvres open and close properly and that there is no restriction in the free-air flow.

Electrical System

- The electrical installation exterior to your generator should have been performed by qualified licensed electricians. All local and state

codes should have been consulted and complied with. It is essential that all load circuit breakers adequately protect electrical functions, all circuits are properly grounded and wiring is correct capacity.

- Tag open switches.
- DON'T tamper with interlocks.
- Before starting work on the generating set, disconnect batteries. This will prevent inadvertent starting of the set.
- Use extreme caution when making adjustments on the electrical components in the control cabinet while the engine is running. High voltages are present and could cause serious personal injury.
- DO NOT SMOKE while servicing batteries. Verify correct polarity of battery cables before connecting. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by electrical arcing or by smoking. When connecting batteries, connect the ground lead last.

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	FORD
Engine Series	2711 E
Number of Cylinders.....	4
Displacement.....	254-cubic inches (4.16 litres)
BHP @ 1800 r/min.....	63 (47 kW)
Compression Ratio	16.0:1
Bore	4.22-inches (107.19 mm)
Stroke	4.52-inches (114.81 mm)
Fuel	ASTM No. 2 Diesel
Battery Voltage.....	12 Volt Negative Ground
Battery Group (Two 6-Volt, 135 A.H. [486 kC])	2H
Starting Method	Solenoid Shift
Governor Regulation.....	5% Maximum
Battery Charging Current	35-Ampere

GENERATOR DETAILS

Type.....	UR 15 60 Hz	UR 515 50 Hz
Rating (Watts)		
60 Hertz Continuous Standby	30 000	(37.5 kVA)
50 Hertz Continuous Standby	25 000	(31.25 kVA)
AC Voltage Regulation.....	±2%	
60 Hertz r/min	1800	
50 Hertz r/min	1500	
Output Rating	0.8 PF	
AC Frequency Regulation	3 Hz Max. No Load to Full Load	

CAPACITIES AND REQUIREMENTS

Cooling System (Including Radiator)	16 Quarts (15-litres)
Engine Oil Capacity (Filter, Lines, Crankcase).....	9.5 Quarts (9.0-litres)
Exhaust Connection (inches pipe thread)	2 (Female)

AIR REQUIREMENTS (1800 r/min)

Engine Combustion.....	104-cfm (0.05 m ³ /s)
Radiator Cooled Engine.....	6000-cfm (2.83 m ³ /s)
Total for Radiator Cooled Model	6104-cfm (2.88 m ³ /s)
Alternator Cooling Air (1800 r/min)	1000-cfm (0.5 m ³ /s)
(1500 r/min)	833-cfm (0.4 m ³ /s)
Fuel Consumption at Rated Load ASTM No. 2 Diesel	2.6-gph (2.73 cm ³ /s)

GENERAL

Height	45.6-inches (1.16 m)
Width	33.0-inches (0.84 m)
Length	66.0-inches (1.68 m)
Approximate Weight (Mass) 1-Phase.....	1700-lbs (771.1 kg)
3-Phase.....	1575-lbs (714.4 kg)

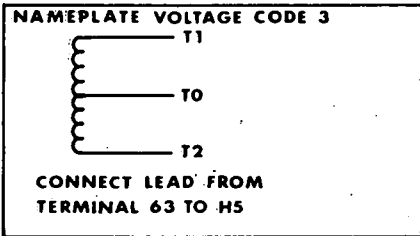
TABLE I. UR GENERATOR VOLTAGE/CURRENT OPTIONS

VOLTS	FREQ	PHASE	AMPERES	DOUBLE DELTA	SERIES DELTA	PARALLEL WYE	SERIES WYE	REF VOLTAGE WIRE (W12) TAP
110/220	50 Hz	1	142*	x				H6
115/230	50 Hz	1	136*	x				H6
120/240	60 Hz	1	156*	x				H5
110/190	50 Hz	3	95			x		H3
115/200	50 Hz	3	90			x		H4
120/208	50 Hz	3	87			x		H4
120/208	60 Hz	3	104			x		H3
110/220	50 Hz	3	82		x			H6
127/220	50 Hz	3	82			x		H5
127/220	60 Hz	3	98			x		H4
115/230	50 Hz	3	78		x			H6
120/240	60 Hz	3	90		x			H5
139/240	60 Hz	3	90			x		H5
220/380	50 Hz	3	47				x	H3
230/400	50 Hz	3	45				x	H4
240/416	50 Hz	3	43				x	H4
240/416	60 Hz	3	52				x	H3
254/440	50 Hz	3	41				x	H5
254/440	60 Hz	3	49				x	H4
277/480	60 Hz	3	45				x	H5
9X 347/600	60 Hz	3	36					H5—Not Reconnectible
3 120/240	60 Hz	1	156					H5—Not Reconnectible

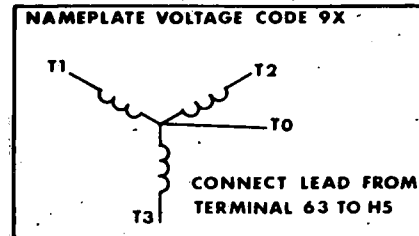
30 kW 37.5 kVA 60 Hz
25 kW 31.25 kVA 50 Hz

* - These current values are available only from special long stack units (B125 option). When standard 3 phase unit is connected into Double Delta configuration, maximum current is 2/3 that of value given.

120/240 VOLT, 1 PHASE, 60 HERTZ



347/600 VOLT, 3 PHASE, 60 HERTZ



THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASES	FREQUENCY	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	115/230 110/220	1	50	H6			
15	120/240	3	60	H5	SERIES DELTA		
515	115/230 110/220	3	50	H6			
15	120/208 127/220 139/240	3	60	H3	PARALLEL WYE		
515	110/190 115/200 120/208 127/220	3	50	H3			
15	240/416 254/440 277/480	3	60	H3			
515	220/380 230/400 240/416 254/440	3	50	H3			

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FIGURE 1. GENERATOR RECONNECTIONS

DESCRIPTION

GENERAL

An Onan DEH 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 DEH is a Ford-Dorset 2711E as described in the engine manual. Basic measurements and requirements will be found under *SPECIFICATIONS*. For operation, maintenance and service information, consult the Ford-Dorset manual.

AC GENERATOR

The generator is an ONAN Type UR, 12 lead, 4-pole revolving field, reconnectible, 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 2.

DC Panel

Panel Light and Switch: Illuminates control panel.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine (wired to a sensor unit located on the engine).

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 3) lights to give warning of—

- Overcrank
- Overspeed
- Low oil pressure
- High engine temperature
- 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.)

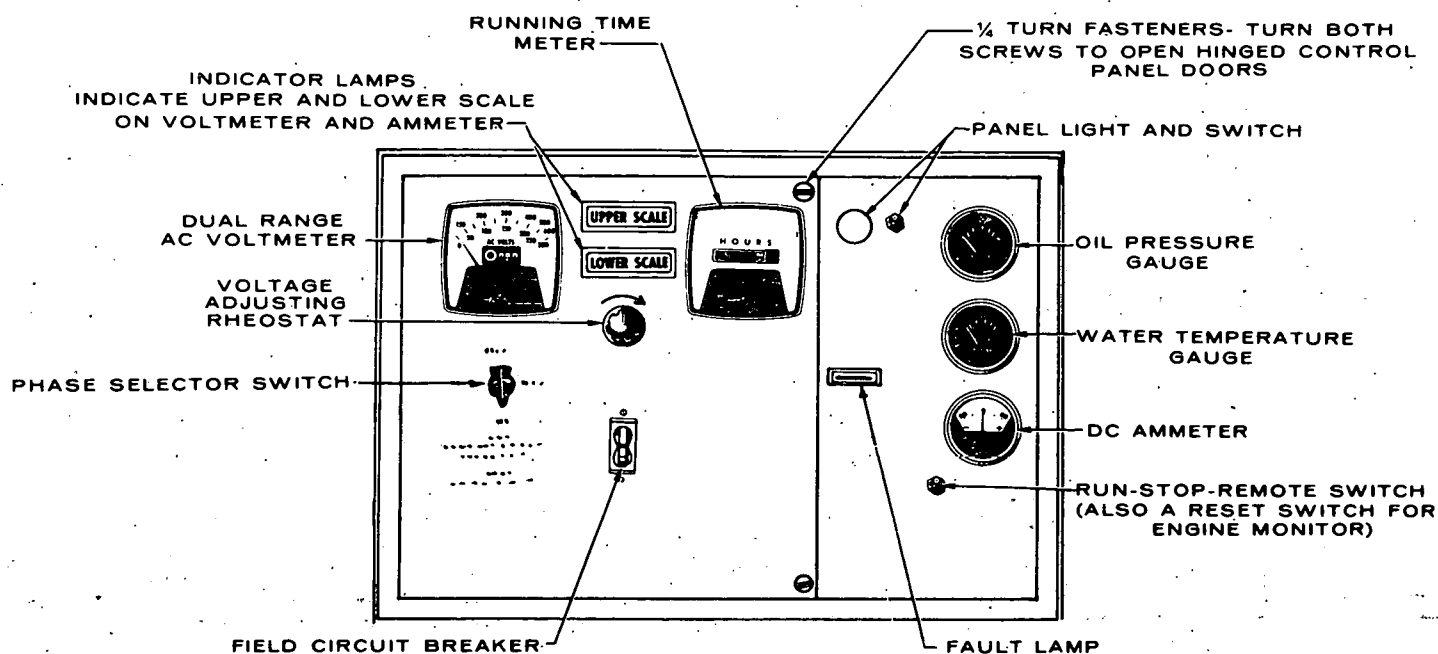


FIGURE 2. TYPICAL CONTROL PANEL (ONE FAULT LAMP)

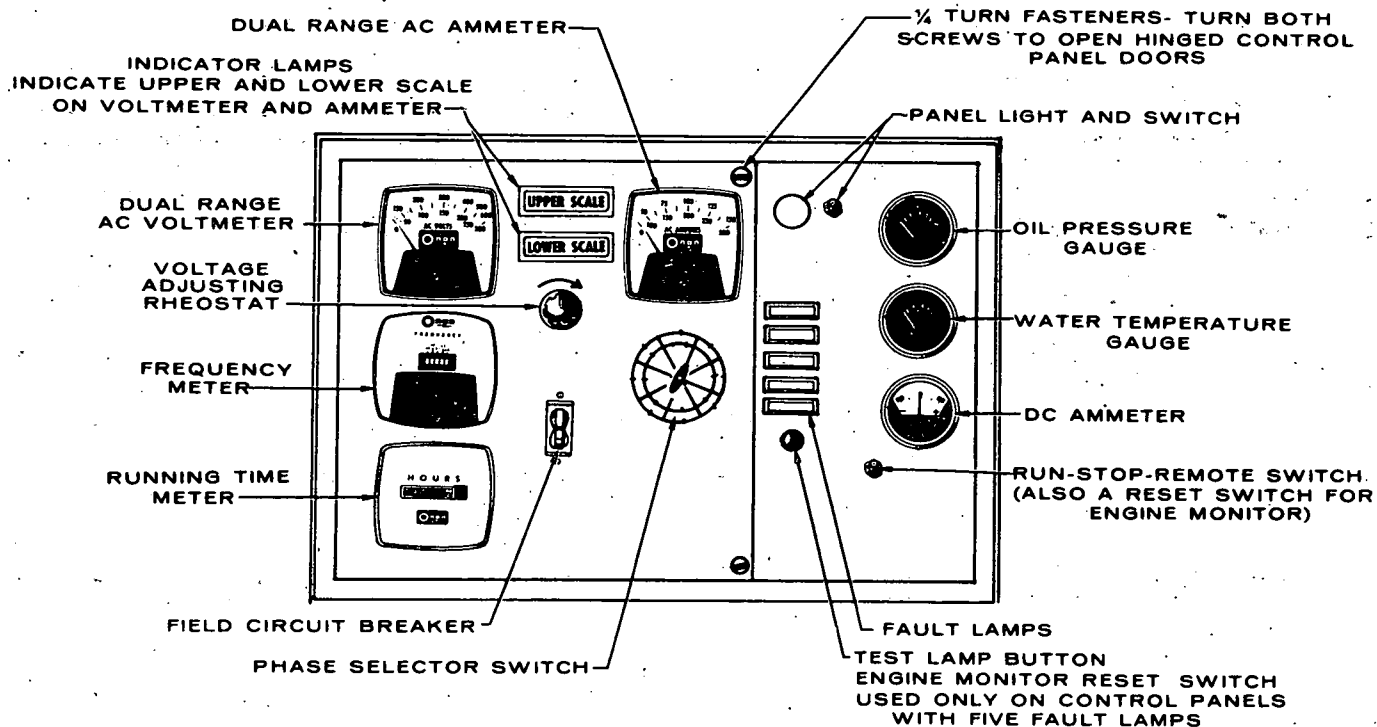


FIGURE 3. OPTIONAL CONTROL PANEL (FIVE FAULT LAMPS)

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 1.

Voltage Regulator, Begin Spec G: 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.

Voltage Regulator, Prior to Spec G: Solid state unit consisting of printed circuit board VR21.

An exciter-regulator assembly designated VR22 containing an SCR bridge circuit and commutating reactor is mounted on the generator end bell (see Figure 4) and works in conjunction with VR21.

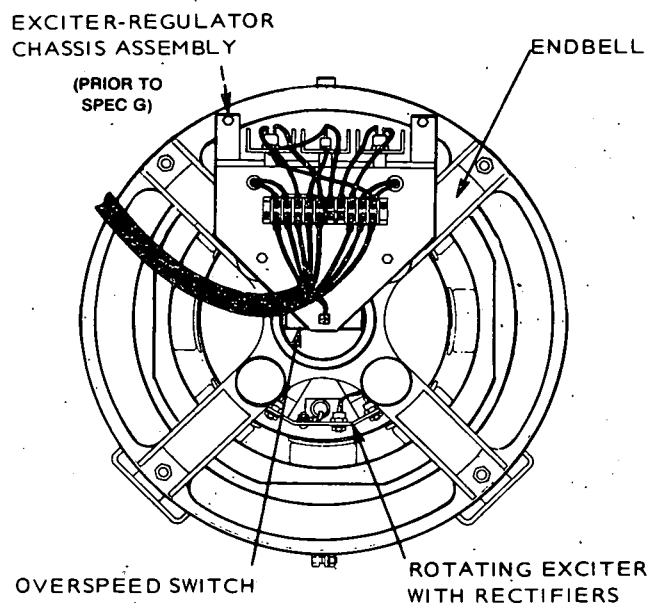


FIGURE 4. GENERATOR (GRILLE REMOVED)

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.

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.

TABLE 2. FAULT LAMP OPTIONS

SYSTEM	FAULT	FAULT LAMP	STOP ENGINE	EXTERNAL ALARM	PRE-ALARM
PENN STATE SINGLE LIGHT	Overcrank Overspeed Low Oil Pressure High Engine Temperature	x x x x	x x	x x x x	
STANDARD SINGLE LIGHT	Overcrank Overspeed Low Oil Pressure High Engine Temperature	x x x x	x x x x	x x x x	
5 LIGHT	Overcrank Overspeed Low Oil Pressure High Engine Temperature Low Engine Temperature	x x x x x	x x x x	x x x x	
5 LIGHT PRE-ALARM	Overcrank Overspeed Low Oil Pressure High Engine Temperature Low Engine Temperature	x x x x x	x x * * 	x x x x	 x 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 5 and 6. When replacing a sensor, do not substitute, use recommended items. Resistance units are matched to the gauge they supply, and cut-off switches are close-tolerance actuation parts, made for a specific application.

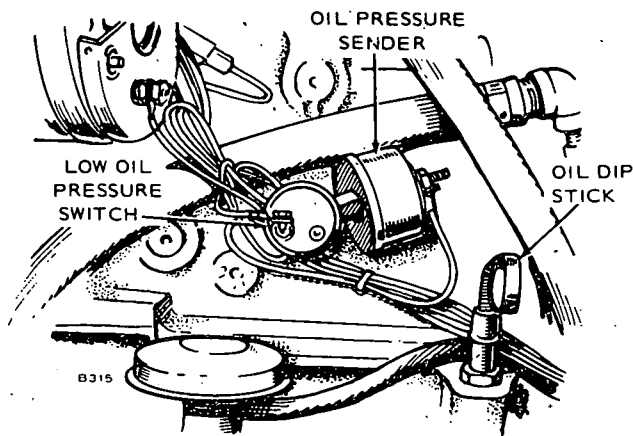


FIGURE 5. OIL PRESSURE MONITORS

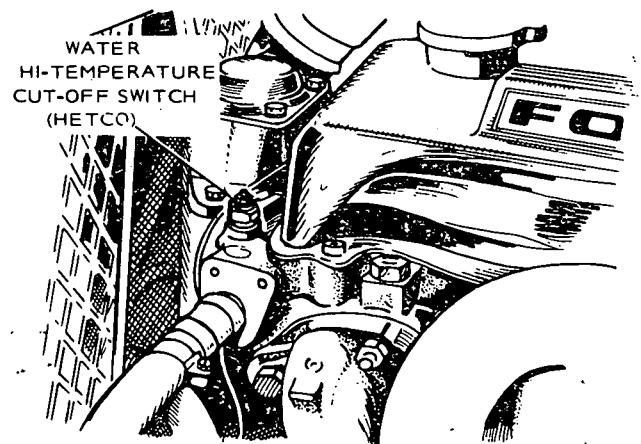
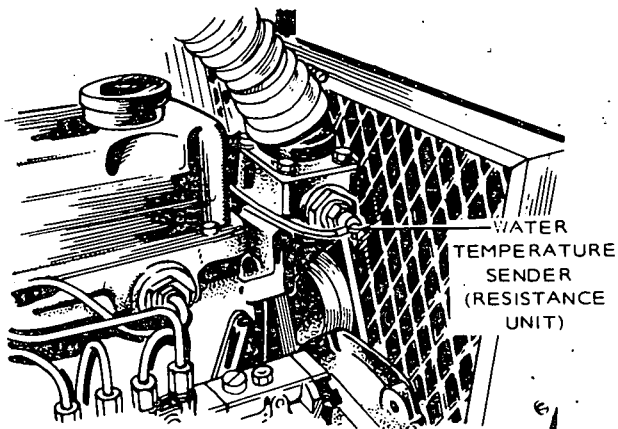


FIGURE 6. ENGINE TEMPERATURE MONITORS

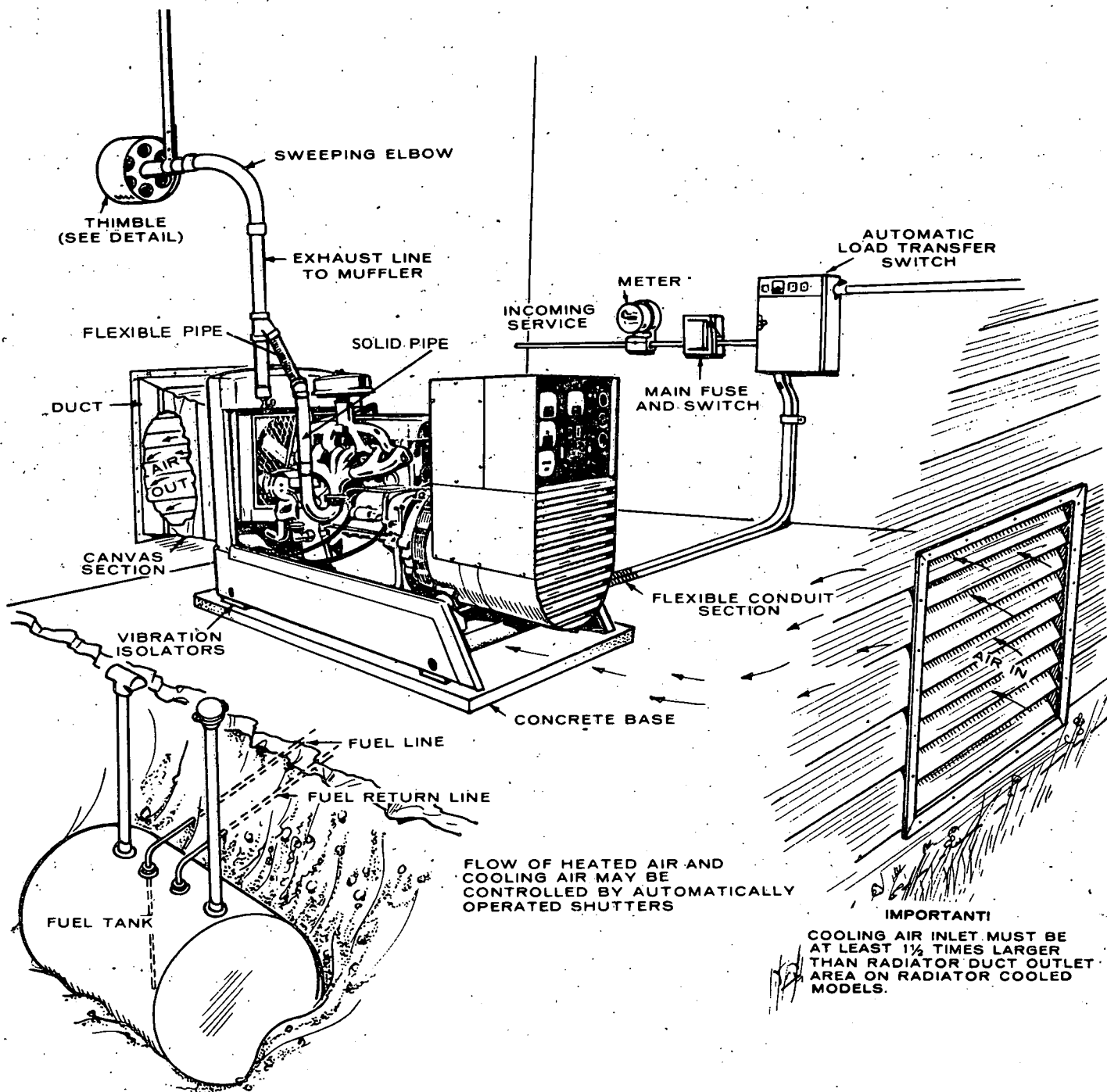


FIGURE 7. TYPICAL MODEL DEH INSTALLATION

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 7.

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/m.

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 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.

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.

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 line 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 8 for typical installation.

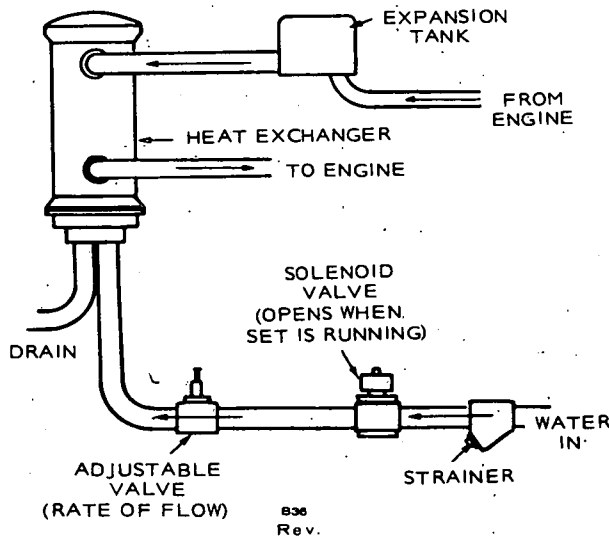


FIGURE 8. TYPICAL HEAT EXCHANGER SYSTEM

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 9.

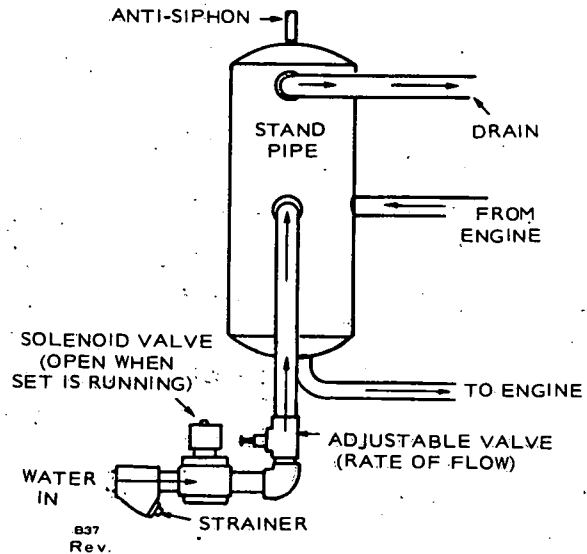


FIGURE 9. TYPICAL STANDPIPE SYSTEM

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 7.

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.

GENERAL WATER FILTER

Electric generating sets can be equipped with an optional cooling system filter (corrosion resistor). This filter is a unit which directs coolant from the system through a filtering and treating device. It softens water, neutralizes acidity and protects against corrosion by the use of a replaceable chemically activated filtering element. In addition, the unit contains a sacrificial metal plate which arrests pitting of metals in the system by electro-chemical action.

Exact location of filter will vary because of other optional equipment which may also be installed.

Two types of elements are available from your Onan dealer or distributor.

1. Regular formula (chromate).
2. PAF formula (borate) year round type.

CAUTION Do not use anti-freeze with an anti-leak formula. The stop-leak element can prevent or retard the flow through the filter, thereby eliminating the filtering process completely.

The regular formula can be used with plain water and selected antifreezes. The best protection results will be gained by using the borate formula element with a permanent antifreeze.

ONAN recommends that shutoff valves be installed to the engine side of the inlet and outlet of the coolant filter, for ease in changing elements. Another suggestion, if so desired, a thick-walled pyrex tube can be inserted and clamped into the line at a convenient point to serve as a flow indicator. This flow indicator will act in the capacity of a sight gauge to observe general condition, possible air pockets and presence of contaminants in the coolant flow. See Figure 10 for installation recommendations.

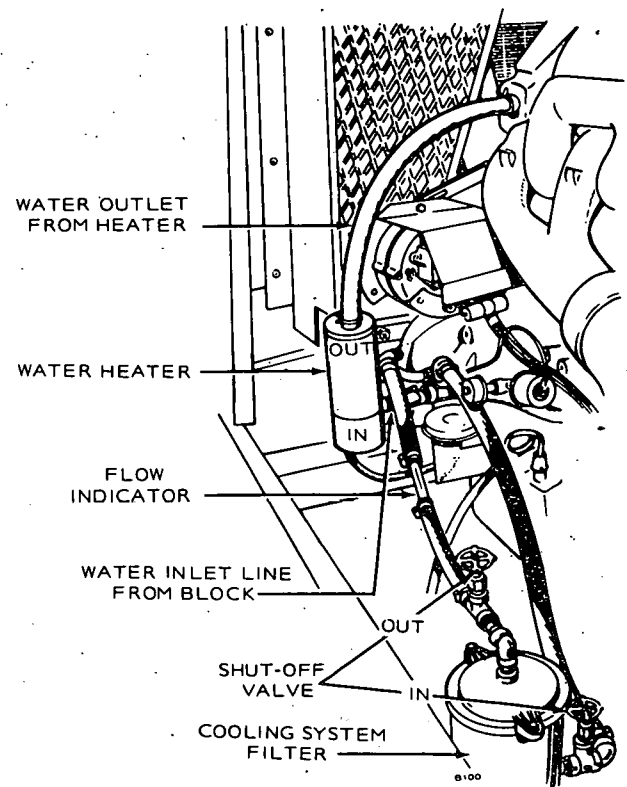


FIGURE 10. COOLING SYSTEM (RADIATOR)

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 11) must be used where exhaust pipes pass through walls or partitions. Pitch exhaust pipes downward or install a condensation trap (Figure 12) 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 7 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 2-inch (50 mm) pipe size outlet of the engine with a flexible portion between the engine and the muffler.

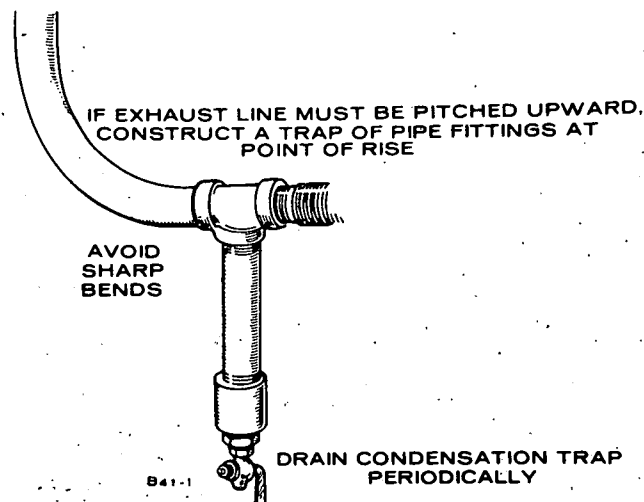


FIGURE 12. EXHAUST CONDENSATION TRAP

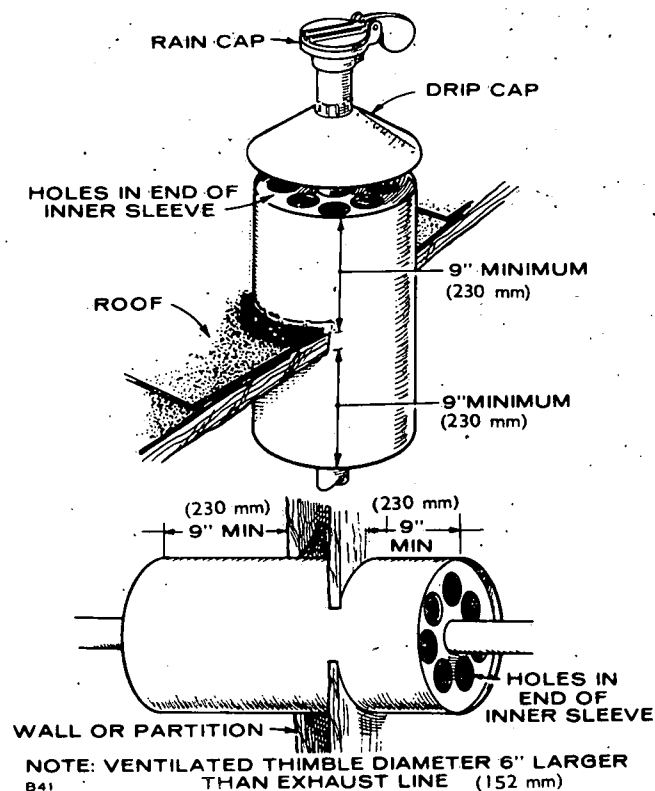


FIGURE 11. EXHAUST THIMBLE

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:

2.5-inch (67 mm) pipe 34 feet (10.5 m)
3.0-inch (76 mm) pipe 166 feet (50.5 m)

Maximum permissible exhaust restriction (back pressure) is 20.4-inches H₂O (5.1 kPa).

FUEL SYSTEM

Ford-Dorset engines used on DEH sets are designed for use with ASTM No. 2 Diesel fuel with a minimum Cetane rating of 43 and maximum Sulphur content of 0.40.

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 6 feet (1.8 m) is not recommended without a day tank installation, because of fuel drainage. Horizontal run, if the supply tank is level with the fuel pump, should not exceed 12.5-feet (3.9 m). However, a day tank is again recommended. A fuel sediment trap should be installed between fuel transfer pump and supply tank.

The fuel inlet is to the transfer pump and is threaded for 3/8-inch pipe. Injectors' return line requires a 1/8-inch low pressure hose connection. Refer to Figure 13.

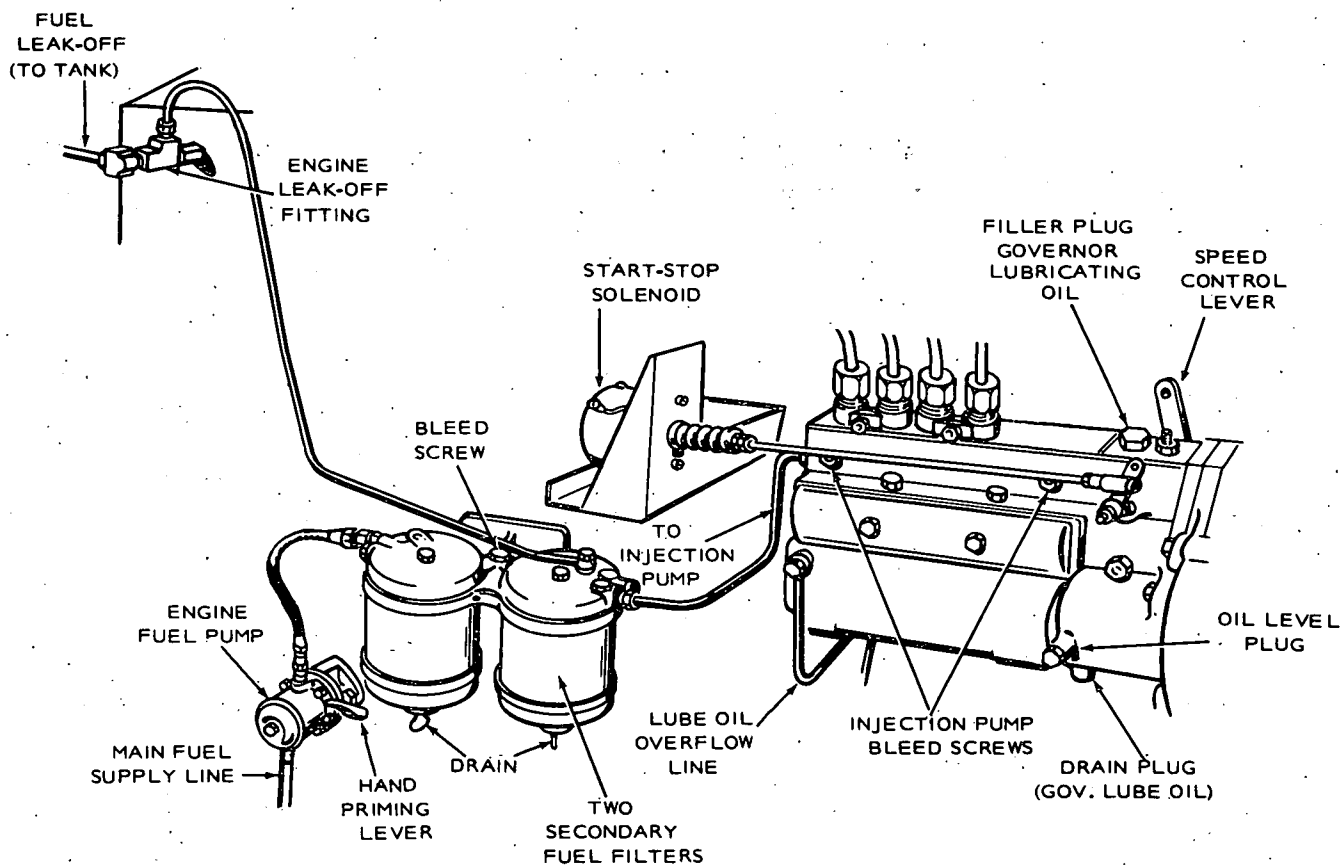


FIGURE 13. FUEL SYSTEM

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 the main fuel tank. Refer to the installations included with the tank. See Figure 14 for an example of a day tank installation. Tank and lines must be below level of injector pump return outlet.

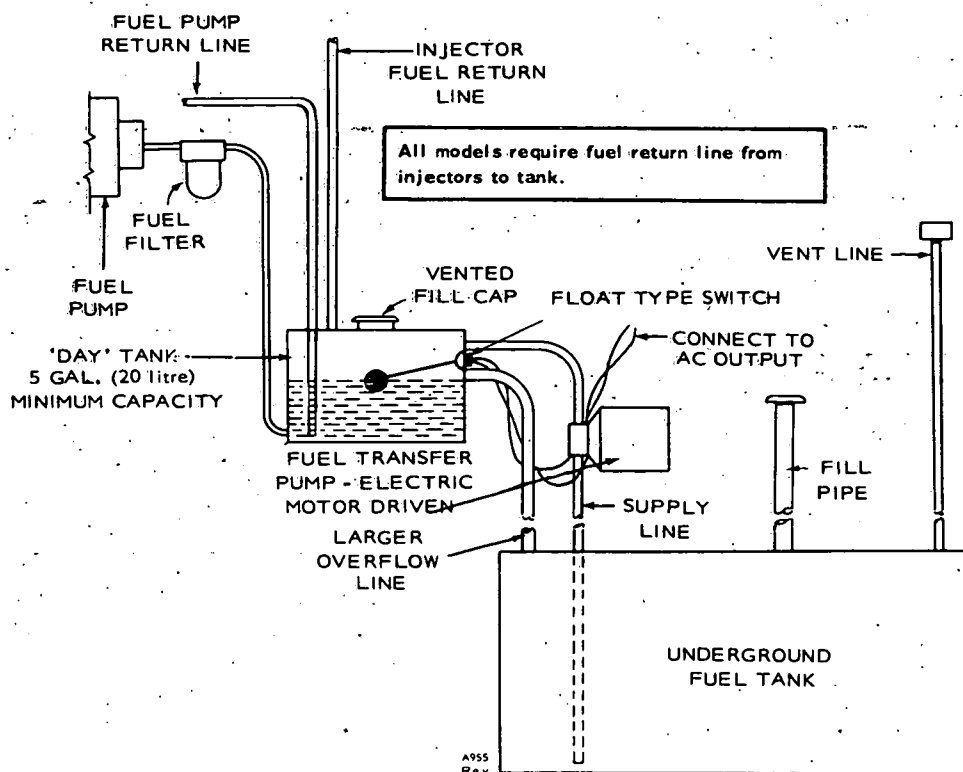


FIGURE 14. DAY TANK (TYPICAL)

BATTERY

Starting the unit requires 12-volt battery current. Use two 6-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 15. 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. Onan automatic transfer switches include such a battery charging circuit.

WARNING

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

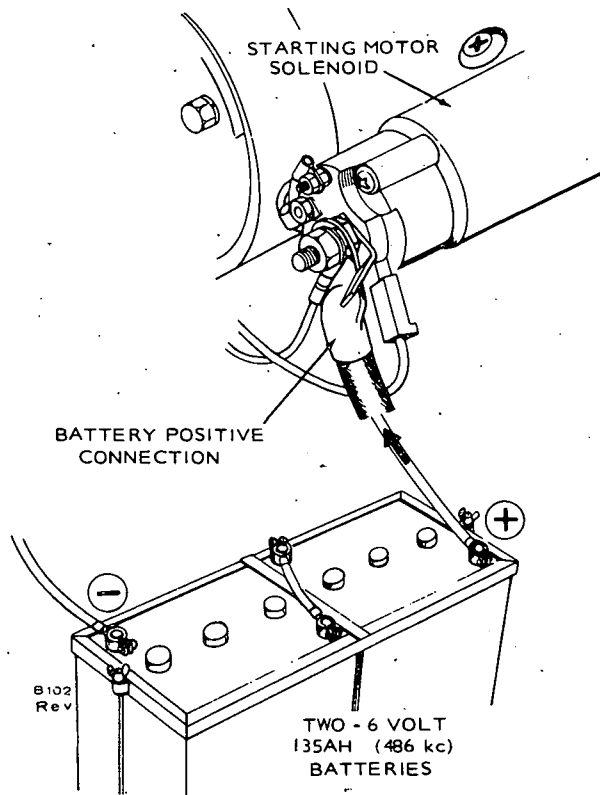


FIGURE 15. BATTERY CONNECTION

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature is consistently above 90°F (32.2°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 16. 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.

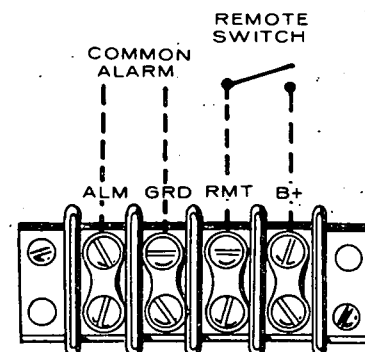


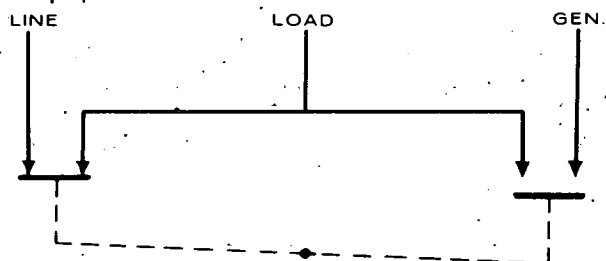
FIGURE 16. REMOTE START CONNECTION (TB12)

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 17. Instructions for connecting an automatic load transfer control are included with such equipment.



NOTE: SHOWN WITH LINE CONNECTED TO LOAD.
FIGURE 17. LOAD TRANSFER SWITCH
(TYPICAL FUNCTION)

Control Box Connections: The factory ships these 12 lead generators with load connection 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 18.
2. Connect wires together as shown on panel drawing and in Figure 1 according to voltage desired.

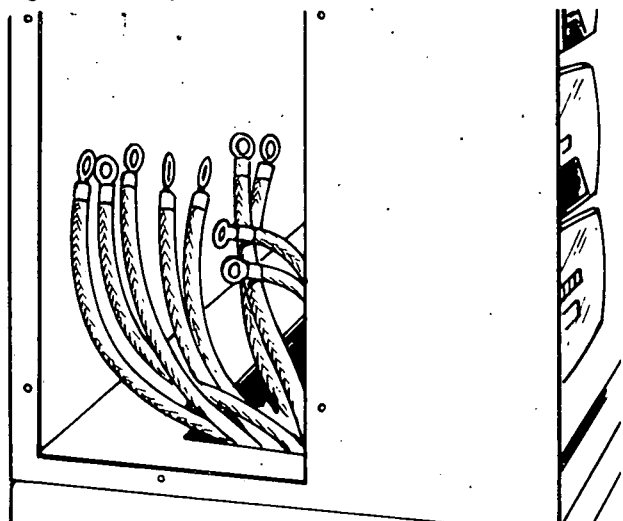


FIGURE 18. CONTROL BOX (SIDE PANEL REMOVED)

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 19.
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.

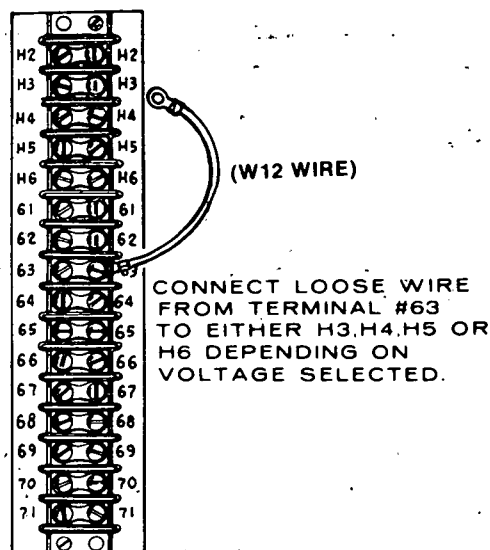


FIGURE 19. REFERENCE VOLTAGE CONNECTION (TB21)

120/240 Volt, Single Phase, 12 Lead: Terminal connection L0 can be grounded (neutral). For 120 volts, connect the hot load wires to either the L1 or L2 connection, Figure 20. Connect the neutral load wire to the grounded L0 connection. Two 120 volt circuits are thus available, with not more than 1/3 the rated capacity of the set available on either circuit. If using both circuits, be sure to balance the load between them.

For 240 volts, connect one load wire to the L1 connection and the second load wire to the L2 connection. Terminal connection L0 is not used for 240 volt service.

Only 2/3 of rated current is available from this connection.

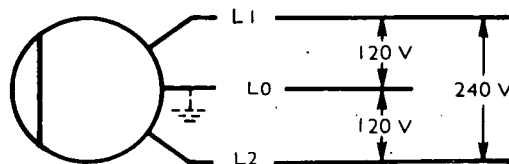


FIGURE 20. 120/240 V. 1-PHASE DOUBLE DELTA

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 21. For 3 phase operation, connect the three load wires to generator terminals L1, L2 and L3—one wire to each terminal. For 3 phase operation 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.

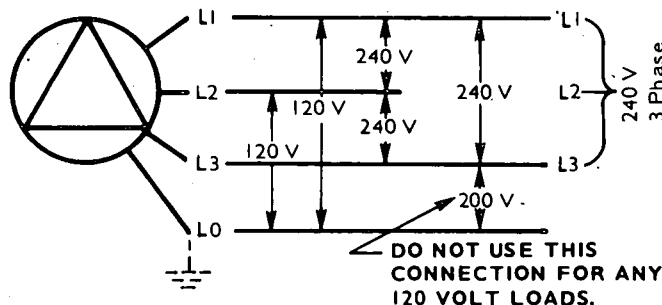


FIGURE 21. 120/240 V. 3-PHASE DELTA

3 Phase, Wye Connected Set: The 3 phase, 4 wire set produces line to neutral voltage and line to line voltage. Line to neutral voltage is the lower voltage as noted on the unit nameplate, 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 22.

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, with not more than 1/6 the rated capacity of the set from any one circuit.

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 22 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye illustration in Figure 1.

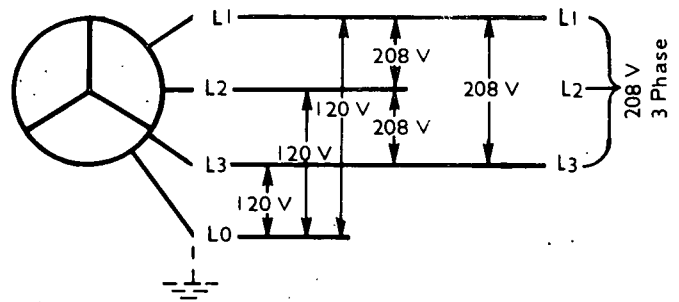


FIGURE 22. 120/208 V. 3-PHASE WYE

120/240 Volt, 1 Phase, 3 Wire Unit (3R Units):

Terminal post T0 is the grounded (neutral) terminal. For 120 volt current, connect the "hot" load wire to either the T1 or T2 terminal. Connect the neutral load wire to the T0 terminal. Two 120 volt circuits are thus available, with not more than 1/2 the rated capacity of the set available on each circuit. Balance the load as closely as possible (Figure 23).

For 240 volt current, connect one load wire to terminal T1 and the second load wire to terminal T2. Terminal T0 is not used for 240 volt service.



If using both 120 and 240 volt current at the same time, use care not to overload either circuit.

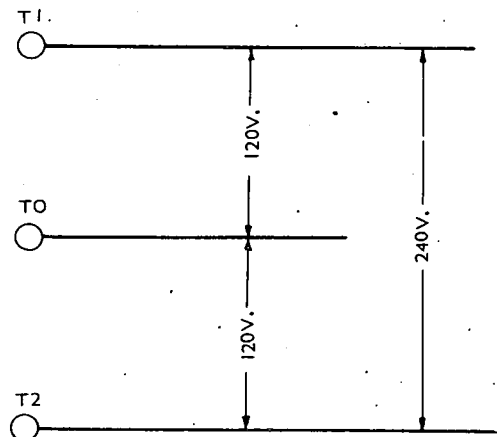


FIGURE 23. 120/240 V. 1-PHASE (CODE 3)

OPERATION

GENERAL

Onan DEH 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 engine to capacities shown. After engine has been run, check dipstick, add oil to bring level to full mark. Record total capacity for future oil changes. For most operating conditions grade CC/DC lubricating oil is recommended. Do not mix brands nor grades of lubricating oils.

Oil viscosity should be as follows:

AMBIENT TEMPERATURE	USE SAE VISCOSITY
Below -10°F (-23°C)	5W-20
-10°F to +40°F (-23°C to 4.5°C)	10-10W
40°F to 70°F (4.5°C to 21°C)	20-20W
70°F to 100°F (21°C to 38°C)	30
90°F and above (32°C)	40

Oil Capacities (nominal)

Oil Pan and Filter—9.5-quarts (9.0 litres)

Cooling System: Cooling system was drained prior to shipment. Fill cooling system before starting. Nominal capacity is 16-quarts (15-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 Ford-Dorset 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.

2. 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 Ford-Dorset 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 Fuel System: Verify that all connections in the fuel system are secure and no leaks exist. Proceed with priming as follows:

1. Open bleed screw on the inlet side of fuel filter. See Figure 24.
2. Actuate priming lever on the side of the fuel transfer pump (Figure 13) until fuel flows from filter bleed screw without showing air bubbles.
3. Close filter inlet bleed screw.
4. Open bleed screw on the outlet side of filter. See Figure 24.
5. Again, actuate priming lever until a bubble-free flow of fuel comes out of the bleed screw.
6. Close filter outlet bleed screw.
7. Open one or two bleed screws on fuel injection pump.
8. Repeat priming lever actuation until bubble-free fuel is emitted from bleed screws on injection pump.
9. Close bleed screw(s).
10. Torque all the bleed screws.

Filter—5-7 lb-ft (6.88 to 9.5 N.m)

Pump—3-5 lb-ft (4.1 to 6.8 N.m)

1. SECURING BOLT
2. BLEED SCREWS
3. SEAL
4. FILTER ELEMENT
5. BOWL
6. DRAIN CAP
7. SEAL

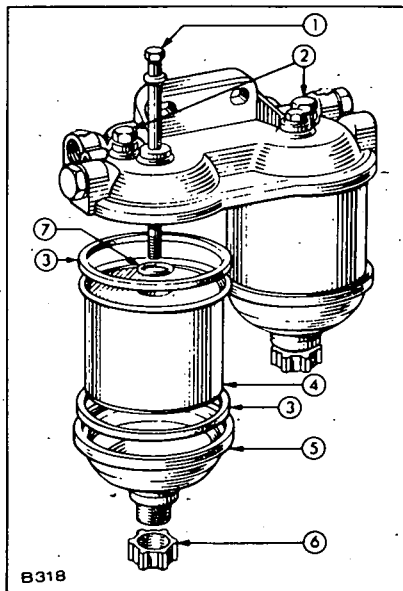


FIGURE 24. FUEL FILTER

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 30 psi (207 kPa) and 55 psi (380 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 180°F to 195°F (82°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 170°F to 200°F (76.7°C to 93.3°C).

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.

STOPPING

To reduce and stabilize the engine temperatures, 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.

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.	<p>1. See engine service manual for troubleshooting fuel system.</p> <p>After correcting problem, reset engine monitor relay by placing Run-Stop/Reset-Remote switch to Stop/Reset, then back to the required running position.</p>
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.	<p>3. Check the following:</p> <ul style="list-style-type: none"> 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.

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.

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.

OUT-OF-SERVICE PROTECTION

Generator sets removed from service for extended periods of time should be protected from rust and corrosion. The natural lubrication qualities of ASTM No. 2 Diesel fuel should protect a diesel engine for at least 30-days when unit is not in service. To protect a unit that will be out of service over 30 days, Onan recommends the following procedure:

1. Check coolant, top up if necessary using recommended anti-freeze.

2. Run set until thoroughly warm; generator under at least 50% load.
3. Shut down engine and drain oil base while still warm. Refill and attach a warning tag indicating viscosity of oil used.
4. Service air cleaner.
5. Clean throttle and governor linkage and protect by wrapping with a clean cloth.
6. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
7. Clean off dirt and dry entire unit. Coat parts likely to rust with a light coat of grease or oil.
8. Disconnect battery and follow standard battery storage procedure. Apply a film of non-conductive grease (e.g., vaseline) to battery cable lugs.
9. Fill fuel tank to prevent condensation contamination.
10. Provide a suitable cover for the entire unit.

RETURNING A UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check warning tag on oil base and verify that oil viscosity is still correct for existing ambient temperature.
3. Clean and check battery. Measure specific gravity (1.260 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 if necessary.
5. Connect batteries.
6. Verify that no loads are connected to generator.
7. 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 1000-feet (305 m), standard cooling, normal ambients and with No. 2 Diesel fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

Engine horsepower loss is approximately 3 percent for each 1000 feet (305 m) of altitude above sea level. Use lower power requirement at high altitudes to prevent smoke, over-fueling and high temperatures.

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 Ford-Dorset 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

Follow a definite schedule of inspection and servicing, based on operating hours (Table 5). Keep an accurate logbook of maintenance, servicing, and operating time. Use the running time meter to keep a record of operation and servicing. Service periods outlined are recommended for normal service and operating conditions. For continuous duty, extreme temperature, etc., service more frequently. For infrequent use, light duty, etc., service periods can be lengthened accordingly. Refer to Ford-Dorset engine manual for details of engine service and maintenance procedures.

WARNING

Before performing 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.

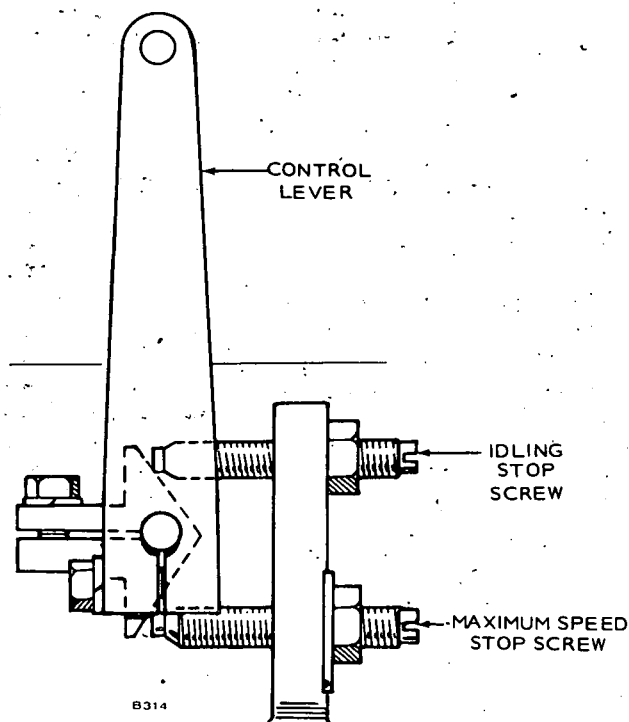


FIGURE 25. GOVERNOR SPEED ADJUSTMENT

ENGINE SPEED

Generator frequency is in direct ratio to engine speed which is controlled by the governor. The governor controlling the DEH set is integral with the injector pump. High and low speed limit stops are set at the ONAN testing facility and normally do not require further adjustment, therefore if your set is on continuous standby service, the governor may never need to be touched.

If however the unit is removed for repair or the set is used frequently, adjustment may be necessary due to wear of internal components.

To adjust governor, proceed as follows:

1. Loosen lock nuts on idle stop screw and maximum speed stop screw. Refer to Figure 25.
2. Start engine; apply full load.

If governor setting is considerably out of adjustment, adjust low speed stop screw until frequency meter indicates approximately 63 Hz before applying load.

3. Back off maximum speed stop screw (screwdriver slot).
4. Turn idle speed stop screw clockwise until frequency meter indicates 60 Hz. (Counterclockwise reduces rpm.)
5. Turn maximum speed stop until it bottoms on governor control lever.
6. Secure lock nuts.

DUST AND DIRT

1. Keep set clean. Keep cooling system free of dirt, etc.
2. Service air cleaners frequently.
3. Store oil and fuel in dust-tight containers.
4. See engine operation and maintenance manual.

COOLANT CORROSION RESISTOR (Water Filter)

The PAF formula elements can be used with most permanent antifreezes, but is not recommended for use with plain water. It is necessary to drain and flush the system thoroughly when changing from one element formula to the other if a non-compatible antifreeze is in use. See Figure 10 for view of the system.

At each 300 to 500 hour interval of operation, depending on conditions, service the coolant filter as follows:

1. Thoroughly clean filter body and surrounding area.
2. Close coolant inlet and outlet shutoff valves.
3. Remove drain plug from bottom of filter body and drain coolant.
4. Remove capscrews attaching filter cover to body and remove cover (Figure 26).

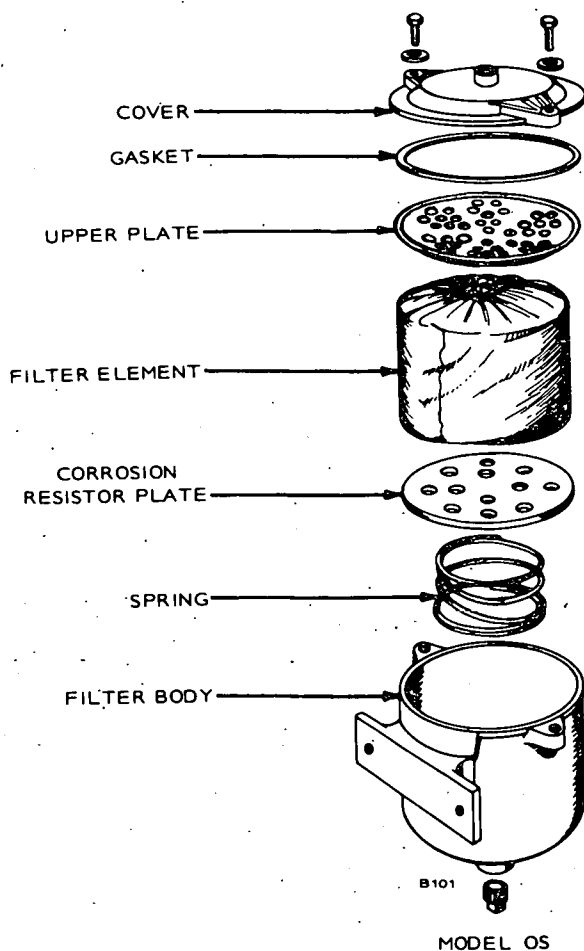


FIGURE 26. CHANGING CORROSION RESISTOR ELEMENT AND PLATE

5. Lift upper plate and filter element out of filter body. Discard filter element.
6. Remove lower corrosion resistor plate and spring from filter body.
7. Inspect and clean lower corrosion resistor plate, buffing it to a bright finish. If plate is thin and pliable, or has developed holes, replace it.
8. Remove and clean sump plate. Clean sump area in filter body.
9. Install sump plate, spring, and lower corrosion resistor plate.
10. Install new filter element.
11. Position upper plate in filter body.
12. Make certain gasket is in good condition, then install cover and secure with attaching capscrews.
13. Replace drain plug and open inlet and outlet shutoff valves.

Initially the element should be changed after 150 hours of operation for borate (PAF) formula filter elements.

Do not use soluble oil or other conditioners in the cooling system. However, filter efficiency is not affected by use of permanent type antifreeze in the system.

CAUTION If a stop-leak is added to the coolant, do not allow it to circulate through the filter. Shutoff valves are provided in inlet and outlet lines for isolating the filter from remainder of cooling system.

Whenever coolant supply is changed (spring and fall), the system must be drained and flushed.

On an extremely dirty system, the coolant should be drained and flushed before a new element is installed. In a few rare cases, additional flushing and change of filter may be necessary in order to completely purge the system. Generator sets subject to excessive idling or frequent start and stop cycles, or units located in areas with dust, air contaminants, or other noxious atmospheric conditions, will require more frequent servicing.

After maintenance has been completed, check flow indicator if one has been installed to see if air bubbles (which can cause pump cavitation) are in the system. If air is present, bleed the system by disconnecting the filter outlet line momentarily until the coolant flows in a solid stream.

GENERAL ENGINE MAINTENANCE

Refer to the engine manual furnished with the generating set for additional details on servicing procedures not covered by this manual. Refer to Table 5 for general information on clearing the electric generating set of any malfunctions which have developed during the period of operation.

START-STOP SOLENOID

(Failure to Shut Down)

In case the set does not shut down when moving Run-Stop/Reset-Remote switch to *Stop* position, the stop solenoid linkage may be out of adjustment. See Figure 27. Adjust as follows:

1. Remove the joint that attaches the stop solenoid rod to injection pump arm.
2. With the engine running, move the lever arm on the injection pump back slowly towards radiator just until engine stops.
3. Hold lever in this same position and adjust linkage accordingly.
4. Snap rod joint back on injection pump arm.

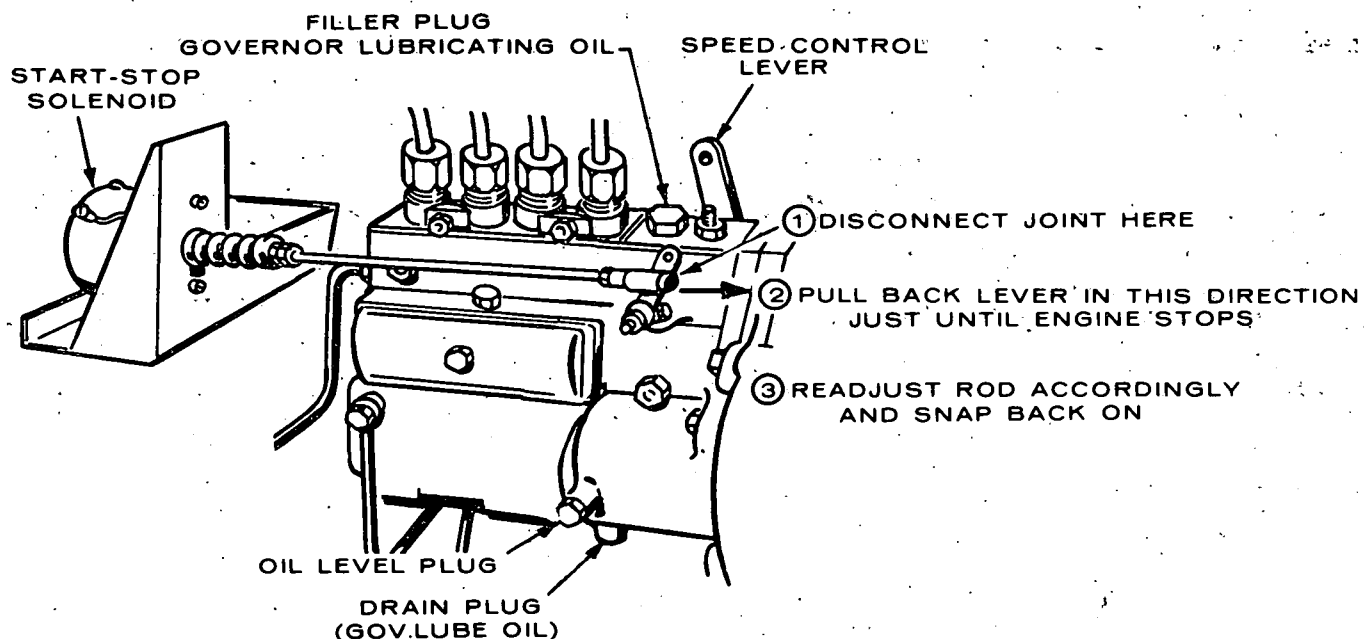


FIGURE 27. STOP-SOLENOID LINKAGE ADJUSTMENT

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 the bearing every 1000 hours with the unit running. Apply light smear of Molykote grease if unit appears dry.

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

Check generator voltage. It may be necessary to make a slight readjustment of the voltage rheostat to obtain the preferred voltage at average load.

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 the diodes to overheat and will result in their 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 30 in. lb. (3.4 N•m) or finger tight plus a quarter turn. Blow dust out of control panel.

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.

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

TABLE 5. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	10	50	200	400
Inspect Complete Set	x			
Check Engine Oil Level	x			
Check Radiator Coolant Level	x			
Check Fuel	x1			
Check Governor Oil Level		x		
Check Air Cleaner (Clean if Required)		x2		
Check Electrolyte Level of Battery		x		
Stop-Solenoid Linkage		x2		
Adjust Fan Belt Tension			x3	
Change Governor Oil			x	
Change Engine Oil & Filter			x2	
Clean Fuel Lift Pump			x	
Clean Sediment Bowl & Filter			x	
Check Starter			x5	
Clean & Inspect Battery Charging (DC) Alternator			x	
Check AC Generator			x6	
Replace Fuel Filter Element				x2
Replace Air Cleaner Element				x2
Remove & Service Injectors				x4
Adjust Valve Clearances				x
Examine Water Filter Element				x

x1 - After every run.

x2 - Perform more often in extremely dusty conditions.

x3 - Adjust to 1/2-inch (12.5 mm) depression between pulleys. Refer to Ford engine manual.

x4 - Check for proper spray pattern, etc. Refer to the Ford manual.

x5 - Oil front bearing sparingly; check brushes.

x6 - Check brushes (if installed), replace if worn to 5/8-inch (15.9 mm) or if damaged. DO NOT LUBRICATE.

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PARTS CATALOG

This catalog applies to the standard DEH Generator Sets as listed below. Parts are arranged in groups of related items. Each illustrated part is identified by a reference number corresponding to the same reference number in the parts list for that group. Parts illustrations are typical. Using the *Model* and *Spec No.* from the nameplate, select the parts from this catalog that apply to your set. Unless otherwise mentioned in the description, parts are interchangeable between models. Right and left sides are determined by facing the engine end (front) of the set.

SET DATA TABLE

MODEL AND SPEC NO.	ELECTRICAL DATA				
	WATTS	VOLTS	HERTZ	WIRE	PHASE
25.0 DEH-53R/*	25,000	120/240	50	3	1
25.0 DEH-515R/*	25,000	£	50	12	1 or 3
30.0 DEH-3R/*	30,000	120/240	60	3	1
30.0 DEH-15R/*	30,000	£	60	12	1 or 3
30.0 DEH-9XR/*	30,000	347/600	60	4	3

* - The Specification Letter advances (A to B, B to C, ...Z to AA, etc.) with manufacturing changes.
A Specification Number, other than 1, designates customer option(s).

£ - These sets are reconnectible, refer to Specifications (Generator Details) in Operator's Manual for Electrical Data.

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

REPLACEMENT ENGINE

100-0993 1 Engine, Replacement (Ford Motor Company Model 2711E)

General Description:

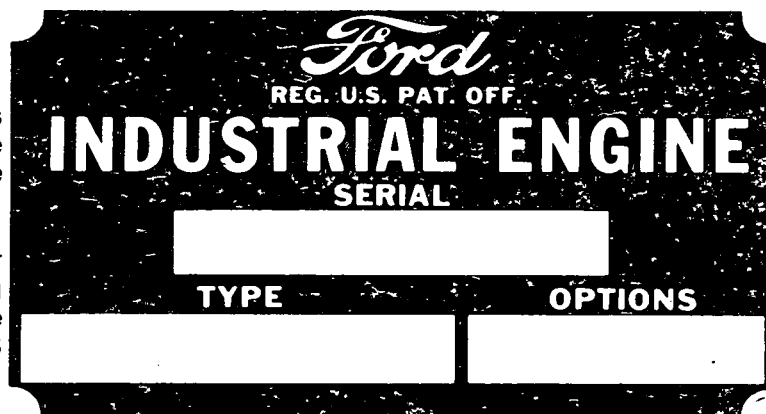
Includes—Complete Cylinder Block, Fuel Pump, Fuel Filter, Oil Filter, Starter Motor, Governor, Fan Blades (pusher type), Flywheel, Water Pump, Oil Pan, Exhaust Manifold.

Excludes—Alternator, Alternator Mounting Brackets, Alternator Belt, Temperature Sender, Oil Pressure Sender, Air Cleaner, Radiator, Fan Belt and Front Mounting Brackets.

ENGINE PARTS

Engine parts modified or added by Onan will be in this parts list and have Onan part numbers. These supersede similar parts listed in the Ford Engine manual.

All Ford engine parts must be ordered from your nearest authorized Ford distributor. When ordering parts, refer to the engine nameplate giving the complete engine TYPE, SERIAL and OPTIONS number.



NOTICE!

ITEMS REFERENCED AS **OPTIONAL** INDICATE PART IS FACTORY INSTALLED AND MAY NOT BE APPLICABLE TO ALL MODELS. FOR FIELD CONVERSIONS ADDITIONAL PARTS ARE USUALLY REQUIRED.

INSTRUCTIONS FOR ORDERING **Onan** REPAIR PARTS

For parts or service, contact the dealer from whom you purchased this equipment or refer to your Nearest Authorized Onan Parts and Service Center.

To avoid errors or delay in filling your parts order, please furnish all information requested.

Always refer to the nameplate on your unit:

1. Always give the MODEL and SPEC NO. and SERIAL NO.

The nameplate is a rectangular metal plate with a black background and white text. At the top, the Onan logo is centered. Below it, the text "ELECTRIC GEN SET" is printed. There are two horizontal lines for "MODEL" and "SERIAL NO.". Below these, the word "IMPORTANT" is printed in large, bold letters, followed by the text "ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS". The middle section contains various specifications: "CONTINUOUS" and "RATING" with a line between them; "HERTZ 60 RPM 1800"; "3 PHASE" and "1 PHASE" with lines between them; "KW" and "KVA" with lines between them; "VOLTS 120/208 127/220 139/246 120/240 240/416"; "AMPS" with lines; "VOLTS 254/440 277/480 347/600 120/240"; "AMPS" with lines; "BAT" and "VOLTS" with lines between them. The bottom section contains the text "MANUFACTURED BY ONAN", "DIVISION OF ONAN CORPORATION", "MINNEAPOLIS, MINN. 55432, U.S.A.", and "FOR ELECT EQUIPMENT ONLY" with a small circular logo on the right.

For handy reference, insert "YOUR" nameplate information in the spaces above.

2. Do not order by reference number or group number; always use part number and description.
3. Give the part number, description and quantity needed of each item. If an older part cannot be identified, return the part prepaid to your dealer or nearest AUTHORIZED SERVICE STATION. Print your name and address plainly on the package. Write a letter to the same address stating the reason for returning the part.
4. State definite shipping instructions. Any claim for loss or damage to your unit in transit should be filed promptly against the transportation company making the delivery. Shipments are complete unless the packing list indicates items are back ordered.

Prices are purposely omitted from this Parts Catalog due to the confusion resulting from fluctuating costs, import duties, sales taxes, exchange rates, etc.

For current parts prices, consult your Onan Dealer, Distributor or Parts and Service Center.

"En esta lista de partes los precios se omiten de proposito, ya que bastante confusion resulto de fluctuaciones de los precios, derechos aduanales, impuestos de venta, cambios extranjeros, etc."

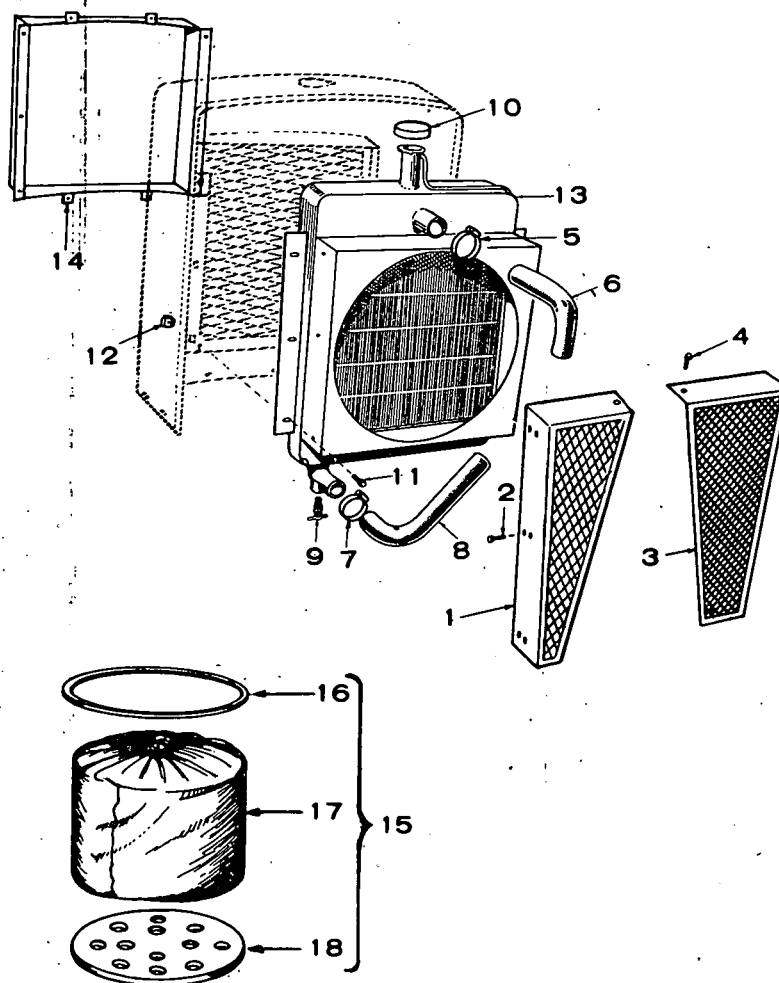
Consiga los precios vigentes de su distribuidor de productos "ONAN".

COOLING SYSTEM GROUP (Radiator Cooled Generator Sets)

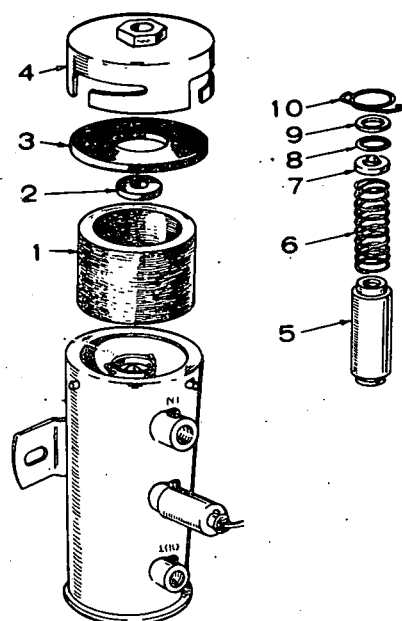
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	130-0352	1	Guard, Fan - Right Side
2	815-0181	4	Screw, Tapping, Thread Cutting - Hex Head with External Tooth Washer (#10-32 x 1/2")
3	130-0351	1	Guard, Fan - Left Side
4	815-0181	4	Screw, Tapping, Thread Cutting - Hex Head with External Tooth Washer (#10-32 x 1/2")
5	503-0365	1	Clamp, Hose
6	503-0441	1	Hose, Rubber - Upper
7	503-0311	3	Clamp, Hose
8	503-0441	1	Hose, Rubber - Lower
9	504-0028	1	Valve - Drain
10	130-0449	1	Cap - Radiator
11	821-0014	8	Screw, Self-Locking - Hex Head (5/16-18 x 1/2")
12	870-0113	8	Nut, Clinch (5/16-18)
13	130-0815	1	Radiator
14	405-1054	1	Flange, Duct - Optional
15	KIT, REPLACEMENT-WATER FILTER		
	130-0769	1	Regular (Includes Parts Marked *)
	130-0772	1	Special (Includes Parts Marked +)
16	GASKET, COVER		
	130-0777	1	*Regular Element
	130-0778	1	+PAF Element
17	ELEMENT, FILTER		
	130-0773	1	*Regular Element
	130-0776	1	+PAF Element
18	PLATE, FILTER ELEMENT (Lower)		
	130-0779	1	*Regular Element
	130-0780	1	+PAF Element

* - Contained in the #130-0769 Element Replacement Kit for the original element.

+ - Contained in the #130-0772 Element Replacement Kit for Permanent Anti-Freeze.

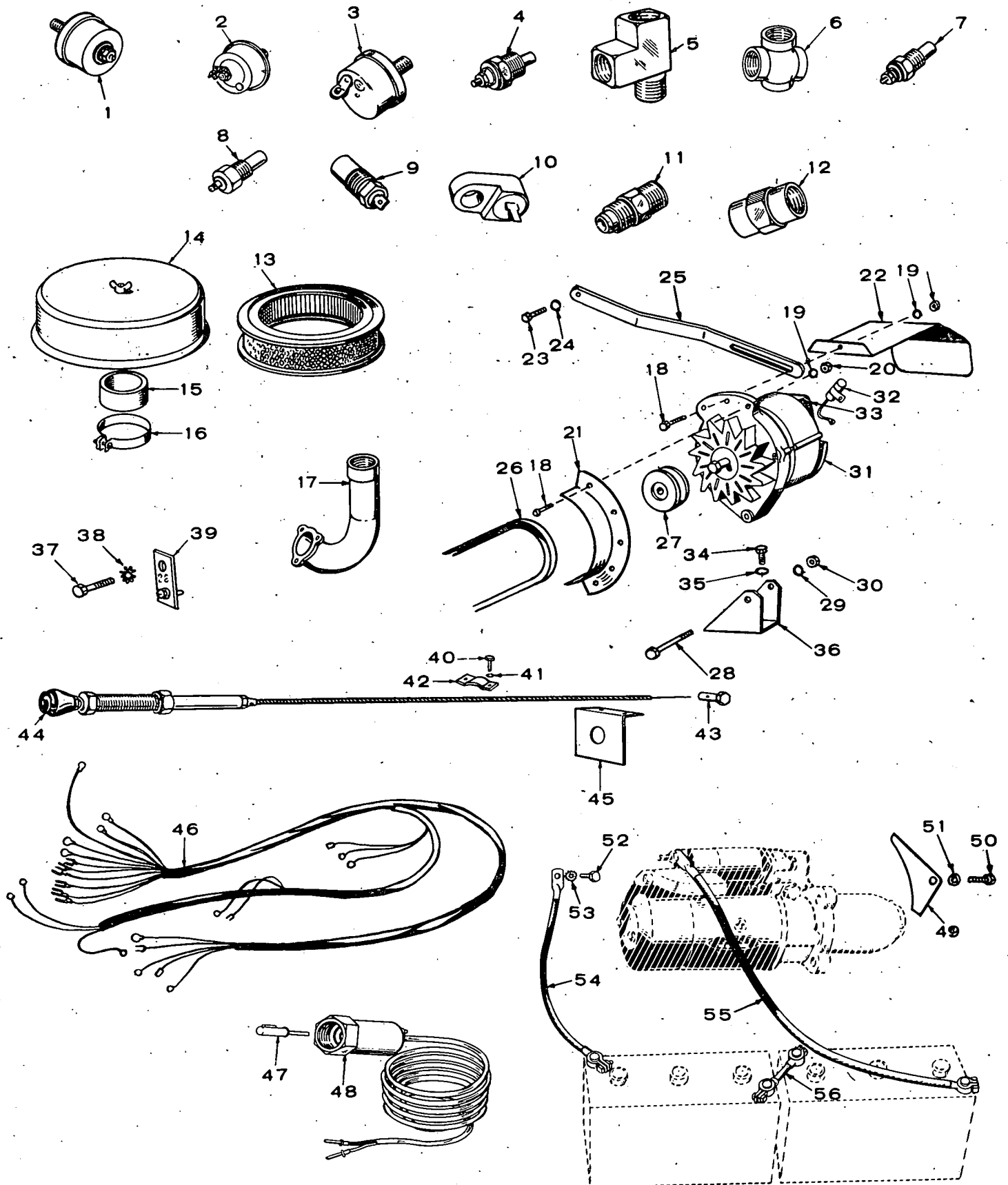


ELECTRIC FUEL PUMP PARTS GROUP - OPTIONAL EQUIPMENT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149-0554	1	Pump, Fuel
1	149-1445	1	Filter
2	149-1447	1	Magnet
3	149-1446	1	Gasket, Cover
4	149-1453	1	Cover
5	149-1452	1	Plunger
6	149-0705	1	Spring, Plunger Return
7	149-1451	1	Spring Cup & Valve
8	149-1450	1	Gasket, Spring Cup
9	149-1449	1	Washer, Cup Gasket
10	149-1448	1	Retainer, Cup & Plunger

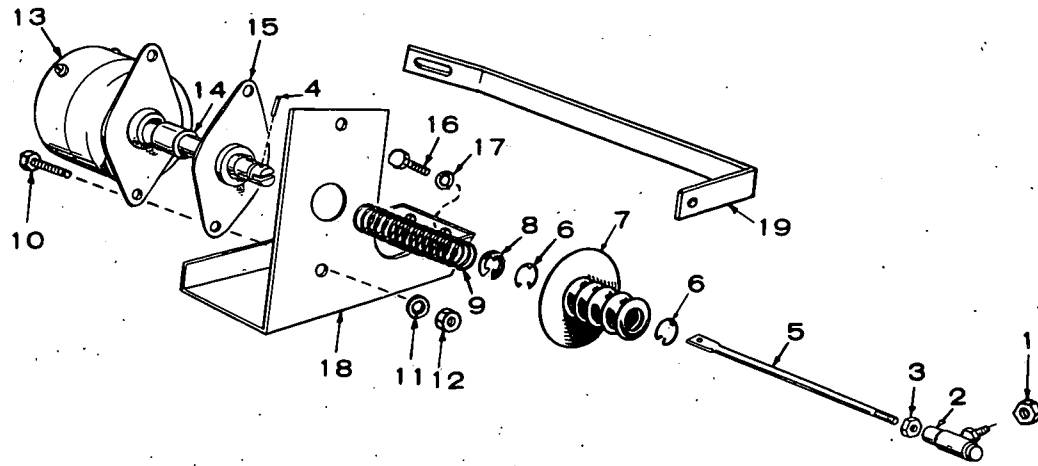
MISCELLANEOUS ENGINE PARTS GROUP



MISCELLANEOUS ENGINE PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	SENDER, OIL PRESSURE			33	191-0732	1	*Regulator, Voltage (Part of Alternator)
	193-0108	1	Spec B Through G	34	800-0048	2	Screw, Cap - Hex Head (5/16-18 x 7/8")
	193-0244	1	Begin Spec H	35	850-0045	2	Washer, Lock - Spring (5/16)
2	309-0169	1	Switch, Low Oil Pressure	36	191-0786	1	Bracket, Mounting - Alternator
3	309-0064	1	Switch, Low Oil Pressure Shutdown - Optional	37	800-0047	1	Screw, Cap - Hex Head (3/8-16 x 5/8")
4	SENDER, OIL TEMPERATURE			38	856-0010	1	Washer, Lock - External/Internal Tooth (3/8")
	193-0202	1	Spec B Through G	39	332-1292	1	Bracket, Terminal
	193-0249	1	Begin Spec H	VERNIER THROTTLE ASSEMBLY-OPTIONAL (Includes Parts Marked +)			
5	502-0361	1	Tee, Pipe - 1/8"	40	815-0104	2	+Screw, Machine - Fillister Head (#8-32 x 5/16")
6	505-0763	1	Cross, Pipe - (1/8") - Optional	41	526-0052	2	+Washer, Flat - Brass (17/64" ID x 9/16" OD x 1/32" Thk)
7	SENDER, WATER TEMPERATURE			42	152-0036	1	+Clamp, Cable
	193-0104	1	Spec B Through G	43	152-0158	1	+Swivel
	193-0246	1	Begin Spec H	44	152-0120	1	+Cable, Throttle
8	309-0179	1	Switch, High Water Temperature	45	151-0230	1	+Bracket, Angle - Throttle Mounting
9	309-0178	1	Switch, High Water Temperature Alarm - Optional	46	338-0537	1	Harness, Engine Control
10	309-0269	1	Switch, Low Engine Temperature - Optional	47	302-0967	1	Tang, Drive - Optional (Tach Sender)
11	502-0193	1	Connector, Pipe - Fuel Line (1/8")	48	302-0750	1	Sender, Tach - Optional
12	502-0051	1	Coupling, Pipe - (1/8")	49	191-0802	1	Cover, Plate - Starter Hole
13	140-1089	1	Element, Air Cleaner	50	800-0069	1	Screw, Cap - Hex Head (7/16-14 x 3/4")
14	140-1091	1	Cleaner, Air	51	850-0055	1	Washer, Lock - Spring (7/16")
15	503-0597	1	Hose, Air Cleaner	52	800-0090	1	Screw, Cap - Hex Head (1/2-13 x 1")
16	503-0354	2	Clamp, Hose - Air Cleaner	53	856-0008	2	Washer, Lock - External/Internal Tooth (1/2)
17	155-0863	1	Adapter, Exhaust Tube	54	416-0530	1	Cable, Electrical - Battery (16")
18	800-0030	2	Screw, Cap - Hex Head (5/16-18 x 1-1/4")	55	416-0531	1	Cable, Electrical - Battery (24")
19	850-0045	2	Washer, Lock - Spring (5/16)	56	416-0446	1	Cable, Electrical - Battery Jumper
20	862-0015	2	Nut, Hex (5/16-18)	57	501-0225	1	Line, Fuel - Begin Spec H
21	191-0725	1	Guard, Belt	58	501-0227	1	Line, Fuel - Begin Spec H
22	191-0619	1	Shield, Heat - Alternator	* - For components, contact your nearest Motorola Dealer or Motorola Automotive Products, Inc., 9401 W. Grand Ave., Franklin Park, Illinois 60131.			
23	800-0025	1	Screw, Cap - Hex Head (5/16-18 x 5/8")				
24	850-0045	1	Washer, Lock - Spring (5/16)	+ - Included in Optional Vernier Throttle Assembly.			
25	191-0101	1	Bracket, Adjusting - Alternator				
26	511-0084	1	Belt, Drive - Alternator				
27	191-0781	1	Pulley, Drive - Alternator				
28	800-0095	1	Screw, Cap - Hex Head (1/2-13 x 2-1/4")				
29	850-0060	1	Washer, Lock - Spring (1/2)				
30	862-0016	1	Nut, Hex (1/2-13)				
31	191-0665	1	*Alternator (Includes Regulator & Fan) - Motorola #7D44039B				
32	312-0058	1	Capacitor (.10 MFD)				

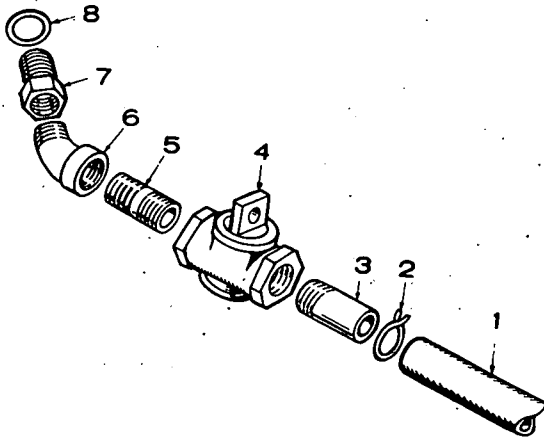
STOPPING SOLENOID GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	115-0025	1	Nut, Hex - Hardened (1/4-28)
2	150-0638	1	Joint, Ball - Rod to Injection Pump
3	115-0025	1	Nut, Hex - Hardened (1/4-28)
4	516-0103	1	Pin, Roll (1/8 x 1/2")
5	306-0215	1	Rod, Connecting - Solenoid to Injector Pump
6	518-0218	2	Ring, Retaining
7	306-0193	1	Cover, Plunger - Solenoid
8	518-0203	1	Ring, Retaining
9	306-0161	1	Spring, Plunger - Solenoid
10	812-0151	2	Screw, Machine - Round Head (1/4-20 x 3/4")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
11	850-0040	2	Washer, Lock - Spring (1/4)
12	862-0001	2	Nut, Hex (1/4-20)
13	307-0628	1	Solenoid (12 Volt)
14	306-0222	1	Plunger, Solenoid
15	306-0162	1	Spacer, Mounting - Solenoid
16	800-0069	2	Screw, Cap - Hex Head (7/16-14 x 3/4")
17	850-0050	2	Washer, Lock - Spring (7/16)
18	306-0214	1	Bracket, Mounting - Solenoid
19	306-0226	1	Brace - Solenoid Mounting Bracket

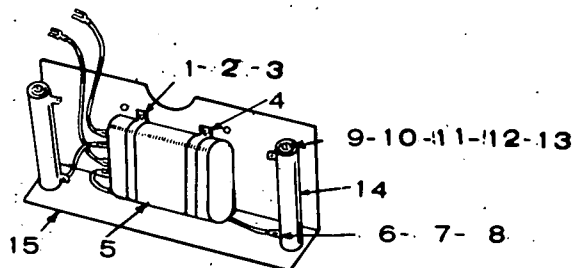
OIL DRAIN GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	503-0131	1	Clamp, Hose
2	503-0484	1	Hose, Rubber - Drain
3	505-0135	1	Nipple, Pipe - Half
4	504-0030	1	Valve, Ball - Oil Drain
5	505-0101	1	Nipple, Pipe - Close
6	505-0119	1	Elbow, Pipe - Street (45°)
7	102-0619	1	Reducer, Pipe - Oil Drain
8	102-0532	1	Gasket, "O" Ring - Oil Drain

VOLTAGE REGULATOR FILTER GROUP

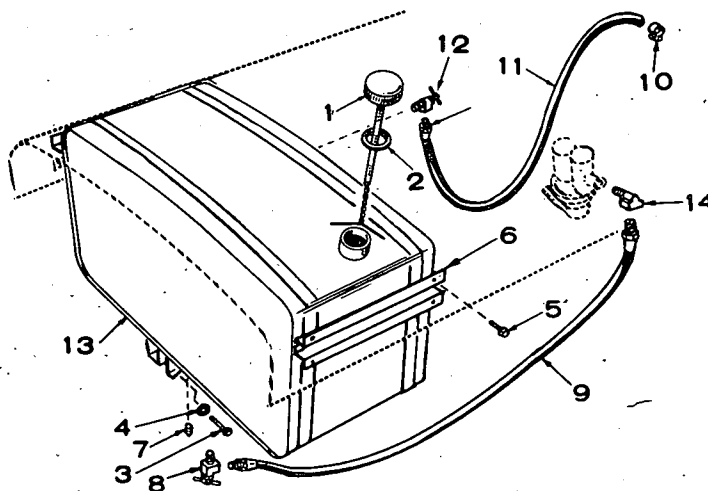
Optional



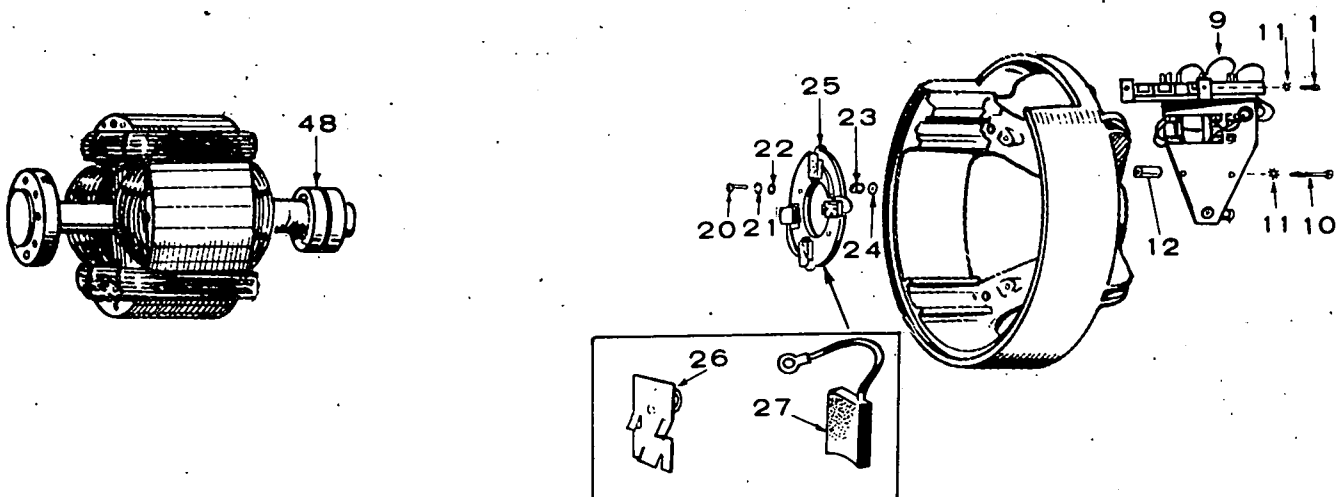
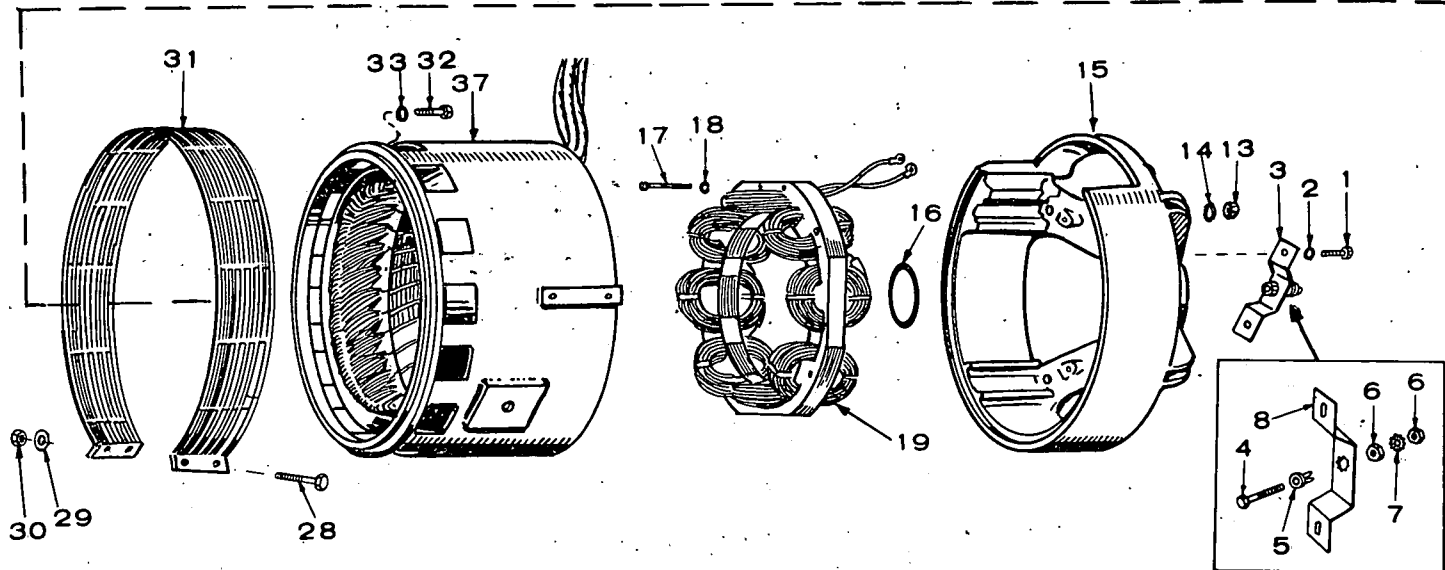
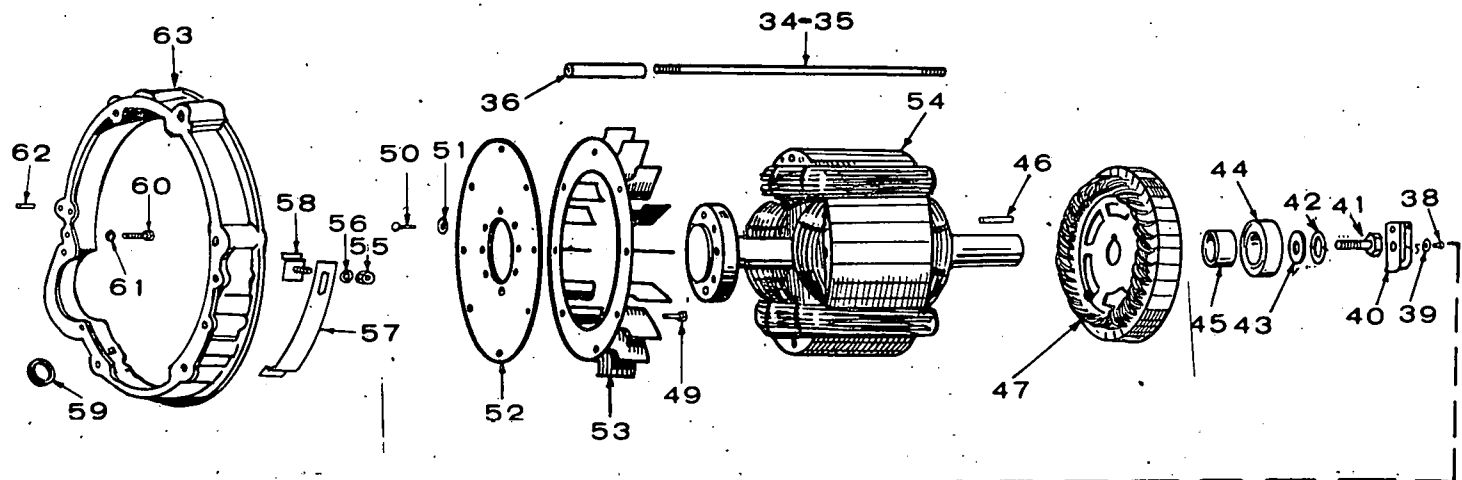
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	232-2219	1	Filter, Voltage Regulator - (Complete)
1	812-0061	4	Screw, Machine - Round Head (#6-32 x 3/8")
2	850-0020	5	Washer, Lock - Spring (#6)
3	860-0006	4	Nut, Hex (#6-32)
4	312-0189	2	Bracket, Hold-down - Capacitor
5	312-0188	1	Capacitor, Plastic Dielectric, Metal Case (15 MFD, 440 VAC)
6	815-0001	4	Screw, Machine - Binding Head, Brass (#6-32 x 1/4")
7	853-0003	4	Washer, Lock - External Tooth (#6)
8	860-0006	4	Nut, Hex (#6-32)
9	812-0165	2	Screw, Machine - Round Head (1/4-20 x 4-1/2")
10	304-0427	4	Washer, Shoulder - Centering
11	304-0292	2	Insulator, Disk
12	850-0040	2	Washer, Lock - Spring (1/4)
13	862-0001	2	Nut, Hex (1/4-20)
14	354-0025	2	Resistor, Wirewound (10-Ohm, 100 Watts, 5%)
15	232-2218	1	Bracket, Angle - Mounting

MOUNTED FUEL TANK GROUP (Housed Sets Only) - OPTIONAL EQUIPMENT

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	159-0512	1	Cap and Indicator
2	159-0751	1	Gasket, Gas Cap
3	812-0158	2	Screw, Machine - Round Head (1/4-20 x 2")
4	850-0040	2	Washer, Lock - Spring (1/4)
5	821-0010	8	Screw, Self-Locking - Hex Head (1/4-20 x 1/2")
6	159-0489	1	Strap Assembly, Mounting
7	505-0057	1	Plug, Pipe - Square Head
8	504-0013	1	Valve, Globe
9	501-0007	1	Hose, Rubber
10	503-0685	1	Clamp, Hose
11	501-0009	1	Hose, Rubber
12	504-0007	1	Valve, Globe
13	159-0490	1	Tank, Fuel (20 gallon)
14	502-0002	1	Elbow, Pipe - 90°



GENERATOR GROUP



GENERATOR GROUP

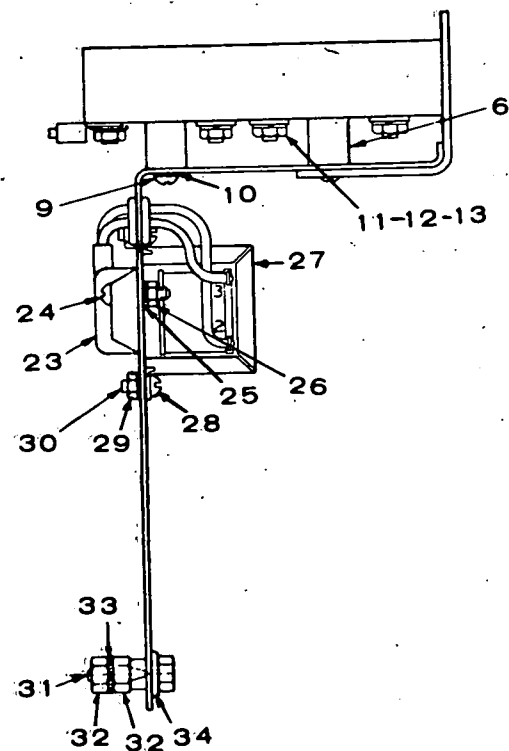
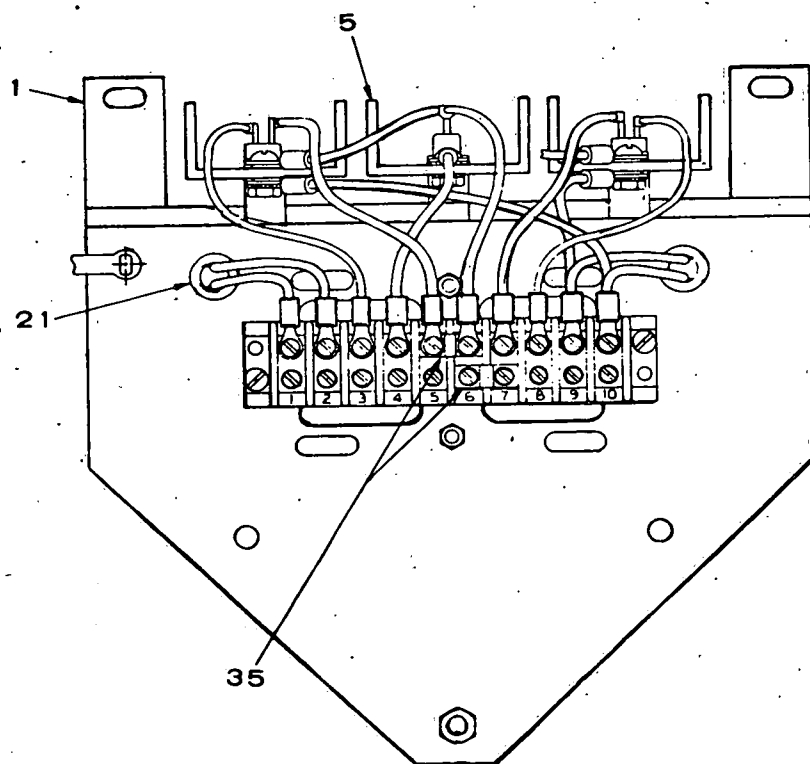
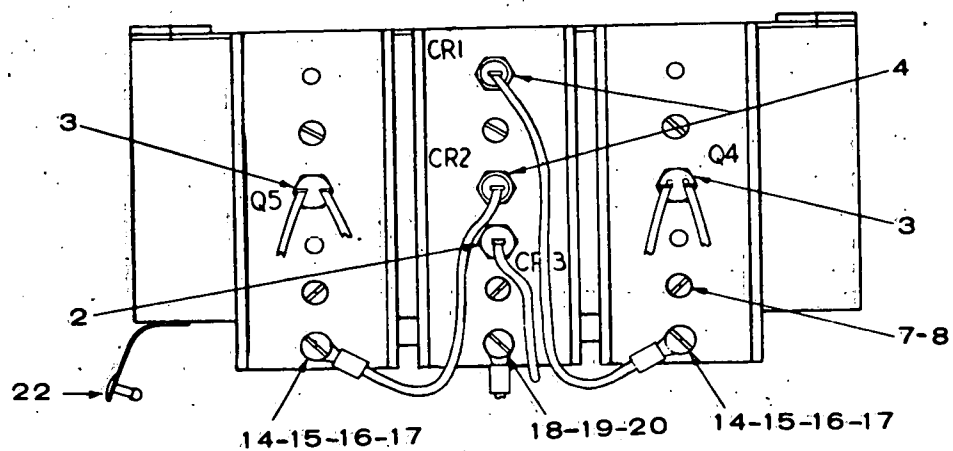
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	800-0003	2	Screw, Cap - Hex Head (1/4-20 x 1/2")	35	520-0721	4	Stud (3/8-16 x 3/8-16 x 16-11/32") Used on Three Phase Sets
2	850-0040	2	Washer, Lock - Spring (1/4")	36	503-0611	4	Hose, Rubber
3	150-1456	1	Contact Assembly - Overspeed Switch (Includes Parts Marked †) - Begin Spec G	37	STATOR, WOUND		
4	150-0723	1	†Point, Overspeed Switch	220-1552		1	25.0DEH-53R Sets
5	870-0250	1	†Nut, Insulated - Overspeed Switch	220-1994		1	25.0DEH-515R Sets
6	862-0001	2	†Nut, Hex (1/4-20)	220-1552		1	30.0DEH-3R Sets
7	853-0013	1	†Washer, Lock - External Tooth (1/4")	220-1451		1	30.0DEH-15R Sets
8	150-1356	1	†Bracket, Overspeed Switch	220-1599		1	30.0DEH-9XR Sets
9	VOLTAGE REGULATOR ASSEMBLY Spec B Though F (See Separate Group for Complete Breakdown)			38	812-0189	1	Screw, Machine - Round Head (3/8-16 x 3/4")
305-0491		1	Brushless Generator	39	856-0010	1	Washer, Lock - External/Internal Tooth (3/8")
305-0489		1	Brush Type Generator	40	150-0717	1	Switch, Overspeed
10	800-0009	2	Screw, Cap - Hex Head (1/4-20 x 1-1/2") Spec B Through F	41	800-0513	1	ROTOR ASSEMBLY, GENERATOR (Includes Parts Marked *)
11	853-0013	4	Washer, Lock - External Tooth (1/4") Spec B Through F	42	850-0079	1	*Screw, Cap - Hex Head, Special Heat Treated, Unplated (3/4-10 x 1-1/2")
12	305-0481	2	Spacer, Sleeve	43	526-0238	1	*Washer, Lock - Spring (3/4")
13	862-0011	4	Nut, Hex - Special, Grade 8 (3/8-16)	44	510-0101	1	*Washer, Flat - Steel Alloy (13/16" ID x 2" OD x 3/16" Thk)
14	850-0050	4	Washer, Lock - Spring (3/8")	45	232-2102	1	*Bearing, Ball
15	211-0185	1	End Bell - Generator	46	515-0145	1	*Spacer, Sleeve
16	509-0125	1	Seal, Oil - "O" Ring	47	201-1739	1	*Key, Machine (1/4" x 1/4" x 7/8")
17	800-0009	4	Screw, Cap - Hex Head (1/4-20 x 1-1/2")				*Rotor Assembly, Exciter - Brushless Generators Only (See Separate Group for Components)
18	850-0040	4	Washer, Lock - Spring (1/4")	48	204-0083	1	*Ring, Collector - Brush Type Generators Only
19	220-2353	1	Stator, Exciter - Brushless Generator	49	805-0018	8	Bolt, Hex Head - Grade 8 (3/8-16 x 1")
20	114-0023	4	Screw, Cap - Hex Head, Special - Heat Treated (1/4-20 x 1-1/4")	50	805-0033	8	*Bolt, Hex Head - Grade 8 (5/8-11 x 1")
21	850-0040	4	Washer, Lock - Spring (1/4")	51	526-0259	8	*Washer, Flat - Special Hardened Steel 5/8"
22	526-0018	4	Washer, Flat (17/64" ID x 5/8" OD x 1/16" Thk)	52	232-2078	1	*Disk, Drive - Generator
23	212-1225	4	Spacer, Sleeve	53	205-0089	1	*Fan, Centrifugal - Generator
24	526-0016	4	Washer, Flat (17/64" ID x 9/16" OD x 1/32" Thk)	54	ROTOR, WOUND		
25	212-0342	1	Rig Assembly, Brush (Includes Brush and Springs Marked +) - Brush Type Generators	201-1714		1	25.0DEH-53R Sets
26	212-1105	4	+Spring, Brush	201-1716		1	25.0DEH-515R Sets
27	214-0046	4	+Brush, Generator	201-1719		1	30.0DEH-3R Sets
28	800-0008	2	Screw, Cap - Hex Head (1/4-20 x 1-1/4")	201-1716		1	30.0DEH-15R Sets
29	850-0040	2	Washer, Lock - Spring (1/4")	201-1716		1	30.0DEH-9XR Sets
30	862-0001	2	Nut, Hex (1/4-20)	55	862-0001	2	Nut, Hex (1/4-20)
31	234-0368	1	Screen, Air Outlet - Generator	56	850-0040	2	Washer, Lock - Spring (1/4")
32	800-0051	8	Screw, Cap - Hex Head (3/8-16 x 1-1/4")	57	232-2210	2	Cover, Adapter Slot
33	850-0050	8	Washer, Lock - Spring (3/8")	58	232-2211	2	Catch, Adapter Slot Cover
34	520-0718	4	Stud (3/8-16 x 3/8-16 x 14-11/16") Used on Single Phase Sets	59	508-0001	1	Grommet, Rubber - Generator Adapter
				60	800-0072	9	Screw, Cap - Hex Head (7/16-14 x 1-1/4")
				61	850-0055	9	Washer, Lock - Spring (7/16")
				62	516-0152	2	Pin, Straight, Headless
				63	231-0149	1	Adapter - Engine to Generator

† - Included in Overspeed Contact Assembly No. 150-1456.

+ - Included in Brush Rig Assembly No. 212-0342.

* - Included in Generator Rotor Assembly.

VOLTAGE REGULATOR GROUP - SPEC B THROUGH F



VOLTAGE REGULATOR GROUP - SPEC B THROUGH F

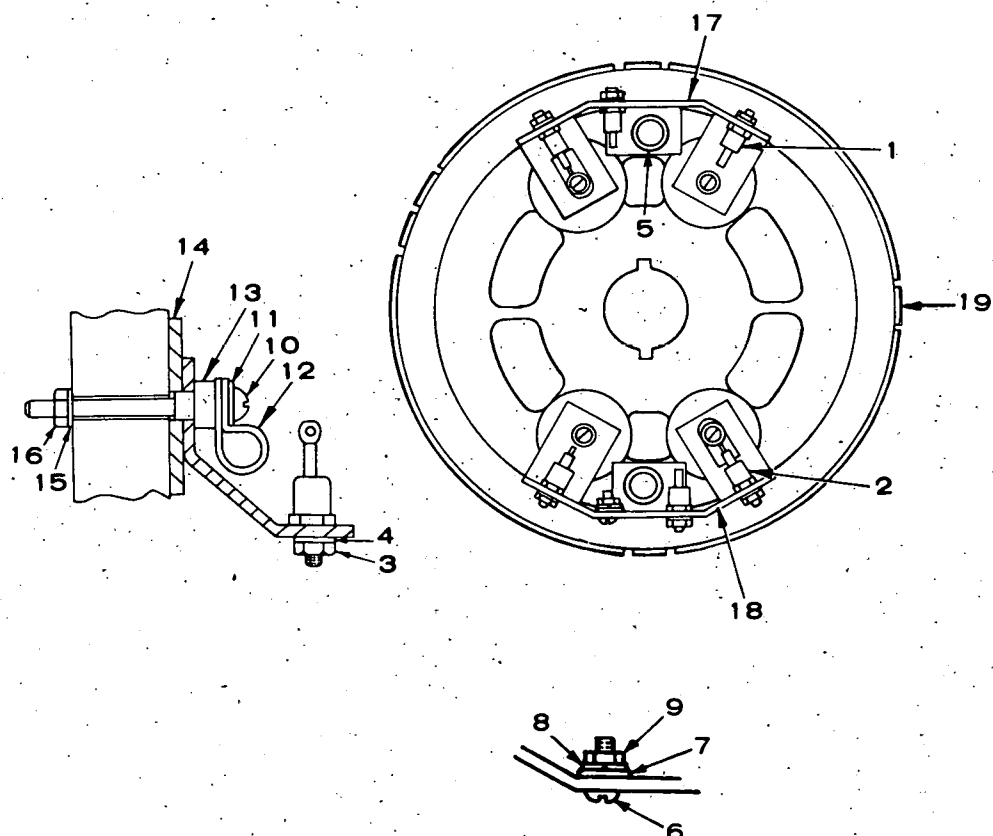
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	CHASSIS ASSEMBLY, VOLTAGE REGULATOR (Complete)		
	305-0491		Brushless Generator (Includes Parts Marked *)
	305-0489	1	Brush Type Generator (Includes Parts Marked †)
1	305-0482	1	*†Chassis, Voltage Regulator
2	358-0029	1	*†Rectifier, Silicon (CR3)
3	RECTIFIER, SILICON CONTROLLED		
	364-0014	2	*Brushless Generator (Q4 & Q5)
	364-0012	2	*†Brush Type Generator (Q4 & Q5)
4	RECTIFIER, SILICON		
	358-0035	2	*Brushless Generator (CR1 & CR2)
	358-0031	2	*†Brush Type Generator (CR1 & CR2)
5	363-0048	3	*†Heat Sink, Rectifier
6	332-1265	6	*†Insulator, Stand off
7	812-0077	6	*†Screw, Roundhead - Heat Sink Mtg. (8-32 x 3/8")
8	853-0005	6	*†Washer, Lock - ET - Heat Sink Mtg. (#8)
9	812-0077	6	*†Screw, Machine Roundhead - Stand off Insulator Mtg. (#8-32 x 3/8")
10	853-0005	6	*†Washer, Lock - ET - Stand off Insulator Mtg. (#8)
11	871-0010	3	*†Nut, Hex - Rectifier Mounting (CR1, CR2 & CR3) (#10-32)
12	526-0009	3	*†Washer, Flat (7/32" I.D. x 1/2" O.D. x 1/16" Thick) - Rectifier Mtg. (CR1, CR2 & CR3)
13	850-0030	3	*†Washer, Lock - Spring - Rectifier Mtg. (CR1, CR2 & CR3) (#10)
14	812-0079	2	*†Screw, Machine - Roundhead - Rectifier Lead to Heat Sink (#8-32 x 1/2")
15	526-0048	2	*†Washer, Flat (Brass) (.172" I.D. x 3/8" O.D. x 1/32" Thick)
16	853-0005	2	*†Washer, Lock - ET - Rectifier Lead to Heat Sink (#8)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
17	871-0007	2	*†Nut, Hex - Rectifier Lead to Heat Sink (#8-32)
18	812-0079	1	*†Screw, Machine Roundhead - Terminal Block Lead to Heatsink (#8-32 x 1/2")
19	853-0005	1	*†Washer, Lock - ET - Terminal Block to Heat Sink (#8)
20	871-0007	1	*†Nut, Hex - Terminal Block Lead to Heat Sink (#8-32)
21	508-0002	2	*†Grommet, Rubber
22	332-1415	1	*†Clamp, Cable
23	332-1266	1	*†Block, Terminal
24	812-0081	2	*†Screw Machine - Roundhead - Terminal Block Mounting (#8-32 x 5/8")
25	853-0005	2	*†Washer, Lock - ET - Terminal Block Mounting (#8)
26	860-0008	2	*†Nut, Hex - Terminal Block Mounting (#8-32)
27	REACTOR ASSEMBLY, COMMUTATOR		
	315-0343	1	*Brushless Generator
	315-0341	1	*†Brush Type Generator
28	812-0077	2	*†Screw, Machine - Roundhead - Reactor Mtg. (#8-32 x 3/8")
29	853-0005	2	*†Washer, Lock - ET - Reactor Mounting (#8)
30	860-0008	2	*†Nut, Hex - Reactor Mtg. (#8-32)
31	150-0723	1	*†Point, Contact - Overspeed Switch
32	862-0001	2	*†Nut, Hex - Contact Point (1/4-20)
33	853-0013	1	*†Washer, Lock - ET - Contact Point (1/4)
34	870-0250	2	*†Nut, Insulator - Contact Point (1/4)
35	332-1043	2	*†Jumper - Terminal Block

* - Parts included in 305-0491 Voltage Regulator.

† - Parts included in 305-0489 Voltage Regulator.

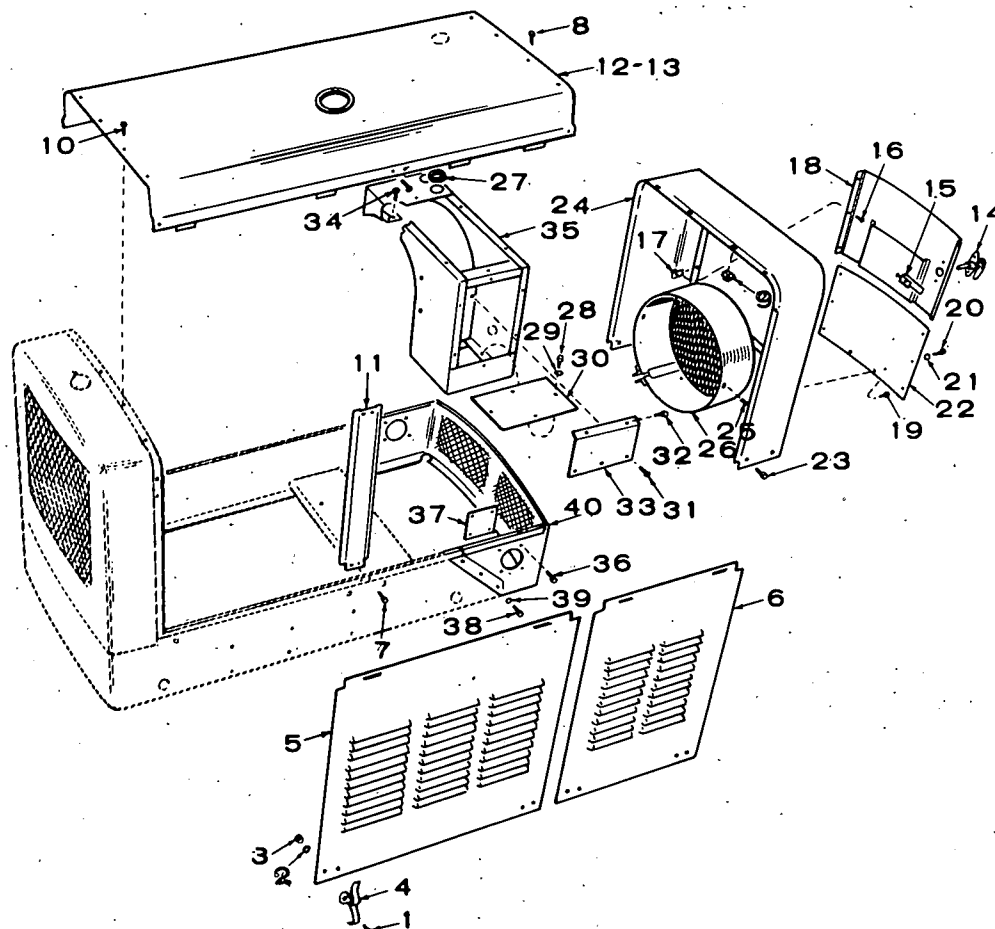
EXCITER ROTOR GROUP



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	508-0124	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

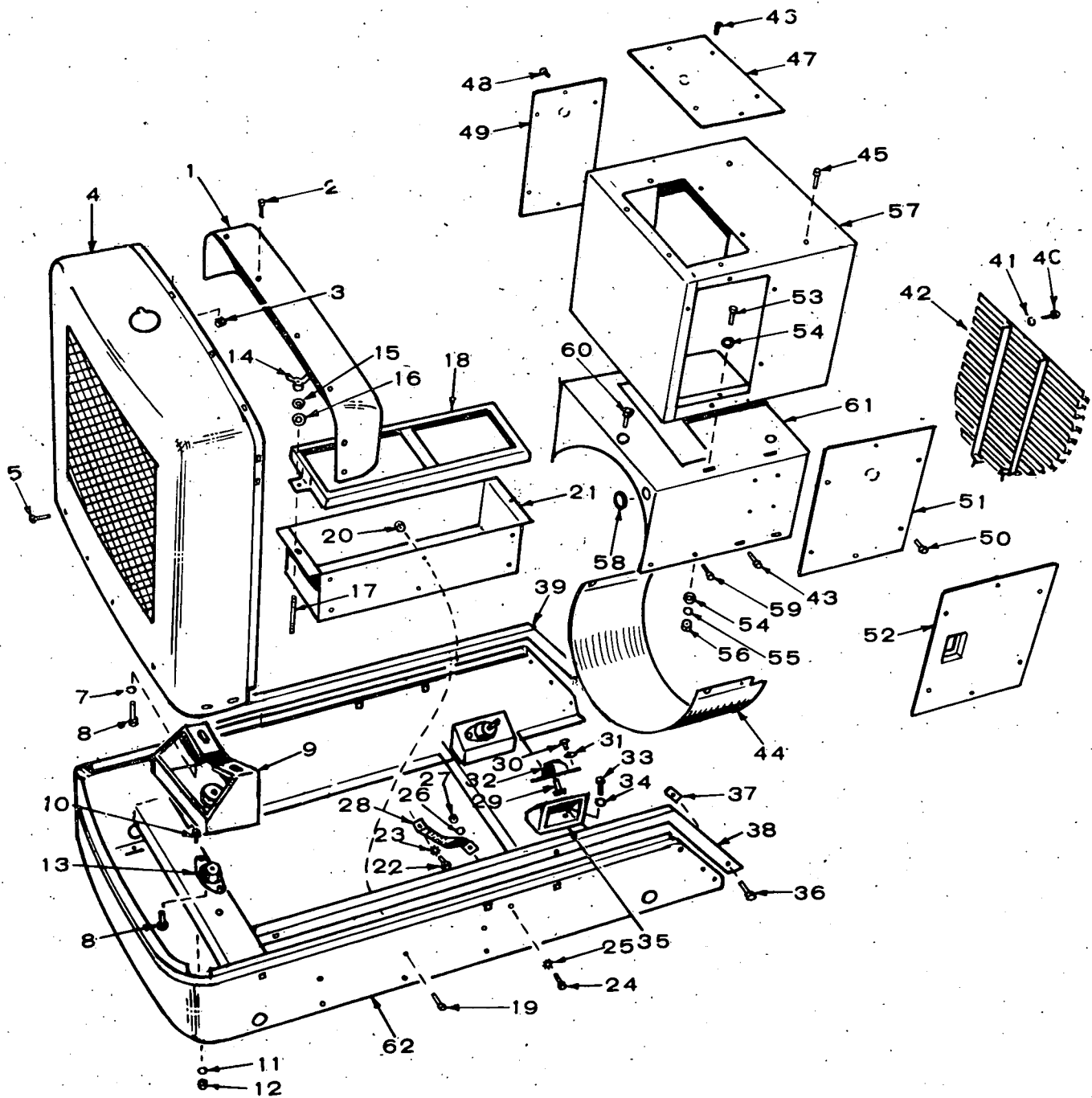
MOUNTING AND HOUSING GROUP (Housed Sets)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
HOUSED SETS - OPTIONAL (Includes following parts and unhoused set items indicated in previous group)			
1	813-0098	16	Screw, Machine - Round Head (#10-32 x 3/8")
2	850-0030	16	Washer, Lock - Spring (#10)
3	870-0053	16	Nut, Hex (#10-32)
4	406-0105	8	Clamp, Door
5	405-1808	2	Door, Louvered - Engine Section
6	405-1832	2	Door, Louvered - Generator Section
7	821-0014	4	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
8	821-0016	6	Screw, Self-locking - Hex Head (5/16-18 x 3/4")
9	870-0113	6	Nut, Clinch (5/16-18)
10	821-0014	6	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
11	405-1814	2	Support, Housing - Center
12	405-1831	1	Panel, Housing - Top (Used with standard exhaust manifold)
13	405-1844	1	Panel, Housing - Top (Used with water cooled exhaust manifold)
14	406-0157	1	Handle, Latch (with Keys)
15	406-0089	1	Catch, Latch
16	809-0059	3	Screw, Tapping - Pan Head (#14 x 1/2")
17	870-0106	3	Nut, Spring Sheet (#14)
18	405-1777	1	Door, Access - Rear
19	821-0014	2	Screw, Self-locking - Hex Head (5/16-18 x 1/2")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
20	813-0098	6	Screw, Machine - Round Head (#10-32 x 3/8")
21	850-0030	6	Washer, Lock - Spring (#10)
22	405-1780	1	Panel, Access - Rear
23	821-0014	4	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
24	405-1812	1	Panel, Housing - Rear
25	821-0010	4	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
26	234-0369	1	Cover, End Bell - Generator
27	508-0001	2	Grommet, Rubber (3/4" ID x 1-9/32" OD)
28	813-0098	4	Screw, Machine - Round Head (#10-32 x 3/8")
29	850-0030	4	Washer, Lock - Spring (#10)
30	301-3195	1	Plate, Blank - Bottom, Junction Box
31	821-0010	3	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
32	821-0014	2	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
33	301-3196	1	Bracket, Support - Current Transformer Assembly
34	821-0010	1	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
35	301-3191	1	Box, Junction
36	821-0010	8	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
37	403-0895	2	Plate, Cover
38	800-0048	6	Screw, Cap - Hex Head (3/8-16 x 3/4")
39	850-0050	6	Washer, Lock - Spring (3/8)
40	403-0894	1	Adapter, Chassis - Rear

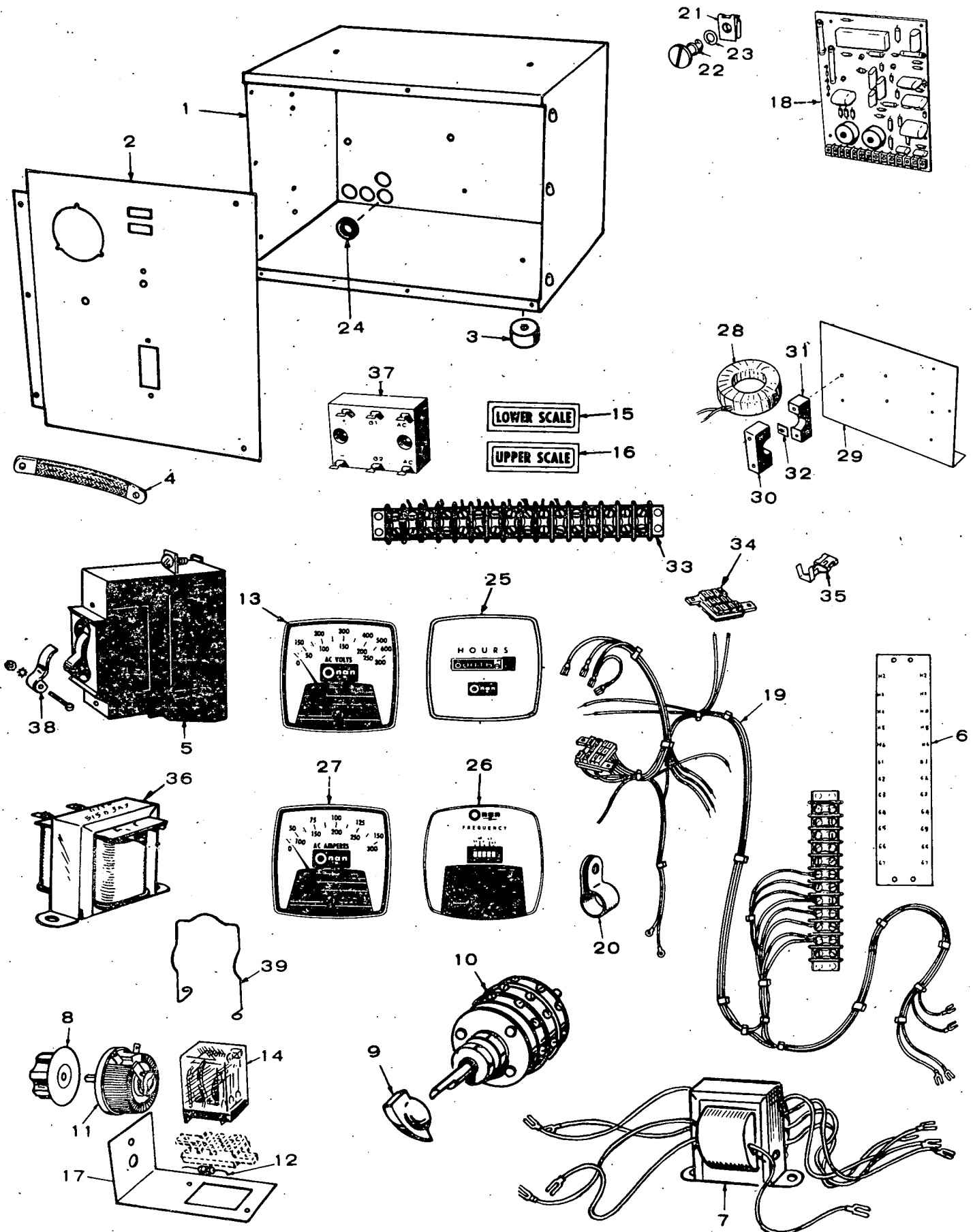
MOUNTING AND HOUSING GROUP (Unhoused Sets)



MOUNTING AND HOUSING GROUP (Unhoused Sets)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	405-1409	1	Extension, Hood - Radiator Spec B Through G	33	800-0091	4	Screw, Cap - Hex Head (1/2-13 x 1-1/4")
2	821-0014	8	Screw, Self-Locking - Hex Head (5/16-18 x 1/2")	34	850-0055	4	Washer, Lock - Spring (1/2)
3	870-0113	8	Nut, Clinch (5/16-18) (Also used with Housed Sets)	35	232-2106	2	Bracket, Support - Generator Spec B Through G
4	405-1811	1	Panel, Radiator (Also used with Housed Sets)	36	821-0014	6	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
5	821-0014	8	Screw, Self-locking - Hex Head (5/16-18 x 1/2")	37	870-0020	6	Nut, Plate (5/16-18)
6	800-0050	2	Screw, Cap - Hex Head (3/8-16 x 1")	38	403-0913	1	Trim, Chassis - Right Side Spec B Through G
7	850-0050	2	Washer, Lock - Spring (3/8)	39	403-0914	1	Trim, Chassis - Left Side Spec B Through G
8	800-0520	1	Screw, Cap - Special Hex Head, Unplated (3/4-10 x 1")	40	812-0146	4	Screw, Machine - Round Head (1/4-20 x 3/8")
9	403-0910	1	Support, Engine	41	850-0040	4	Washer, Lock - Spring (1/4)
10	800-0090	2	Screw, Cap - Hex Head (1/2-13 x 1")	42	234-0370	1	Grille, Inlet, Air
11	850-0060	2	Washer, Lock - Spring (1/2)	43	821-0010	7	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
12	862-0016	2	Nut, Hex (1/2-13)	44	234-0361	1	Wrapper, End Bell - Generator
13	402-0030	1	Mount, Vibration	45	821-0014	4	Screw, Self-locking - Hex Head (5/16-18 x 1/2") - Control Box Mounting
14	865-0007	2	Nut, Wing (5/16-18)	46	815-0350	6	Screw, Tapping - Hex Head, Slotted (#10-32 x 3/8")
15	850-0045	2	Washer, Lock - Spring (5/16)	47	301-3156	1	Panel, Blank - Top (Also used on Housed Sets)
16	526-0115	2	Washer, Flat (11/32" ID x 11/16" OD x 1/16" THK)	48	815-0350	6	Screw, Tapping - Hex Head, Slotted (#10-32 x 3/8")
17	520-0663	2	Stud (5/16-18 x 3-1/4")	49	301-3156	1	Panel, Blank - Left Side
18	416-0480	1	Frame, Hold-down - Battery	50	815-0350	6	Screw, Tapping - Hex Head, Slotted (#10-32 x 3/8")
19	821-0029	6	Screw, Self-locking - Hex Head (3/8-16 x 3/4")	51	301-3156	1	Panel, Blank - Right Side (Also used on Housed Sets)
20	870-0281	6	Nut, Self-locking (3/8-16)	52	301-3192	1	Panel, Circuit Breaker - Right Side - Optional (Used with Line Load Circuit Breaker)
21	416-0666	1	Tray - Battery	53	800-0003	4	Screw, Cap - Hex Head (1/4-20 x 1/2)
22	800-0090	1	Screw, Cap - Hex Head (1/2-13 x 1")	54	526-0018	8	Washer, Flat (17/64" ID x 5/8" OD x 1/16" THK)
23	856-0013	1	Washer, Lock - External/Internal Tooth (1/2)	55	850-0040	4	Washer, Lock - Spring (1/4)
24	800-0091	1	Screw, Cap - Hex Head (1/2-13 x 1-1/4")	56	862-0001	4	Nut, Hex (1/4-20)
25	856-0013	1	Washer, Lock - External/Internal Tooth (1/2)	57	301-3155	1	Housing, Control Box
26	850-0050	1	Washer, Lock - Spring (1/2)	58	508-0001	1	Grommet, Rubber (3/4" ID x 1-9/32" OD)
27	862-0016	1	Nut, Hex (1/2-13)	59	821-0014	4	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
28	337-0090	1	Lead, Electrical - Ground (Flexible)	60	821-0010	1	Screw, Self-locking - Hex Head (1/4-20 x 1/2")
29	800-0520	2	Screw, Cap - Special Hex Head, Unplated (3/4-10 x 1")	61	301-3154	1	Saddle - Control Box Housing
30	800-0071	4	Screw, Cap - Hex Head (7/16-14 x 1")	62	403-1111	1	Chassis - Engine/Generator (Also used with Housed Sets)
31	850-0055	4	Washer, Lock - Spring (7/16)				
32	402-0030	2	Mount, Vibration				

CONTROL GROUP (AC Output Portion)



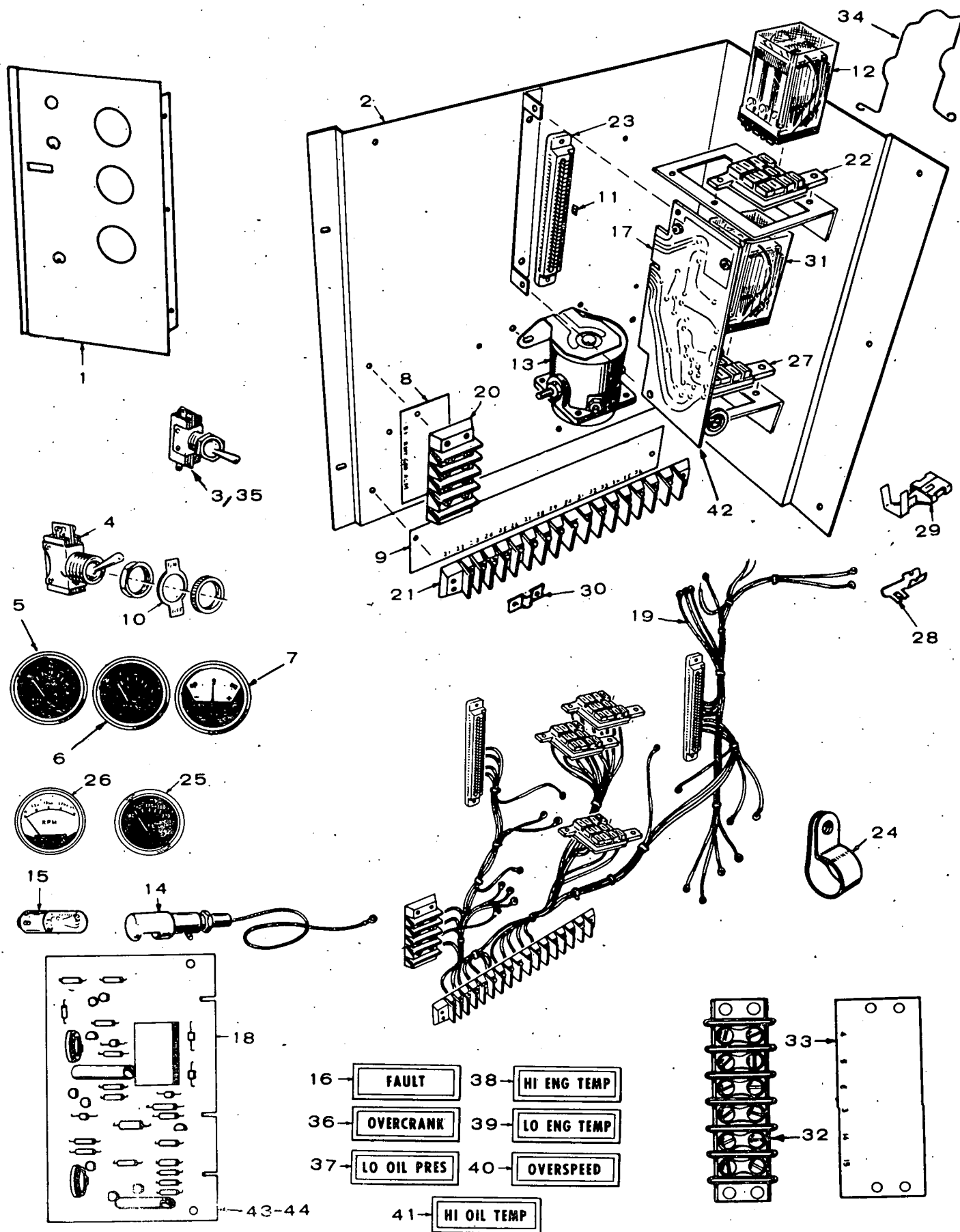
CONTROL GROUP (AC Output Portion)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301-3158	1	Box, Control	19	HARNESS, WIRING - AC CONTROL (INCLUDES PARTS MARKED ★)		
2	PANEL ONLY, CONTROL		Sets Without Meter Panel				Sets Without Meter Panel
	301-3167	1	25.0DEH-53R & 30.0DEH-3R Sets		338-0522	1	25.0DEH-53R & 30.0DEH-3R Sets
	301-3168	1	25.0DEH-515R & 30.0DEH-15R Sets		338-0524	1	25.0DEH-515R & 30.0DEH-15R Sets
	301-3341	1	30.0DEH-9XR Sets		338-0570	1	30.0DEH-9XR Sets
	301-3169	1	Sets With Meter Panel		338-0523	1	Sets With Meter Panel
			25.0DEH-53R & 30.0DEH-3R Sets				25.0DEH-53R & 30.0DEH-3R Sets
	301-3170	1	25.0DEH-515R & 30.0DEH-15R Sets		338-0525	1	25.0DEH-515R & 30.0DEH-15R Sets
			30.0DEH-9XR Sets				30.0DEH-9XR Sets
3	402-0078	4	Mount, Vibration	20	332-0050	1	Clamp, Loop
4	337-0049	1	Lead, Electrical - Ground	21	406-0332	2	Receptacle, Turnbutton Fastener
5	320-0431	1	Breaker, Circuit	22	406-0333	2	Stud, Turnbutton Fastener
6	MARKER STRIP			23	406-0334	2	Washer, Lock - Turnbutton Stud
	332-1248	1	Strip, Marker (12 Place)	24	508-0001	4	Grommet, Rubber (1-1/16" OD)
	332-1242	1	Strip, Marker - Optional (16 Place)	25	TIME TOTALIZING METER		
7	TRANSFORMER, VOLTAGE				302-0466	1	Meter, Time Totalizing - 60 Hertz
	315-0342	1	Spec B Through G		302-0469	1	Meter, Time Totalizing - 50 Hertz
	315-0431	1	Begin Spec H	26	ELECTRICAL FREQUENCY METER		
8	303-0032	1	Knob		302-0221	1	Meter, Electrical Frequency - 60 Hertz
9	303-0076	1	Knob, Pointer		302-0256	1	Meter, Electrical Frequency - 50 Hertz
10	ROTARY SWITCH			27	AMMETER		
	308-0012	1	Switch, Rotary - 2 Pole, 4 Position		302-0412	2	Ammeter (0-250) - Optional
	308-0284	1	Switch, Rotary - 4 Pole, 4 Position - Optional		302-0719	1	Ammeter (0-75, 0-150)
11	303-0170	1	Rheostat	28	CURRENT TRANSFORMER		
12	350-0556	1	† Resistor, Composition (47,000-Ohm, 1/2 Watt, 5%)		302-0079	3	25.0DEH-515R & 30.0DEH-15R Sets
13	VOLTMETER				302-0209	2	25.0DEH-53R & 30.0DEH-3R Sets
	302-0421	1	Voltmeter - Optional (0-300 Volt)		302-0117	3	30.0DEH-9XR Sets
	302-0718	1	Voltmeter - Optional (0-300 Volt, 0-600 Volt)	29	302-0729	1	Bracket, Angle - Current Transformer Mounting
	302-0779	1	Voltmeter - Optional (0-750 Volt)	30	302-0235	3	Clamp, Retaining, Transformer - Upper
14	307-1061	1	Relay, Armature	31	302-0236	3	Clamp, Retaining, Transformer - Lower
15	322-0130	1	Light, Indicator - Optional (Lower Scale)	32	302-0253	As Req.	Shim - Transformer Mounting
16	322-0131	1	Light, Indicator - Optional (Upper Scale)	33	TERMINAL BOARD		
17	301-3244	1	Bracket, Angle - Relay Socket		332-0607	1	† Board, Terminal (12 Place)
18	REGULATOR BOARD, VOLTAGE (See Separate Group for Breakdown)				332-0795	1	† Board, Terminal (16 Place) - Optional
	332-1268	1	Spec B Through G	34	323-0764	1	† Socket, Relay
	332-1956	1	Begin Spec H	35	332-1280	As Req.	† Terminal, Lug
				36	315-0384	1	Reactor - Begin Spec G
				37	305-0524	1	Rectifier Assembly - Begin Spec G
				38	320-0307	1	Lock, Handle - Circuit Breaker - Optional (Penn State Sets)
				39	307-1157	1	Clip, Retaining - Relay

† - Included in Wiring Harness

★ - See Separate Group for Components

CONTROL GROUP (Engine Section)



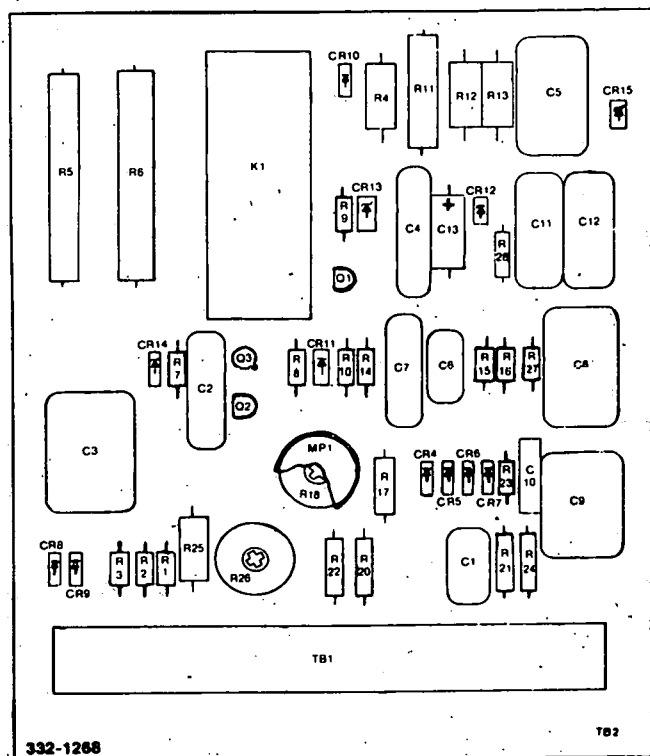
CONTROL GROUP (Engine Section)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL ONLY, ENGINE CONTROL			23	332-1271	2	†Housing, Connector (PC Boards)
	301-3165	1	Sets With One Fault Light	24	332-0051	1	Clamp, Loop
	301-3267	1	Sets With Five Fault Lights - Optional	25	GAUGE, OIL TEMPERATURE - OPTIONAL		
2	301-3253	1	Bracket, Angle - Control Mounting		193-0187	1	Spec B Through G
3	308-0138	1	Switch, Toggle (SPDT)		193-0248	1	Begin Spec H
4	308-0002	1	Switch, Toggle (SPST)	26	302-0749	1	Tachometer, Electrical - Optional
5	GAUGE, OIL PRESSURE			27	323-0764	1	†Socket, Relay
	193-0107	1	Spec B Through G	28	332-1269	As Req.	†Contact, Electrical - PC Board Connector
	193-0243	1	Begin Spec H	29	332-1280	As Req.	†Terminal, Lug
6	GAUGE, WATER TEMPERATURE			30	332-1043	1	†Jumper
	193-0106	1	Spec B Through G	31	307-1061	1	Relay, Armature
	193-0245	1	Begin Spec H	32	332-0699	1	†Board, Terminal (6 Place)
7	302-0061	1	Ammeter (30-0-30)	33	332-1240	1	Strip, Marker
8	332-1239	1	Strip, Marker	34	307-1157	3	Clip, Retaining - Relay
9	332-1241	1	Strip, Marker	35	308-0327	1	Switch, Toggle - Optional (SPDT) Penn State
10	308-0003	1	Plate, Switch (On-Off)	36	322-0107	1	Light, Indicator (Overcrank)
11	332-1276	4	Plug, Key	37	322-0108	1	Light, Indicator (Low Oil Pressure)
12	307-1058	2	Relay, Armature	38	322-0109	1	Light, Indicator (Hi Engine Temp)
13	307-1031	1	Relay, Armature	39	322-0110	1	Light, Indicator (Low Engine Temp)
14	322-0149	1	Light, Panel	40	322-0111	1	Light, Indicator (Overspeed)
15	322-0004	1	Lamp, Incandescent (12 Volt)	41	322-0112	1	Light, Indicator (Hi Oil Temp)
16	322-0128	1	Light, Indicator (Fault)	42	300-0714	1	*Control, Cycle Cranker - Optional
17	300-0733	1	*Control, Cycle Cranker	43	300-0730	1	*Control, Engine Monitor - Optional
18	300-0679	1	*Control, Engine Monitor	44	300-0681	1	*Control, Engine Monitor - 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	†Board, Terminal (4 Place)				
21	332-0795	1	†Board, Terminal (16 Place)				
22	332-0765	2	†Socket, Relay				

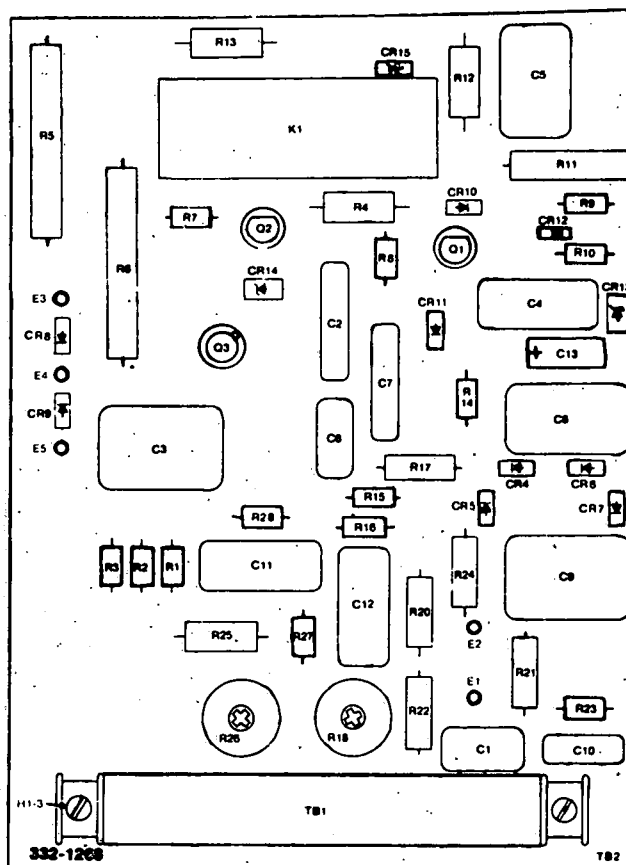
* - See Separate Group for Components.

† - Included in Wiring Harness.

VOLTAGE REGULATOR GROUP SPEC B THROUGH G



(LATEST PRODUCTION)



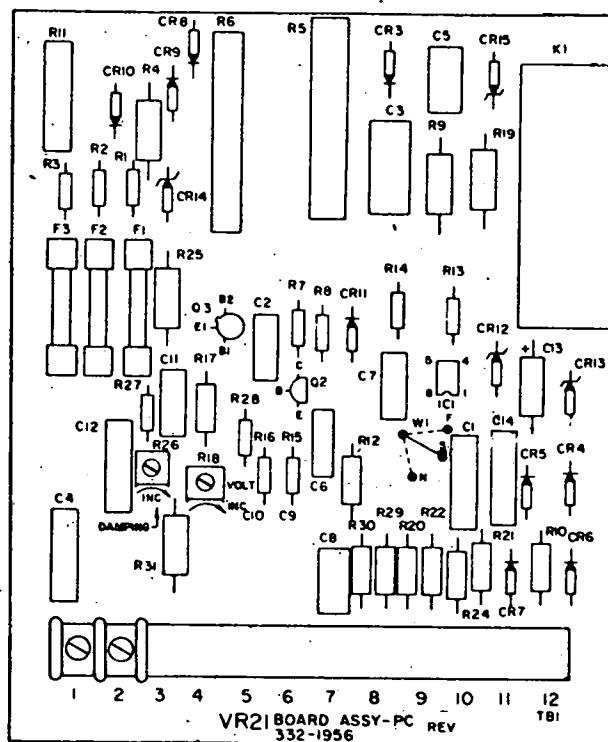
(EARLY PRODUCTION)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
C1	355-0018	1	Capacitor, Plastic Die (.47 MFD, 100 VDC, 2%)
C2	355-0005	1	Capacitor, Plastic Die (.22 MFD, 200 VDC, 10%)
C3	355-0017	1	Capacitor, Plastic Die (.47 MFD, 400 VDC, 10%)
C4	355-0006	1	Capacitor, Plastic Die (.47 MFD, 200 VDC, 10%)
C5	355-0016	1	Capacitor, Plastic Die (1 MFD, 100 VDC, 10%)
C6	355-0015	1	Capacitor, Plastic Die (.1 MFD, 200 VDC, 10%)
C7	355-0005	1	Capacitor, Plastic Die (.22 MFD, 200 VDC, 10%)
C8	355-0016	1	Capacitor, Plastic Die (1 MFD, 100 VDC, 10%)
C9	355-0017	1	Capacitor, Plastic Die (.47 MFD, 400 VDC, 10%)
C10	355-0014	1	Capacitor, Plastic Die (.047 MFD, 200 VDC, 10%)
C11	355-0020	1	Capacitor, Plastic Die (.1 MFD, 400 VDC, 10%)
C12	355-0006	1	Capacitor, Plastic Die (.47 MFD, 200 VDC, 10%)
C13	356-0039	1	Capacitor, Electrolytic (100 MFD, 10 Volts)
CR4	357-0014	1	Diode, Rectifier
CR5	357-0014	1	Diode, Rectifier
CR6	357-0014	1	Diode, Rectifier
CR7	357-0014	1	Diode, Rectifier
CR8	357-0014	1	Diode, Rectifier
CR9	357-0014	1	Diode, Rectifier
CR10	357-0014	1	Diode, Rectifier
CR11	357-0014	1	Diode, Rectifier
CR12	359-0016	1	Diode, Zener
CR13	359-0025	1	Diode, Zener
CR14	359-0026	1	Diode, Zener
CR15	359-0015	1	Diode, Zener
E1-5	332-0833	5	*Terminal, Stud
H1	812-0081	2	*Screw, Round Head (#8-32 x 5/8")
H2	853-0005	2	*Washer, Lock - External Tooth (#8)
H3	860-0008	2	*Nut, Hex (#8-32)
K1	307-1063	1	Relay, Armature
MP1	517-0127	1	Cover, Potentiometer
Q1	362-0017	1	Transistor
Q2	362-0017	1	Transistor
Q3	361-0004	1	Transistor

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
R1	350-0355	1	Resistor, Composition (47-Ohm, 1/2 Watt, 5%)
R2	350-0351	1	Resistor, Composition (33-Ohm, 1/2 Watt, 5%)
R3	350-0351	1	Resistor, Composition (33-Ohm, 1/2 Watt, 5%)
R4	350-1075	1	Resistor, Composition (4.7 Megohm, 2 Watt, 5%)
R5	353-0040	1	Resistor, Wire Wound (270-Ohm, 10 Watt, 5%)
R6	353-0039	1	Resistor, Wire Wound (5000-Ohm, 15 Watt, 5%)
R7	350-0398	1	Resistor, Composition (3000-Ohm, 1/2 Watt, 5%)
R8	350-0447	1	Resistor, Composition (330,000-Ohm, 1/2 Watt, 5%)
R9	350-0423	1	Resistor, Composition (33,000-Ohm, 1/2 Watt, 5%)
R10	350-0423	1	Resistor, Composition (33,000-Ohm, 1/2 Watt, 5%)
R11	352-0151	1	Resistor, Wire Wound (15,000-Ohm, 5 Watt, 5%)
R12	350-1014	1	Resistor, Composition (13,000-Ohm, 2 Watt, 5%)
R13	350-1007	1	Resistor, Composition (6800-Ohm, 2 Watt, 5%)
R14	350-0443	1	Resistor, Composition (220,000-Ohm, 1/2 Watt, 5%)
R15	350-0435	1	Resistor, Composition (100,000-Ohm, 1/2 Watt, 5%)
R16	350-0447	1	Resistor, Composition (330,000-Ohm, 1/2 Watt, 5%)
R17	351-0521	1	Resistor, Film (12,100-Ohm, 1/4 Watt, 1%)
R18	303-0168	1	Potentiometer (5000-Ohm, 3 Watt, 5%)
R19			Not used
R20	351-0520	1	Resistor, Film (28,000-Ohm, 1/4 Watt, 1%)
R21	351-0522	1	Resistor, Film (5110-Ohm, 1/4 Watt, 1%)
R22	351-0520	1	Resistor, Film (28,000-Ohm, 1/4 Watt, 1%)
R23	350-0355	1	Resistor, Composition (47-Ohm, 1/2 Watt, 5%)
R24	351-0523	1	Resistor, Film (8870-Ohm, 1/4 Watt, 1%)
R25	350-1011	1	Resistor, Composition (10,000-Ohm, 2 Watt, 5%)
R26	303-0164	1	Potentiometer (8000-Ohm, 3 Watt, 20%)
R27	350-0447	1	Resistor, Composition (100,000-Ohm, 1/2 Watt, 5%)
R28	350-0459	1	Resistor, Composition (1 Megohm, 1/2 Watt, 5%)
TB1	332-1252	1	Terminal Board
TB2	332-1258	1	Printed Wiring Board

* - Used only on Early Production Units.

VOLTAGE REGULATOR GROUP BEGIN SPEC H



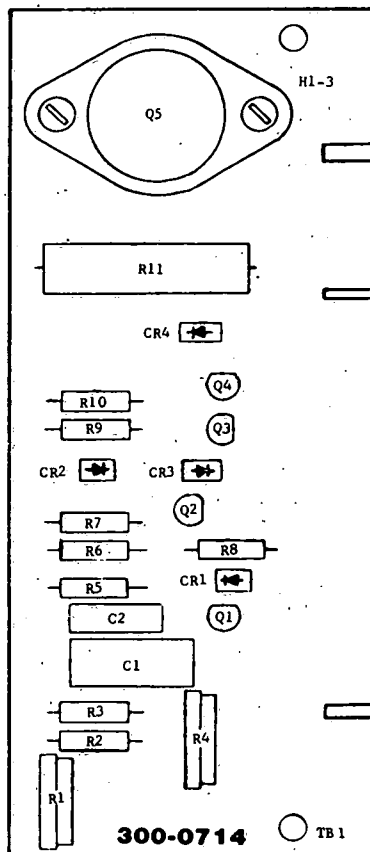
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	332-1956	1	Board Assembly, Printed - Complete	R11	352-0151	1	Resistor - Fixed 5 Watt, 15,000-Ohm
C1,14	355-0042	2	Capacitor - 47 Mfd, 250 Volt	R12	351-0909	1	Resistor - 1/2 Watt, 90,900-Ohm
C2, C7	355-0043	2	Capacitor - 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 Thru 11	357-0014	9	Rectifier - Silicon	R24	351-0523	1	Resistor - Metal Film - 1/4 Watt, 8,870-Ohm
CR12	359-0036	1	Diode - Zener 5.6 Volt	R25, R31	350-1011	2	Resistor - 2 Watt, 10,000-Ohm
CR13	359-0025	1	Diode - Zener 20 Volt	R26	303-0211	1	Potentiometer - 1/2 Watt, 100,000-Ohm
CR14	359-0026	1	Diode - Zener 18 Volt	R28	350-0568	1	Resistor - 1/2 Watt .47 Meg-Ohm
F1, F2, F3	321-0204	3	Fuse 1/4 Amp	TB1	332-1252	1	Terminal Block
IC1	367-0005	1	Integrated Circuit	CR15	359-0015	1	Diode - Zener - 24 Volt
Q2	362-0017	1	Transistor - Silicon NPN	K1	307-1063	6	Clip - Fuse
Q3	361-0004	1	Transistor - Unijunction	R9	350-1014	1	Relay, Magnetic Reed
R1	350-0355	1	Resistor - 1/2 Watt, 47-Ohm	R19	350-1007	1	Resistor - 2 Watt, 13,000-Ohm
R2, R3	350-0351	2	Resistor - 1/2 Watt, 33-Ohm				Resistor - 2 Watt, 6,800-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				

CRANKER CONTROL GROUP - 12 VOLT STANDARD



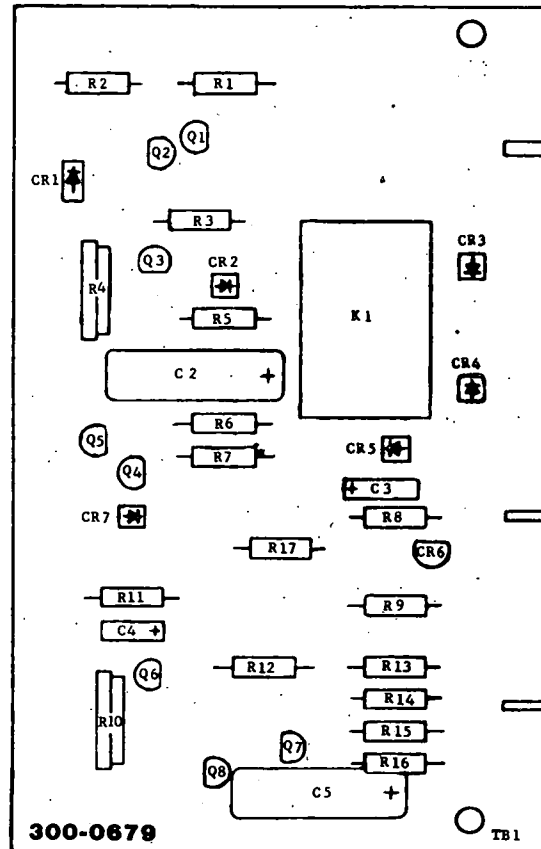
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0733		Control, Cranker - 12 Volt
CR1	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)
TB1	332-1285	1	Printed Wiring Board

CRANKER CYCLE CONTROL GROUP - 12 VOLT OPTIONAL



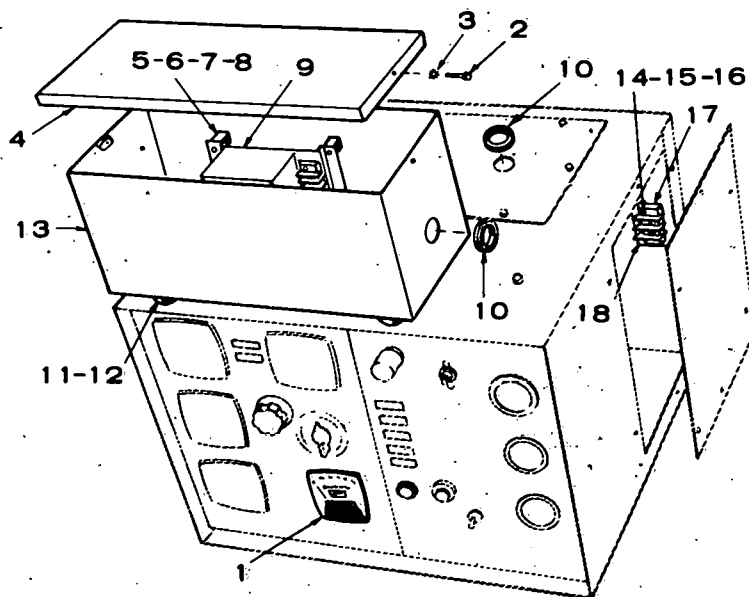
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0714		Control, Cranker Cycle - 12 Volt
C1	356-0039	1	Capacitor, Electrolytic (100 Mfd, 10 Volt)
C2	355-0010	1	Capacitor, Plastic Dielectric (.0022 Mfd, 100 VDC, 10%)
CR1	359-0027	1	Diode, Zener
CR2	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)
CR3	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)
CR4	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)
H1	812-0061	2	Screw, Machine, Round Head (#6-32 x 3/8")
H2	853-0003	2	Washer, Lock - External Tooth (#6)
H3	860-0006	2	Nut, Hex (#6-32)
Q1	362-0008	1	Transistor
Q2	362-0008	1	Transistor
Q3	362-0017	1	Transistor
Q4	362-0026	1	Transistor
Q5	362-0019	1	Transistor
R1	303-0171	1	Potentiometer (100,000-Ohm, 1/4 Watt)
R2	350-0560	1	Resistor, Composition (0.1 Megohm, 1/2 Watt, 10%)
R3	350-0548	1	Resistor, Composition (10,000-Ohm, 1/2 Watt, 10%)
R4	303-0171	1	Potentiometer (100,000-Ohm, 1/4 Watt)
R5	350-0558	1	Resistor, Composition (68,000-Ohm, 1/2 Watt, 10%)
R6	350-0420	1	Resistor, Composition (24,000-Ohm, 1/2 Watt, 5%)
R7	350-0546	1	Resistor, Composition (6800-Ohm, 1/2 Watt, 10%)
R8	350-0520	1	Resistor, Composition (47-Ohm, 1/2 Watt, 5%)
R9	350-0548	1	Resistor, Composition (10,000-Ohm, 1/2 Watt, 10%)
R10	350-0500	1	Resistor, Composition (1-Ohm, 1/2 Watt, 10%)
R11	352-0152	1	Resistor, Wirewound (25-Ohm, 5 Watt, 5%)
TB1	332-1275	1	Printed Wiring Board

ENGINE CONTROL MONITOR GROUP - 12 VOLT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	300-0679		Monitor, Engine Control - 12 Volt	R1	350-0536	1	Resistor, Composition (1000-Ohm, 1/2 Watt, 10%)
C1			Not used	R2	350-0526	1	Resistor, Composition (100-Ohm, 1/2 Watt, 10%)
C2	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R3	350-0548	1	Resistor, Composition (10,000-Ohm, 1/2 Watt, 10%)
C3	356-0040	1	Capacitor, Electrolytic (10 Mfd, 20 Volt)	R4	303-0169	1	Potentiometer (3.5 Meg Ohm, 1/4 Watt, 30%)
C4	356-0030	1	Capacitor, Electrolytic (1 Mfd, 35 Volt)	R5	350-0572	1	Resistor, Composition (1-Meg Ohm, 1/2 Watt, 10%)
C5	355-0005	1	Capacitor, Plastic Dielectric (.22 Mfd, 200 VDC, 10%)	R6	350-0552	1	Resistor, Composition (22,000-Ohm, 1/2 Watt, 10%)
CR1	359-0027	1	Diode, Zener (1 Watt, 7.5 Volt, 5%)	R7	350-0536	1	Resistor, Composition (1000-Ohm, 1/2 Watt, 10%)
CR2	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R8	350-0505	1	Resistor, Composition (2.7-Ohm, 1/2 Watt, 10%)
CR3	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R9	350-0517	1	Resistor, Composition (27-Ohm, 1/2 Watt, 10%)
CR4	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R10	303-0169	1	Potentiometer (3.5-Meg Ohm, 1/4 Watt, 30%)
CR5	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R11	350-0584	1	Resistor, Composition (10-Meg Ohm, 1/2 Watt, 10%)
CR6	364-0017	1	Diode, Rectifier (8 Amp, 30 Volt)	R12	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
CR7	357-0004	1	Diode, Rectifier (400 MA, 400 Volt)	R13	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
K1	307-1039	1	Relay, Armature (12 Volt)	R14	350-0529	1	Resistor, Composition (270-Ohm, 1/2 Watt, 10%)
Q1	361-0003	1	Transistor	R15	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
Q2	362-0025	1	Transistor	R16	350-0540	1	Resistor, Composition (2200-Ohm, 1/2 Watt, 10%)
Q3	362-0025	1	Transistor	R17	350-1128	1	Resistor, Composition (220-Ohm, 2 Watt, 10%)
Q4	361-0003	1	Transistor	TB1	332-1246	1	Printed Wiring Board
Q5	362-0025	1	Transistor				
Q6	362-0025	1	Transistor				
Q7	362-0008	1	Transistor				
Q8	362-0008	1	Transistor				

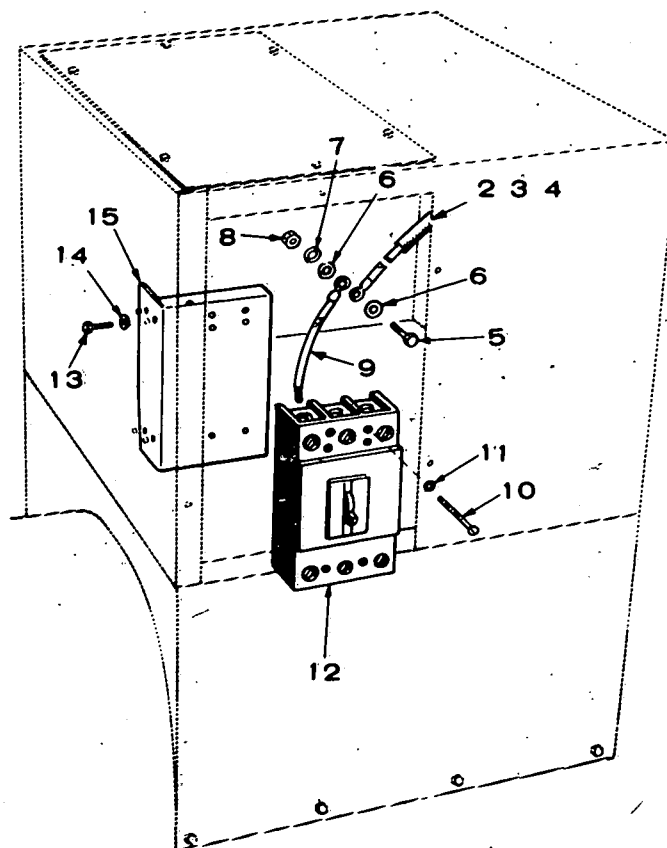
WATTMETER GROUP - OPTIONAL



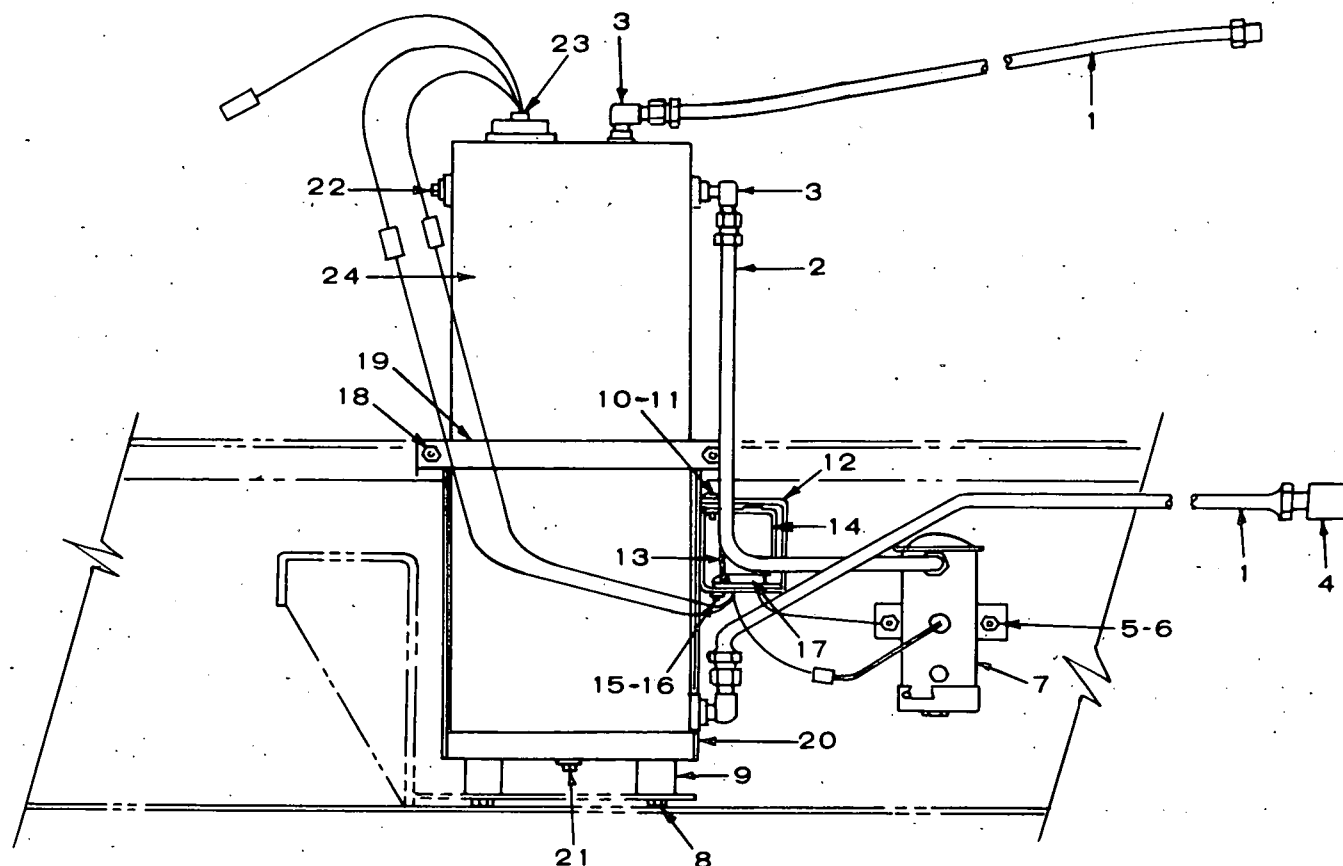
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	302-0766	1	Wattmeter (0-35KW)
2	815-0026	2	Screw, Machine - Truss Head (#10-32 x 3/8")
3	853-0008	2	Washer, Lock - External Tooth (#10)
4	301-3476	1	Cover, Box - Transducer
5	860-0008	8	Nut, Hex (#8-32)
6	853-0005	8	Washer, Lock - External Tooth (#8)
7	526-0003	8	Washer, Flat (11/64" ID x 3/8" OD x 1/32" THK)
8	402-0354	4	Mount, Vibration
9	302-0902	1	Transducer, Watt
10	508-0001	2	Grommet, Rubber (1-1/6" OD)
11	821-0014	4	Screw, Self-locking - Hex Head (5/16-18 x 1/2")
12	402-0070	4	Mount, Vibration
13	301-3477	1	Box, Transducer
14	812-0063	4	Screw, Machine - Round Head (#6-32 x 1/2")
15	853-0003	4	Washer, Lock - External Tooth (#6)
16	860-0006	4	Nut, Hex (#6-32)
17	332-0609	1	Board, Terminal (2 Place)
18	332-0610	1	Strip, Marker

CIRCUIT BREAKER GROUP - OPTIONAL

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
5	800-0028	5	Screw, Cap - Hex Head (5/16-18 x 1")
6	526-0022	10	Washer, Flat (21/64" ID x 9/16" OD x 1/16" THK)
7	850-0045	5	Washer, Lock - Spring (5/16)
8	862-0015	5	Nut, Hex (5/16-18)
9	226-0891	3	Lead, Electrical
10	812-0094	4	Screw, Machine - Round Head (#8-32 x 3-5/8")
11	850-0025	4	Washer, Lock - Spring (#8)
12	320-0412	1	Circuit Breaker (3 Pole, 100 Amp, 240 VAC)
13	800-0003	2	Screw, Cap - Hex Head (1/4-20 x 1/2")
14	850-0040	2	Washer, Lock - Spring (1/4)
15	301-3197	1	Bracket, Angle - Circuit Breaker Mounting
16	301-3192	1	Panel, Circuit Breaker (Illustrated in Housing Group, Item 54)

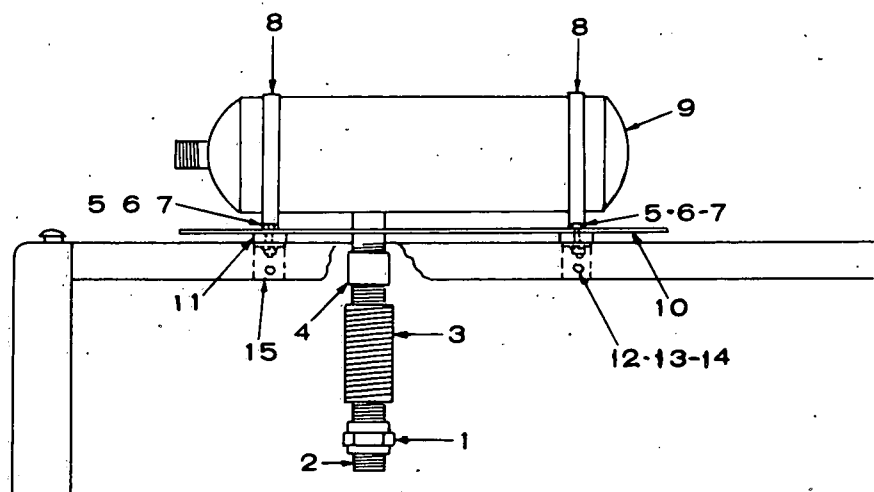


179-0441 INSTALLATION DAY FUEL TANK - OPTIONAL EQUIPMENT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0441		Installation of Day Fuel Tank	11	850-0030	1	Washer, Lock - Spring (#10)
1	501-0008	2	Line, Fuel - Flexible	12	415-0326	1	Cover, Relay
2	501-0015	1	Line, Fuel - Flexible	13	307-1157	1	Spring, Retaining - Relay
3	502-0041	3	Elbow, Pipe - Street, Brass (1/4" x 1/4")	14	307-1058	1	Relay, Armature - 12 VDC
4	502-0051	1	Coupling, Pipe - Brass (1/4" x 1/4")	15	812-0001	2	Screw, Machine - Round Head (#6-32 x 3/8")
5	821-0018	2	Screw, Self-locking - Hex Head (1/4-20 x 5/8")	16	870-1183	2	Nut, Hex - With External Tooth Lockwasher (#6-32)
6	870-0212	2	Nut, Hex - Self-locking	17	323-0897	1	Socket, Relay (Includes leads)
7	149-0554	1	Pump, Fuel - Electric (See Separate Group for Components)	18	821-0013	2	Screw, Self-locking - Hex Head (1/4-20 x 1")
8	821-0014	8	Screw, Self-locking - Hex Head (5/16-18 x 1/2")	19	415-0323	1	Strap, Retaining
9	402-0070	4	Mount, Vibration	20	415-0324	1	Bracket, Angle - Tank Support
10	813-0098	1	Screw, Machine - Round Head (#10-32 x 3/8")	21	505-0110	1	Plug, Pipe - Square Head (3/8")
				22	505-0054	1	Plug, Pipe - Square Head (1/4")
				23	415-0321	1	Switch, Float - Liquid Level
				24	415-0325	1	Tank, Fuel

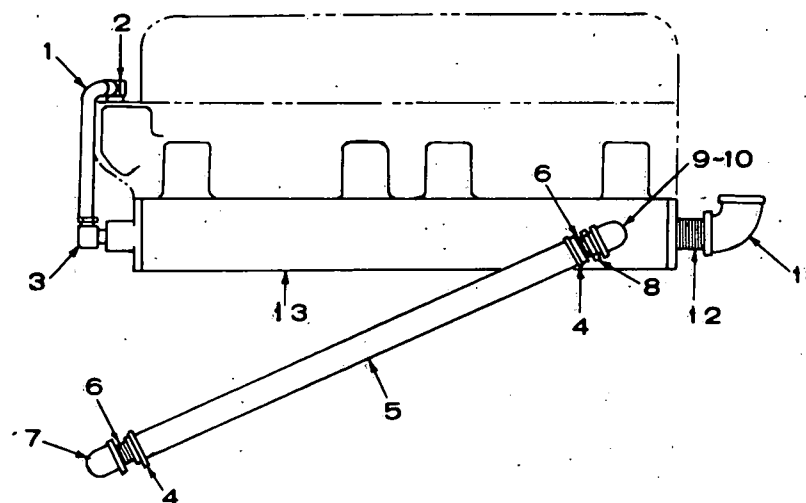
(179-0368) INSTALLATION EXHAUST MUFFLER (HOUSED SETS)
Optional Equipment - Spec B Through Serial #K760188585 During Spec G



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0368		Installation of Exhaust Muffler
1	505-0454	1	Union, Pipe (2")
2	505-0172	1	Nipple, Pipe (Close x 2")
3	155-1082	1	Pipe, Exhaust - Flexible
4	505-0203	1	Coupling, Pipe (2")
5	800-0028	4	Screw, Cap - Hex Head (5/16-18 x 1")
6	850-0045	4	Washer, Lock - Spring (5/16")
7	862-0015	4	Nut, Hex (5/16-18)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
8	140-0649	2	Strap, Retaining
9	155-1268	1	Muffler, Exhaust
10	155-0978	1	Heat Shield
11	526-0172	4	Washer, Flat (1/2" ID x 2-1/4" OD x 1/4" THK)
12	800-0026	6	Screw, Cap - Hex Head (5/16-18 x 3/4")
13	850-0045	6	Washer, Lock - Spring (5/16")
14	862-0015	6	Nut, Hex (5/16-18)
15	155-0789	2	Support - Muffler

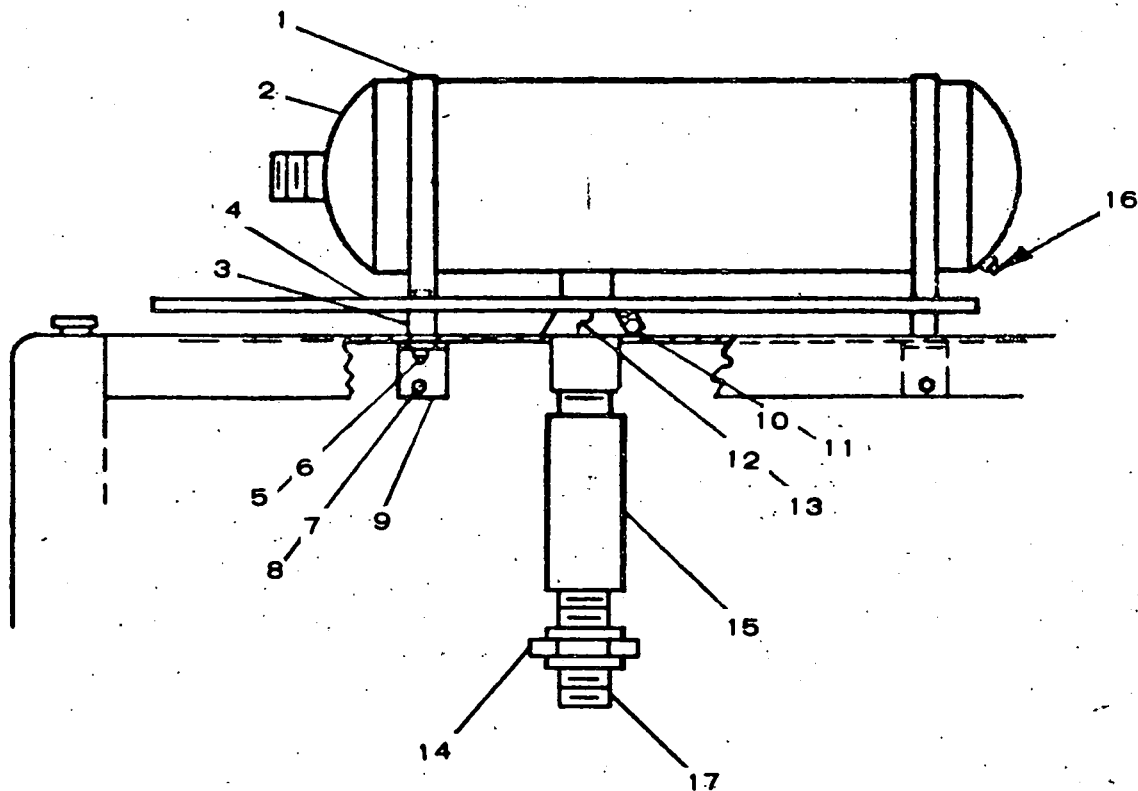
179-0264 INSTALLATION WATER COOLED EXHAUST MANIFOLD - OPTIONAL EQUIPMENT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0264		Installation of Water Cooled Exhaust Manifold
1	130-0674	1	Line Assembly, Water
2	502-0074	1	Elbow, Pipe - 90° (3/8 NPT)
3	502-0073	1	Elbow, Pipe - 90° (1/2 NPT)
4	503-0183	2	Clamp, Hose
5	503-0386	As Req.	Hose, Rubber (5/8" ID) - 30" Required
6	505-0135	2	Nipple, Pipe - Half (3/8" NPT x 1-1/2")
7	505-0120	1	Elbow, Pipe - 90°, Street (3/8" NPT)

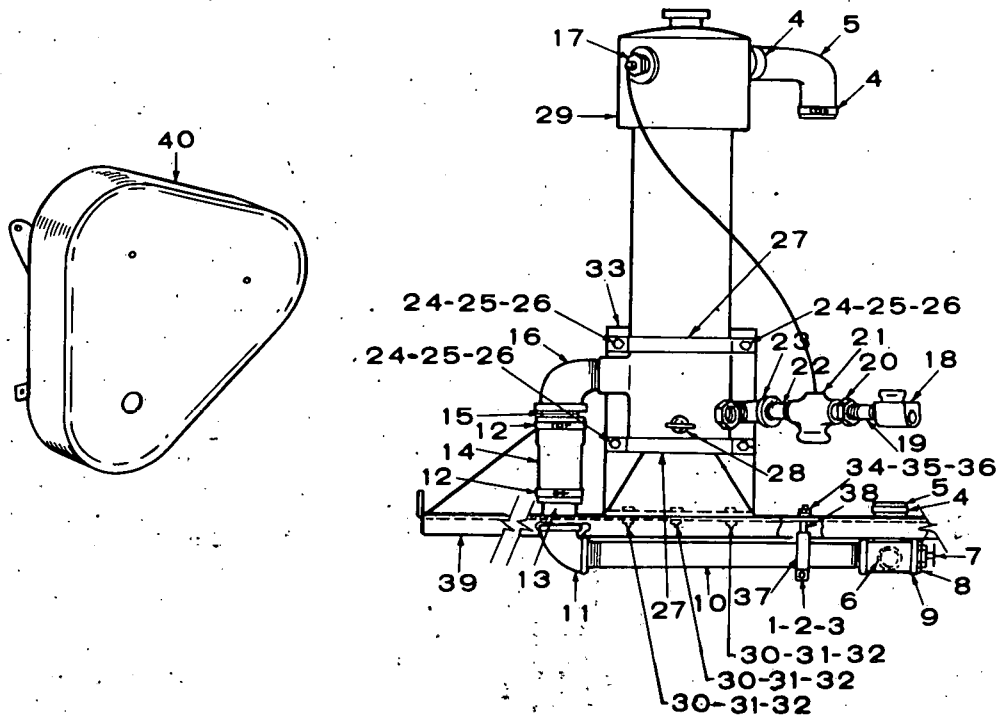
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
8	505-0019	1	Reducer, Pipe (1/2" NPT x 3/8" NPT)
9	505-0040	1	Elbow, Pipe - 90° (1/2" NPT)
10	505-0100	1	Nipple, Pipe - Close (1/2" NPT)
11	505-0175	1	Elbow, Pipe - 90° (2" NPT)
12	505-0172	1	Nipple, Pipe (2" NPT x 2" LG)
13	154-0888	1	Manifold, Exhaust - Water Cooled

(179-0368) INSTALLATION EXHAUST MUFFLER (HOUSED SETS)
Optional Equipment - Begin Serial #K760188586 During Spec G



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	140-0649	2	Band, Muffler
2	155-0988	1	Muffler, Exhaust
3	155-1430	4	Spacer, Muffler
4	155-0978	1	Shield, Heat
5	800-0037	4	Screw, Cap - Hex Head (5/16-18 x 3" lg)
6	870-0048	4	Nut, Lock (5/16-18)
7	800-0026	6	Screw, Cap - Hex Head (5/16-18 x 3/4" lg)
8	870-0048	6	Nut, Lock (5/16-18)
9	155-0789	2	Bracket, Muffler Support
10	813-0105	2	Screw, Machine - Round Head (#10-32 x 1" lg)
11	870-0188	2	Nut, Lock (#10-32)
12	155-0978	1	Shield, Rain
13	895-0157	1	Asbestos
14	505-0454	1	Union, Pipe (2")
15	155-1484	1	Tube, Exhaust (9" lg)
16	505-0056	1	Plug, Pipe (1/2")
17	505-0645	1	Nipple, Pipe

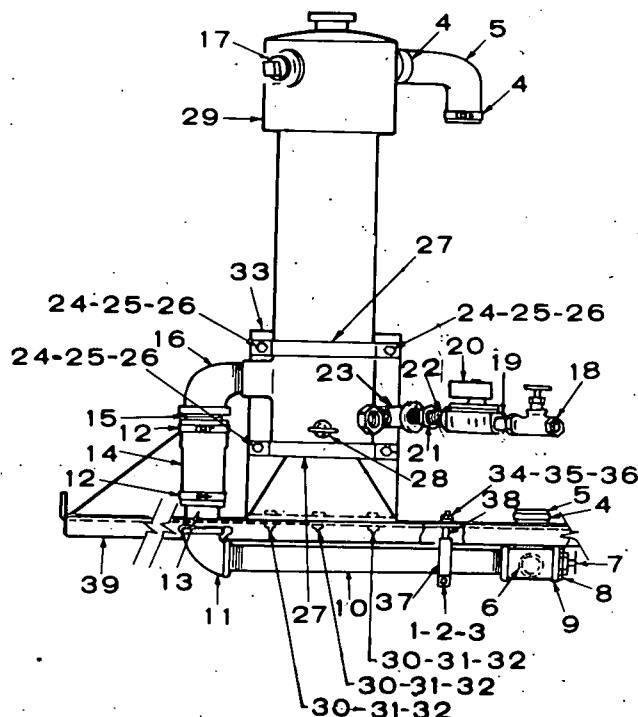
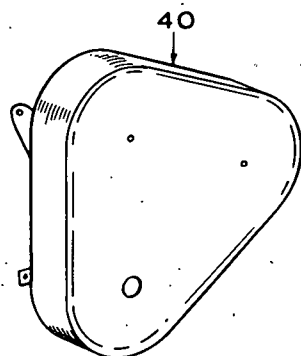
179-0388 HEAT EXCHANGER COOLING WITH REGULATOR - OPTIONAL EQUIPMENT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0388		Installation of Heat Exchanger with Regulator
1	800-0004	1	Screw, Cap - Hex Head (1/4-20 x 5/8")
2	850-0040	1	Washer, Lock - Spring (1/4")
3	862-0001	1	Nut, Hex (1/4-20)
4	503-0311	4	Clamp, Hose
5	503-0441	2	Hose, Rubber (Premolded) - 1-3/4" ID
6	505-0628	1	Nipple, Pipe - Half (1-1/2" NPT x 3")
7	504-0003	1	Cock, Drain (1/4" NPT)
8	505-0426	1	Reducer, Pipe (1-1/2" NPT x 1/4" NPT)
9	505-0317	1	Tee, Pipe (1-1/2" NPT)
10	505-0424	1	Nipple, Pipe (1-1/2" NPT x 16-1/2")
11	505-0043	1	Elbow, Pipe - 90° (1-1/2" NPT)
12	503-0311	2	Clamp, Hose
13	505-0628	1	Nipple, Pipe - Half (1-1/2" NPT x 3")
14	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 8" Required
15	505-0444	1	Nipple, Pipe - Half (1-1/2" NPT x 2-1/4")
16	505-0462	1	Elbow, Pipe - Street, 90° (1-1/2" NPT)
17	505-0129	1	Reducer, Pipe (1" NPT x 3/4" NPT)
18	307-0833	1	Valve, Solenoid
19	505-0100	1	Nipple, Pipe (1/2" NPT x 1-1/8")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
20	505-0021	1	Reducer, Pipe (3/4" NPT x 1/2" NPT)
21	309-0241	1	Valve, Regulator
22	505-0102	1	Nipple, Pipe - Close (3/4" NPT)
23	505-0691	1	Elbow, Pipe - Street, 45° (3/4" NPT)
24	800-0004	4	Screw, Cap - Hex Head (1/4-20 x 5/8")
25	850-0040	4	Washer, Lock - Spring (1/4")
26	862-0001	4	Nut, Hex (1/4-20)
27	130-0802	2	Strap, Retaining
28	504-0005	1	Cock, Drain (1/8" NPT)
29	130-0796	1	Tank, Heat Exchanger
30	800-0026	3	Screw, Cap - Hex Head (5/16-18 x 3/4")
31	850-0045	3	Washer, Lock - Spring (5/16")
32	862-0015	3	Nut, Hex (5/16-18)
33	130-0819	1	Bracket, Mounting - Heat Exchanger
34	800-0012	1	Screw, Cap - Hex Head (1/4-20 x 2-1/4")
35	850-0040	1	Washer, Lock - Spring (1/4")
36	862-0001	1	Nut, Hex (1/4-20)
37	331-0101	1	Hanger, Pipe
38	212-1197	1	Spacer, Sleeve (1-11/16" LG)
39	130-0805	1	Bracket, Support - Heat Exchanger
40	130-0785	1	Guard, Belt

179-0371 INSTALLATION HEAT EXCHANGER COOLING - OPTIONAL EQUIPMENT

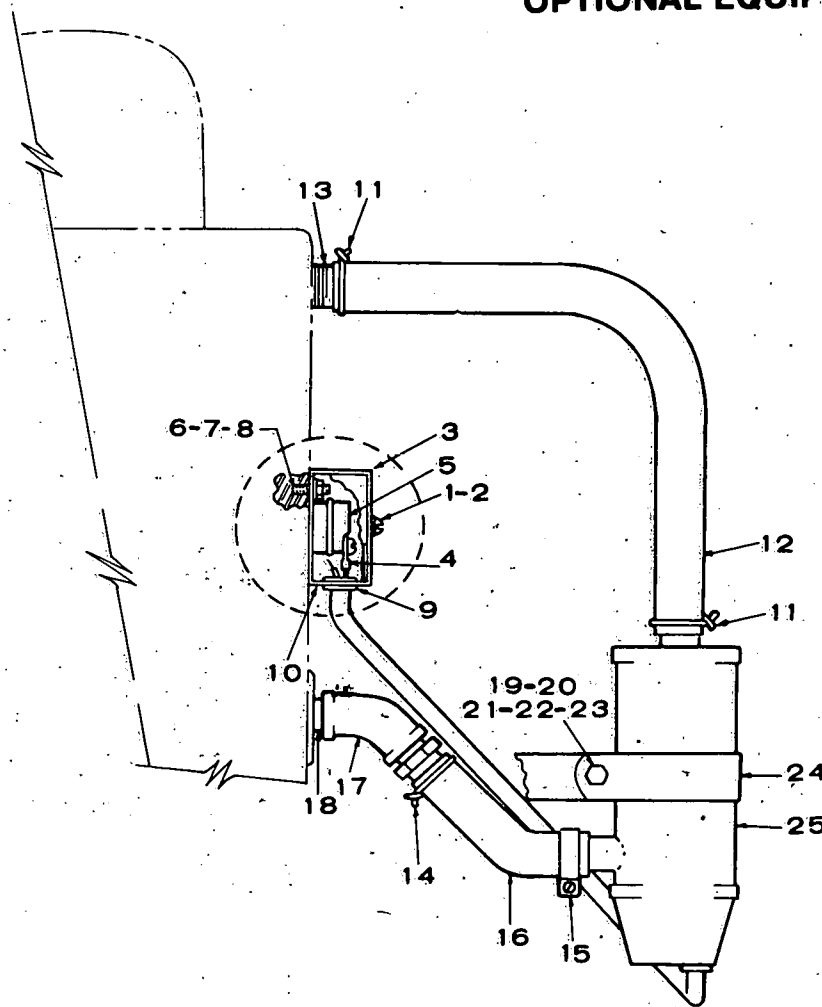


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0371		Installation of Heat Exchanger
1	800-0004	1	Screw, Cap - Hex Head (1/4-20 x 5/8")
2	850-0040	1	Washer, Lock - Spring (1/4")
3	862-0001	1	Nut, Hex (1/4-20)
4	503-0311	4	Clamp, Hose
5	503-0441	2	Hose, Rubber (Premolded) - 1-3/4" ID
6	505-0628	1	Nipple, Pipe - Half (1-1/2" NPT x 3")
7	504-0003	1	Cock, Drain (1/4" NPT)
8	505-0426	1	Reducer, Pipe (1-1/2" NPT x 1/4" NPT)
9	505-0317	1	Tee, Pipe (1-1/2" NPT)
10	505-0424	1	Nipple, Pipe (1-1/2" NPT x 16-1/2")
11	505-0043	1	Elbow, Pipe - 90° (1-1/2" NPT)
12	503-0311	2	Clamp, Hose
13	505-0628	1	Nipple, Pipe - Half (1-1/2" NPT x 3")
14	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 8" Required
15	505-0444	1	Nipple, Pipe - Half (1-1/2" NPT x 2-1/4")
16	505-0462	1	Elbow, Pipe - Street, 90° (1-1/2" NPT)
17	505-0140	1	Plug, Pipe (1" NPT)
18	504-0019	1	Valve, Globe

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
19	505-0100	1	Nipple, Pipe (1/2" NPT x 1-1/8")
20	307-0833	1	Valve, Solenoid
21	505-0100	1	Nipple, Pipe (1/2" NPT x 1-1/8")
22	505-0021	1	Reducer, Pipe (3/4" NPT x 1/2" NPT)
23	505-0691	1	Elbow, Pipe - Street, 45° (3/4" NPT)
24	800-0004	4	Screw, Cap - Hex Head (1/4-20 x 5/8")
25	850-0040	4	Washer, Lock - Spring (1/4")
26	862-0001	4	Nut, Hex (1/4-20)
27	130-0802	2	Strap, Retaining
28	504-0005	1	Cock, Drain (1/8" NPT)
29	130-0796	1	Tank, Heat Exchanger
30	800-0026	3	Screw, Cap - Hex Head (5/16-18 x 3/4")
31	850-0045	3	Washer, Lock - Spring (5/16")
32	862-0015	3	Nut, Hex (5/16-18)
33	130-0819	1	Bracket, Mounting - Heat Exchanger
34	800-0012	1	Screw, Cap - Hex Head (1/4-20 x 2-1/4")
35	850-0040	1	Washer, Lock - Spring (1/4")
36	862-0001	1	Nut, Hex (1/4-20)
37	331-0101	1	Hanger, Pipe
38	212-1197	1	Spacer, Sleeve (1-11/16" LG)
39	130-0805	1	Bracket, Support - Heat Exchanger
40	130-0785	1	Guard, Belt

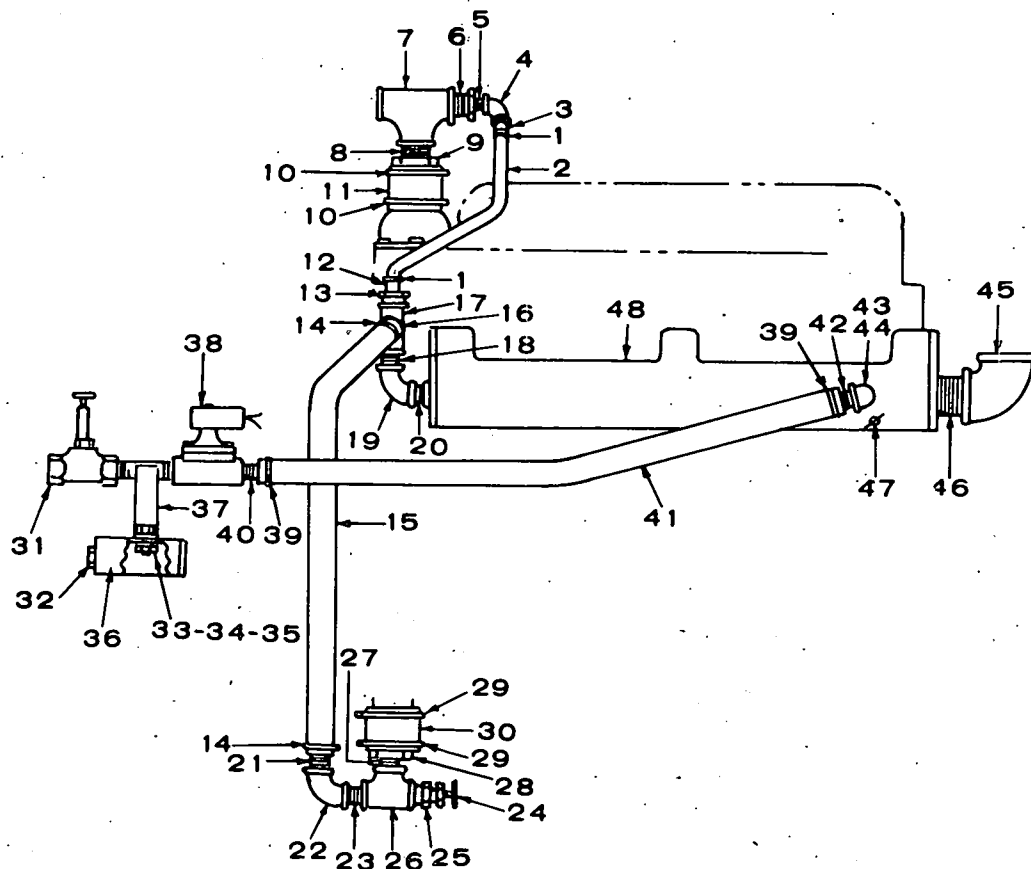
179-0180 INSTALLATION WATER JACKET HEATER - 120 VOLT

OPTIONAL EQUIPMENT



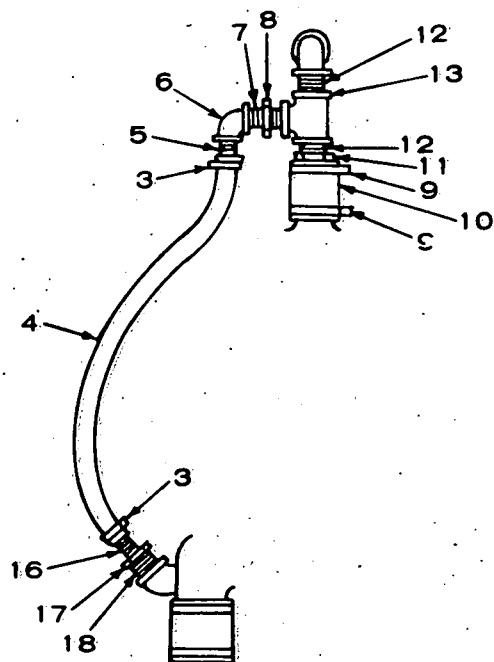
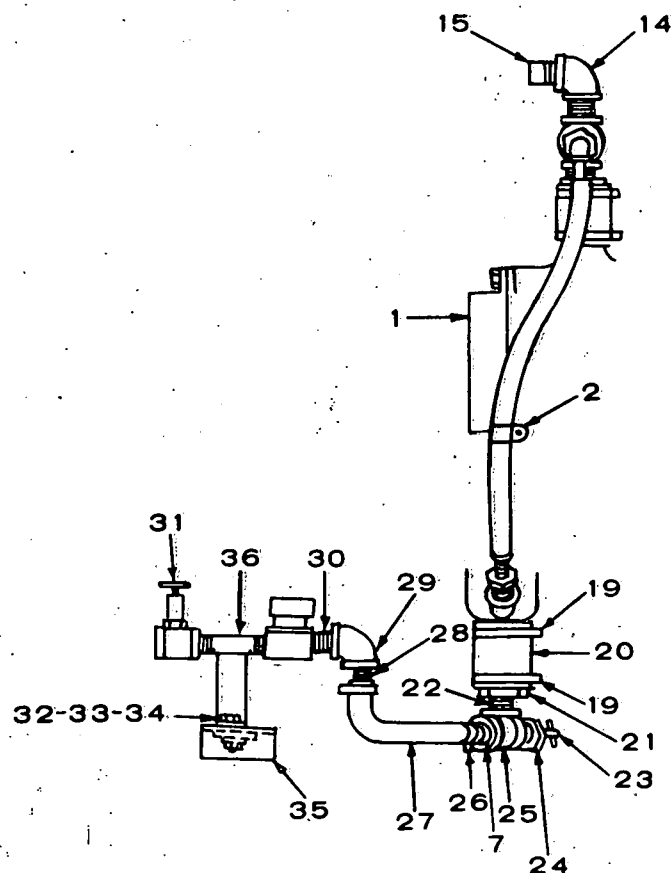
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0180		Installation of Water Jacket Heater - 120 Volt	14	503-0197	1	Clamp, Hose
1	812-0076	2	Screw, Machine - Round Head (#8-32 x 5/16")	15	503-0183	1	Clamp, Hose
2	850-0025	2	Washer, Lock - Spring (#8)	16	503-0386	As Req.	Hose, Rubber (5/8" ID) - 24" Required
3	333-0013	1	Cover, Box - Thermostat	17	505-0112	1	Elbow, Pipe - 45° (1/4" NPT)
4	332-0149	1	Terminal, Lug	18	505-0071	1	Nipple, Pipe (1/4" NPT x 2")
5	309-0106	1	Thermostat	19	800-0030	1	Screw, Cap - Hex Head (5/16-18 x 1-1/4")
6	520-0446	2	Stud (#10-32 x 3/4")	20	850-0045	1	Washer, Lock - Spring (5/16")
7	850-0030	2	Washer, Lock - Spring (#10)	21	526-0030	2	Washer, Flat (13/32" ID x 7/8" OD x 1/8" THK)
8	870-0053	2	Nut, Hex (#10-32)	22	856-0008	2	Washer, Lock - External/Internal Tooth (5/16")
9	508-0008	1	Grommet, Rubber	23	862-0015	1	Nut, Hex (5/16-18)
10	333-0012	1	Box, Thermostat	24	130-0755	1	Bracket, Support - Water Heater
11	503-0197	2	Clamp, Hose	25	333-0052	1	Heater, Water - Engine
12	503-0386	As Req.	Hose, Rubber (5/8" ID) - 12" Required				
13	505-0135	1	Nipple, Pipe - Half (3/8" NPT x 1-1/2")				

179-0256 INSTALLATION CITY WATER COOLING WITH WATER COOLED EXHAUST MANIFOLD - OPTIONAL EQUIPMENT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0256		Installation of City Water Cooling with Water Cooled Exhaust Manifold	25	505-0019	1	Reducer, Pipe (1/2" NPT x 3/8" NPT)
1	503-0183	2	Clamp, Hose	26	505-0108	1	Tee, Pipe (1/2" NPT)
2	503-0110	As Req.	Hose, Rubber (1/2" ID) - 12" Required	27	505-0100	1	Nipple, Pipe - Close (1/2" NPT)
3	505-0302	1	Nipple, Pipe - Half (1/4" NPT x 1-1/2")	28	110-0576	1	Adapter, Hose to Pipe
4	505-0038	1	Elbow, Pipe - 90° (1/4" NPT)	29	503-0311	2	Clamp, Hose
5	505-0099	1	Nipple, Pipe - Close (1/4" NPT)	30	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 3" Required
6	505-0020	1	Reducer, Pipe (3/4" NPT x 1/4" NPT)	31	504-0019	1	Valve, Globe
7	505-0166	1	Tee, Pipe (3/4" NPT)	32	821-0014	6	Screw, Self-locking - Hex Washer Head (5/16-18 x 1/2")
8	505-0102	1	Nipple, Pipe - Close (3/4" NPT)	33	800-0007	2	Screw, Cap - Hex Head (1/4-20 x 1")
9	110-1543	1	Adapter, Hose to Pipe	34	850-0040	2	Washer, Lock - Spring (1/4")
10	503-0311	2	Clamp, Hose	35	862-0001	2	Nut, Hex (1/4-20)
11	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 3" Required	36	130-0499	1	Bracket, Angle
12	505-0302	1	Nipple, Pipe - Half (1/4" NPT x 1-1/2")	37	110-0526	1	Bracket & Nipple Assembly
13	505-0018	1	Reducer, Pipe (1/2" NPT x 1/4" NPT)	38	307-0833	1	Valve, Globe
14	503-0189	2	Clamp, Hose	39	503-0189	2	Clamp, Hose
15	503-0386	As Req.	Hose, Rubber (5/8" ID) - 14" Required	40	505-0185	1	Nipple, Pipe - Half (1/2" NPT x 1-1/2")
16	110-0576	1	Adapter (1-3/4 x 1/2")	41	503-0386	As Req.	Hose, Rubber (5/8" ID) - 36" Required
17	505-0108	1	Tee, Pipe (1/2" NPT)	42	505-0185	1	Nipple, Pipe - Half (1/2" NPT x 1-1/2")
18	505-0100	1	Nipple, Pipe - Close (1/2" NPT)	43	505-0040	1	Elbow, Pipe - 90° (1/2" NPT)
19	505-0040	1	Elbow, Pipe - 90° (1/2" NPT)	44	505-0100	1	Nipple, Pipe - Close (1/2" NPT)
20	505-0100	1	Nipple, Pipe - Close (1/2" NPT)	45	505-0175	1	Elbow, Pipe - 90° (2" NPT)
21	505-0185	1	Nipple, Pipe - Half (1/2" NPT x 1-1/2")	46	505-0172	1	Nipple, Pipe - Close (2" NPT)
22	505-0040	1	Elbow, Pipe - 90° (1/2" NPT)	47	504-0005	1	Cock, Drain
23	505-0100	1	Nipple, Pipe - Close (1/2" NPT)	48	154-0888	1	Manifold, Exhaust - Water Cooled
24	504-0028	1	Cock, Drain (3/8" NPT)				

179-0319 INSTALLATION CITY WATER COOLING - OPTIONAL EQUIPMENT

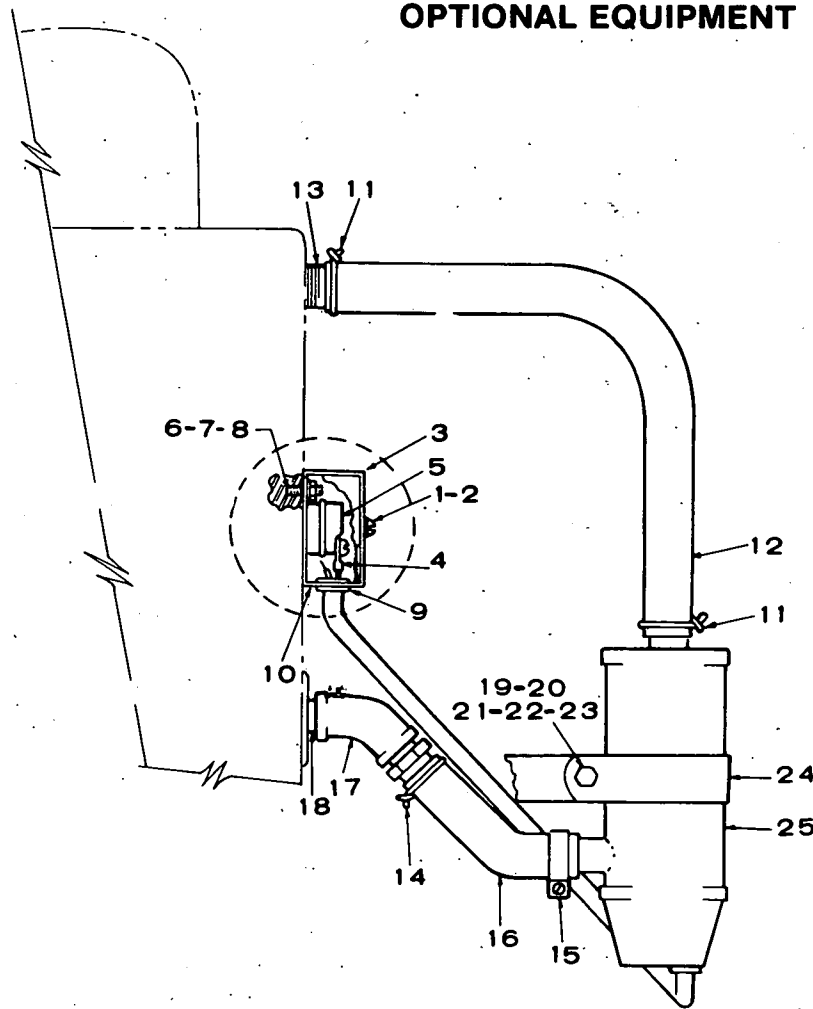


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0319		Installation of City Water Cooling
1	130-0785	1	Guard, Belt
2	148-0284	1	Bracket, Hose Support
3	503-0032	2	Clamp, Hose
4	503-0110	As Req.	Hose, Rubber (1/2" ID) - 30" Required
5	505-0010	1	Nipple, Pipe - HALF (1/4" NPT x 1")
6	505-0038	1	Elbow, Pipe - 90° (1/4" NPT)
7	505-0099	1	Nipple, Pipe - Close (1/4" NPT x 7/8")
8	505-0020	1	Reducer, Pipe (3/4" NPT x 1/4" NPT)
9	503-0365	2	Clamp, Hose
10	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 3" Required
11	110-1543	1	Adapter, Hose to Pipe
12	505-0102	2	Nipple, Pipe - Close (3/4" NPT x 1-3/8")
13	505-0166	1	Tee, Pipe (3/4" NPT)
14	505-0132	1	Elbow, Pipe - 90° (3/4" NPT)
15	505-0324	1	Nipple, Pipe - HALF (3/4" NPT x 2")
16	505-0010	1	Nipple, Pipe - Half (1/4" NPT x 1")
17	505-0017	1	Reducer, Pipe (3/8" NPT x 1/4" NPT)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
18	505-0119	1	Elbow, Pipe - 45° Street (3/8" NPT)
19	503-0365	2	Clamp, Hose
20	503-0356	As Req.	Hose, Rubber (1-3/4" ID) - 3" Required
21	110-0576	1	Adapter, Hose to Pipe
22	505-0100	1	Nipple, Pipe - Close (1/2" NPT x 1-1/8")
23	504-0003	1	Cock, Drain (1/4" NPT)
24	505-0018	1	Reducer, Pipe (1/2" NPT x 1/4" NPT)
25	505-0108	1	Tee, Pipe (1/2" NPT)
26	503-0189	1	Clamp, Hose
27	503-0191	As Req.	Hose, Rubber (3/4" ID) - 11" Required
28	505-0185	2	Nipple, Pipe - Half (1/2" NPT x 1-1/2")
29	505-0040	1	Elbow, Pipe - 90° (1/2" NPT)
30	505-0100	1	Nipple, Pipe - Close (1/2" NPT x 1-1/8")
31	504-0019	1	Valve, Globe
32	800-0007	2	Screw, Cap - Hex Head (1/4-20 x 1")
33	850-0040	2	Washer, Lock - Spring (1/4")
34	862-0001	2	Nut, Hex (1/4-20)
35	130-0499	1	Bracket, Angle
36	110-0526	1	Bracket & Nipple Assembly

179-0376 INSTALLATION WATER JACKET HEATER - 240 VOLT

OPTIONAL EQUIPMENT



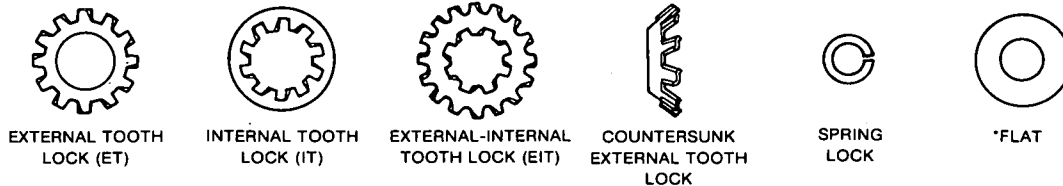
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	179-0376		Installation of Water Jacket Heater - 240 Volt
1	812-0076	2	Screw, Machine - Round Head (#8-32 x 5/16")
2	850-0025	2	Washer, Lock - Spring (#8)
3	333-0056	1	Cover, Box - Thermostat
4	332-0149	1	Terminal, Lug
5	309-0256	1	Thermostat
6	520-0446	2	Stud (#10-32 x 3/4")
7	850-0030	2	Washer, Lock - Spring (#10)
8	870-0053	2	Nut, Hex (#10-32)
9	508-0008	1	Grommet, Rubber
10	333-0012	1	Box, Thermostat
11	503-0197	2	Clamp, Hose
12	503-0386	As Req.	Hose, Rubber (5/8" ID) - 12" Required
13	505-0135	1	Nipple, Pipe - Half (3/8" NPT x 1-1/2")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
14	503-0197	1	Clamp, Hose
15	503-0183	1	Clamp, Hose
16	503-0386	As Req.	Hose, Rubber (5/8" ID) - 24" Required
17	505-0112	1	Elbow, Pipe - 45° (1/4" NPT)
18	505-0071	1	Nipple, Pipe (1/4" NPT x 2")
19	800-0030	1	Screw, Cap - Hex Head (5/16-18 x 1-1/4")
20	850-0045	1	Washer, Lock - Spring (5/16")
21	526-0030	2	Washer, Flat (13/32" ID x 7/8" OD x 1/8" THK)
22	856-0008	2	Washer, Lock - External/Internal Tooth (5/16")
23	862-0015	1	Nut, Hex (5/16-18)
24	130-0755	1	Bracket, Support - Water Heater
25	333-0073	1	Heater, Water - Engine

HARDWARE IDENTIFICATION

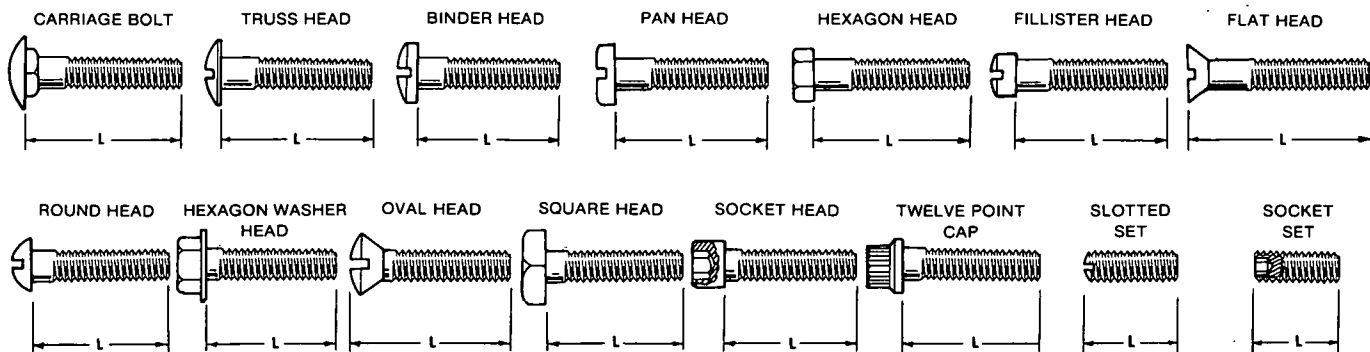
Illustrated hardware items are only for identification purposes. All hardware items listed throughout this parts catalog are steel SAE grade five (5) or lower (zinc plated with clear chromate dip) unless parts description indicates differently. All dimensions are in inches.

WASHER TYPES



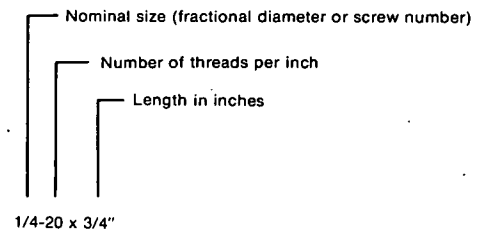
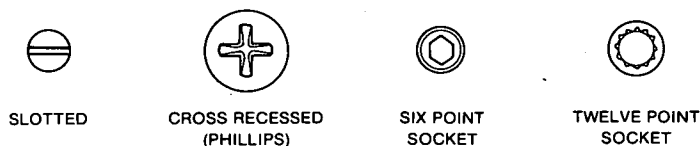
* - Flat washer dimensions given are: Inside Diameter (ID), Outside Diameter (OD) and Thickness (Thk).

BOLT AND SCREW TYPES



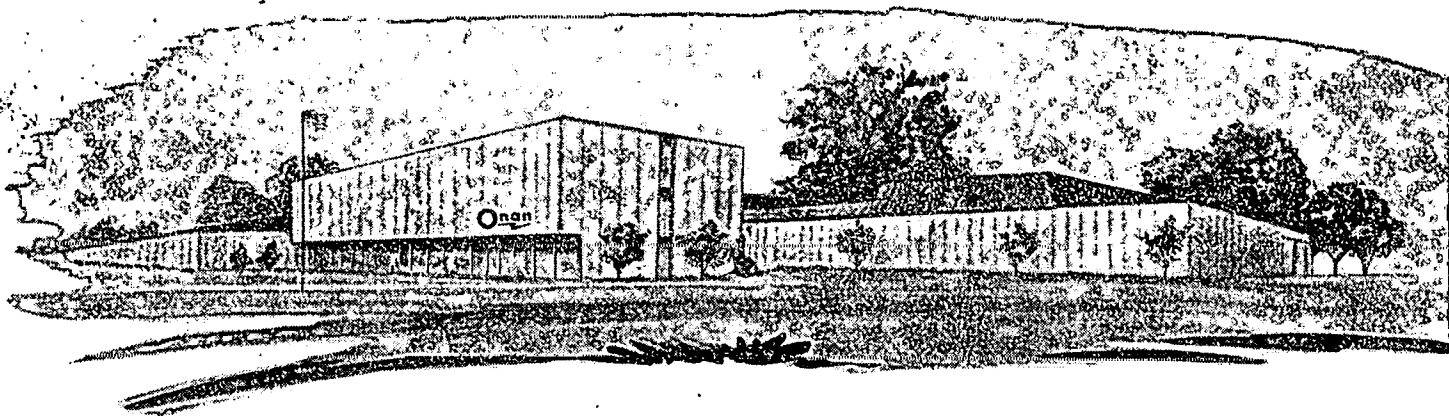
L - Measure length between these points.

INTERNAL DRIVE TYPES



NUT TYPES





ONAN 1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432
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